Groundwater and spring monitoring 2024, Mt Shamrock Quarry

Annual monitoring review

Holcim (Australia) Pty Ltd

21 February 2025

→ The Power of Commitment

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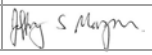
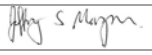
S4	0	A. Wilson	J. Morgan		J. Morgan		21/2/25

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1. Introduction

1.1 Overview

GHD Pty Ltd (GHD) has been engaged by Holcim (Australia) (Holcim) to undertake an annual hydrogeological review for their Mt Shamrock Quarry in Pakenham, Victoria.

The Pakenham (Mt Shamrock) Quarry Environmental Management Plan (v3, July 2021) requires a groundwater monitoring program to ensure that water discharged from the Quarry minimises any potential impact on receiving waters, does not affect the environmental values of the receiving waters and assesses any long term trends in groundwater levels.

The following requirements to meet these objectives include:

– Ongoing groundwater level monitoring
– Annual visual inspection of identified springs at/surrounding the quarry
– Completion of an annual assessment to understand if quarry operations are potentially impacting on groundwater levels

The objective of this report is to provide a consolidated review, and interpretation of the groundwater level and quality results collected during 2024. Reference to and incorporation of earlier monitoring data collected by others as part of the site's groundwater monitoring is also reviewed.

1.2 Scope of work

Holcim engaged GHD to undertake an annual groundwater monitoring review for their Mt Shamrock Quarry in Pakenham (site) for 2024. GHDs scope of work included:

– Conducting groundwater and spring monitoring in accordance with the relevant environmental management plan requirements
– Review and summarise quarry mining activity for the year
– Groundwater monitoring:
  - Groundwater level monitoring from the site groundwater monitoring bore network A field inspection of the groundwater monitoring bores to assess bore condition
  - Compilation of photographic record for each bore
– Spring monitoring:
  - An annual field inspection of the nominated springs at the site to assess current condition and comparison with previous inspections
  - Compilation of photographic record for each spring
  - Collection of field water quality parameters from each spring
– Preparation of a concise interpretive report (this report) documenting the results of the above, including the addition of other field data collected by Holcim and its contractors during 2024.

1.3 Purpose of this report

The purpose of this report is to:

– Document the results of the groundwater and spring monitoring completed by Holcim at their site in 2024.
– Assess the potential impacts of quarry operations on identified environmental values pertinent to groundwater
– If required, provide recommendations to expand, rationalise or improve the monitoring to meet the objectives of the Environmental Management Plan (EMP) pertinent to groundwater

1.4 Previous reports

A number of reports and studies have been undertaken for this site which contain information on monitoring bore drilling and installation, groundwater sampling, geotechnical and hydrogeological conditions. These reports have been referenced in Section 11 along with other documents referenced throughout this report.

1.5 Data sources

This report has relied on a number of data sources which have been assumed to be accurate and up to date. These include:

- Published geological and hydrogeological mapping
- State drilling records: GEDIS (Geological, Exploration and Development Information System), WMIS (Water Management Information System)
- Government produced literature including land use planning information, meteorological, and topographical data
- Holcim supplied information including historical monitoring bore records (onsite drilling, bore construction, water levels and quality), elevation information, etc

These data sources have been referenced, where relevant, throughout this report. A complete list of references is provided in Section 11 of this report.

2. Background information

2.1 Site location

The site is located approximately 4 km north of Pakenham and immediately west of the Healesville – Koo Wee Rup Road. The quarry has been in operation since 1974, i.e. just over 50 years, with basalt (Older Volcanics) quarried for use as rail ballast, aggregates and road bases.

The site location is shown in Figure 1.

2.2 Topography

The site forms a high point in the landscape (Mount Shamrock) with an elevation of approximately 220 m Australian Height Datum (AHD). This high point forms a perimeter around the current quarry operations with generally a steep drop off to the surrounding farmland. Elevations near surrounding roads are typically around 100 m AHD.

2.3 Monitoring objectives

The objective of the groundwater monitoring program during 2024 has been to continue with the collection of groundwater level data and inspect selected springs to meet the compliance and conformance targets outlined in the EMP.

2.3.1 Environmental Management Plan requirements

Section 2.4 of the EMP documents management measures and a monitoring schedule for surface water, drainage and groundwater. Those pertinent to groundwater have been summarised in Table 1 and Table 2.

In addition to the groundwater level monitoring summarised in Table 1, Holcim have deployed automated dataloggers (dataloggers) in bores MB01, MB06 and MB07. These dataloggers have been programmed to collect water level data every six hours, i.e. more frequently than that collected manually.

Visual inspection of springs at the site is undertaken as per section 2.5.4 of the EMP.

Table 1 Site management measures

Management measure	Description	Timing
Groundwater level gauging (external)	Water level gauging will be conducted quarterly, and an annual evaluation undertaken, to determine how the groundwater levels respond to the following: – Seasonal rainfall changes – Extension of the quarry – Revegetation to parts of the plateau surface – Progressive rehabilitation of quarry	Quarterly
Groundwater Level Gauging (internal)	Monthly water level gauging (MB01 – MB06) will be conducted by site personnel	Monthly
Groundwater Beneficial Use Assessment	Properties surrounding the quarry will be regularly assessed to confirm that the assessed beneficial uses of groundwater in accordance with section 15 of the SEPP (Waters) on the properties is supported by actual practices	Annual
Notes: Source: EMP v3, July 2021 The SEPP (Waters) has since been replaced by the Environmental Reference Standard (ERS) Items listed pertinent to groundwater only		

Table 2 Site monitoring schedule

Item/ location	Test	Frequency	Assessment methodology	Acceptance criteria
Monitoring bores MB01 to MB06	Level Gauging (Standing Water Height)	Quarterly (January, April, July, October)	AS5667.11:1998 or similar	Plot trends and any significant changes in groundwater levels, report in Site Environmental Management Program
Monitoring bores MB01 to MB06	Level Gauging (Standing Water Height)	Monthly	Direct observation	N/A
Notes: Source: EMP v3, July 2021 Items listed pertinent to groundwater only				

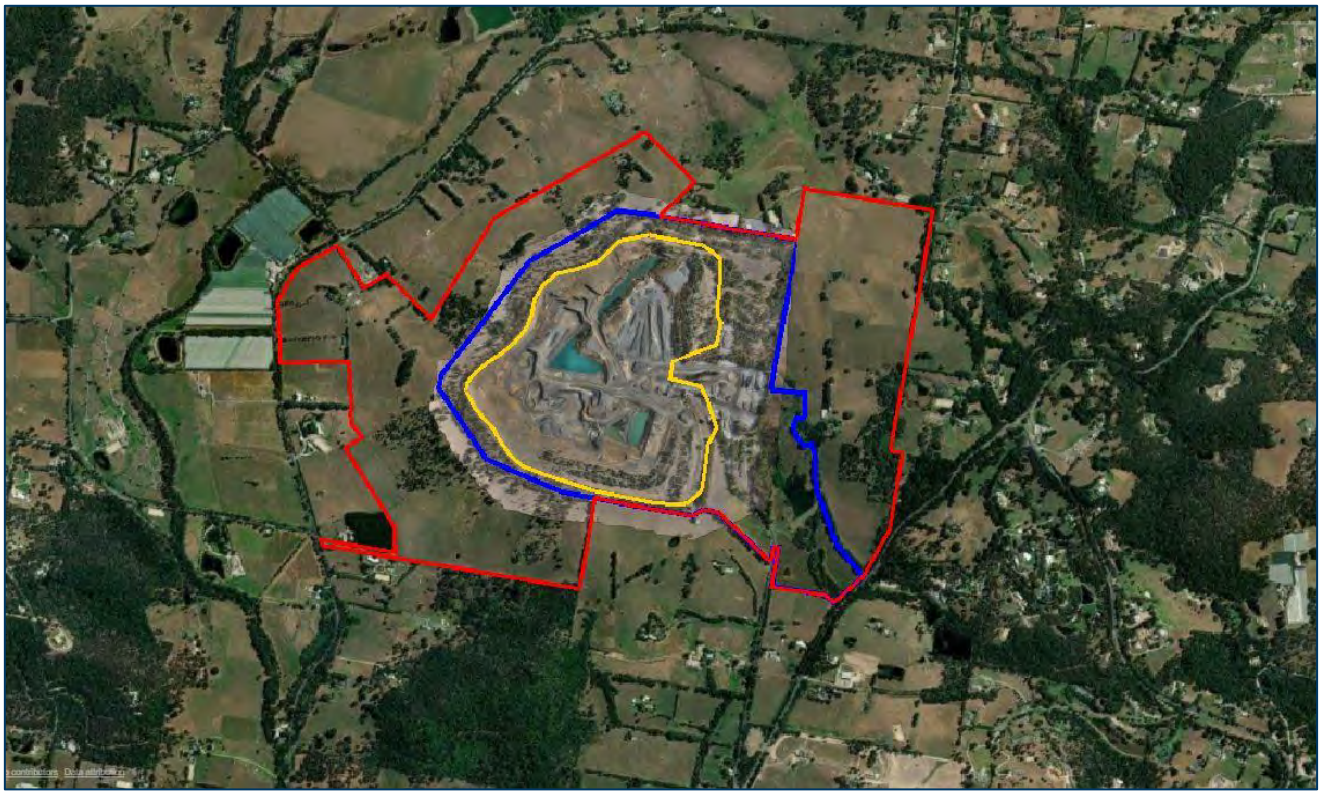


Figure 1 Site location

Source: Holcim

2.4 Summary quarry mining activities

AECOM (2024) provided a summary of quarry extension activities between 2005 and 2023. AECOM (2024) interpret that a consistent fall in water levels in bores MB03B and MB05B was related to the extraction and pumping of groundwater in the western section of Area 2. AECOM (2024) indicated that water levels in other bores at the site did not show any obvious response from quarry extension activities.

2.4.1 2024 mining activities

Based on information provided by Holcim to GHD, it is understood that:

– There was no significant stripping (rocky overburden and clay removal) or reclamation works undertaken in 2024. Minor shaping however was completed for the 2023 reclamation works
– Area 1 (Northern mining area) focussed on upper benches. Mining was undertaken to an elevation of approximately RL (Relative Level) 173
– Area 2 (Southern mining area) focussed on lower benches. Mining was undertaken to an elevation of approximately RL162

The 2024 quarry work areas are shown in Figure 2, which has been supplied by Holcim. The closet bores to Area 1 and Area 2 are nested bores MB03B/ MB05B and nested bores MB02C/MB04C.

Figure 2 *Holcim heatmap. 6th December 2024 compared to January 2024*

Source: Holcim

3. Groundwater characterisation

3.1 Regional groundwater characterisation

A review of available groundwater information neighbouring the quarry has been completed to characterise the groundwater system, and potential influences on water quality and water levels. This information is summarised in Table 3.

Table 3 Regional groundwater characterisation summary

Item	Description
Geology	A summary the geological profile at the site, from youngest to oldest, includes: – Quaternary aged alluvium consisting of silty sands and clays, primarily deposited in the Toomuc Creek Valley – Tertiary aged Older Volcanics which consist of dense, blue/black, olivine basalt. This is the resource quarried at the site and has a maximum thickness of 70 m with a varied weathered profile of up to 26 m, but generally in the order of 10 m. It is hypothesised that this basalt flow was in a generally north-south trending ancient valley which forms the current ridge line, as the surrounding sediments have been eroded over time geologically by more recent drainage lines. – Tertiary aged Werribee Formation consisting of clay, poorly consolidated clay with some organic material – Palaeozoic aged bedrock consisting of either Devonian aged granite or Silurian aged siltstone and sandstone
Groundwater use	Groundwater use close to the quarry has been summarised in Section 3.2.
Surrounding land use	The site use comprises a mix of farmland, currently used for cattle grazing, and remnant indigenous vegetation. A pony club has been identified immediately to the north of the quarry and some light industry has been identified adjacent neighbouring roads. Scattered residential properties are present in the area associated with the farming and light industry. More intensive urban development is present approximately 3 km south of the site. This urban development forms the outskirts of the Pakenham suburb.
Aquifer developed	The quarry is located upon Tertiary age Older Volcanics which consist of basalt. This is the resource quarried. Where saturated, the basalt forms the water table aquifer. The Werribee Formation underlies the basalt. GHD (2023) reported that URS (2005) conceptualised the springs to be groundwater discharge from outcropping Werribee Formation aquifer at the base of the basalt. GHD consider, to the north particularly, that the springs are more likely to be groundwater discharge directly from the Older Volcanics aquifer, where it overlies Werribee Formation which was logged as being fine grained
Potential contamination sources	Victoria Unearthed was interrogated to identify potential contamination sources close to the site. The quarry has been identified as an EPA licensed area operating under EPA licence OL000000544. This licence has been attached as Appendix A. Several EPA audit areas and points were identified on either side of the Princes Highway near Pakenham. These sites are more than approximately 3 km south of the quarry. Given the distance from the site (and lower elevation), these are deemed a low risk to the groundwater environment at the site. The area is used for grazing and pony clubs have been identified close to the site. Grazing of livestock can result in faecal contamination and changes in nutrient (e.g., nitrate, phosphorous) concentrations in groundwater. Given the low density of grazing and depth to groundwater at the site, livestock grazing is deemed pose a low risk to groundwater quality. In addition, the farming land may have been subject to the application of fertilisers, weedicide/herbicide as well as fuel and oil leaks from farm machinery.

Item	Description
Regional groundwater quality	The Department of Energy, Environment and Climate Action (DEECA) SAFE datasets indicate regional groundwater salinity for the majority of the site to be between 500 mg/L and 1,000 mg/L Total Dissolved Solids (TDS). Groundwater salinity south and north of the site is interpreted to be between 1,000 mg/L and 3500 mg/L TDS and less than 500 mg/L TDS, respectively. There is limited groundwater quality information available for nearby bores (refer Section 3.2). In the available data within 3 km of the site, 10 bores had laboratory Electrical Conductivity (EC) information. EC for these 10 bores ranged from 720 µS/cm to 5,800 µS/cm with an average of approximately 2,075 µS/cm. Most of the bores reported an EC less than 2,500 µS/cm. Based on a conversion factor of 0.6, this suggests a groundwater salinity of between approximately 430 mg/L and 3,500 mg/L TDS with an average of approximately 1,250 mg/L TDS.
Groundwater management	The site does not fall within a designated Groundwater Management Area (GMA) and thus is not subject to specific plans and rules regarding the development of groundwater. It is noted however that the regulating authority, Southern Rural Water (SRW), may require a technical hydrogeological assessment to support any proposed groundwater development.
Regional groundwater trends	State Observation Network (SON) bore 84032 is located approximately 10 km south of the site and is screened in the Older Volcanics. Whilst the bore has not been actively monitored by the State since 2016, Holcim have commenced monitoring water levels from this bore as part of their groundwater monitoring program. The results of groundwater monitoring from this bore are discussed in Section 6.2.1.
Groundwater Dependant Ecosystems	Local creeks and drainage lines near the site have been identified as potential aquatic Groundwater Dependent Ecosystems (GDEs) and include Toomuc Creek (west) and Kennedy and Pakenham Creeks (south). These have been identified as high potential GDEs. Scattered potential terrestrial GDEs have been identified near the site but predominantly to the west. These have been identified as both low to high potential terrestrial GDEs.

3.2 Neighbouring groundwater use

DEECA's Visualising Victorias Groundwater (VVG) was interrogated to identify groundwater bores in the area and characterise groundwater use near the site.

The following comments are made regarding the VVG data:

– Bores installed prior to the proclamation of the original *Water Act* (1969) may not be registered as there was no mandatory requirement to licence bores prior to this date
– VVG does not provide information regarding the operation status of the bores
– Bores installed without a bore construction licence are unlikely to be registered on VVG (unless detected by later audits)
– Many bores have not been surveyed for location. Bore locations registered were often those initially proposed on the bore construction licence application. In many instances drilling contractors could not gain access to these sites and final locations often have a positional accuracy greater than 250 m
– The information registered on the VVG is subject to the accuracy of the bore completion reports submitted by drilling contractors
– Information registered on VVG is subject to change since the completion of the bore e.g. water level information, pump setting depth, groundwater quality
– Some information is not available on VVG e.g. pump setting depth and bore ownership

The search identified 31 bores within an approximate 3 km radial search from the centre of the site and a summary is provided in Table 4. Neighbouring bores have been tabulated in Appendix B.

Of the 10 observation bores, two of these, bores WRK082149 and WRK082152 were identified on bore decommissioning licence WLE067411, supplied to GHD by Holcim, i.e. these were Holcim monitoring bores.

Table 4 Neighbouring bore summary

Bore Use	Number of bores	Depth range (m)
Stock/ domestic	16	16 - 103
Observation	10	1.5 – 12.2
Irrigation	1	14.7
Unknown	3	30.5 - 88
Not listed	1	25

3.3 Aquifer hydraulic parameters

GHD (2023) indicated that published aquifer parameters were used as part of the assessment, as no site testing had been completed. Aquifer (slug) testing was recommended from site monitoring bores in order to obtain site specific hydraulic conductivity so that the estimated radius of influence of the quarry could be updated.

Slug testing was completed at the site by AECOM (AECOM, 2024) and the results of the testing have been provided to GHD by Holcim. A summary of the results is presented in Table 5.

Table 5 Summary of slug test results

Bore ID	Average hydraulic conductivity (m/sec)	Calculated average hydraulic conductivity (m/day)	Interpreted lithology	Bore depth (m)	Interpreted hydraulic conductivity category
MB01	9.9×10^{-7}	0.09	Silty CLAY (Werribee)	71.9	Very low
MB02C	2.0×10^{-6}	0.17	Sandy CLAY (Werribee)	36.7	Low
MB03B	5.7×10^{-7}	0.05	Silty CLAY (Werribee)	52.9	Very low
MB04C	3.8×10^{-5}	3.28	Basalt (Older Volcanics)	30.8	Moderate
MB05B	5.3×10^{-6}	0.46	Basalt (Older Volcanics)	47	Low
MB06	6.4×10^{-6}	0.55	Basalt (Older Volcanics)	50.5	Low

Notes:

Source: AECOM (2024) report provided to GHD by Holcim

AECOM (2024) present the average hydraulic conductivity in m/sec. Average hydraulic conductivity in m/day calculated by GHD

Interpreted lithology and hydraulic conductivity category from AECOM (2024)

4. Groundwater and spring monitoring network

4.1 Groundwater monitoring bore network

4.1.1 Site monitoring bores

Based on information provided by Holcim to GHD, and documented in previous annual reviews, GHD understands that six bores, MB01 to MB06 were installed in 2001 and formed the original monitoring bore network. Bores were installed in both the basalt of the Older Volcanics and the underlying Werribee Formation.

Bores MB01 and MB06 have remained operation since their installation in 2001. Over time, with quarry development however, some of the remaining original bores have been lost or damaged. Where lost or damaged, these bores have been replaced.

It is noted that Holcim have indicated that bores MB02c and MB4c, located on the quarry floor, have been installed in overburden material.

In addition to bores MB01 to MB06, bore MB07 was installed in 2024 at a location to the north east of the quarry. Bore MB07 was installed to support future quarry expansion activities in this area and groundwater level monitoring has only recently commenced.

Owing to the paucity of data, i.e. approximately six months of monitoring, from bore MB07 it has been excluded from this review. The results from bore MB07 will be included in a future review, once a greater data set is available.

A summary of the monitoring bores at the site is provided in Table 6. Bores shaded blue in Table 6 are operational and currently monitored.

Monitoring bores at the site are shown on Figure 3. Available monitoring bore logs, provided by Holcim, are included in Appendix C.

4.1.2 State Observation Network bore

State Observation Network (SON) bore 84032 was identified approximately 10 km south of site, adjacent Burke Road. This bore screens the Older Volcanics between 48 m and 60 m depth. Summary details of this bore have been included in Table 6. Given the distance of the bore from the site it has not been shown on Figure 3.

The bore has not been actively monitored by the State since 2016 however Holcim have commenced monitoring water levels from the bore to aid in identifying groundwater level variations away from their site.

GHD understands that Holcim's approval to access and monitor water levels from SON bore 84032 has been provided by DEECA.

4.2 Spring monitoring locations

Ten springs surrounding the quarry, SP01 to SP10, have been monitored to assess potential changes in spring function (flow, level, quality) that may be impacted by quarry operation. Each monitoring event has included a walkover and visual inspection at each spring location and measurement of field water quality parameters including Electrical Conductivity (EC), pH, temperature, Oxidation Reduction Potential (ORP) and Dissolved Oxygen (DO). It is noted that:

– Springs SP09 and SP10 have since been reclassified with spring SP09 classified as a seep
– AECOM (2024) reported that a new spring, SP11, had been identified by Holcim in 2023 on the western side of the quarry. When inspected by AECOM however there was insufficient flow to collect field parameters.

A summary of the springs at the site has been provided.

Table 6 Summary of Holcim site monitoring bores

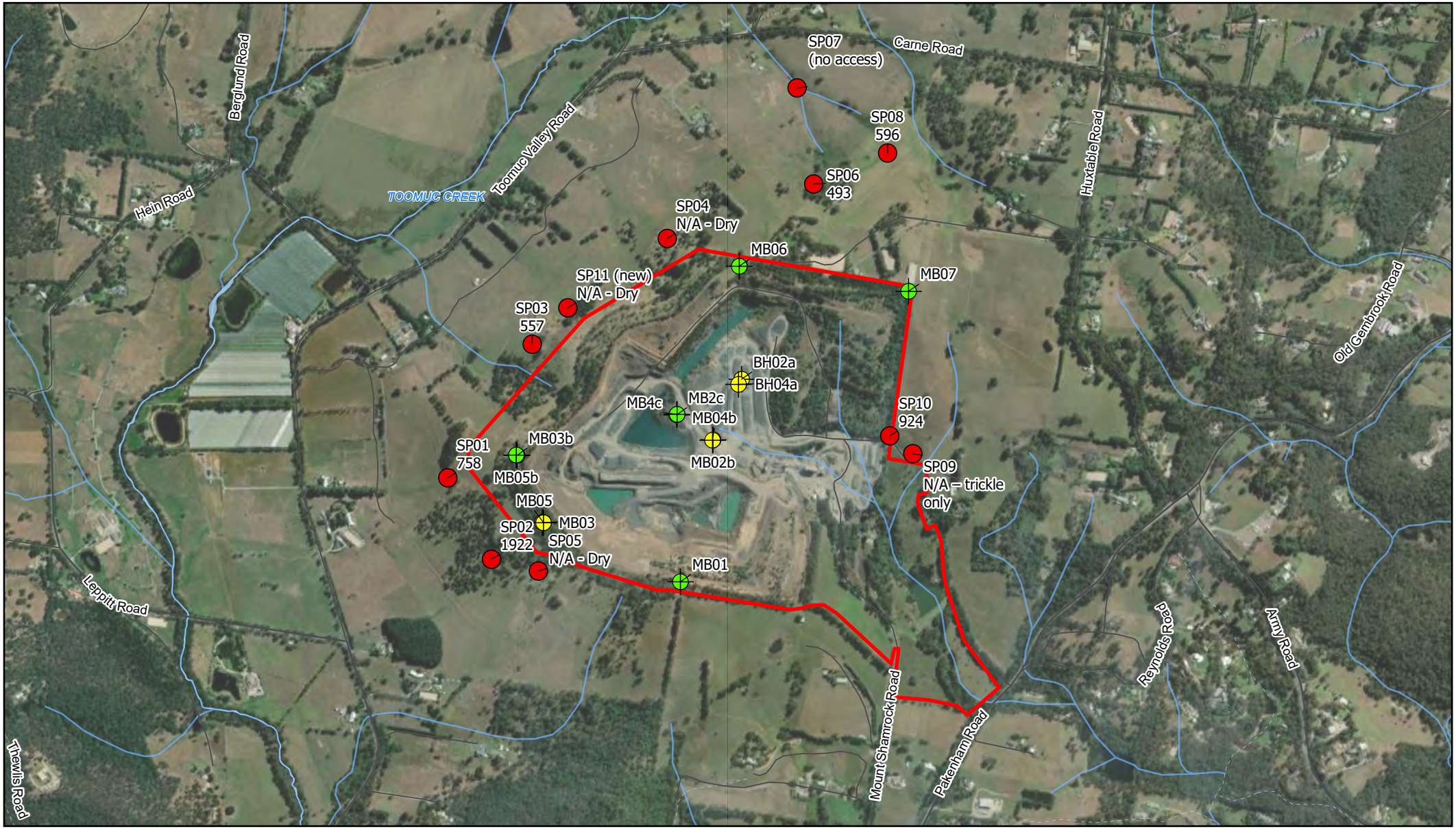
Bore ID	Installation date	MGA Z55 Coordinates		Elevation (m AHD)	Screened interval (m)	Screened aquifer	Status
		Easting	Northing				
MB01	7-Mar-01	366135.13	5789516	216.518	67.0 – 72.5	Werribee Formation	Operational
MB02a	13-Mar-09	N/A	N/A	N/A	14 – 17	Werribee Formation	Destroyed
MB02b	22-Oct-14	366344.3	5790135.03	174.64	8.8 – 11.8	Werribee Formation	Decommissioned
MB2c	17-Jan-17	366232.07	5790211.78	191.68	33.77 – 36.77	Werribee Formation/ potential overburden	Operational
MB03	6-Mar-01	365817.18	5789879.64	229.69	71 – 77	Werribee Formation	Destroyed
MB03b	24-Oct-14	365739.25	5790087.04	209.9	49 – 52	Werribee Formation	Operational
MB04a	13-Mar-09	N/A	N/A		8.7 – 11.7	Basalt (Older Volcanics)	Destroyed
MB04b	22-Oct-14	366342.72	5790133.59	174.7	1 – 1.5	Basalt (Older Volcanics)	Decommissioned
MB4c	17-Jan-17	366233.33	5790213.41	191.84	30.4 – 30.9	Basalt (Older Volcanics)//potential overburden	Operational
MB05	6-Mar-01	365820.83	5789879.07	229.84	51 – 57	Basalt (Older Volcanics)	Decommissioned
MB05b	27-Oct-14	365736.94	5790087.88	209.55	40 – 46	Basalt (Older Volcanics)	Operational
MB06	13-Mar-01	366321.06	5790488.4	219.84	44 – 50	Basalt (Older Volcanics)	Operational
MB07	2024	366948	5790593	242.84	64 - 70	Basalt (Older Volcanics)	Operational

Notes:
Source: AECOM (2024) and Holcim
MGA – Map Grid of Australia
m AHD – metres Australian Height Datum
All bores comprise 50 mm internal diameter PVC
Bores shaded blue are operational and currently monitored. Bore MB07 installed in 2024.

Table 7 Summary of springs

Spring ID	MGA Z55 Coordinates	MGA Z55 Coordinates	Elevation (m AHD)	Location relative to quarry	Classification/ general comment
	Easting	Northing			
SP01	365525.204	5790017.447	155.628	South west	Spring. This spring provides irrigation and stock water to a number of properties in the local area Adjacent general current quarrying area.
SP02	365660.221	5789766.116	145.731	South west	Spring Water emanating from the spring terminates at small dam. The dam catchment would include both surface water run-off and groundwater (spring flow). Adjacent general current quarrying area.
SP03	365785.971	5790429.762	160.522	West	Spring Spring flows towards small dam, healthy vegetation surrounding this. Adjacent general current quarrying area.
SP04	366203	5790756	166.903	North west	Spring Pooled water, but historically dry or damp seep with healthy vegetation.
SP05	365805	5789730	161	South	Spring Spring is historically observed to be dry with healthy vegetation Adjacent general current quarrying area
SP06	366655.043	5790924.065	165.962	North	Spring. Flow into a dam. The spring is accessible by livestock
SP07	Not accessible		-	North	Seep. Downslope and down catchment from SP06. Reclassified as seep only in 2005, and not monitored
SP08	366883.083	5791019.567	171.744	North	Spring. In an adjacent creek line to SP06. Spring flow into a wetland.
SP09	366961	5790092	-	East	Spring. Flow into wetlands.
SP10	366890	5790147	166	East	Seep. Reclassified as a seep only in 2005.
SP11 (new)	365896	5790542	179	West	Spring

Notes:
Surveyed coordinates and elevations for springs SP01 – SP03, SP06 and SP08 provided by Holcim. Elevation taken at the top of stake at each spring
Handheld GPS coordinates for springs SP04, SP05, SP10 and SP11 collected by GHD in December 2024
Elevation for spring SP04 written on stake at spring
Approximate elevations for springs SP05, SP10 and SP11 collected with handheld GPS by GHD in December 2024
Approximate location for spring SP09 provided based on GIS mapping



Boreholes

- Operational
- Lost/destroyed
- MiningTenement

- Spring Location (EC µS/cm) Dec 2024
- Watercourse
- Stream
- Drain/Channel/Other

Paper Size ISO A4

0 125 250 375 500

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Holcim (Australia) Pty Ltd
Pakenham Quarry
Groundwater and Spring Monitoring

Project No. **31-12643509**
Revision No. **B**
Date **03/02/2025**

Mount Shamrock Quarry Monitoring Bore and Spring Location Plan

FIGURE 3

N:\AU\Melbourne\Projects\31\12643509\GIS\Maps\Working\12643509_Location_Plan_A4L\12643509_Location_Plan_A4L.aprx - Bore Spring Locations
Print date: 03 Feb 2025 - 17:07

Data source: World Imagery: Maxar. VicMap, 2025. Holcim, 2024. AECOM, 2024. GHD, 2024. Created by: lgreen

5. Groundwater and spring monitoring

5.1 2024 monitoring

5.1.1 Groundwater level monitoring

During 2024, groundwater level was completed monthly from bores MB01 to MB06. Following approval from DEECA to access SON bore 84032 (refer Section 4.1.2), groundwater level monitoring was completed in November and December 2024.

Groundwater level monitoring was completed by AECOM, Holcim and GHD as summarised in Table 8.

Table 8 Groundwater level monitoring - 2024

Month	Monitoring completed by
January 2024	AECOM
February – November 2024	Holcim
December 2024	GHD (bores MB01 – MB06), Holcim (SON bore 84032)

As indicated in Section 2.3.1, dataloggers have been deployed in bores MB01, MB06 and MB07 and collect water level data every six hours.

Groundwater level data has been provided to GHD by Holcim. Tabulated manual groundwater levels are included in Appendix D. Monitoring bore hydrographs have been prepared for each bore. In constructing the hydrographs, the following rules were applied:

– Consistent range on the (reduced) water level (y-axis/ordinate axis), where possible
– Consistent range on the time (x-axis/abscissa), where possible
– Reduced water level trends (to metres above Australian Height Datum) shown

The monitoring bore hydrographs are presented in Appendix E. Where datalogger information was available, this has been included on the hydrographs.

5.1.2 Spring monitoring

GHD hydrogeologists completed a survey of the springs on 12 December 2024. The survey included:

– An inspection of each spring to assess the current condition, and so it can be compared to previous inspections
– Where possible, collection of field water quality parameters from each spring, including Electrical Conductivity (EC), pH, temperature, Oxygen Reduction Potential (ORP) and Dissolved Oxygen (DO)
– Where possible, estimate spring flows
– Compilation of a photographic record

A summary of the spring monitoring is presented in Table 9. As flow rates and ECs from each spring are documented in AECOM (2024) these have been included along with the December 2024 results.

Historical spring observations, supplied by Holcim to GHD, have been tabulated in Appendix F. In addition, GHDs summary of spring monitoring (GHD, 2023) has been updated and also included in Appendix F.

Spring EC and rainfall for the period 2001 to 2024 has been shown graphically in Appendix G. A photographic record of the springs for the December 2024 inspection has also been included in Appendix H.

EC recorded at each spring in December 2024 is also shown on Figure 3.

Table 9 Spring inspection results, December 2024

Spring ID	Location relative to quarry	Flow/Level measurement method	Elevation (m AHD)	Measured water level (m) Dec 2024	Water level height (m AHD)	EC (µS/cm)	EC (µS/cm)	Flow rate (m^3/day)		Observation
					Dec-24	Jan-24	Dec-24	Jan-24	Dec-24	
SP01	South west	Bucket and flow meter. Measuring tape	155.628	0.19	155.438	724	758	10.3	4.7	Water flows into bin. Due to location of bin, not all water captured in bin. Flow meter installed 1 November 2024 at tank below spring. Flow meter reading - 262 m^3. Assuming an initial flow meter reading of 0 m^3, this suggests an approximate daily flow rate of 6.4 m^3
SP02	South west	Bucket and flow meter Measuring tape	145.731	0.26	145.471	1892	1922	15.1	1.3	Spring is fenced. Lush healthy vegetation. Flow meter installed between spring and water tank on 4 December 2024. Flow meter reading -10 m^3. Assuming an initial flow meter reading of 0 m^3, this suggests an approximate daily flow rate of 0.9 m^3 Meter to be read weekly by Holcim.
SP03	West	Bucket Measuring tape	160.522	0.185	160.337	768	557	0.3	2.5	Spring is fenced. Lush healthy vegetation. Water flows into wheelie bin. Small drainage line upslope of spring. Water also allowed to flow into small tank directly below spring. PVC pipe needs to be

Spring ID	Location relative to quarry	Flow/Level measurement method	Elevation (m AHD)	Measured water level (m) Dec 2024	Water level height (m AHD)	EC (µS/cm)	EC (µS/cm)	Flow rate (m^3/day)		Observation
					Dec-24	Jan-24	Dec-24	Jan-24	Dec-24	
										disconnected for some time to allow for surges in water to cease, i.e. prior to measuring flow rate.
SP04	North west	-	166.903	-	-	1041	Dry	NR	NR	Heavy weed growth including blackberries and thistles at spring. Spring appears to have been historically fenced but evidence of livestock at spring now observed. Spring currently dry, but flows have been historically reported. Trace moisture at located immediately above spring.
SP05	South	-	161	-	-	Dry	Dry	NR	NR	Location dry, but areas of healthy vegetation observed. Holcim indicates this location was historically wet but has remained largely dry for at least four years
SP06	North	Measuring tape	165.962	0.445	165.517	397	493	NR	-	Spring not fenced. Accessible by livestock. Landowner has historically damned the spring. Potential seepage through dam wall into local gully. Wet ground upslope of spring, lush vegetation below spring. Turbid/ murky water.

Spring ID	Location relative to quarry	Flow/Level measurement method	Elevation (m AHD)	Measured water level (m) Dec 2024	Water level height (m AHD)	EC (µS/cm)	EC (µS/cm)	Flow rate (m^3/day)		Observation
					Dec-24	Jan-24	Dec-24	Jan-24	Dec-24	
										Water level lower than that recorded in January 2024.
SP07	North	-	No access							Spring no longer observed.
SP08	North	Bucket	171.744	N/A	-	431	596	13	7.9	Located on private property. Lush vegetation, including reeds surrounding large pool of water. Flow rate measured from small culvert where spring overflows. Holcim indicates that water level in spring remains reasonably consistent over time but flow rates in drainage line respond to rainfall events.
SP09	East	-	N/A	-	-	457	924	21.6	NR	Spring located on Holcim land. No access for livestock. Large spring, heavily vegetated. Trickle of water only in overflow/ discharge pipe. Insufficient to accurately measure flows. Holcim indicates area is always wet.
SP10	East	-	166	-	-	N/A	Insufficient water	NR	NR	AECOM (2024) indicated that this has been reclassified as a spring and no longer observed.

Spring ID	Location relative to quarry	Flow/Level measurement method	Elevation (m AHD)	Measured water level (m) Dec 2024	Water level height (m AHD)	EC (µS/cm)	EC (µS/cm)	Flow rate (m^3/day)		Observation
					Dec-24	Jan-24	Dec-24	Jan-24	Dec-24	
										In December 2024 minor seepage was identified adjacent gate.
SP11	West	-	179	-	-	N/A	Insufficient water	Not flowing	Not flowing	Identified in 2023 by landholder as a wet patch and lush vegetation in an otherwise dry area. Not fenced. Damp/ soft ground. Water pooling where disturbed by livestock.

Notes:

Water level at spring measured on survey peg. Measurement is from top of survey peg to water level.

Survey peg at spring SP08 not located

NR – not recorded

EC and Flow rate recorded in January 2024 from AECOM (2024).

December 2024 monitoring completed on 12 December. This includes water level heights, water quality and flow rates.

5.1.3 Quarry dam water levels

Water level data is also recorded by Holcim from their northern and southern dams located within the quarry. These dam water levels are collected in order to allow comparison to groundwater levels at the site.

Tabulated water levels in site dams are provided in Appendix I. Water level information, provided by Holcim, is available between October 2020 and December 2024.

6. Discussion of results - groundwater levels

6.1 External influences on groundwater levels

6.1.1 Rainfall

To assess the influence of rainfall on water levels, rainfall information was obtained from the Bureau of Meteorology (BOM). To maintain consistency with previous reporting, rainfall information has been obtained from the Dandenong BOM climate station 086224.

Monthly rainfall received during 2024 has been summarised in Table 10. During 2024, the data indicates that rainfall at Dandenong during 2024 was approximately 50 mm below the long-term average.

Table 10 Monthly rainfall, 2024. Dandenong (086224) climate station

Month	Rainfall (mm) as recorded at Dandenong Climate Station (2024)	Long Term Average Monthly Rainfall (mm)
		Dandenong
January	114	48.7
February	23.2	53.5
March	14	49.4
April	142.1	75.4
May	35.6	64.5
June	30.2	68.3
July	117.1	67.2
August	32.3	69.7
September	62.5	64.8
October	66.6	73.9
November	53.1	86.4
December	50.5	72.6
Annual Total	**741.3**	**794.8**

Note:
Average monthly rainfall calculated using data from January 2002 to December 2024 (22 years) from data obtained from BOM.

Cumulative deviation from the mean monthly rainfall plots have been generated for the period 2002 to 2024. These have been included with the hydrographs (refer Appendix E) to characterise the influence of rainfall on groundwater levels. The absolute value of the residual mass curve is not important, but rather the slope:

– A positive slope indicates a wetter than average period
– A negative slope indicates a drier than average period
– A section of both negative and positive indicates a period of generally average rainfall
– The grade of the slope indicates how much wetter or drier than average the climate is

6.2 Groundwater level monitoring results

6.2.1 SON bore 84032

The regional groundwater level response has been characterised using SON bore 84032 which screens the Older Volcanics. The bore has not been actively monitored by the State since 2016, however Holcim have commenced monitoring water levels from this bore as part of their groundwater monitoring program.

A hydrograph for SON bore 84032 has been included in Appendix E. Groundwater levels from 2002 until the State ceased monitoring in 2016 are shown, along with water levels recorded by Holcim in November and December 2024.

Between approximately 2006 and mid 2010 there was a fall in water levels, coincident with the Millennium drought conditions experienced across the State. Water levels began to recover in 2010, consistent with increasing rainfall, and by 2012 had recovered to levels pre-drought conditions. A gradual fall in water levels is also noted between 2014 to when monitoring ceased in 2016, which is also consistent with below average rainfall.

Water levels measured by Holcim in 2024 were reported at approximately 11 m AHD, broadly consistent with previous monitoring, although this is following a number of wetter than average years post around 2020.

There is insufficient water level data between 2016 and 2024 to draw further conclusions on water level behaviour however, based on the available data, the water level response from SON bore 84032 appears to be influenced by climatic conditions, i.e. rainfall.

Ongoing monitoring by Holcim is recommended to confirm trends in regional groundwater levels, i.e. away from the site, and to support future reviews.

6.2.2 Site monitoring bores

Groundwater level monitoring is completed from site bores in order to meet the requirements of the EMP (refer Section 2.3.1) and groundwater levels are available from 2022 to the present, except for a period between 2005 and 2008.

Tabulated groundwater level data is presented in Appendix D and hydrographs are included in Appendix E. A discussion of water level responses in the bores is included below.

Monitoring bores MB01 and MB06

Monitoring bores MB01 (Werribee Formation) and MB06 (Older Volcanics) are located at the south and north of the quarry, respectively.

– Based on the available water level data between 2002 and 2005, water levels in both bores showed an obvious response to the prevailing rainfall trends, falling during periods of below average rainfall and rising during periods of above average rainfall
– Following a break in the monitoring between early 2005 and 2008, water levels were observed to have fallen significantly, more than 8 m, coincident with a period of below average rainfall
– Water levels continued to fall in bore MB06 (Older Volcanics) until 2010 whereas water levels in bore MB01 (Werribee Formation) rose during the period of below average rainfall (which is thought to be related to the stripping of overburden/vegetation removal during this time)
– Following a break in the monitoring in 2014, the water level response in both bores appears to have been largely driven by the prevailing climate with water levels rising and falling in response to rainfall. The most obvious response is a period in late 2022/ early 2023 when water levels in the bores rose as rainfall totals increased. The rise in water levels is more pronounced in bore MB06 (Older Volcanics)
– Except for a period between 2008 and 2011, water levels in bore MB06 (Older Volcanics) have been higher than in bore MB01 (Werribee Formation). Since 2015, an approximate average head difference of 4 m has been recorded

Nested monitoring bores MB02 and MB04

Nested monitoring bores MB02 (Werribee Formation) and MB04 (Older Volcanics) are located on the quarry floor however Holcim has indicated that the more recent bores replacement monitoring bores may be installed in overburden material.

– Based on the available data, water levels in the bores did not appear to fall during a long period of below average rainfall between 2006 and 2010
– Following a break in the monitoring between mid-2008 and mid-2009, water levels were observed to rise significantly, more than 10 m, coincident with a period of above average rainfall

– Following another break in the monitoring between early 2011 and early 2015, water levels were observed to have fallen significantly, approximately 10 m, coincident with a period of below average rainfall. Water levels continued to fall steadily until approximately early 2019
– Whilst rainfall has generally increased since 2020, water levels in the bores has remained relatively stable. Small falls in water levels in each bore were observed however in late 2024 (more so in the Werribee Formation bore), consistent with below average rainfall. The groundwater level in MB04 (older Volcanics) appears to strongly correspond with the northern dam level
– Historically, water levels in bore MB02 (Werribee Formation) have been higher than in bore MB04 (Older Volcanics). More recently however, since 2020, water levels have been higher in bore MB04. An approximate average head difference of 1.2 m is noted during this more recent period

Nested monitoring bores MB03 and MB05

Nested monitoring bores MB03 (Werribee Formation) and MB05 (Older Volcanics) are located on to the south west of the site, near the quarry crest.

– Based on the available water level data between 2002 and 2011, water levels in both bores showed an obvious response to the prevailing rainfall trends, falling during periods of below average rainfall and rising during periods of above average rainfall
– Following a break in the monitoring between early 2011 and early 2015, water levels were observed to have fallen significantly, more than 10 m, coincident with a period of below average rainfall. Water levels continued to fall until approximately mid 2016
– Above average rainfall has been observed between early 2020 and late 2022 however the water level response has not been as pronounced as during previous above and below average rainfall periods
– Water levels in bore MB03 (Werribee Formation) fell sharply between November 2022 and March 2023. AECOM (2024) indicate that this fall was in response to quarrying from Area 2. Whilst water levels initially recovered, they have since fallen slightly in response to reduced rainfall
– Historically, water levels in bore MB05 (Older Volcanics) have been higher than in bore MB03 (Werribee Formation), sometimes up to 2 m. Since 2015 however, the approximate average head difference has fallen to 0.2 m

6.2.3 Dam water levels

Dam water levels, provided by Holcim, have been included on the hydrographs. Based on the data between late 2020 and December 2024, the northern dam averages a pit water level of approximately 173 m AHD and the Southern Dam approximately 165 m AHD. This is consistent to that reported by AECOM (2024).

During 2024 water levels in the northern dam have varied by approximately 1 m whereas water levels in the southern dam have varied by only approximately 0.2 m.

The water level in the northern dam broadly corresponds with water levels recorded from bore MB04 (Older Volcanics) located on the quarry floor. Water levels in the southern dam are lower than groundwater levels recorded from all bores.

6.3 Summary

Overall, the groundwater levels observed in monitoring bores reflect a response of the groundwater system to the prevailing climate, i.e. rainfall. Whilst water level declines in bores MB03 and MB05 are likely related to quarry deepening in 2022/2023 adjacent the bores, there is no obvious indication that groundwater levels are being influenced more broadly by the quarry operations, i.e., the other monitoring bore site trends generally reflect a climate response.

7. Classification of Groundwater and Protected Environmental Values

This section has been included in order to allow for reviewing the classification of the local ground water to identity the protected environmental values specific to this site.

7.1 Classification of groundwater

The *Environment Protection Act* (2017) specifies objectives of the EPA. The Act requires a prevention based approach, rather than preventing waste and pollution impacts and managing these after they have occurred. Central to the Act is the general environmental duty (GED) which requires Victorians to reduce the risk of their activities potentially harming the environment or human health through waste and pollution.

The Act introduces two subordinate instruments:

– Environment Protection Regulations (EPR)
– Environment Reference Standard (ERS)

The ERS is used to assess and report on the environmental conditions throughout Victoria, as it:

– Identifies environmental values (human health and the environment) to be achieved or maintained in Victoria
– Specifies indicators and objectives used to measure, determine, or assess whether those environmental values are being achieved, maintained, or threatened

The ERS is not meant to represent a compliance standard but rather has a primary function to provide an environmental assessment and reporting benchmark. The ERS contains environmental values for each element of the environment in separate parts, i.e. air, land, water (surface and groundwater), however, the different elements of the environment can impact each other and the interactions between them need to be considered.

The ERS (2021) provides that groundwater is categorised into segments, with each segment having particular identified values. The segments and their environmental values are summarised in Table 11.

Table 11 Protected environmental values and groundwater segments

Environmental value	Segment (TDS mg/l)						
	A1 (0-600)	A2 (601-1,200)	B (1,201-3,100)	C (3,101-5,400)	D (5,401-7,100)	E (7,101-10,000)	F (>10,000)
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓						
Potable water supply (acceptable)		✓					
Potable mineral water supply	✓	✓	✓	✓			
Agriculture and irrigation (irrigation)	✓	✓	✓				
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	
Industrial and commercial use	✓	✓	✓	✓	✓		
Water-based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties	✓	✓	✓	✓	✓	✓	✓

Note: TDS – Total Dissolved Solids (mg/L).

Environmental value	Segment (TDS mg/l)						
	A1 (0-600)	A2 (601-1,200)	B (1,201-3,100)	C (3,101-5,400)	D (5,401-7,100)	E (7,101-10,000)	F (>10,000)
Source ERS (2021).							

7.1.1 Groundwater quality indicators and objectives

The indicators and objectives for groundwater, for each environmental value have been summarised in Table 12. The environmental values may not apply to groundwater if:

– There is insufficient aquifer yield to sustain the environmental value, having regard to variations within the aquifer and reasonable bore development techniques to improve yield; or
– The application of that groundwater, such as for irrigation, may be a risk to the environmental values of land or the broader environment due to the soil properties; or
– The background water quality level exceeds (or is less than, in the case of indicators such as pH, dissolved oxygen and many biological indicators) the relevant objective specified in Table 12 and as a result the environmental value cannot be achieved

Table 12 Groundwater indicators and objectives

Environmental value	Indicators	Objectives
Water dependent ecosystems and species (in surface waters)	For groundwater that discharges to surface water, the indicators are the indicators applicable to the relevant surface water as specified in Division 3 of Part 5 of this ERS	The level that ensures the groundwater does not affect receiving waters to the extent that the level of any indicator in the receiving waters: – Exceeds the level of that indicator (if specified as an upper limit); or – Is less than the level of that indicator (if specified as a lower limit), – Specified for surface water in Division 3 of Part 5 of this ERS.
Water dependent ecosystems and species (in subterranean waters with a hydrogeological setting conducive to the presence of troglofauna and stygofauna)	Indicators that are relevant to the subterranean species of troglofauna and stygofauna, which may include TSS, salinity, toxicants in water, toxicants in sediment and dissolved oxygen	The level that ensures the groundwater quality does not adversely affect the troglofauna and stygofauna that depend on the groundwater.
Potable water supply	Indicators specified in the ADWG	Health-related guideline value for each indicator specified in the ADWG. Aesthetic guideline value for each indicator specified in the ADWG.
Potable mineral water supply	Indicators specified in the ADWG	Health guideline values for each indicator specified in the ADWG. Aesthetic guideline values for each indicator set out in the ADWG.
Agriculture and irrigation (irrigation)	Indicators specified for irrigation and water for general on-farm use in the ANZG	Level of that indicator specified in the ANZG
Agriculture and irrigation (stock watering)	Indicators specified for livestock drinking water quality in the ANZG	Level of that indicator specified in the ANZG
Industrial and commercial	Indicators specific to the particular industrial or commercial activity and their use of water	Groundwater quality that is suitable for its industrial or commercial use
Water-based recreation	E. coli	10 E. coli/100mL (if no human faecal contamination sources identified)

Environmental value	Indicators	Objectives
		0 E. coli/100mL (if human faecal contamination sources identified)
	Chemical hazards, aesthetic effects	Level of indicators (where specified) and descriptions in applicable guidance, in the Recreational Water Guidelines
Buildings and structures	pH, sulphate, chloride, redox potential, salinity or any chemical substance or waste that may have a detrimental impact on the structural integrity of buildings or other structures	Groundwater that is not corrosive to or otherwise adversely affecting structures or building
Geothermal	Temperature between 30°C and 70°C.	Geothermal properties of groundwater to be maintained for current and future users of the resource

Note: ANZG - means the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)

The background water quality level is the objective for an indicator if:

– The objective is not able to be attained due to the background water quality level of that indicator; or
– The background water quality level better protects the environmental values than the objective specified in Table 12

The ERS (2021) requires that occupational health and safety, odour and amenity also be considered, due to the fact that vapours sourced from impacted groundwater may present a potential risk to workers, and that odours or discolouration may result in degradation of overall environmental values of groundwater.

7.1.2 Identified groundwater segment

In identifying the relevant groundwater segment, several sources of data were reviewed:

– Field water quality monitoring from the springs over the entire dataset indicate that salinity ranges from 149 mg/l TDS (SP09, February 2002) to 2,808 mg/L TDS (SP02, January 2003) with an average of approximately 760 mg/L TDS
  - Water quality monitoring in December 2024 indicated that salinity ranged from 296 mg/L TDS (SP06) to 1,153 mg/L TDS (SP02) with an average of approximately 525 mg/L TDS
– Regional salinity information (refer Section 3.1) indicates that the groundwater salinity at the site is between 500 mg/L and 1,000 mg/L TDS but higher groundwater salinity, 1,000 mg/L to 3500 mg/L TDS is interpreted south of the site
– Historical site monitoring bore salinity data taken during bore development ranges from approximately 1140 mg/L TDS to approximately 2,320 TDS

The historical monitoring bore salinity results are considered the most representative of local groundwater salinity. It is acknowledged that the water at the springs may not be a true representative of groundwater quality as the springs are likely to capture rainfall, either directly or as runoff leading to dilution and reduction of salinity. As such, and using site specific monitoring bore data, groundwater at the site, Segment B (i.e. 1,201-3,100 mg/L TDS) has been adopted. The distinctly high salinity from spring SP02, relative to other springs, is a strong indicator that this spring may be predominately recharged by the groundwater system.

7.1.3 Protected Environmental Values

Segment B groundwater quality needs to be maintained to protect the following environmental values:

Table 13 Relevant protected environmental values

Environmental value	Existing use	Relevance
Water dependent ecosystems and species	Yes	**Relevant** Groundwater quality must be maintained to protect aquatic ecosystems at the point of groundwater discharge. Based upon the ERS, the site falls within the Central Foothills and Coastal Plains segment which is a slightly to moderately modified water dependent ecosystem.
Potable mineral water supply	Onsite – no Offsite - no	**Not relevant** The groundwater is not within a recognised mineral water province and is not known to display properties desirable in a mineral water e.g. spritzig or effervescence. There is a limited likelihood of groundwater being used for this purpose in this area.
Agriculture and irrigation (irrigation)	Onsite – No Offsite – yes	**Relevant** Bores within irrigation use have been identified and therefore this is a relevant environmental value that requires protection.
Agriculture and irrigation (stock watering)	Onsite – no Offsite - yes	**Relevant** There are stock bores neighbouring the site. The salinity of the groundwater is acceptable to a wide range of livestock species. This is a relevant environmental value that requires protection.
Industrial and commercial	Onsite – no Offsite - yes	**Relevant** There are no nearby bores with a commercial or industrial licence and the neighbouring land use is predominantly farming. Whilst development of groundwater for such abstractive benefit seems unlikely, protection of this environmental value is reasonable.
Water-based recreation (primary contact recreation)	Onsite – no Offsite - potentially	**Relevant** Whilst local waterways are likely to be too small to support water based recreation, neighbouring bores may be used for such purpose, e.g. swimming pool top up.
Traditional Owner cultural values	Yes	**Relevant** No specific engagement with the local traditional owners has been undertaken as part of this commission. In the absence of the such engagement, it has been assumed that protection of groundwater that discharges into local waterways is required to maintain traditional owner cultural values
Cultural and spiritual values	Yes	**Relevant** This environmental value may include traditional aquaculture, fishing, harvesting, cultivation of freshwater and marine foods, fish, grasses, medicines and filtration of water holes. There are no objectives specified in the ERS. In the absence of site-specific criteria, the objectives for other environmental values of water dependent ecosystems and species have been adopted.
Buildings and structures	Not on site. Neighbouring residential properties (likely shallow foundations)	**Not relevant** There are some buildings, including residential properties, located remote from the quarry. It is noted that most water levels tend to be greater than 20 m depth and therefore the buildings would need to have basements and/or foundation structures that penetrate below this depth.
Geothermal properties	No	**Not relevant** The groundwater is too shallow to have an elevated temperature and therefore this value is not considered relevant to the assessment.

8. Discussion of results – springs

8.1 Spring monitoring results

8.1.1 Electrical Conductivity

Where there was sufficient water, field measurements of EC for the springs were recorded during the December 2024 inspection and these have been recorded in Table 9, along with the results from the previous (January 2024) annual inspection.

In most cases there was limited change in the EC with the exception of:

– Spring SP04. EC in January 2024 was 1,041 µS/cm in January 2024 but was dry in December 2024
– Spring SP09. EC in January 2024 was 457 µS/cm in January 2024 but was reported as 924 µS/cm in December 2024

Long term rainfall and spring EC has been presented graphically in Appendix G.

The data indicates that spring SP02, located south west of the quarry, has consistently reported the highest EC, usually between 2,000 µS/cm and 2,500 µS/cm, and as noted previously is likely to be predominantly groundwater fed. Since 2016 however, the EC of the water from the spring has been slowly falling, from just above 3,000 µS/cm to 1,922 µS/cm in December 2024. The falls in EC from late 2019 are broadly consistent with a longer term rise in rainfall in the region.

The remaining springs where long term EC records are available (SP01, SP03, SP04, SP06, SP08 and SP09) have reported ECs of generally between 500 µS/cm and 1,000 µS/cm, consistent with long term records.

The long term record for spring SP02 indicates that the salinity has varied between 957 mg/L TDS and 2,808 mg/L TDS with an average of approximately 1,629 mg/L TDS. Whilst the average water salinity from this spring is consistent with Segment B groundwater it is noted that recent monitoring has identified a falling salinity trend, potentially reflecting an increasing portion of recharge from local rainfall (and related interflow).

8.1.2 Spring flows

Whilst instantaneous estimates of flow rates are made from the springs, flow meters have been installed at springs SP01 and SP02 (refer Table 8) to provide more accurate long term measurements of spring flows.

A summary of the flows recorded at each spring is provided in Table 14. In most instances, spring flows have fallen since they were last inspected in January 2024, noting that monthly rainfall totals prior to the January 2024 monitoring were significantly higher than that prior to the December 2024 monitoring. This variation in rainfall is considered to be the primary cause of the flow/level reductions noted over the two monitoring periods.

The flows recorded in December 2024 generally fall within the historical range for each spring however they are typically at the lower end of the range (refer Appendix F).

On-going monitoring will eventually allow climate and level /flow results to be plotted to provide a more complete picture of the spring flow/level trends.

Table 14 Summary of spring flows

Spring ID	Location relative to quarry	Flow rate (m^3/day)			Flow meter reading m^3	Comment
		Jan-24	Dec-24	Flow meter, December 2024		
SP01	South west	10.3	4.7	6.4	262	Spring flows have fallen since previous inspection in January 2024 Flow meter reading is broadly consistent with instantaneous reading
SP02	South west	15.1	1.3	0.9	10	Spring flows have fallen since previous inspection in January 2024 Flow meter reading is broadly consistent with instantaneous reading
SP03	West	0.3	2.5	N/A – no flow meter		Spring flows have risen since previous inspection in January 2024.
SP04	North west	NR	NR	N/A – no flow meter		Spring currently dry.
SP05	South	NR	NR	N/A – no flow meter		Spring currently dry.
SP06	North	NR	-	N/A – no flow meter		Spring visibly flowing into the dam, no visible flow out of the dam
SP07	North	Spring no longer observed.				
SP08	North	13	7.9	N/A – no flow meter		Spring flows have fallen since previous inspection in January 2024
SP09	East	21.6	NR	N/A – no flow meter		Insufficient flow. Spring flows have fallen since previous inspection in January 2024
SP10	East	NR	NR	N/A – no flow meter		N/A – trace seepage only
SP11	West	Not flowing	Not flowing	N/A – no flow meter		No change since previous inspection in January 2024
Notes. GHD inspection completed 12 December 2024 Flow meter reading for springs SP01 and SP02 commenced at 0 m^3						

8.1.3 Spring and groundwater level comparison

During the December 2024 inspection, water levels were measured at the springs where these was sufficient water. These water levels have been summarised in Table 15, along with measured groundwater levels in nearby monitoring bores.

Based on the available data for December 2024, the groundwater elevation at the bores is generally greater, i.e. higher, than that recorded from the springs. This is consistent with the findings of AECOM (2024).

Table 15 Spring and groundwater elevations

Spring ID	Location relative to quarry	Elevation (m AHD)	Measured spring water level (m)	Spring water level height (m AHD)	Nearest monitoring bore(s)	Groundwater elevation (m AHD)
SP01	South west	155.628	0.19	155.438	MB03, MB05	168.45 (MB03) 168.75 (MB05)
SP02	South west	145.731	0.26	145.471	MB03, MB05	168.45 (MB03) 168.75 (MB05)
SP03	West	160.522	0.185	160.337	MB03, MB05	168.45 (MB03) 168.75 (MB05)
SP06	North	165.962	0.445	165.517	MB06	176.56

8.2 Summary

There is no obvious indication that quarry operations are impacting on the springs. Observed flows from the springs may reflect the response to rainfall in the lead up to the annual inspections, i.e. increased monthly rainfall in the lead up to the monitoring results in increased flows. The recent installation of flow meters at springs SP01 and SP02 will allow for a greater understanding of spring flows longer term and seasonally, assuming flow volumes are recorded at regular intervals.

9. Bore maintenance

Table 16 summarises the monitoring bore condition observed in December 2024, along with recommended maintenance actions. A photographic record of the bore headworks in December 2024 has been included as Appendix H.

Whilst most bores are in good condition, recommendations have been made to further secure and maintain selected bores.

Table 16 Monitoring bore condition, December 2024

Bore ID	Condition	Comment
MB01	Bore located on steep slope. Difficult to access from quarry side and slope potentially subject to erosion following rainfall. Concrete headworks have been exposed on quarry side and steel casing rocks slightly.	Access bore from south of bore, if possible, to avoid field staff traversing steep, loose slope. Recement around bore headworks to further secure the installation.
MB02C/ MB04C	Nested monitoring bore site on quarry floor. Good condition. Spoil piles around the bore provide some protection from mobile plant.	-
MB03B/ MB05B	Nested monitoring bore site south west of quarry. Good condition however long grass starting to grow near bores.	Slash as required to avoid bores becoming obscured by grass.
MB06	Good condition but steel headworks are rusting	Clean headworks.
General	Bores not identified/ labelled or locked	Label bores so they can be identified by field staff. Consider securing (locking) bores to prevent unauthorised access.

10. Conclusions and recommendations

10.1 Conclusions

Based on the groundwater and spring review, Table 17 summarises the conclusions from the groundwater monitoring completed at the site in 2023.

Table 17 Conclusions

Item	Comment
Groundwater levels	Baseline groundwater level monitoring required as part of the EMP is currently undertaken monthly by Holcim. Holcim have also commenced groundwater level monitoring from SON bore 84032, south of the site, to further understand regional groundwater levels and to inform future reviews. The water level response geographically across the site monitoring bore network was variable, but generally consistent ranges are observed within individual bores. Overall, the bores are responding to climatic variation. Water levels in bores MB03 and MB05 fell in response to quarrying operations in 2022/2023 water levels have since started recovering. During 2024 there was no obvious indication that groundwater levels were being influenced locally by abstraction, i.e., neighbouring irrigation, or as influenced by quarry operations.
Dam water levels	During 2024, water levels in the northern dam varied by 1 m whilst water levels in the southern dam varied by 0.2 m. This variation is less than in 2023 when water levels in the northern dam varied by 2 m and by 1 m in the southern dam. Groundwater levels in bore MB04 strongly correlate with the northern pit surface water levels.
Spring monitoring	Ten springs have been historically monitored at the site. Recently spring SP09 has been reclassified as a seep and spring SP11 has been identified and added to the monitoring. In general, flows at springs in December 2024 were less than that recorded in January 2024, and it is suspected that high monthly rainfall totals prior to the January 2024 monitoring contributed to the increased flows. The spring flows recorded in December 2024 were generally within the historical range. Holcim has also recently installed flow meters at SP01 and SP02 in order understand spring flows longer term and seasonally. Spring EC at SP02 is consistently the highest, more than 2,000 µS/cm, though a recent slight falling trend was noticed along with increased rainfall. EC in the remaining springs in generally less than 1,000 µS/cm and no distinct trends have been noted. Based on this assessment, there is no obvious indication that quarry operations are impacting on the springs.
Identified environmental values	This assessment has classified the groundwater at site has been classified as falling within Segment B, consistent with the previous review. Based on this assessment, there is no obvious indication that quarry operations are impacting on identified groundwater environmental values.
Monitoring bore maintenance	Bores need to be maintained in a functional condition to ensure that quality, defensible monitoring data (water level and water quality) can be obtained from the installations. This enables the potential impacts of mining to be assessed. Bores MB01 is difficult to access from the quarry side of the site and alternative access is recommended. Minor maintenance to the headworks is also recommended to further secure the installation.
Note: EC – Electrical Conductivity	

10.2 Recommendations

This report makes the following recommendations (Table 18):

Table 18 Recommendations

Recommendation	Comment
Continue with groundwater and spring monitoring as per the approved EMP.	To ensure compliance with the EMP.
Include identified new spring SP11 in the monitoring	Assess long term behaviour of the spring for potential inclusion in the EMP.
Undertake regular measurements of the flow meters at springs SP01 and SP02.	To understand spring flows longer term and seasonally and to compare to annual instantaneous measurements. Measurements to be taken monthly for the first year (2025) and then at a minimum quarterly frequency.
Continue with groundwater monitoring from SON bore 84032.	Further understand regional groundwater levels and to inform future reviews. Monitoring to be completed monthly for the first year (2025) and then at a minimum quarterly frequency.
Continue to measure pit water levels	For comparison to groundwater levels.
Complete ongoing inspection and maintenance of the monitoring bore headworks (for all monitoring bores).	Complete at a minimum quarterly frequency. To ensure monitoring network integrity

11. References

Bureau of Meteorology, Climate data online. **http://www.bom.gov.au/climate/data/**. Accessed January 2025

AECOM, 2024. Pakenham Quarry Hydraulic Conductivity Testing. Ltr Pakenham Quarry Hydraulic Conductivty Testing v2, dated 12 January 2024. Prepared for Holcim

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DEECA. Visualising Victorias Groundwater. **https://www.vvg.org.au/**. Accessed January 2025

GHD, 2023. *Pakenham Quarry. Hydrogeological Review.* GHD report 12598748-REP-0-Pakenham Quarry Hydrogeological Review-A_1, prepared for Holcim, dated June 2023

Appendices

Appendix A

EPA licence OL000000544

Operating licence

Environment Protection Act 2017

Licence number	OL000000544
Issue date	23 November 1979
Last amended	25 November 2022
Expiry date	31 December 9999
Licence holder	HOLCIM (AUSTRALIA) PTY LTD
ACN	099732297
Activity site(s)	95 Shamrock Rd, Pakenham, VIC, 3810, AU
Prescribed permission activities	C01 (Extractive industry and mining)

Issued under section 74(1)(a) of the *Environment Protection Act 2017* (the Act).

Margaret Green
Team Leader, Licensing
Delegate of Environment Protection Authority Victoria (EPA)

Operating licence

Environment Protection Act 2017

Context

Environment Protection Authority Victoria (EPA) is Victoria's environmental regulator acting in accordance with the *Environment Protection Act 2017* (the Act). Our regulatory role is to work with community, industry and business to prevent and reduce the harmful effects of pollution and waste on Victoria's environment and people.

Why we issue operating licences

A range of operating activity types are prescribed in the Environment Protection Regulations 2021 (the Regulations) because they give rise to risks of harm to human health or the environment. We issue operating licences so applicants can lawfully undertake prescribed operating activities. Section 45 of the Act provides that a person must not engage in a prescribed operating activity except as authorised by an operating licence in respect of that activity.

When we issue operating licences

EPA can issue an operating licence under section 74(1) of the Act. When issuing an operating licence, EPA takes into account a number of factors, including the measures an applicant has taken or proposes to take in order to comply with the Act when engaging in the prescribed permission activity.

EPA can amend, suspend or revoke a licence for a range of reasons. This can include in response to changes in activities, risks or licence holder performance. All operating licence details are publicly accessible via the EPA Public Register.

Key information and obligations

Interpretation

For the purposes of this operating licence "You" means the "licence holder" identified on the first page. Unless a contrary intention appears, words or terms used in the conditions of your licence have the same meaning as in the Act, and in any regulations made pursuant to the Act.

Compliance

Your licence is subject to conditions. These conditions confer legal obligations on you as the licence holder. Some of these are general in nature, while others require you to do (or not to do) specific things. The requirements of these conditions do not detract from each other in any way, nor do they affect any other duties or obligations with which you are required to comply by law. You must fulfil all duties and perform all obligations set out in this licence or otherwise required by law.

Strict penalties apply for non-compliance with any part of your .

You must comply with the Act and regulations administered by EPA. This includes, but is not limited to, compliance with the general environmental duty (GED).

Duties under the Act

Under the Act, you have legal obligations in relation to your prescribed and non-prescribed activities. These legal obligations exist to minimise risks of harm to human health and the environment from pollution and waste.

You may be committing an offence and be liable to a penalty under the Act if your actions or omissions constitute a breach of these legal obligations.

General environmental duty

The Act places the onus on you to understand the risks associated with your operation or activity and requires you to minimise the risk of harm. This is called the general environmental duty (GED).

Sections 6 and 25 of the Act provide the legal basis for the GED. These sections state that a person engaging in an activity which may give rise to risks of harm to human health or the environment from pollution or waste must eliminate or minimise those risks, as far as reasonably practicable.

Duty to notify EPA of notifiable incidents

A notifiable incident is a pollution incident that causes or threatens to cause material harm to human health or the environment or is a prescribed notifiable incident. Under section 32 of the Act, you have an obligation to notify EPA of a notifiable incident as soon as practicable after you become aware of the incident.

Duty to take action to respond to harm caused by pollution incident

Under section 31 of the Act, if a pollution incident has occurred as a result of an activity (whether by act or omission) and the pollution incident causes or is likely to cause harm to human health or the environment, a person who is engaging in that activity must, so far as reasonably practicable, restore the affected area to the state it was in before the pollution incident occurred.

Duty to notify of contaminated land

Under section 40(1) of the Act, a person in management or control of land must notify EPA if the land has been contaminated by notifiable contamination as soon as practicable after the person becomes aware of the notifiable contamination.

Notifiable contamination means contamination which is prescribed in the Regulations, or contamination for which the cost of action to remediate the land is likely to exceed $50,000, or any other prescribed amount.

Duties relating to industrial waste, priority wastes and reportable priority wastes

Under parts 6.4 and 6.5 of the Act, a person has obligations in relation to the generation, receiving, recording, managing, transporting, and disposal of industrial, priority wastes and reportable priority wastes. These duties include:

- Duties of persons depositing industrial waste.

- Duties of persons receiving industrial waste.
- Duty of persons involved in transporting industrial waste.
- Duties of persons managing priority waste.
- Duty to investigate alternatives to waste disposal.
- Duty to notify of transaction in reportable priority waste.
- Duty of persons transporting reportable priority waste.

For further information on waste classifications see schedule 5 of the Regulations.

Further information and resources

To aid compliance with the Act and the Regulations, Environment Reference Standards (ERS), Compliance Codes, Position Statements and Guidelines have been developed to address a range of environmental objectives, permitted and non-permitted activities and risks.

You should understand how the Victorian environment protection framework applies to you and your activity, operation or business by making yourself familiar with the Act, Regulations, Compliance Codes and other relevant guidance material.

To assist you with understanding your obligations refer to www.epa.vic.gov.au.

Amendment

You can apply at any time to EPA for an amendment to your licence under section 57 of the Act. EPA may also decide to amend a licence under its own initiative according to section 58 of the Act.

Transfer

A person may apply to EPA for the transfer of this licence to a new licence holder pursuant to section 56 of the Act.

Duration of licence

This operating licence is subject to the expiry date identified on the first page. It will remain in force until that time unless it is first surrendered by the licence holder (with consent from EPA), or it is suspended or revoked by EPA.

Operating licence structure

Your operting licence has multiple parts:

- Conditions
- Appendix 1 – locality plan
- Appendix 2 – activity plan
- Appendix 3 – contour plan
- Appendix 4 – waste acceptance table
- Appendix 5 – air discharge table
- Appendix 6 – water discharge table

- Appendix 7 – landfill cell table

Conditions

General conditions

OL_G1	A copy of this licence must be kept at the activity site and be easily accessible to persons who are engaging in an activity conducted at the activity site. Information regarding the requirements of the licence and the Act duties must be included in site induction and training information.
OL_G2	You must immediately notify the Authority by calling 1300 EPA VIC (1300 372 842) in the event of: a) A discharge, emission or deposit which gives rise to, or may give rise to, actual or potential harm to human health or the environment; b) A malfunction, breakdown or failure of risk control measures at the activity site which could reasonably be expected to give rise to actual or potential harm to human health or the environment; or c) Any breach of the licence.
OL_G3	You must notify the Authority within 48 hours of the occurrence of any the following: (a) Any change to your name or address (including your registered address and activity site as applicable); (b) You become, or are likely to become, an insolvent under administration; (c) You become, or are likely to become, an externally administered company under the Corporations Act; or (d) A change to an officer (as defined in the Act). You must update your information in the EPA Interaction Portal if any other relevant administrative details for your business change.
OL_G4a	You must provide to the Authority with a Permission Information and Performance Statement (PIPS) in the form determined by the Authority within 2 months of receiving notification in writing from the Authority. The PIPS may be released to the public (in whole or in part).
OL_G4b	Information and monitoring records used for the preparation of, inclusion in, or support of, any reporting or notification that is required of you by the Authority (including data reporting, performance reporting, documents evidencing any risk and monitoring program) must be: a) retained for five years; and b) made available to the Authority on request.
OL_G5	1. You must develop a risk management and monitoring program for your activities which: (a) identifies all the risks of harm to human health and the environment which may arise from the activities you are engaging in at your activity site; (b) clearly defines your environmental performance objectives; (c) clearly defines your risk control performance objectives; (d) describes how the environmental and risk control performance objectives are being achieved; (e) identifies and describes how you will continue to eliminate or minimise the risks in 1(a) (above) so far as reasonably practicable (SFARP); and (f) describes how the information collated in compliance with this clause, is or will be disseminated, used or otherwise considered by you or any other entity. 2. The risk management and monitoring program must be: (a) documented in writing; (b) signed by a duly authorised officer of the licensed entity; and (c) made available to the Authority on request.

OL_G7	You must: (a) develop and maintain a decommissioning plan that is in accordance with the current decommissioning guidelines published by the Authority; (b) provide the decommissioning plan to the Authority upon request; (c) supply to the Authority an updated detailed decommissioning plan 40 business days prior to commencement of decommissioning, if you propose to divest a section of the licensed site, cease part or all of the licensed activity or reduce the basis upon which the licence was granted to a point where licensing is no longer required; and (d) decommission the licensed site in accordance with the detailed decommissioning plan, to the satisfaction of the Authority and within any reasonable timeframe which may be specified by the Authority.

Standard conditions

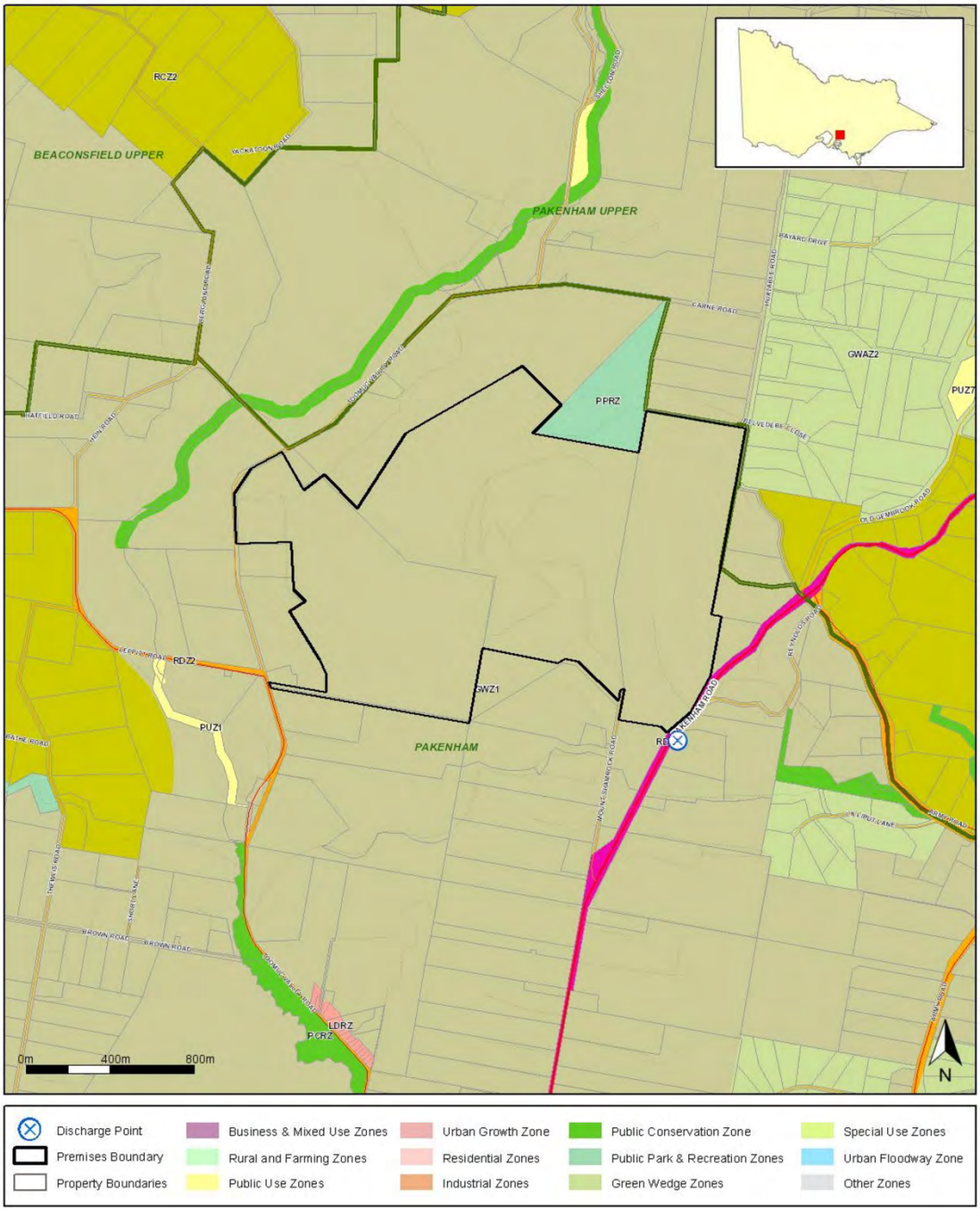
OL_WM14	All plant and equipment must be maintained and operated in proper working condition, in accordance with the manufacturer's specifications.

Specific conditions

OL_DW2	Discharge of waste to surface waters must be in accordance with Appendix 6.
OL_WM13	Notwithstanding the discharge limits set out in this licence, the licence holder's risk management and monitoring program must address: (a) Causes of short-term variation in emissions (which may include equipment or process failures and replacement of components); (b) Opportunities to reduce long term and event-driven emissions through practices or controls; and (c) Key indicators of emission variation including process and system indicators.

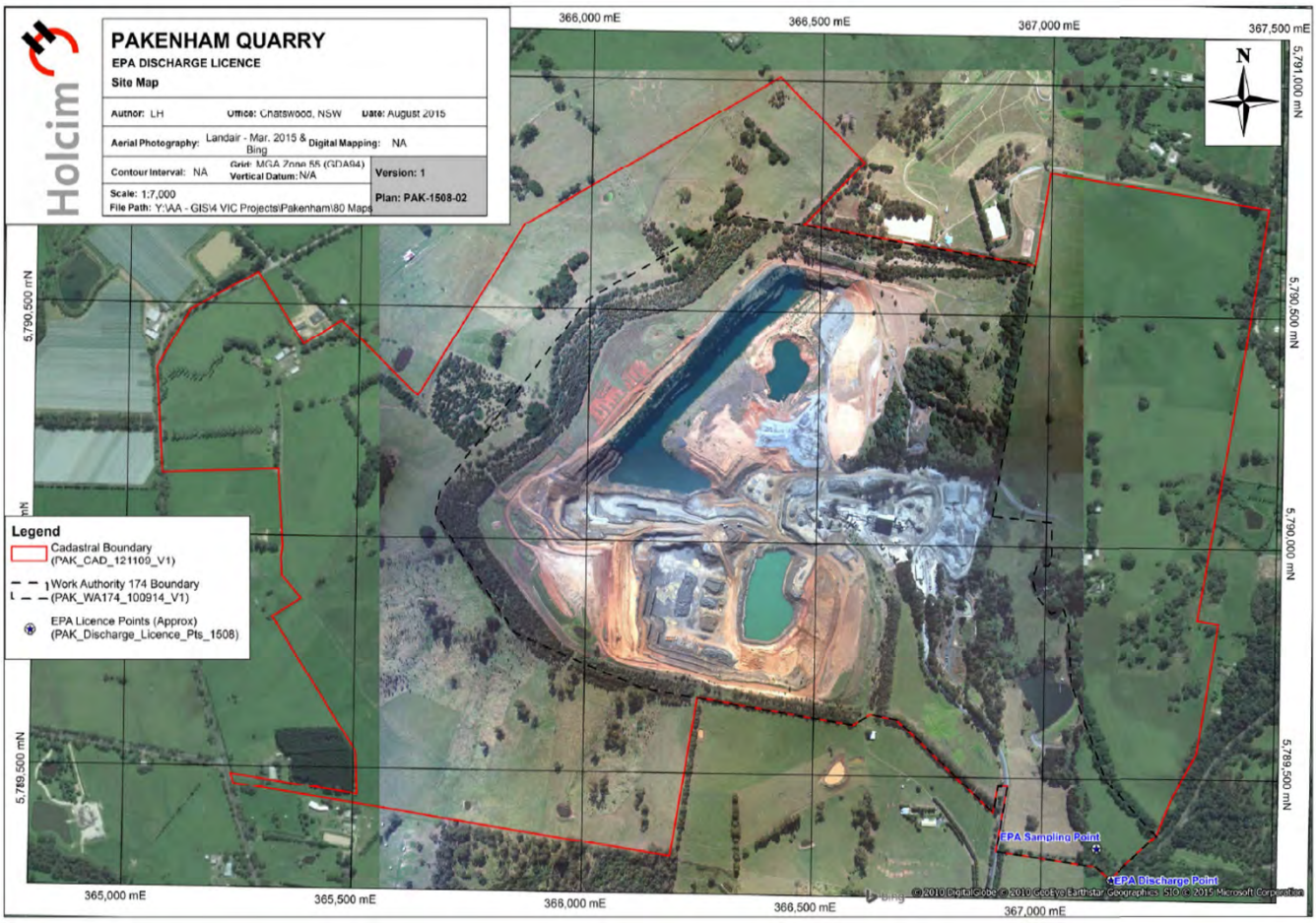
Appendices

Appendix 1 – locality plan



Before relying on the information in this map, carefully evaluate its accuracy, currency, completeness and relevance. Obtain appropriate professional advice before using this information.

Appendix 2 – activity plan



Before relying on the information in this map, carefully evaluate its accuracy, currency, completeness and relevance. Obtain appropriate professional advice before using this information.

Appendix 3 – contour plan

There is no contour plan for this licence.

Appendix 4 - waste acceptance table

There is no waste acceptance for this licence.

Appendix 5 – air discharge table

There are no air discharge points for this licence.

Appendix 6 –water discharge table

Discharge Point ID	Discharge Point Name	Indicator	Limit Type	Unit	Discharge Limit
1	Discharge to tributary of Pakenham Creek	Flow Rate	Mean	ML/day	0.84000
1	Discharge to tributary of Pakenham Creek	Turbidity	Annual median	Ntu	15.00000
1	Discharge to tributary of Pakenham Creek	pH	Minimum	pH	6.00000
1	Discharge to tributary of Pakenham Creek	Turbidity	Maximum	Ntu	30.00000
1	Discharge to tributary of Pakenham Creek	Electrical conductivity	Annual median	µS/cm	1000.00000
1	Discharge to tributary of Pakenham Creek	pH	Maximum	pH	9.00000
1	Discharge to tributary of Pakenham Creek	Electrical conductivity	Maximum	µS/cm	1200.00000

ML/d = megalitres per day
mg/L = milligrams per litre

µg/L = micrograms per litre
µS/cm = microsiemens per centimetre
pH = pH Units
Org/mL = organisms per 100 millilitre
pg/L = picograms per litre
Ntu = Nephelometric Turbidity Units
% sat = percent saturation
pcu = Platinum-Cobalt Units
ADMI = American Dye Manufacturers' Institute

Appendix 7 – landfill cells

There are no landfill cells for this licence.

Appendix B

Summary of neighbouring bores

Bore ID	Easting (MGA)	Northing (MGA)	Map zone	Constructed date	Constructed depth (m)	Uses
64195	367562.2	5792514.1	55	9/02/1980 0:00	48.8	DM, ST
64201	367573.2	5791904.1	55	23/12/1985 0:00	57.3	DM, ST
64210	367873.2	5792584.1	55	30/04/1990 0:00	83.6	DM, ST
64216	365333.2	5792884.1	55	10/01/1987 0:00	51.8	DM, ST
84069	367574.2	5790282.1	55	14/04/1977 0:00	55	DM, ST
84072	366413.2	5790004.1	55	23/08/1977 0:00	58	NKN
84073	366533.2	5790044.1	55	25/08/1977 0:00	30.5	NKN
84074	366833.2	5789704.1	55	31/08/1977 0:00	88	NKN
84082	368653.2	5788264.1	55	31/03/1981 0:00	14.7	IR
84096	365413.2	5788084.1	55	9/03/1984 0:00	17.65	DM, ST
84100	366343.2	5787704.1	55	7/03/1985 0:00	20.45	DM, ST
84106	367583.2	5790874.1	55	30/04/1990 0:00	14.9	DM, ST
112797	365853.2	5787424.1	55	24/02/1992 0:00	16	DM, ST
114867	367733.2	5790544.1	55	10/04/1992 0:00	103	DM, ST
114934	367683.2	5790894.1	55	24/10/1992 0:00	65.5	DS
115444	367873.2	5791609.1	55	12/03/1993 0:00	79	DM, ST
121918	367813.2	5791364.1	55	24/11/1992 0:00	74	DM, ST
124394	367873.2	5791609.1	55	20/03/1995 0:00	38.5	ST
132497	368233.2	5791044.1	55	10/11/1997 0:00	91	DM
WRK057121	367874	5789936	55	19/05/2010 0:00	5	OB
WRK057122	367883	5789950	55	19/05/2010 0:00	5	OB
WRK057123	367871	5789955	55	19/05/2010 0:00	5	OB
WRK069238	365481	5787583	55	10/05/2012 0:00	10	OB
WRK069239	365480	5787585	55	9/05/2012 0:00	10	OB
WRK069240	365485	5787585	55	14/05/2012 0:00	9	OB
WRK070147	365489	5787583	55	15/05/2012 0:00	12.2	OB
WRK070148	365485	5787583	55	18/05/2012 0:00	7	OB
WRK082149	366344	5790134	55	22/10/2014 0:00	12	OB
WRK082152	366342	5790133	55	22/10/2014 0:00	1.5	OB
WRK960359	367903	5792649	55	27/02/2002 0:00	99	DM

Notes:
Source: VVG
Bores within a 3 km radial distance from the centre of site

Groundwater Gauging Summary - Hanson Grantville

Bore ID	Bore B109		Bore B110		Bore B111		Bore B112		Bore GW1		Bore MB113		Bore MB114		Bore MB115		Bore MB116	
Collar Height (mAHD)	101.21		103.81		95.38		86.01		70		111.204		83.433		97.457		71.867	
SWL Reading Date	SWL (mbTOC)	RWL (mAHD)	SWL (mbTOC)	RWL (mAHD)	SWL (mbTOC)	RWL (mAHD)	SWL (mbTOC)	RWL (mAHD)	SWL (mbTOC)	RWL (mAHD)	SWL (mbTOC)	RWL (mAHD)	SWL (mbTOC)	RWL (mAHD)	SWL (mbTOC)	RWL (mAHD)	SWL (mbTOC)	RWL (mAHD)
30/09/1994							16.46	69.55										
10/10/1994	11.48	89.73	14.49	89.32	13.75	81.63	17.66	68.35										
14/10/1994	12.23	88.98	14.71	89.10	14.24	81.14	18.37	67.64										
19/10/1994	12.23	88.98	16.30	87.51	14.65	80.73	19.42	66.59										
25/11/1994	12.42	88.79	16.42	87.39	14.63	80.75	Dry						----------					
21/12/1995	11.92	89.29	15.53	88.28	14.77	80.61												
28/09/2006	12.65	88.56	15.63	88.18	14.87	80.51	Dry		Dry									
25/11/2015	12.60	88.61	15.65	88.16	14.92	80.46	19.37	66.64	Dry									
16/02/2017	12.47	88.74	15.59	88.22	14.86	80.52	Dry											
1/03/2017											23.30	87.90	2.94	80.49	15.20	82.26		
23/03/2017	12.48	88.73	15.58	88.23	14.82	80.56	Dry				21.97	89.23	11.29	72.14	15.41	82.05	17.50	54.37
24/03/2017									Dry								23.90	47.97
21/06/2017	12.57	88.64	16.04	87.78	14.83	80.56	Dry		Dry		22.17	89.04	11.44	72.00	15.62	81.84	17.41	54.46
21/09/2017	Blocked		15.66	88.16	14.85	80.53	Dry		Dry		22.11	89.09	11.41	72.02	15.56	81.90	17.32	54.55
14/12/2017	12.55	88.66	15.60	88.21	14.86	80.52	Dry		Dry		21.88	89.33	11.44	72.00	15.61	81.85	17.28	54.59
28/03/2018	12.65	88.56	15.60	88.21	14.79	80.59	Dry		Dry		22.10	89.10	Dry		15.56	81.90	17.33	54.54
14/06/2018	12.62	88.59	15.06	88.26	14.81	80.57	Dry		No access		22.23	88.97	11.46	71.98	15.52	81.94	No access	
5/09/2018	12.64	88.57	15.01	88.31	14.84	80.54	Dry		Dry		22.46	88.75	dry		15.51	81.95	17.38	54.49
17/12/2018	12.67	88.54	15.07	88.25	14.82	80.56	Dry		Dry		22.83	88.37	11.58	71.85	15.50	81.96	17.39	54.48
14/03/2019	12.69	88.52	15.10	88.22	14.92	80.47	Dry		Dry		22.53	88.68	11.47	71.96	15.57	81.89	17.52	54.35
18/06/2019	12.72	88.49	15.48	87.84	14.92	80.46	Dry		Dry		22.77	88.43	11.47	71.97	15.49	81.97	17.53	54.34
18/09/2019	12.65	88.56	15.04	88.28	14.90	80.48	Dry		Dry		22.71	88.49	11.45	71.99	15.44	82.02	17.42	54.45
6/12/2019	12.50	88.71	15.08	88.25	14.88	80.50	Dry		Dry		22.40	88.80	11.57	71.87	15.44	82.02	17.33	54.54
21/04/2020	12.56	88.65	15.07	88.25	14.80	80.58	Dry		Dry		22.57	88.63	11.46	71.98	15.50	81.96	17.31	54.56
13/07/2020	12.56	88.66	15.45	87.87	14.83	80.55	Dry		Dry		22.51	88.69	11.66	71.77	15.48	81.98	17.32	54.55
8/10/2020	12.28	88.93	15.12	88.20	14.78	80.60	Dry		Dry		21.80	89.40	11.41	72.03	15.28	82.18	17.14	54.73
21/12/2020	12.21	89.00	15.08	88.24	14.76	80.63	Dry		Dry		21.64	89.56	11.45	71.98	15.36	82.10	17.06	54.81
24/03/2021	12.35	88.86	15.06	88.27	14.78	80.60	Dry		Dry		21.58	89.63	11.45	71.98	15.36	82.10	17.05	54.82
24/06/2021	12.47	88.74	15.39	87.93	14.82	80.56	Dry		Dry		21.77	89.44	11.44	72.00	15.23	82.22	17.08	54.79
8/09/2021	12.55	88.67	15.73	87.59	14.85	80.53	Dry		Dry		21.86	89.35	11.45	71.98	15.27	82.19	17.10	54.77
20/12/2021	12.41	88.80	15.10	88.22	14.87	80.51	19.393	66.62	Dry		21.61	89.59	11.48	71.95	15.25	82.21	17.04	54.83
22/03/2022	12.43	88.78	15.06	88.26	14.79	80.60	Dry		Dry		21.69	89.51	11.44	71.99	15.26	82.20	17.09	54.78
21/06/2022	12.52	88.69	15.51	87.81	14.83	80.56	Dry		Dry		21.95	89.25	11.46	71.97	15.24	82.22	17.19	54.68
9/09/2022	12.38	88.83	15.17	88.15	14.87	80.51	Dry		Dry		21.48	89.72	11.45	71.98	15.10	82.36	17.18	54.69
8/12/2022	12.10	89.11	15.01	88.31	14.78	80.60	19.37	66.64	Dry		21.03	90.17	11.46	71.98	15.08	82.38	16.97	54.90
3/05/2023	12.27	88.95	15.07	88.25	14.81	80.57	Dry		Dry		21.11	90.09	11.48	71.95	15.13	82.33	16.93	54.94
17-18/07/2023	12.35	88.86	15.41	87.91	14.82	80.56	Dry		Dry		21.22	89.98	11.46	71.97	14.96	82.50	16.97	54.90
19/09/2023	12.28	88.93	15.54	87.78	14.84	80.54	Dry		Dry		20.86	90.34	11.43	72.00	14.86	82.60	16.95	54.92
15/12/2023	12.30	88.91	15.39	87.93	14.86	80.52	Dry		Dry		20.82	90.38	11.49	71.94	14.9	82.56	17.01	54.86
Note:																		

In June 2018, the PVC pipe was observed to be snapped at bore B110, therefore the RL could not be accurately determined at the reference point in mAHD (as the original reference point no longer exists). An estimated RL has been used based on the difference in the previous and observed PVC pipe stick-up in June 2018.

Appendix C

Monitoring bore construction and lithology logs

URS

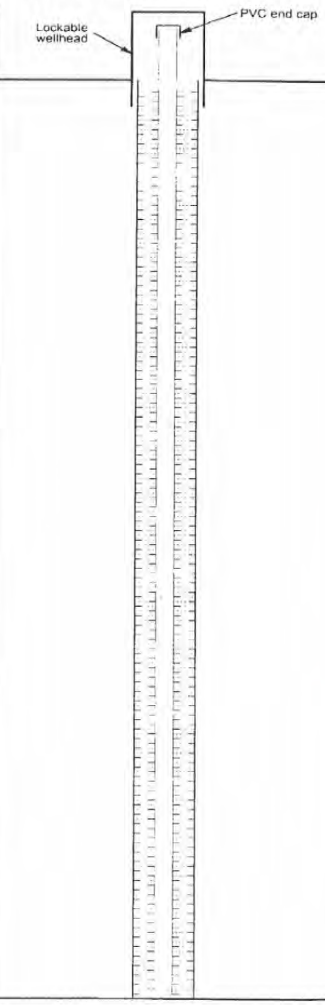
MONITORING WELL MB01

URS Australia Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Drilling Contractor: KH ADAMS & SONS		Project Reference: Pakenham Quarry Groundwater Investigation	Client: CSR Construction Materials Pty Ltd
		Project No.: 46053-010-5050	Location: Mt Shamrock Rd, Pakenham, VIC
Logged By: AL	Bore Size: 120 mm	Relative Level: 216.54 mRL	Drill Type: Down hole hammer
Checked By: BC	Total Depth: 72.50 m	Coordinates: 5789516.00 mN	Drill Model: Edson 6000
Date Started: 03-07-01	Casing Size: 50 mm	366135.15 mE	Drill Fluid: AIR
Date Finished: 03-07-01		Permit No: 57815 / 01	

Sample Interval	PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)
				TOPS	TOPSOIL, dark brown, trace organics		0
				CL-CH	CLAY, medium plasticity, stiff, dark brown, dry-moist	D/M	1
				CLS	sandy CLAY, medium plasticity, loose, orange-brown sand, brown clay balls (<7mm), moist	M	2
				BAS-MW	BASALT, weathered to silty clay, moderately weathered-fresh hard blue-grey basalt chips (<30mm), fine grained crystalline basalt, trace fine grained sand, light brown, dry	D	3
					BASALT, weathered to silty clay, fine grained basalt, light brown, dry, moderately weathered basalt chips (<5mm)	D	4
							5
					BASALT, moderately weathered basalt chips (<5mm), fine grained crystalline basalt, weathered to silty clay, trace fine grained sand, loose, brown-orange, dry-moist	D/M	6
							7
					BASALT, moderately weathered basalt chips (<5mm), fine grained, crystalline, weathered to silty clay, trace fine grained sand, loose, brown, dry-moist	D/M	8
					As above, basalt chips (<10mm) more abundant		9

WELL CONSTRUCTION DETAILS



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MONITORING WELL MB01

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Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500 Fax 8699 7550

Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						10	
				As above, less basalt chips (<5mm)		11	
						12	
			BAS-HW	BASALT, highly weathered to clay with moderately weathered chips (<15mm), light grey, hard, dry	D	13	50mm diameter PVC pipe
						14	
			BAS-MW	BASALT, moderately weathered-fresh, large chips (<60mm), larger chips weathered to orange-brown clay, hard, dry	D	15	
						16	
				BASALT, fresh, crystalline, fine grained, chips (<30mm), blue-grey, hard, dry		17	
				BASALT, moderately weathered-fresh, crystalline, fine grained, light grey, hard, dry		18	Backfill
						19	
						20	
			BAS-FR	BASALT, fresh, crystalline, fine grained, chips (<30mm), blue-grey, hard, dry	D	21	

WELL MBLOGS.GPJ WCC_AUS.GDT 04/10/04

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MONITORING WELL MB01

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Phone 8699 7500
Fax 8699 7550

Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						22	
						23	
						24	
			BAS-MW	BASALT, moderately weathered-fresh, light grey, hard, dry	D	25	
						26	
				BASALT, with brown clay, moderately weathered, chips (<20mm), hard, dry		27	
				BASALT, moderately weathered-fresh, light grey, hard, dry		28	
				BASALT, fresh, chips (<30mm), blue-grey, hard, dry		29	
				BASALT, some weathered to brown clay, moderately weathered, fine grained, crystalline, chips (<20mm), hard, dry		30	
			BAS-FR	BASALT, fresh, crystalline, fine grained, chips (<30mm), blue-grey, hard, dry	D	31	
						32	
						33	

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Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval / PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)
						34
						35
						36
						37
						38
			BAS-MW	BASALT, moderately weathered, crystalline, fine grained, grey, hard, dry	D	39
						40
			BAS-FR	BASALT, fresh, blue-grey, hard, dry	D	41
						42
						43
				Fracture zone		44
			BAS-HW	BASALT, with weathered brown clay, highly weathered, crystalline, fine grained, dark grey, hard, dry	D	45

WELL CONSTRUCTION DETAILS

SWL @ 40.70 mTOC (30/3/01)

Grout

WELL MBLOGS.GPJ WCC_AUS.GDT 04/10/04

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MONITORING WELL MB01

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Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval / PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
			CL-ML	silty CLAY, trace fine grained sand, black, soft, dry-moist	D	46	Bentonite →
				silty CLAY, trace fine grained sand, yellow-green-grey, soft, dry-moist		47	
				silty CLAY, trace fine grained sand, blue-grey, soft, dry-moist		48	
				silty CLAY, low plasticity, grey-green, soft, moist	M	49	
				silty CLAY, low plasticity, light grey, soft, dry	D	50	
				silty CLAY, low plasticity, grey-green, soft, moist-dry	D/M	51	
				silty CLAY, low plasticity, grey, soft, dry-moist		52	
				As above, more clay, darker grey		53	
				Rig refusal, started drilling with water		54	
						55	
						56	
						57	

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Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						58	
						59	
						60	
						61	2mm washed sand gravel pack
						62	
						63	
						64	
						65	
						66	
						67	
						68	
						69	

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MONITORING WELL MB01

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Phone 8699 7500 Fax 8699 7550

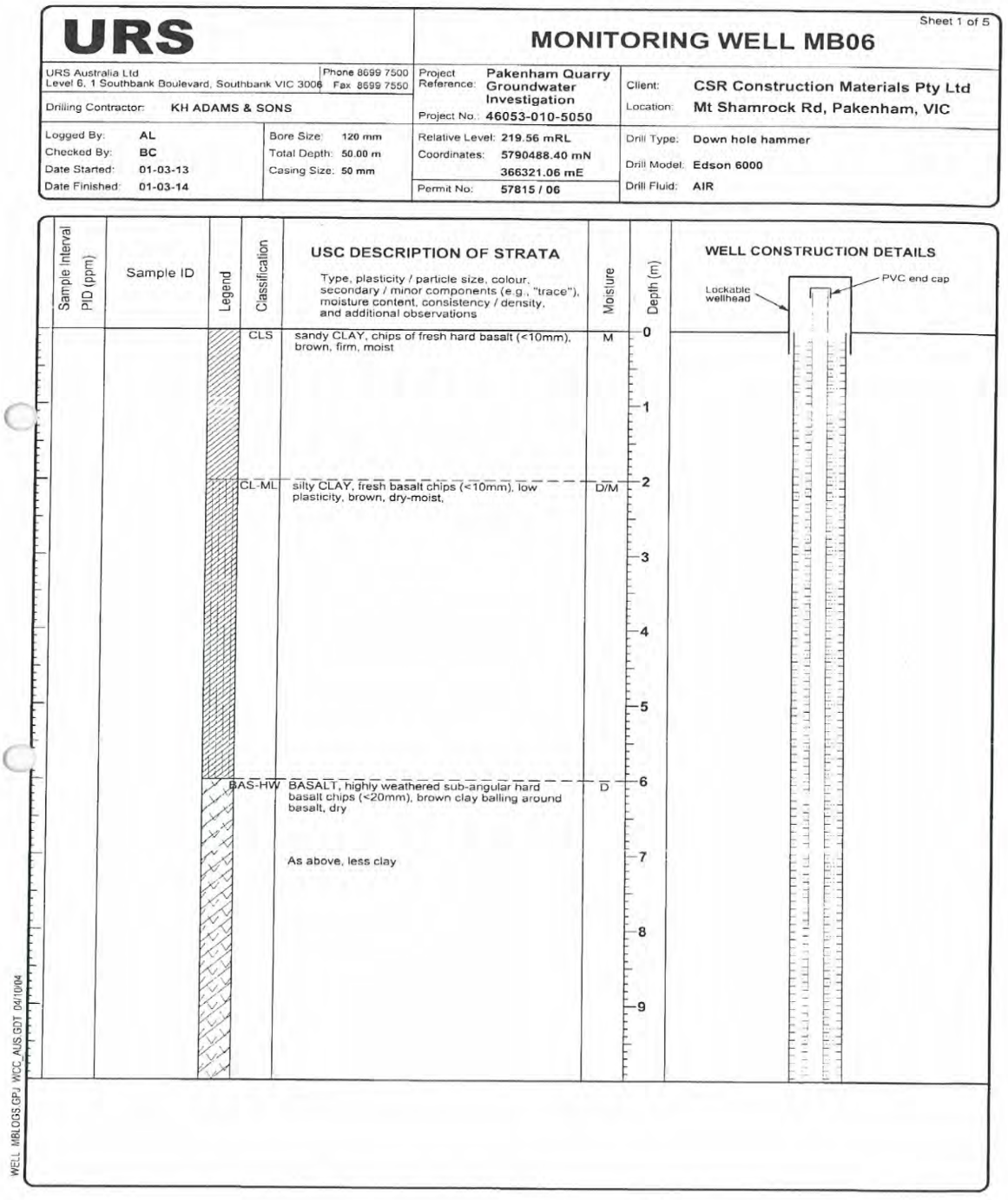
Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
				trace white granite specks (<2mm), hard		70 71 72	50mm diameter factory slotted PVC screen PVC end cap
				End of hole @ 72.5m Unsure if groundwater encountered during drilling as drilling with water		73 74 75 76 77 78 79 80 81	

WELL MBLOGS.GPJ WOC_AUS.GDT 04/10/04

MB06 - still in use



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Sheet 1 of 5

MONITORING WELL MB06

URS Australia Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500 Fax 8699 7550

Drilling Contractor: KH ADAMS & SONS

Logged By: AL
Checked By: BC
Date Started: 01-03-13
Date Finished: 01-03-14

Bore Size: 120 mm
Total Depth: 50.00 m
Casing Size: 50 mm

Project Reference: Pakenham Quarry Groundwater Investigation
Project No.: 46053-010-5050

Relative Level: 219.56 mRL
Coordinates: 5790488.40 mN
366321.06 mE
Permit No: 57815 / 06

Client: CSR Construction Materials Pty Ltd
Location: Mt Shamrock Rd, Pakenham, VIC

Drill Type: Down hole hammer
Drill Model: Edson 6000
Drill Fluid: AIR

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA (Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations)	Moisture	Depth (m)
			CLS	sandy CLAY, chips of fresh hard basalt (<10mm), brown, firm, moist	M	0
			CL-ML	silty CLAY, fresh basalt chips (<10mm), low plasticity, brown, dry-moist,	D/M	2
			BAS-HW	BASALT, highly weathered sub-angular hard basalt chips (<20mm), brown clay balling around basalt, dry	D	6
				As above, less clay		7

WELL CONSTRUCTION DETAILS

Lockable wellhead

PVC end cap

WELL MBLOG5.GPJ WCC_AUS.GDT 04/10/04

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MONITORING WELL MB06

URS Australia Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500 Fax 8699 7550

Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						10	
			BAS-MW	BASALT, highly to moderately weathered, crystalline, fine grained, minor weathered clay, light grey, hard, dry	D	11	
						12	
			BAS-HW	BASALT, weathered to brown low plasticity clay, highly weathered basalt chips (<5mm), hard, dry	D	13	
						14	
						15	
			BAS-MW	BASALT, moderately to highly weathered, crystalline, fine grained, chips (<20mm), minor clay, light grey, hard, dry	D	16	50mm diameter PVC pipe
				As above, trace clay		17	
						18	
						19	
				As above, chips (<30mm)		20	
				BASALT, moderately weathered, crystalline, fine grained, chips (<10mm), blue-grey, hard, dry		21	

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MONITORING WELL MB06

URS Australia Ltd
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Phone 8699 7500 Fax 8699 7550

Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						22	
						23	
				As above, chips (<20mm)		24	
						25	
				BASALT, moderately weathered to fresh, crystalline, fine grained, chips (<40mm), blue-grey, hard, dry		26	Backfill →
				BASALT, moderately weathered, chips (<20mm), trace clay, blue-grey, hard, dry		27	
						28	
				BASALT, moderately weathered to fresh, chips (<30mm), blue-grey, hard, dry		29	
						30	
				BASALT, moderately weathered, chips (<20mm), trace clay, light grey, hard, dry		31	
						32	
				BASALT, moderately weathered to fresh, crystalline, fine grained, chips (<40mm), blue-grey, hard, dry Fracture zone		33	

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MONITORING WELL MB06

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Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval / PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
				As above, chips (<10mm)		34	
						35	
						36	
				As above, chips (<20mm)		37	
						38	
						39	Bentonite
						40	
						41	
						42	SWL @ 41.72 mTOC (30/3/01)
						43	2mm washed sand gravel pack
			BAS-FR	BASALT, fresh, crystalline, fine grained, chips (<20 mm), blue-grey, hard, dry	D	44	
						45	

WELL MBLOGS.GPJ WCC_AUS.GDT 04/10/04

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MONITORING WELL MB06

URS Australia Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
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Project No.: 46053-010-5050

Project Reference: Pakenham Quarry Groundwater Investigation

Sample Interval / PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA Type, plasticity / particle size, colour, secondary / minor components (e.g., "trace"), moisture content, consistency / density, and additional observations	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
						46	
						47	50mm diameter factory slotted PVC screen
						48	
						49	
						50	PVC end cap
				End of Hole @ 50 m Groundwater not encountered during drilling		51	
						52	
						53	
						54	
						55	
						56	
						57	

MONITORING WELL MB02b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Drilling Contractor: **South Western Drilling**

Project Name: **Holcim Drilling**

Project No.: **43283807**

Client: **Holcim (Australia) Pty Ltd**

Location: **Mt. Shamrock Quarry, Pakenham**

Logged By:	**MR**	Bore Size:	**125 mm**	Relative Level (PVC):	**mRL**
Checked By:	**AC**	Total Depth:	**11.80 m**	Coordinates:	**mN**
Date Started:	**22-10-14**	Casing Size:	**50 mm**		**mE**
Date Finished:	**22-10-14**			Permit No:	**WRK082149**

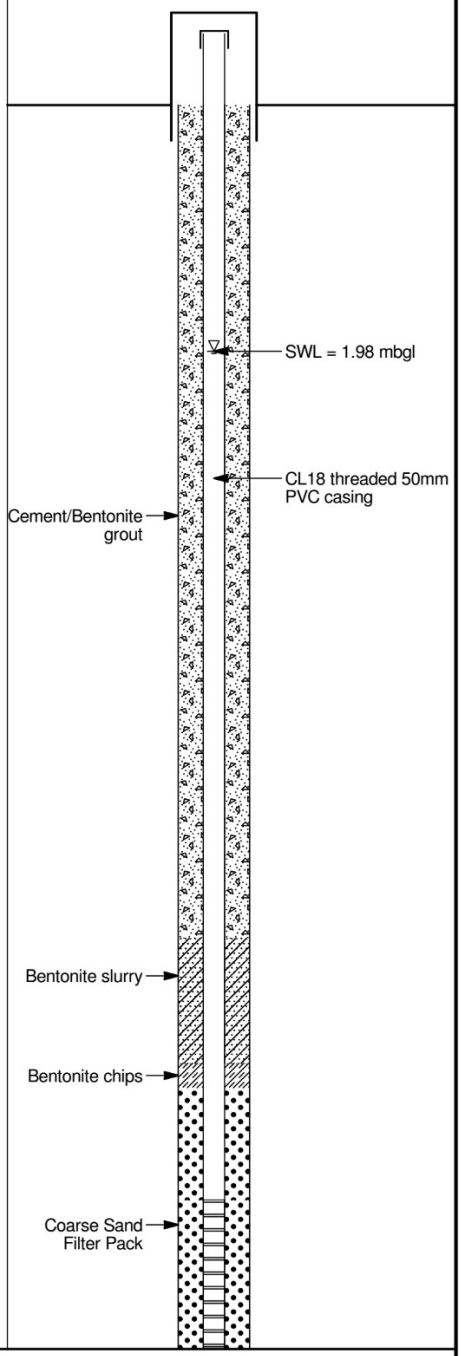
Drill Type: **Air Hammer**

Drill Model: **DB520**

Drill Fluid: **Air**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)
Hand Auger				FILL	FILL: Angular basalt rock to 50 mm, fresh, very hard.	D/M	0
					BASALT: grey-dark grey, firm, slightly weathered, fine-grained.	M	1
						M/W	2
				ML	Clayey SILT: low plasticity, dark grey-black with some black grains, hard.	M/W	
						M	3
				CL	Silty CLAY; brown, hard, low plasticity	D/M	
							4
					Very hard		5
					Softer, grey	D	6
							7
					Light grey, increasing moisture	D/M	8
							9

WELL CONSTRUCTION DETAILS



Remarks: Bentonite slurry used, as chips were bridging at surface.

WELL_NUMBER 43283807_REPLACEMENT BORES 2014.GPJ WCC_AUS.GDT 21/11/14

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MONITORING WELL MB02b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
Air Hammer						M	10	
							11	CL18 threaded 50mm PVC screen
					EOH @ 11.8 m		12	
							13	
							14	
							15	
							16	
							17	
							18	
							19	
							20	
							21	

MONITORING WELL MB03b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Drilling Contractor: **South Western Drilling**

Project Name: **Holcim Drilling**

Project No.: **43283807**

Client: **Holcim (Australia) Pty Ltd**

Location: **Mt. Shamrock Quarry, Pakenham**

Logged By:	**MR**	Bore Size:	**125 mm**	Relative Level (PVC):	**mRL**
Checked By:	**AC**	Total Depth:	**60.00 m**	Coordinates:	**mN**
Date Started:	**22-10-14**	Casing Size:	**50 mm**		**mE**
Date Finished:	**24-10-14**			Permit No:	**WRK082150**

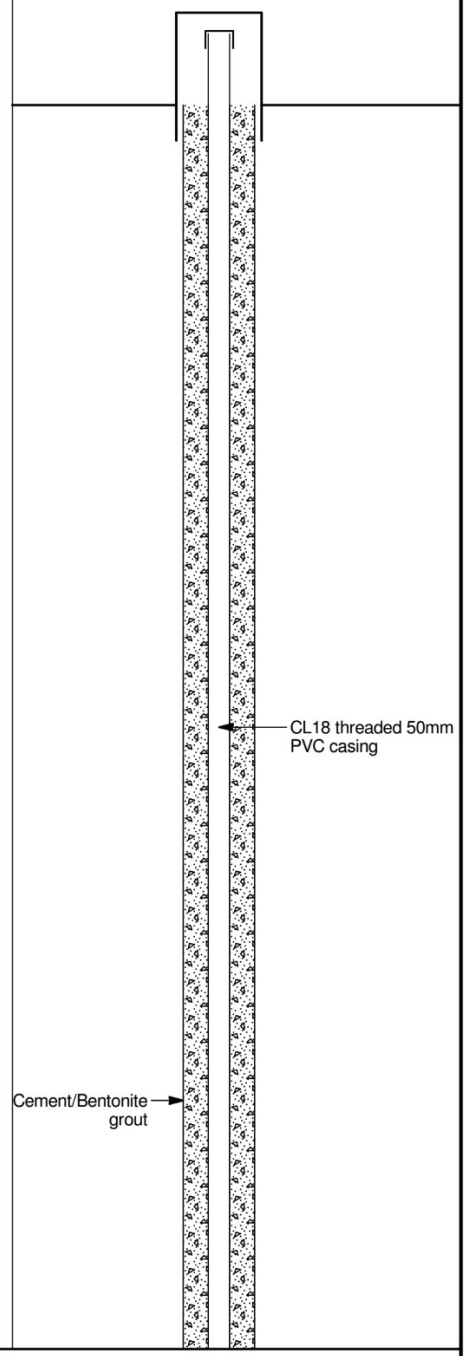
Drill Type: **Air Hammer**

Drill Model: **DB520**

Drill Fluid: **Air**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)
Hand Auger				OL	TOPSOIL: Clayey SILT; dark brown-grey, trace sand	M	0
					Extremely Weathered BASALT: slightly-moderately weathered basalt sands and gravels (0.5- 4mm in diameter) angular-subangular, in Silty CLAY matrix; low-medium plasticity, brown-light brown.	D/M	1
					Hard rocky layer @ 1.6 mbgl	D	2
							3
							4
							5
					Highly Weathered BASALT: medium-high strength, brown-grey, with some silty clay; low plasticity, brown.	D	6
							7
							8
							9

WELL CONSTRUCTION DETAILS



WELL_NUMBER 43283807_REPLACEMENT BORES 2014.GPJ WCC_AUS.GDT 21/11/14

MONITORING WELL MB03b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
					Reducing silty CLAY and increasing strength		10	
					Moderately Weathered BASALT: high strength, grey, very fine grained	D	11	
							12	
							13	
					Very hard band @ 13.3-13.4 mbgl			
					Very hard band @ 13.7-13.9 mbgl			
					Slightly Weathered BASALT: high-very high strength, blue-grey, fine grained, with some light brown-light grey weathered surfaces.	D	14	
							15	
					Soft layer @ 16 mblg		16	
					Fresh-Slightly Weathered BASALT: very high strength, blue-grey, fine grained, trace light grey weathered surfaces.	D	17	
							18	
							19	
							20	
							21	

MONITORING WELL MB03b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: **43283807**

Project Reference: **Holcim Drilling**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
					Fractured zone @ 27.5-28 mbgl		22	
							23	
							24	
							25	
							26	
							27	
					Very fractured @ 29-30 mbgl		28	
							29	
					Some fracturing		30	
							31	
							32	
							33	

MONITORING WELL MB03b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: 43283807

Project Reference: Holcim Drilling

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
					Some moisture detected @ 39.5 mbgl		34	
							35	
							36	
							37	
							38	
							39	SWL = 38.95 mbgl
							40	
					Slightly Weathered BASALT: very high strength, brown-grey, fine grained	D/M	41	
						M	42	
							43	
							44	
						W	45	

MONITORING WELL MB03b

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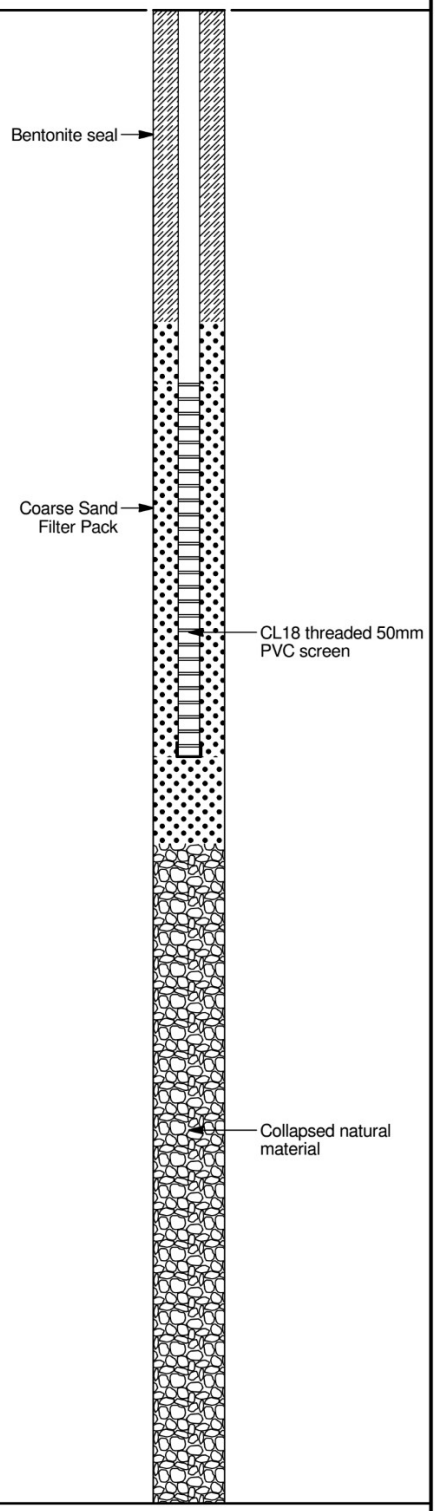
Phone 8699 7500
Fax 8699 7550

Project No.: 43283807

Project Reference: Holcim Drilling

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)
							46
							47
					SILTSTONE (Baked CLAY): low-medium strength, light brown	W	
					MUDSTONE: low strength, dark grey-black, high organic content including lignite, water produced has a slight organic film/sheen.	W	48
				SM	Silty SAND: well graded, fine-coarse grained, sub-rounded, quartz sand, in silty CLAY matrix; low plasticity, brown	W	49
							50
				CL	Silty CLAY: low plasticity, grey brown, with some sand as above, with mica (biotite) and lignite		51
							52
				SM	Silty SAND: well graded, fine-coarse grained sand, sub-rounded to sub-angular. Mostly quartz with some feldspar, biotite and lignite in Silty CLAY matrix; low plasticity, grey-brown.		53
							54
				CL	Interbedding Silty CLAY and Silty SAND as described above.		55
							56
							57

WELL CONSTRUCTION DETAILS



MONITORING WELL MB03b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: 43283807

Project Reference: Holcim Drilling

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
Air Hammer							58	
							59	
					EOH @ 60 mbgl. Target depth reached.		60	
							61	
							62	
							63	
							64	
							65	
							66	
							67	
							68	
							69	

MONITORING WELL MB04b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Drilling Contractor: **South Western Drilling**

Project Name: **Holcim Drilling**

Project No.: **43283807**

Client: **Holcim (Australia) Pty Ltd**

Location: **Mt. Shamrock Quarry, Pakenham**

Logged By:	**MR**	Bore Size:	**125 mm**	Relative Level (PVC):	**mRL**
Checked By:	**AC**	Total Depth:	**1.50 m**	Coordinates:	**mN**
Date Started:	**22-10-14**	Casing Size:	**50 mm**		**mE**
Date Finished:	**22-10-14**			Permit No:	**WRK082152**

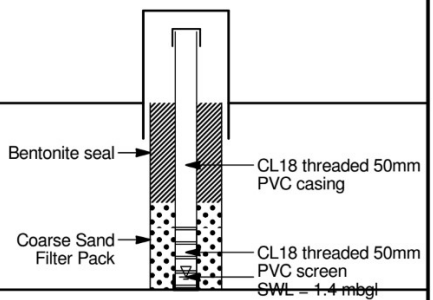
Drill Type: **Air Hammer**

Drill Model: **DB520**

Drill Fluid: **Air**

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)
Hand Auger				FILL	FILL: Basalt rocks, angular, 50 mm in diameter, very high strength, fresh	D	0
Air Hammer					BASALT: high strength, fresh-slightly weathered, fine grained, blue-grey	D/M	1
					~~Becoming dark grey, increasing moisture~~	M	
					EOH @ 1.5 mbgl		2
							3
							4
							5
							6
							7
							8
							9

WELL CONSTRUCTION DETAILS



WELL_NUMBER 43283807_REPLACEMENT BORES 2014.GPJ WCC_AUS.GDT 21/11/14

MONITORING WELL MB05b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Drilling Contractor: **South Western Drilling**

Project Name: **Holcim Drilling**

Project No.: **43283807**

Client: **Holcim (Australia) Pty Ltd**

Location: **Mt. Shamrock Quarry, Pakenham**

Logged By:	**MR**	Bore Size:	**125 mm**	Relative Level (PVC):	**mRL**
Checked By:	**AC**	Total Depth:	**46.00 m**	Coordinates:	**mN**
Date Started:	**24-10-14**	Casing Size:	**50 mm**		**mE**
Date Finished:	**27-10-14**			Permit No:	**WRK082153**

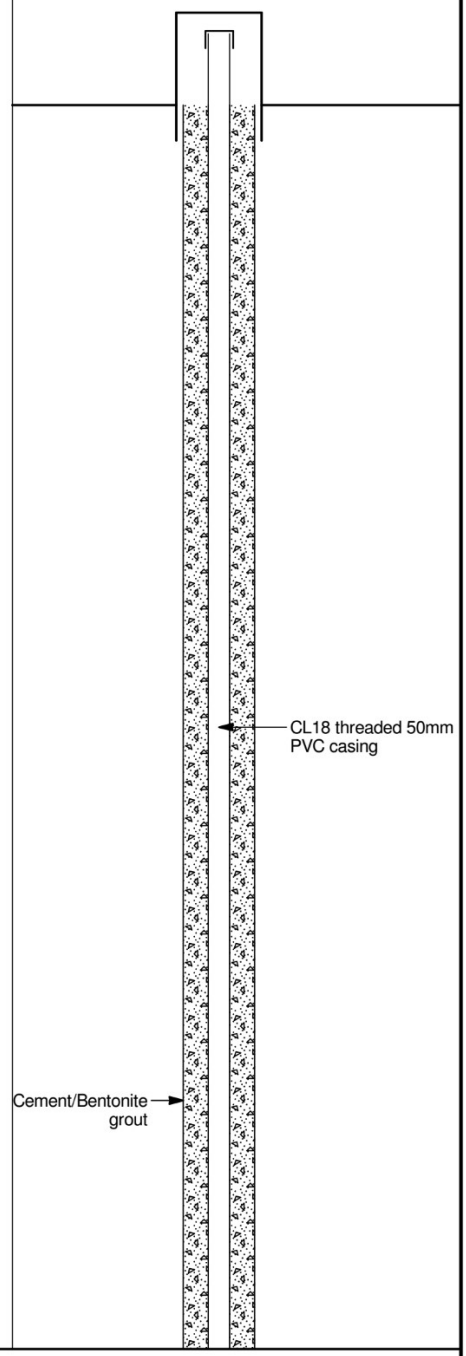
Drill Type: **Air Hammer**

Drill Model: **DB520**

Drill Fluid: **Air**

Drill Method	Sample Interval	PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)
Hand Auger					OH	TOPSOIL: Clayey SILT; low plasticity, dark grey brown, trace sand	M	0
						Extremely Weathered BASALT: highly weathered basalt sand and gravel (0.5-4 mm in diameter) in silty CLAY matrix; low plasticity, brown	D/M	1
								2
							D	3
								4
								5
						Highly Weathered BASALT: medium-high strength, brown-grey, with some silty CLAY; low plasticity, brown.	D	6
								7
						Reducing clay content and increasing strength		8
						Moderately Weathered BASALT: high strength, grey, fine grained, crystaline	D	9

WELL CONSTRUCTION DETAILS



WELL_NUMBER 43283807_REPLACEMENT BORES 2014.GPJ WCC_AUS.GDT 21/11/14

MONITORING WELL MB05b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: 43283807

Project Reference: Holcim Drilling

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
							10	
							11	
							12	
							13	
					Slighly Weathered BASALT: high-very high strength, blue-grey, with some light brown-light grey weathered surfaces	D	14	
							15	
							16	
					Some fracturing @ 17.5 mbgl		17	
					Fresh-Slightly Weathered BASALT: very high strength, blue-grey with trace pale grey weathered surfaces.		18	
							19	
							20	
					Increased fracturing @ 21 mbgl, appearing to gradually increase with depth.		21	

MONITORING WELL MB05b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: 43283807

Project Reference: Holcim Drilling

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
					Extremely hard @ 31.8-32.1 mbgl		22 23 24 25 26 27 28 29 30 31 32 33	

MONITORING WELL MB05b

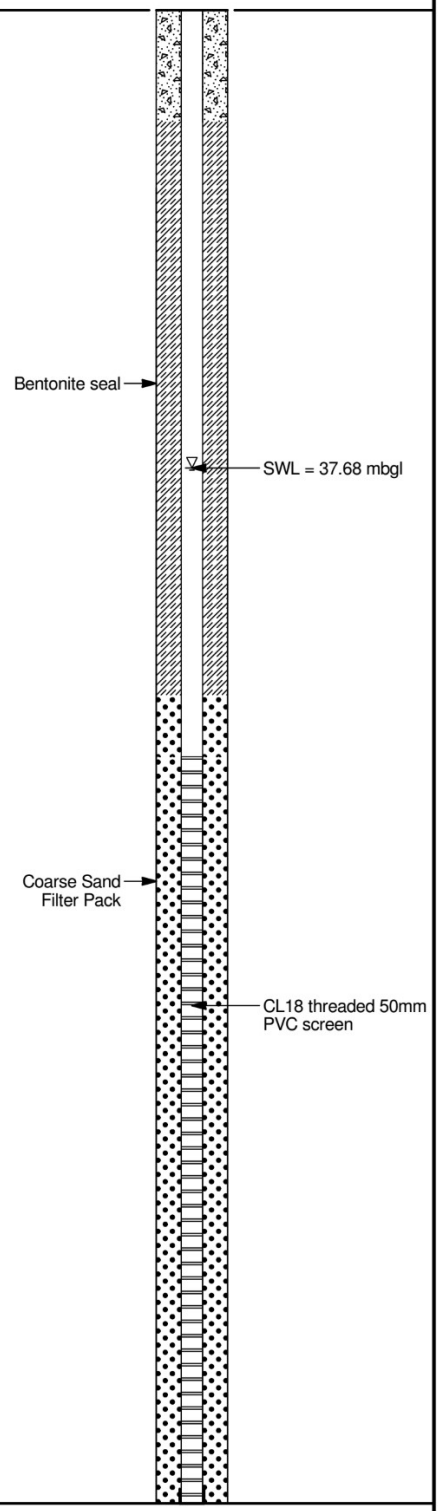
URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: 43283807

Project Reference: Holcim Drilling

Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)
Air Hammer					Fresh BASALT: blue grey, extremely high strength, fine grained, crystaline	D	34
							35
							36
							37
							38
					Moisture evident @ 38.5 mbgl	D/M	39
					Slightly Weathered BASALT: high-very high strength, blue-grey with some brown weathered surfaces	M	40
							41
						M/W	42
							43
						W	44
							45

WELL CONSTRUCTION DETAILS



MONITORING WELL MB05b

URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard, Southbank VIC 3006
Phone 8699 7500
Fax 8699 7550

Project No.: 43283807

Project Reference: Holcim Drilling

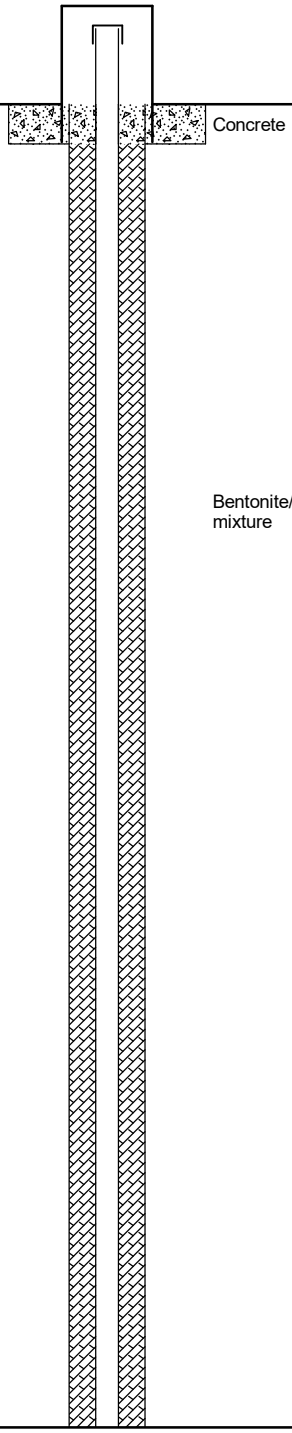
Drill Method	Sample Interval PID (ppm)	Sample ID	Legend	Classification	USC DESCRIPTION OF STRATA	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
					EOH. Target depth reached @ 46 mbgl		46	
							47	
							48	
							49	
							50	
							51	
							52	
							53	
							54	
							55	
							56	
							57	

MONITORING WELL MB02C

Project Name:	Holcim Pakenham	Client:	Holcim Australia
Drilling Contractor:	South Western Drilling	Location:	Mt Shamrock Quarry
Project No:	60451395		
Logged By:	SW	Bore Size:	125mm mm
Checked By:	SW	Total Depth:	36.77 m
Date Started:	16/01/2017	Casing Size:	mm
Date Finished:	17/01/2017		
Top of Casing:	mRL	Drill Type:	Sonic/percussion
Coordinates:	mE	Drill Model:	
	mN	Drill Fluid:	Water
Permit No:	WLI605348		

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)
					GRAVEL: Dark grey, coarse	D	0
					Clayey GRAVEL: Brown,	D	
							1
							2
							3
							4
					GRAVEL: Dark grey, crushed, fine	D	5
					Clayey GRAVEL: Dark brown, fine-coarse	D	6
					Gravelly CLAY: Dark brown	D	7
							8
							9

WELL CONSTRUCTION DETAILS



MONITORING WELL MB02C

Project No.: **60451395** Project Reference: **Holcim Pakenham**

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
							10	
							11	
					Less gravel	D	12	CL18 threaded 50mm PVC casing
					GRAVEL: Dark grey, crushed, mediumt-fine grained	D	13	
							14	
					Very coarse		15	
					Minor clay		16	
					No returns		17	
					Gravelly CLAY: Red/brown,	M	18	
							19	
							20	
							21	

MONITORING WELL MB02C

Project No.: **60451395**

Project Reference: **Holcim Pakenham**

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
							22	
					Dark red/brown		23	
							24	
					Dark brown		25	Bentonite/grout mixture
							26	
							27	
							28	
					FRESH: BASALT: Dark grey, fractured	M	29	
							30	
							31	
					CLAY with minor silt: Black, organic	M	32	
							33	Bentonite plug
					CLAY: Dark grey	M		

MONITORING WELL MB02C

Project No.: **60451395**

Project Reference: **Holcim Pakenham**

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
Sonic/percussion					Clayey SAND: Dark grey, sand fine grained	M	34	50mm slotted pvc in sand screen
					SAND: Dark grey, fine grained	M	35	
					Silty CLAY: Dark grey	M	36	
					Bore terminated at 36.77m		37	
							38	
							39	
							40	
							41	
							42	
							43	
							44	
							45	

MONITORING WELL MB04C

Project Name:	**Holcim Pakenham**			Client:	**Holcim Australia**
Drilling Contractor:	**South Western Drilling**			Location:	**Mt Shamrock Quarry**
		Project No:	**60451395**		
Logged By:	**SW**	Bore Size:	**125mm mm**	Top of Casing:	**mRL**	Drill Type:	**Sonic/percussion**
Checked By:	**SW**	Total Depth:	**30.90 m**	Coordinates:	**mE**	Drill Model:	
Date Started:	**17/01/2017**	Casing Size:	**mm**		**mN**		
Date Finished:	**17/01/2017**			Permit No:	**WLI605348**	Drill Fluid:	**Water**

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
					FILL: Gravel and clay, dark grey/red/brown, clay low plasticity, gravel fine to very coarse	D/M	0	Concrete
							1	
							2	
							3	Bentonite/grout mixture
							4	
							5	
							6	
							7	
							8	
							9	

MONITORING WELL MB04C

Project No.: **60451395**

Project Reference: **Holcim Pakenham**

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)	WELL CONSTRUCTION DETAILS
							10	CL18 threaded 50mm PVC casing
							11	
							12	
							13	
							14	
							15	
							16	
							17	
							18	
							19	
							20	Bentonite/grout mixture
							21	

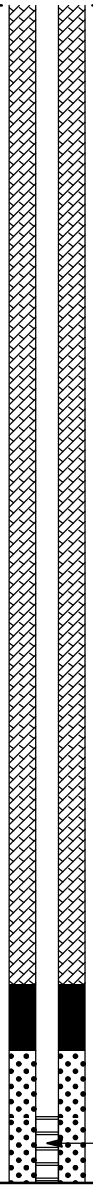
MONITORING WELL MB04C

Project No.: **60451395**

Project Reference: **Holcim Pakenham**

Drill Method	Sample Interval PID (ppm)	Sample ID	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Depth (m)
Sonic/percussion					FRESH: BASALT: Dark grey, fractured	M	22 23 24 25 26 27 28 29 30 31 32 33
					Bore terminated at 30.9m		

WELL CONSTRUCTION DETAILS



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2 | Page

A drawing of a tall pole Description automatically generated with medium confidence

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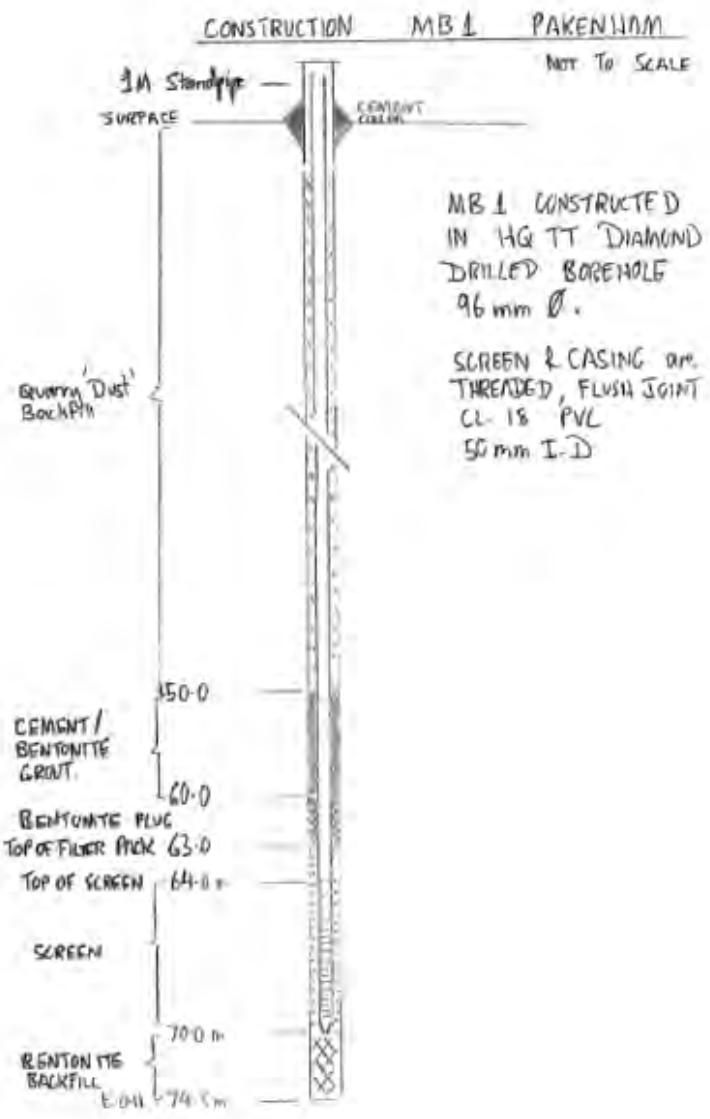


Appendix D

Tabulated groundwater levels

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
30/3/01	175.84	163.35	180.16	163.55	183.76	177.84
6/4/01		163.35		163.39		
7/5/01	175.75	163.63	180.26	163.56	183.55	177.21
24/5/01	175.94	163.67	180.40	163.55	183.46	177.00
31/5/01	175.92	163.62	180.32	163.57	183.36	176.87
7/6/01	175.96	163.63	180.33	163.50	183.34	176.87
14/6/01	176.04	163.70	180.32	163.75	183.30	176.77
21/6/01	176.01	163.87	180.25	163.68	183.23	176.78
28/6/01	175.95	163.75	180.18	163.51	183.04	176.62
5/7/01	176.00	163.73	180.23	163.48	183.13	176.61
12/7/01	175.96	163.73	180.14	163.59	183.02	176.56
19/7/01	175.95	163.75	180.11	163.56	182.95	176.52
26/7/01	175.95	163.74	5789879.07	163.45	182.87	176.54
2/8/01	175.93	163.76	180.02	163.63	182.85	176.52
9/8/01	175.94	163.75	180.05	163.48	182.84	176.46
16/8/01	175.91	163.57	180.00	163.45	182.75	176.51
23/8/01	175.86	163.85	179.94	163.77	182.68	176.33
30/8/01	175.86	163.78	179.91	163.60	182.60	176.38
6/9/01	175.74	163.82	179.94	163.53	182.53	176.38
13/9/01	175.91	163.89	179.82	163.53	182.55	176.36
20/9/01	175.89	163.87	179.75	163.46	182.50	176.51
27/9/01	175.89	163.75	179.70	163.54	182.55	176.56
4/10/01	175.89	163.64	179.78	163.53	182.65	176.68
11/10/01	175.93	163.63	179.80	163.55	182.69	176.78
18/10/2001	175.94	163.60	179.82	163.60	182.75	176.79
25/10/2001	175.95	163.66	179.82	163.61	182.79	176.80
1/11/2001	175.93	163.99	179.75	163.55	182.77	176.74
8/11/2001	175.93	163.92	179.72	163.53	182.76	176.71
15/11/2001	175.93	163.95	179.70	163.57	182.73	176.69
22/11/2001	175.98	164.00	179.74	163.50	182.78	176.70
30/11/2001	176.03	163.89	179.74	163.44	182.77	176.71
7/12/2001	176.00	163.79	179.94	163.58	182.79	176.65
20/12/2001	176.01	163.66	179.63	163.06	182.70	176.67
11/01/2002	176.00	163.47	179.48	163.03	182.56	176.61
18/01/2002	175.99	163.46	179.47	163.03	182.54	176.62
25/01/2002	175.96	163.42	178.99	163.37	182.44	176.50

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
1/02/2002	175.97	163.41	179.29	163.02	182.41	176.46
11/02/2002	175.94	163.59	179.20	163.43	182.35	176.32
20/02/2002	175.85	163.52	179.17	163.40	182.27	176.29
28/02/2002	175.81	163.32	179.11	163.08	182.14	176.17
11/06/2002	175.61	163.13	178.41	162.54	180.94	
16/10/2002	175.33	163.32	177.60	163.20	179.77	175.02
30/01/2003	175.02	162.79	176.81	162.14	178.77	174.59
27/06/2003	174.54	163.06	175.75	162.65	177.55	174.06
9/07/2003	174.44	163.08	175.54	162.44	177.44	174.00
11/09/2003	174.77	163.40	175.28	162.71	177.06	174.04
1/11/2003		162.93	175.06	162.87	177.10	176.52
27/02/2004	174.64	162.37	175.51	162.66	177.99	175.87
19/05/2004	174.51	162.98	175.90	162.76	178.74	175.01
21/07/2004	175.00	163.55	177.20	162.89	178.85	175.02
3/09/2004	175.22	163.70	176.72	163.11	180.55	176.44
10/11/2004	176.32	163.60	179.57	163.32	187.29	179.90
13/01/2005	177.30	163.49	181.33	162.89	188.74	179.78
20/03/2008	170.70	164.01	174.59	163.46	177.18	172.31
18/07/2008	169.00	164.52	174.04	163.53	176.59	172.35
29/09/2008	171.77	164.62	173.59	163.53	174.92	172.26
22/12/2008	173.10	Bore Destroyed	173.29	Bore Destroyed	175.50	171.81
2/04/2009	173.54	MB2a commences	172.59	MB4a commences	174.14	171.56
18/06/2009	174.04	*178.60*	172.99	*177.00*	174.84	171.56
18/08/2009	174.94	*178.60*	173.09	*177.70*	174.84	171.56
29/09/2009	175.54	*178.80*	172.99	*178.66*	174.74	171.46
13/12/2009	176.10	*178.84*	173.29	*179.00*	174.94	170.86
11/03/2010	176.05	*179.14*	173.31	*179.15*	173.92	171.44
15/06/2010	176.19	*179.03*	173.35	*179.53*	174.89	171.46
3/08/2010	176.34	*179.31*	173.51	*180.10*	175.02	171.43
25/11/2010	177.34	*180.57*	175.27	*181.58*	178.79	172.36
26/01/2011	177.24	*182.38*	178.07	*181.30*	177.54	173.46
1/03/2011	178.31	*180.40*	176.49	*183.60*	182.49	173.92
14/06/2011	178.25	Bore Destroyed	179.91	Bore Destroyed	184.35	174.85
8/09/2011	176.44		Bore Destroyed		Bore Destroyed	174.76

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
14/12/2011	173.64					
14/01/2012	173.74					176.56
29/02/2012	174.74					176.28
12/04/2012	175.44					175.81
10/05/2012	175.34					175.66
9/07/2012	174.94					175.83
3/08/2012	172.84					175.81
12/09/2012	174.94					175.86
10/10/2012	175.04					175.96
14/02/2013	175.19					176.06
12/03/2013	175.08					176.30
8/04/2013	175.04					175.81
4/06/2013	174.89					176.06
2/07/2013	174.54					175.81
5/08/2013	172.79					177.91
9/09/2013	175.04					175.81
7/10/2013	175.04					175.81
12/11/2013	172.47					177.41
10/12/2013	174.29					175.44
13/01/2014	175.04					175.91
11/02/2014	175.04					178.11
10/03/2014	176.04					176.96
8/04/2014	174.04					175.32
15/05/2014	174.39					175.46
10/06/2014	175.04	MB2b commences	MB3b commences	MB4b commences	MB5b commences	176.23
19/02/2015	No access	No access	170.92	No access	171.28	
28/03/2015	172.51	173.15	170.61	173.09	170.98	174.88
25/05/2015	172.52	173.29	170.17	173.08	170.52	174.34
23/06/2015	172.69	173.29	170.20	173.37	170.56	174.30
23/07/2015	172.46	173.29	170.08	173.21	170.42	174.12
31/08/2015	172.25	173.45	169.92	173.26	170.26	173.84
29/09/2015	172.12	173.48	169.98	173.32	170.32	173.77
30/10/2015	171.86	173.30	170.04	173.20	170.39	173.71
27/11/2015	171.56	173.21	169.92	173.11	170.26	173.59
17/12/2015	171.47	173.10	169.87	173.03	170.22	173.53
26/02/2016	173.23	172.70	169.46	172.85	169.78	173.11

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
17/06/2016	171.14	173.24	169.22	Dry, bore damaged	169.54	172.78
28/09/2016	171.16	173.24	170.36	172.66	170.79	172.83
15/12/2016	171.22		170.78	172.28	171.21	173.41
16/01/2017		MB02C commences		MB04C commences		
8/05/2017	171.86	172.08	170.10	171.96	170.50	173.29
9/08/2017	171.74	171.62	170.24	171.46	170.69	172.90
9/10/2017	171.49	171.52	170.92	171.26	171.44	171.75
8/12/2017	171.27	171.18	170.69	170.97	171.16	172.61
12/04/2018	170.78	171.32	170.26	170.82	170.70	172.36
3/07/2018	170.04	171.10	170.92	170.89	171.52	172.11
9/10/2018	169.88	171.17	171.71	170.99	172.31	171.95
8/01/2019	169.78	171.24	172.03	171.00	172.57	171.81
5/04/2019	169.35	170.39	170.39	170.30	170.82	171.67
18/07/2019	168.93	170.64	171.58	170.70	172.14	171.38
16/12/2019	169.33	171.69	172.52	171.81	173.04	171.71
31/03/2020	169.39	171.68	172.54	171.94	173.08	171.86
14/08/2020	169.81	172.46	172.01	172.90	172.47	172.67
24/09/2020	169.66	172.30	172.20	172.84	172.59	172.68
30/10/2020	170.89	172.62	172.81	173.24	173.28	174.23
6/11/2020	170.13	172.65	172.99	173.22	173.53	174.35
21/12/2020	170.2	172.36	172.54	172.79	172.99	174.89
10/03/2021	170.36	171.86	171.54	172.21	172.00	174.59
19/04/2021*	169.96	171.76	171.29	172.38	171.7	174.6
25/05/2021*	170.81	171.82	171.27	172.54	171.7	174.3
17/06/2021	170.29	172.01	171.44	172.71	171.92	173.87
28/07/2021*	170.04	172.13	171.35	172.85	171.79	173.71
27/08/2021*	169.96	172.01	171.24	172.69	171.66	173.285
14/09/2021	170.34	172.23	171.48	171.88	172.01	173.29
27/10/2021*	170	172.46	172.3	173.18	172.8	173.52
23/11/2021*	170.30		172.95	173.17	173.50	173.03
20/12/2021	170.89	172.46	172.47	173.06	172.94	173.90
21/01/2022*	170.68	172.07	171.37	172.65	171.70	174.31
21/02/2022*	170.68	171.77	170.78	172.32	171.10	174.44
22/03/2022*	170.58	171.58	170.54	172.16	170.65	173.76
26/04/2022	170.65	171.53	170.28	172.08	170.65	174.29
24/05/2022*	171.07	171.62	170.41	172.21	170.86	174.39

Date	MB01 (Werribee)- Relative Water Level mAHD	MB02, MB2a, MB2b, Mb2c (Werribee)- Relative Water Level mAHD	MB03, MB3b (Werribee) - Relative Water Level mAHD	MB04, MB4a, MB4b, MB4c (Older Volcanics)- Relative Water Level mAHD	MB05, MB05b (Older Volcanics)- Relative Water Level mAHD	MB06 (Older Volcanics)- Relative Water Level mAHD
17/06/2022	170.50	171.87	170.50	172.49	170.98	174.22
20/07/2022*	170.49	171.84	170.47	172.66	170.89	174.03
24/08/2022*	170.56	171.98	170.19	172.85	170.45	173.91
12/09/2022	170.52	172.25	170.75	173.09	171.05	173.93
17/10/2022*	170.87	172.31	170.27	173.17	170.55	174.56
23/11/2022*	171.42	172.43	171.55	173.14	171.91	176.33
19/01/2023*	171.97	171.65	169.90	172.71	170.15	177.80
20/02/2023*	171.89	171.29	169.03	172.55	169.36	177.33
23/03/2023	171.65	171.05	167.32	172.36	167.58	176.93
6/04/2023*	172.37	171.20	168.19	172.45	168.39	176.82
18/05/2023*	171.47	171.60	168.49	172.52	168.47	176.16
22/06/2023	171.28	171.87	168.91	172.73	169.03	175.66
13/07/2023*	171.30	171.97	169.33	172.57	169.45	175.49
3/08/2023*	171.21	171.92	169.43	172.83	169.59	175.26
7/09/2023	171.09	171.77	169.42	172.67	169.57	174.91
25/10/2023*	170.97	171.93	169.53	172.84	169.67	174.54
20/11/2023*	170.92	171.88	169.45	172.68	169.62	174.38
13/12/2023	170.97	171.82	169.35	172.54	169.54	174.26
15/01/2024	170.52	172.05	169.32	173.02	169.47	174.10
Highest Elevation (whole dataset)	178.31	182.38	5789879.07	183.60	188.74	179.90
Lowest Elevation (whole dataset)	168.93	162.37	167.32	162.14	167.58	170.86
Highest Elevation since 2015	173.23	173.48	172.99	173.37	173.53	177.80
Lowest Elevation since 2015	168.93	170.39	167.32	170.30	167.58	171.38
Difference	4.30	3.09	5.66	3.07	5.95	6.42
Source: AECOM (2024)						

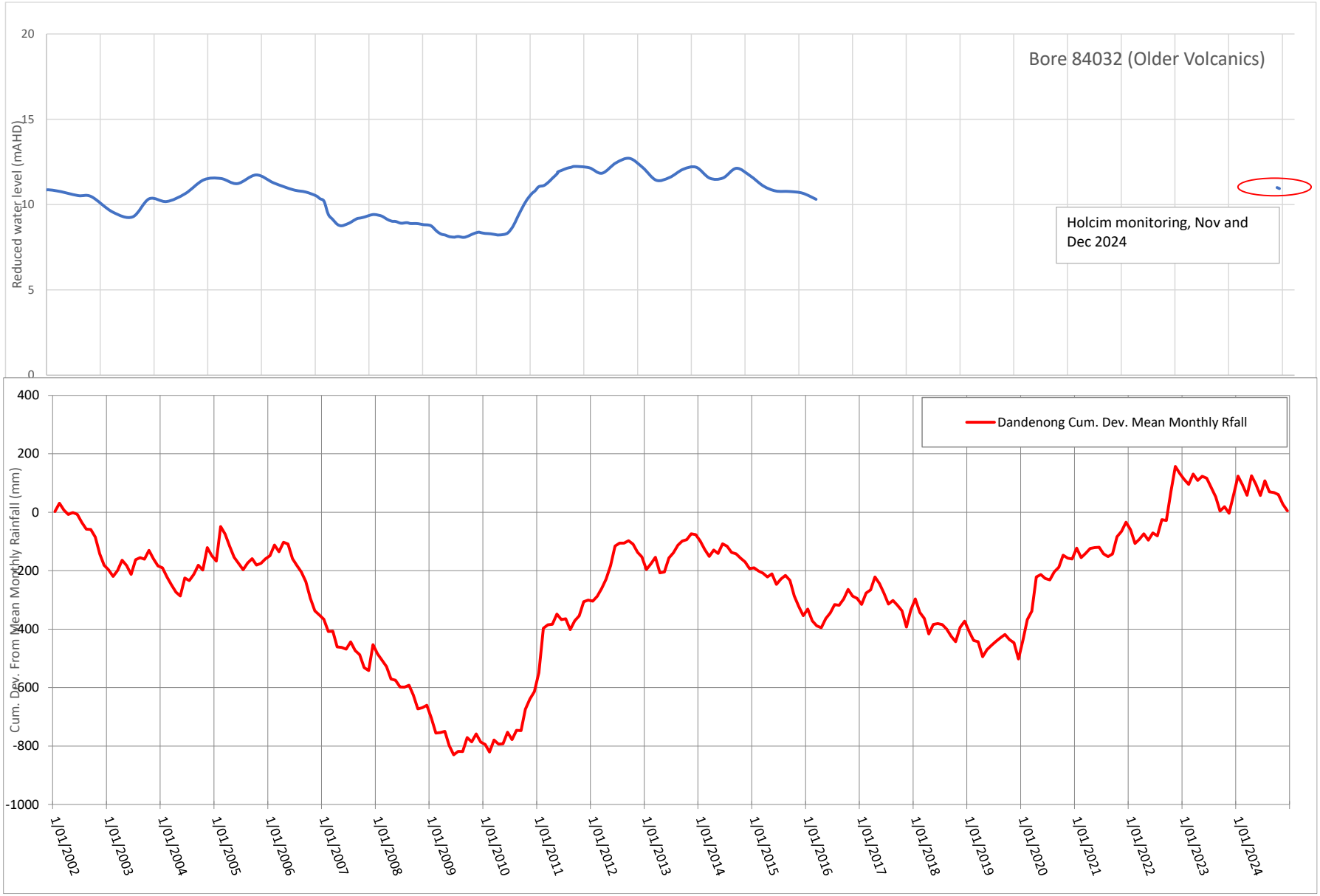
Date	MB01 (RLWL)	MB02C (RLWL)	MB03B (RLWL)	MB04C (RLWL)	MB05B (RLWL)	MB06 (RLWL)	SOB 84032 (measurement in meters)	Contractor
15/01/2024	170.52	172.05	169.32	173.02	169.47	174.10	-	AECOM
07/02/2024	170.92	171.77	169.37	172.53	169.53	174.10	-	J. Everitt
19/03/2024	170.82	171.29	169.16	172.04	169.36	174.07	-	J. Everitt
17/04/2024	170.67	171.32	169.04	172.29	169.23	173.94	-	J. Everitt

Date	MB01 (RLWL)	MB02C (RLWL)	MB03B (RLWL)	MB04C (RLWL)	MB05B (RLWL)	MB06 (RLWL)	SOB 84032 (measurement in meters)	Contractor
02/05/2024	170.63	171.33	169.02	172.26	169.30	173.90	-	J. Everitt
06/06/2024	170.52	171.01	168.91	172.41	169.13	173.88	-	J. Everitt
08/07/2024	170.30	171.05	168.76	172.41	168.98	173.72	-	J. Everitt
08/08/2024	170.42	171.14	168.85	172.99	169.08	173.66	-	J. Everitt
10/09/2024	170.39	170.65	168.80	172.64	169.07	173.67	-	J. Everitt
10/10/2024	170.34	170.57	168.69	172.42	168.95	173.64	-	J. Everitt
26/11/2024	170.21	170.24	168.54	172.38	168.82	173.59	3.07	J. Everitt
12/12/2024	170.17	170.03	168.45	172.37	168.75	173.56	3.13	GHD
Source: Holcim								

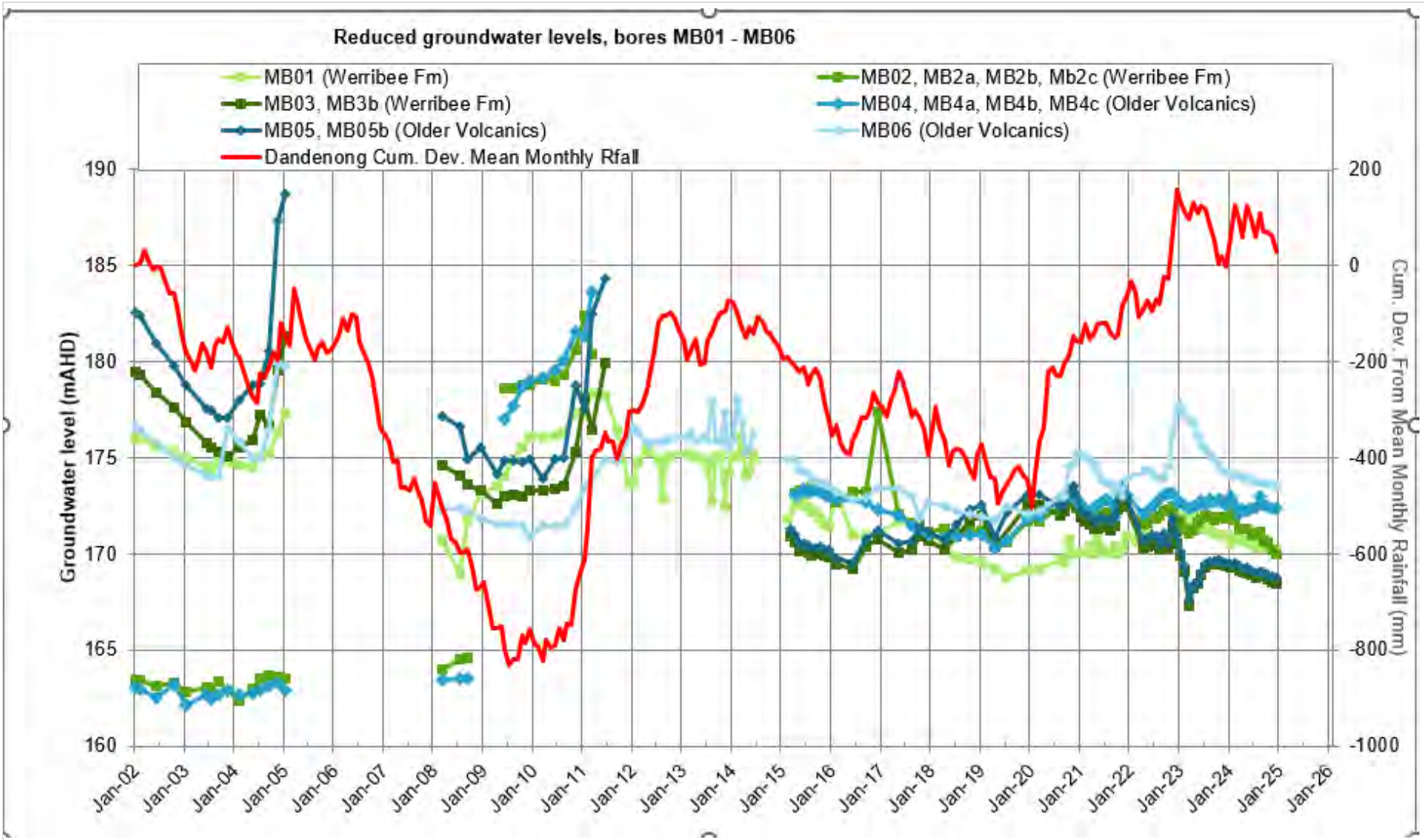
Appendix E

Monitoring bore hydrographs

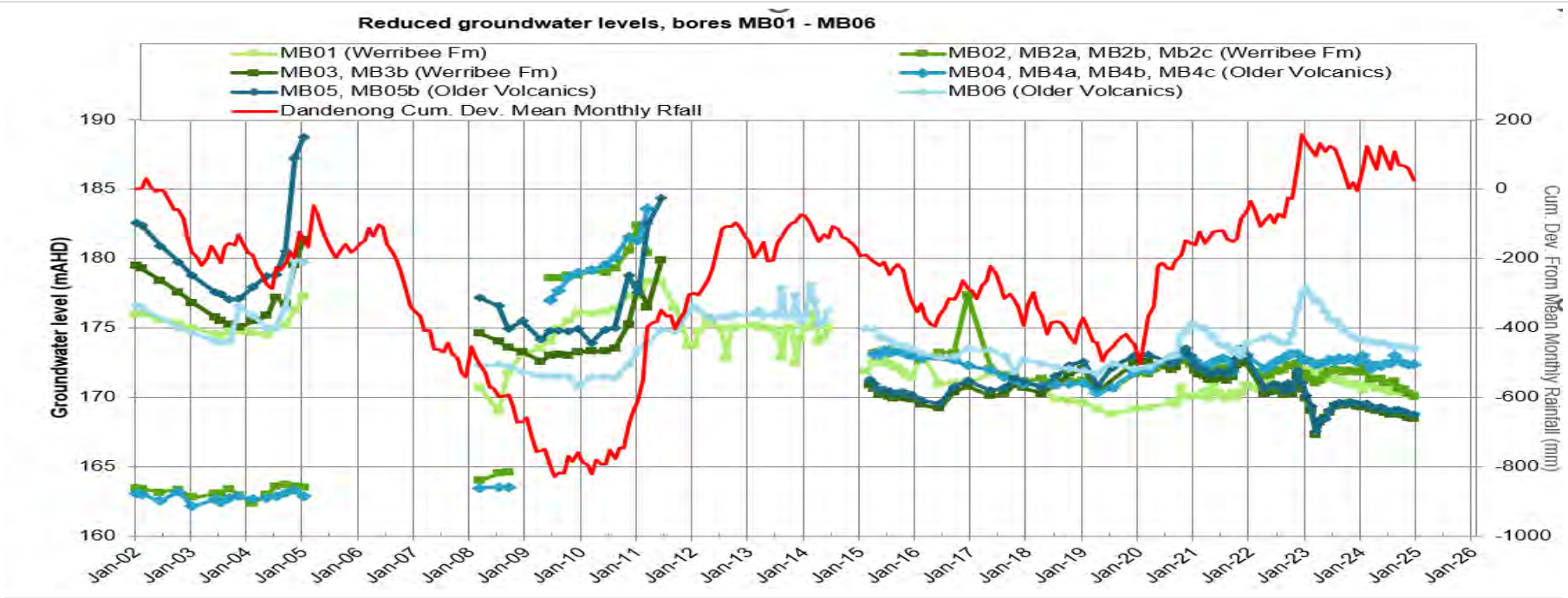
SON bore 84032

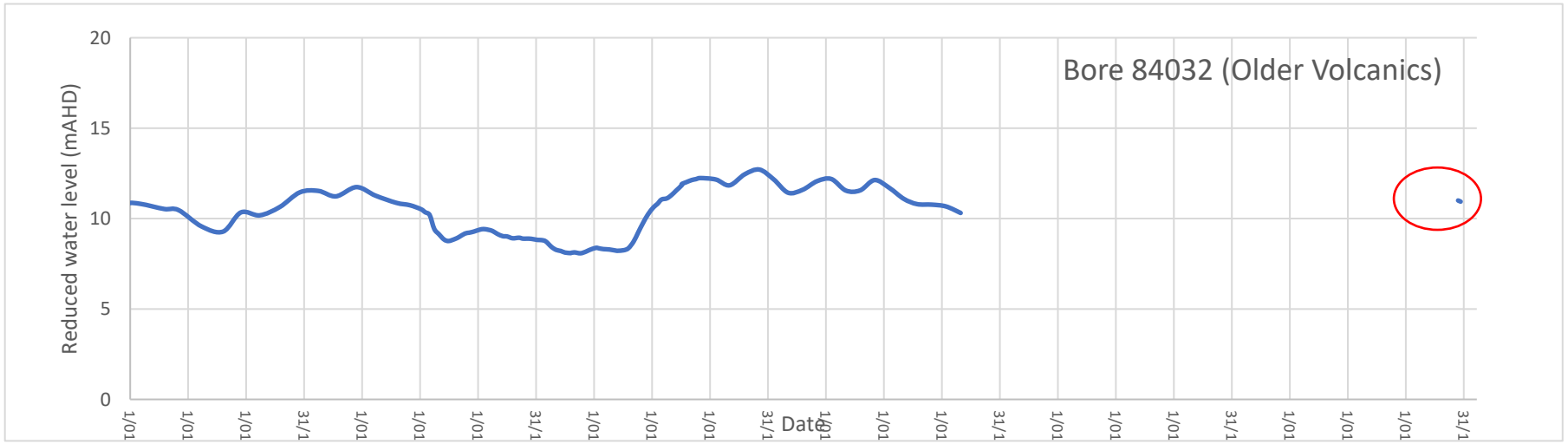


Bores MB01 to MB06 – all data

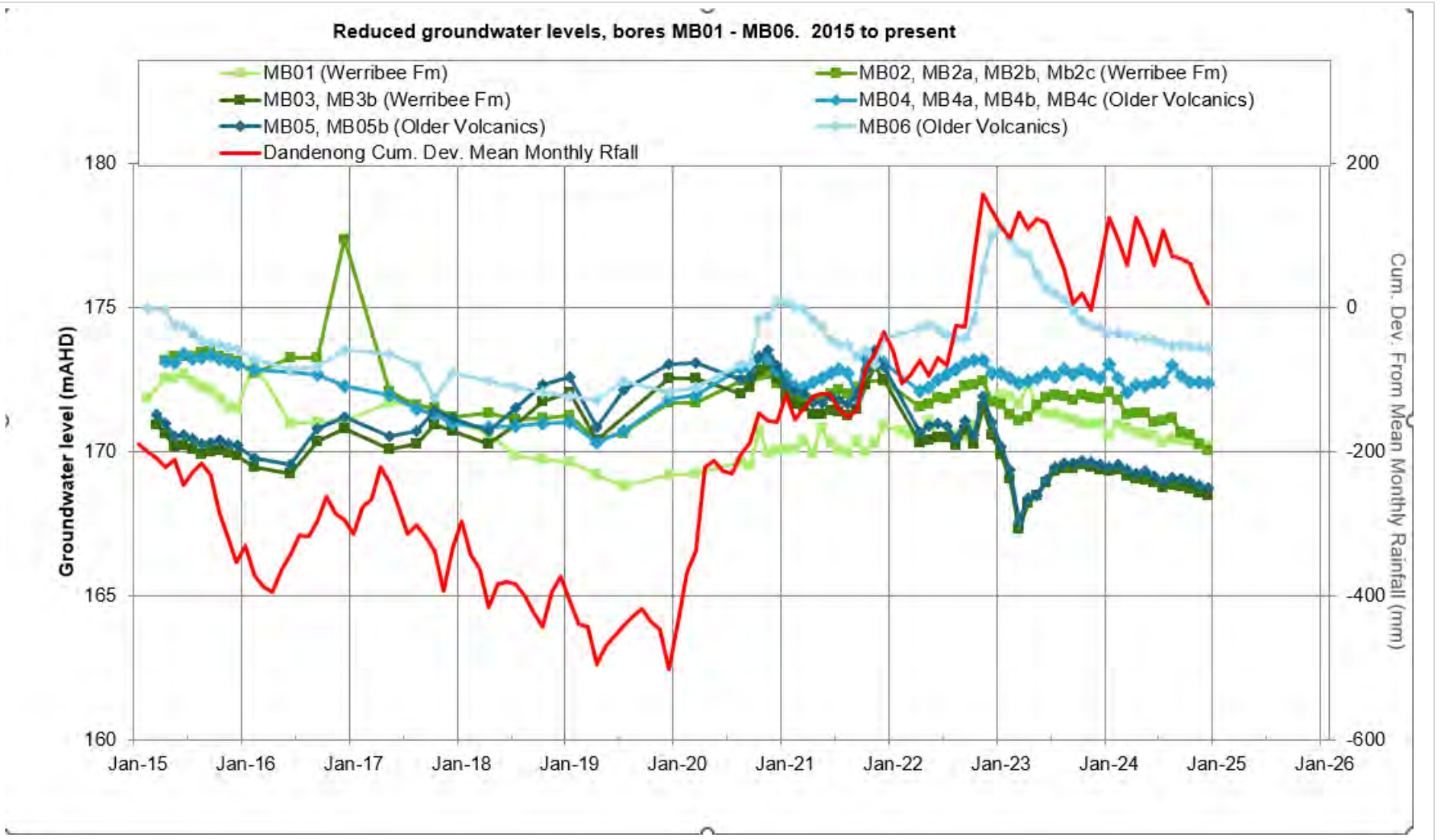


SON bore 84032 and site bores MB01 – MB06; 2002 to present

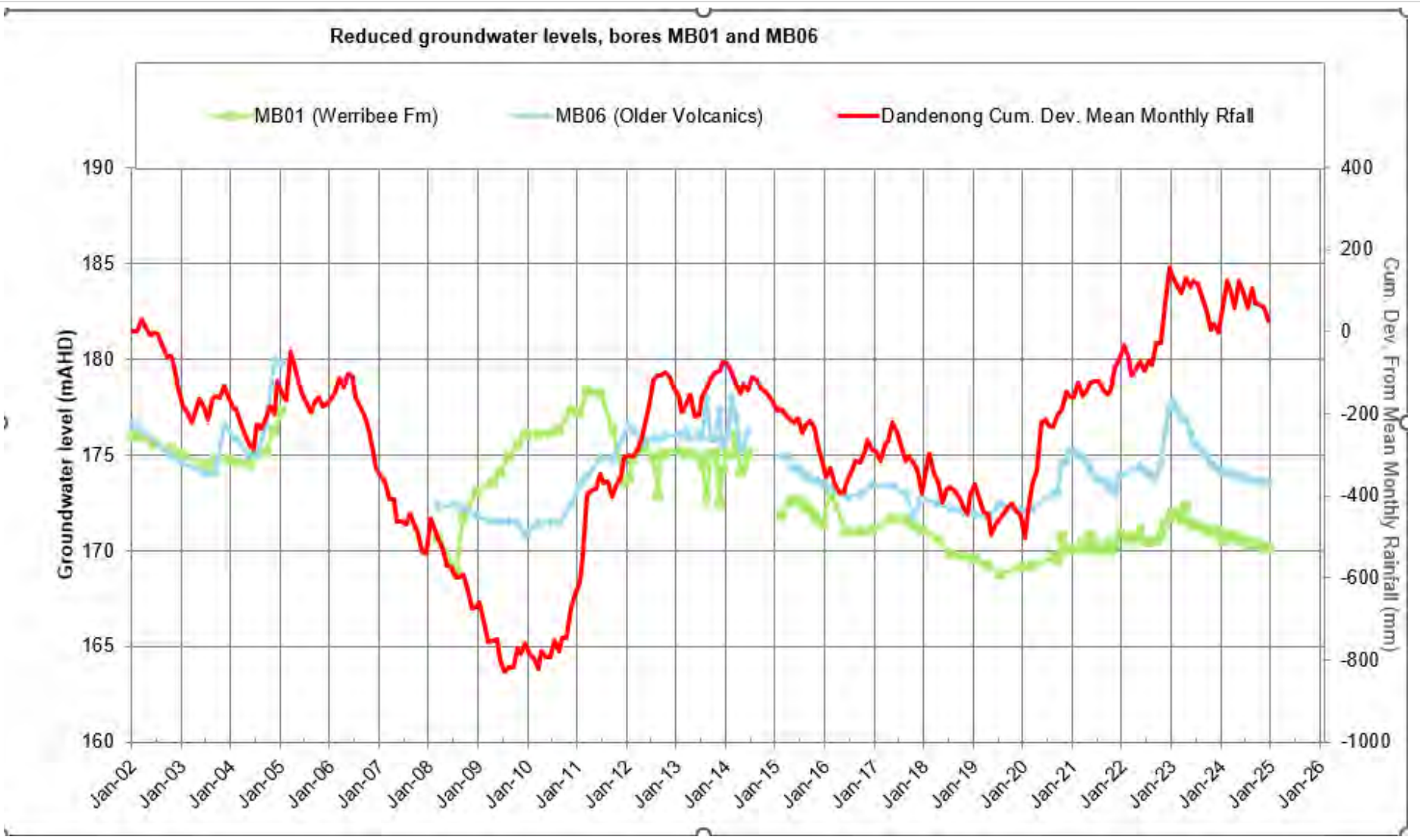




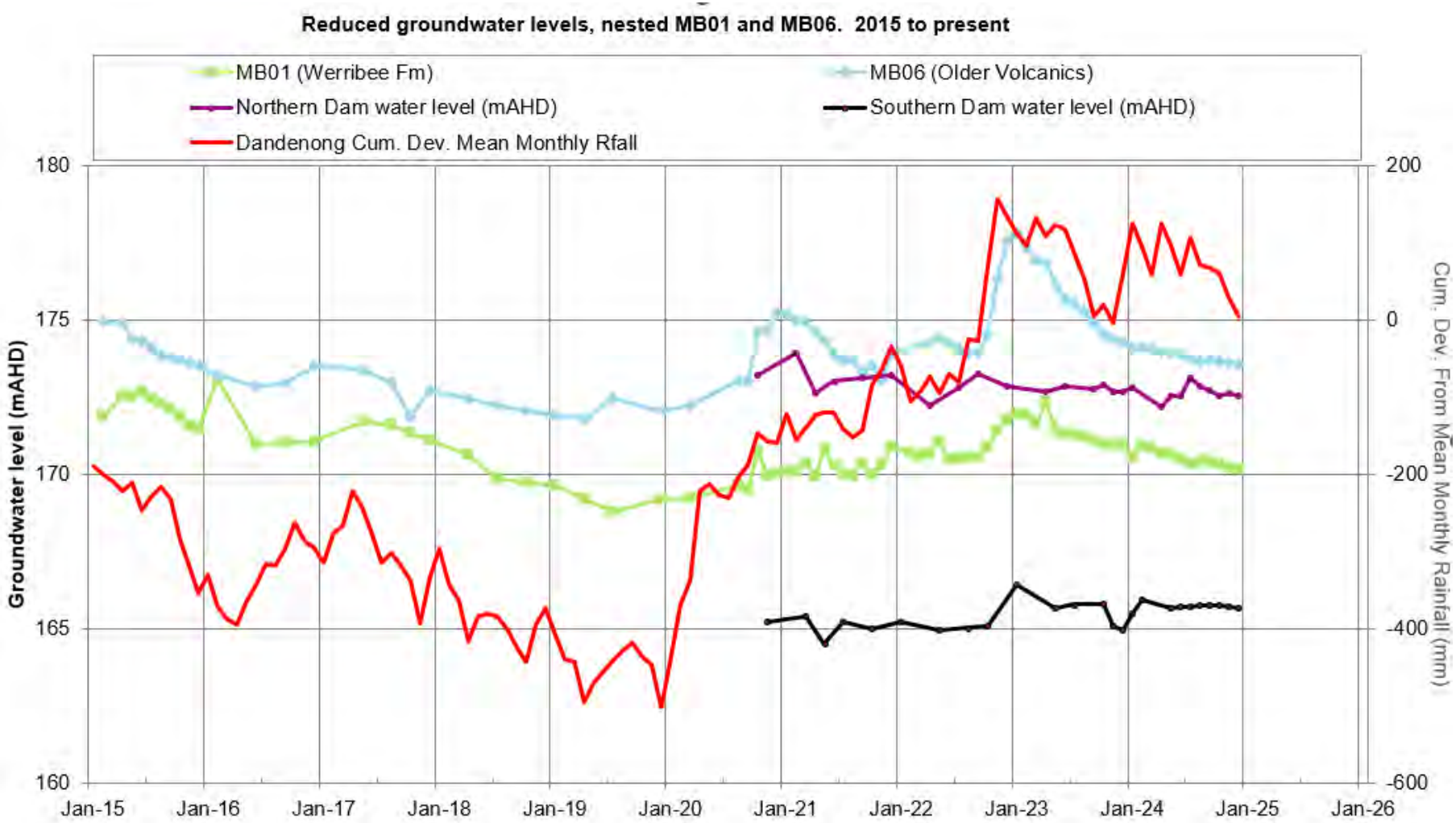
Bores MB01 to MB06 – 2015 to present



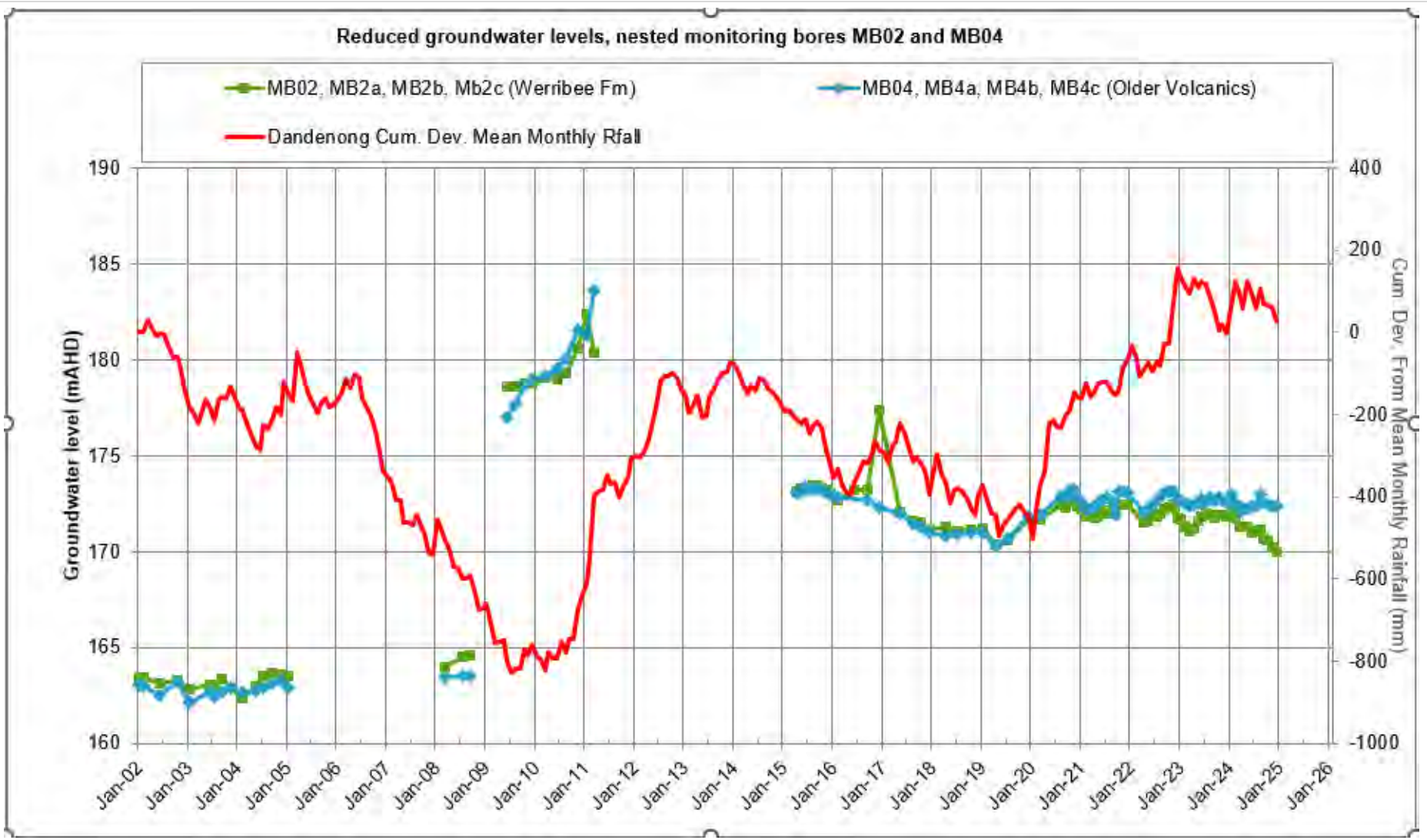
Bores MB01 and MB06 – all data



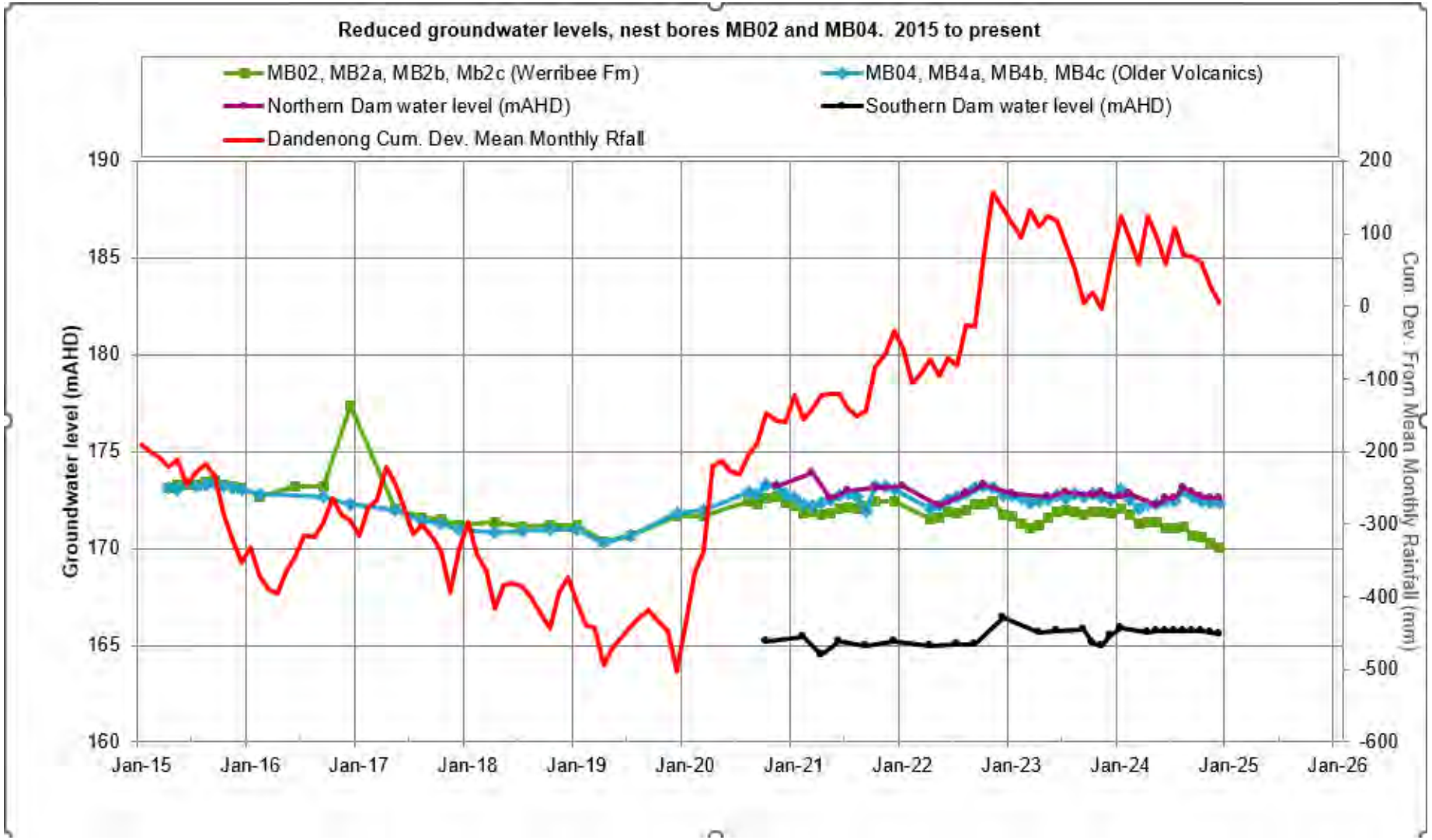
Bores MB01 and MB06 – 2015 to present



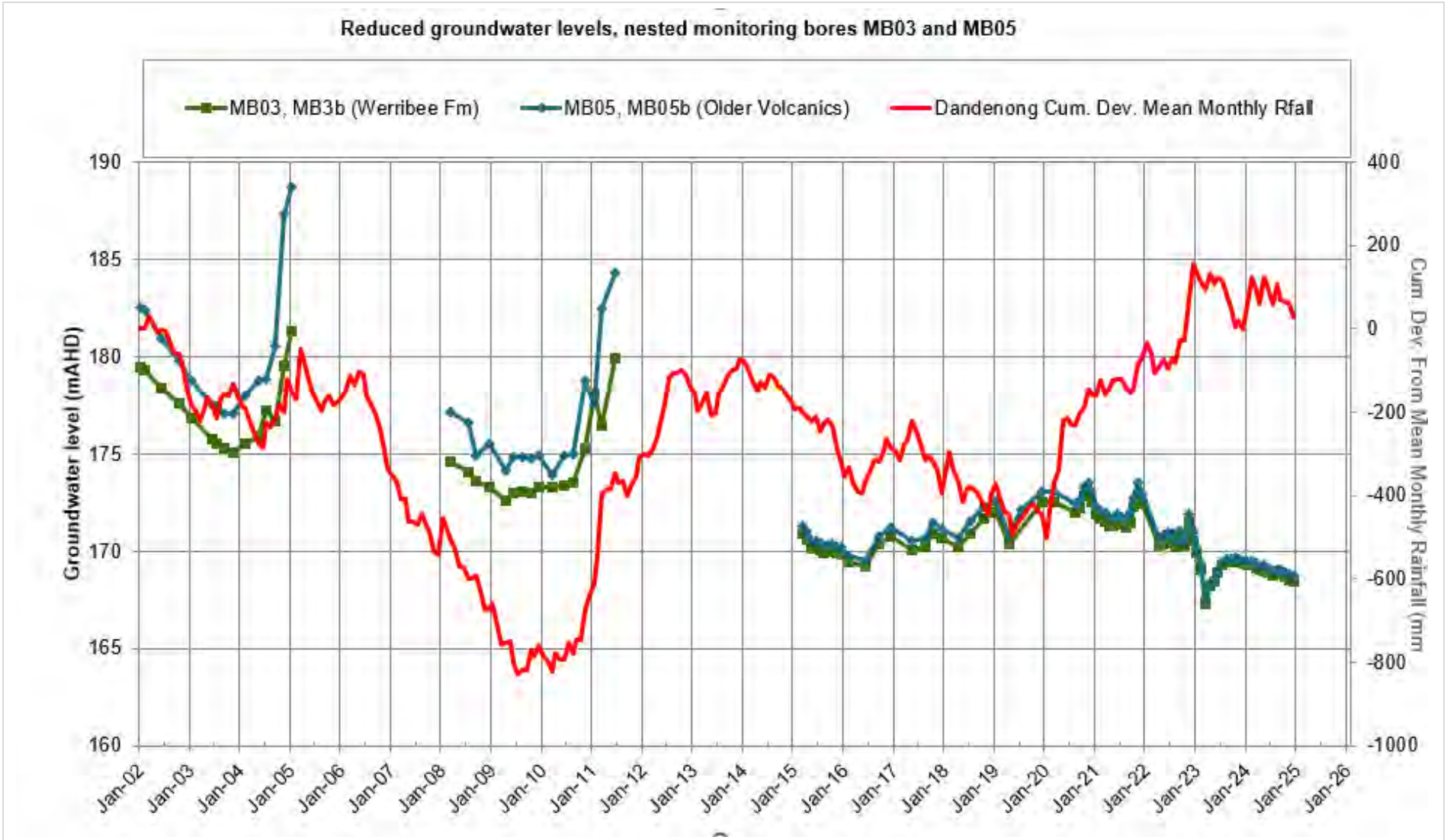
Bores MB02 and MB04 – all data



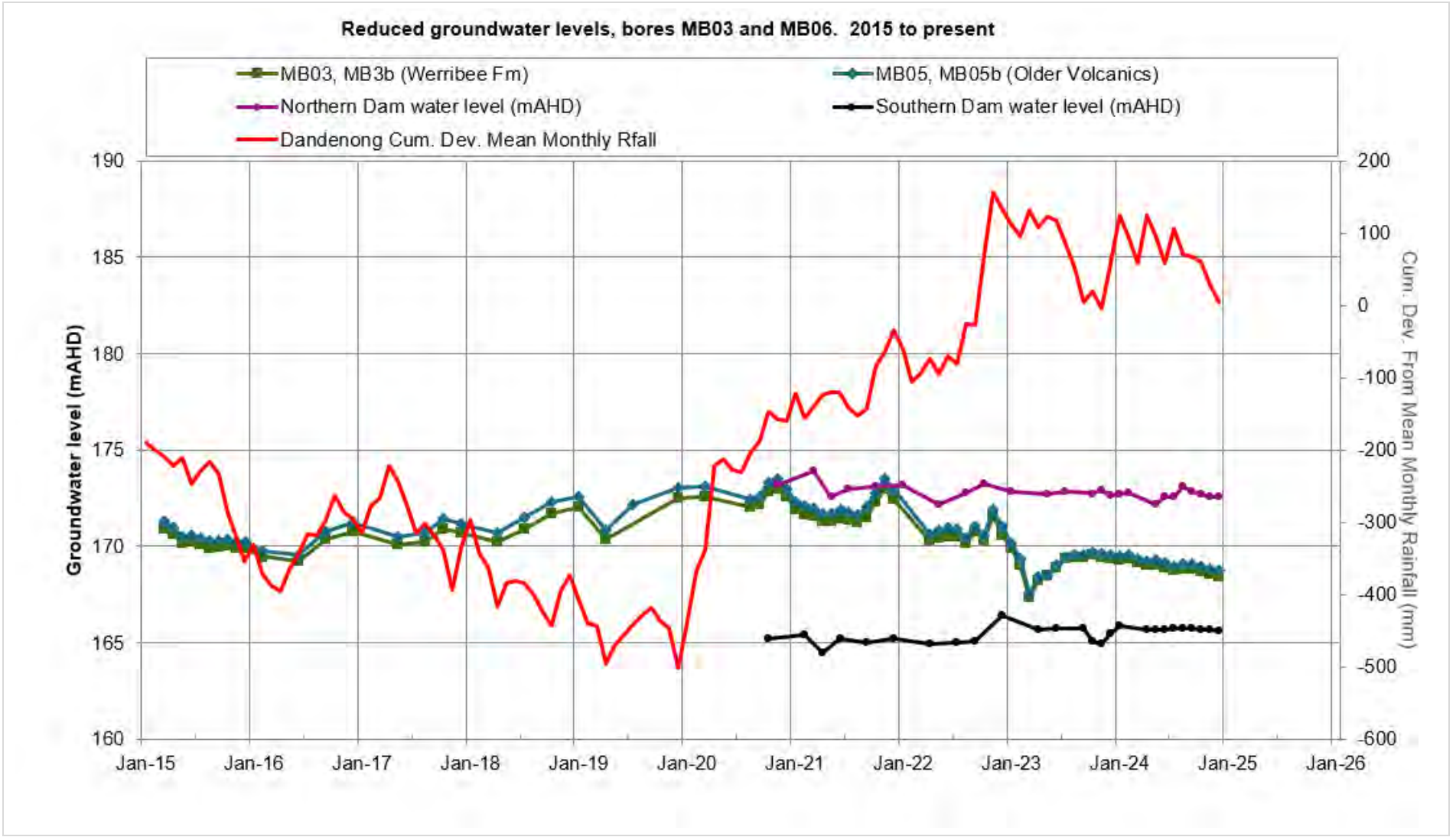
Bores MB02 and MB04 – 2015 to present



Bores MB03 and MB05 – all data



Bores MB03 and MB05 – 2015 to present


Reduced groundwater levels, bores MB03 and MB06. 2015 to present
MB03, MB3b (Werribee Fm)
MB05, MB05b (Older Volcanics)
Northern Dam water level (mAHD)
Southern Dam water level (mAHD)
Dandenong Cum. Dev. Mean Monthly Rfall
Groundwater level (mAHD)
190
185
180
175
170
165
160
200
100
0
-100
-200
-300
-400
-500
-600
Cum. Dev. From Mean Monthly Rainfall (mm)
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25
Jan-26

Appendix F

Mt Shamrock spring historical data

Spring Number	Date	Electrical Conductivity	pH	Redox Potential	Dissolved Oxygen	Temperature	TDS*	Flow rate (m3/day)	Observations
		µS/cm		mV	mg/L	°C	mg/L		
SP01	13-Feb-01	905	7.53	193	-	22.9	588		
	6-Apr-01	1013	6.65	240	1.03	18.4	658		
	7-May-01	1079	7.21	215	5.67	17.2	701		
	15-Jun-01	886	8.21	151	7.11	16.1	576		
	11-Jul-01	994	7.31	194	**	15.8	646		
	13-Aug-01	1104	7.25	189	8.07	17.0	718		
	17-Sep-01	958	7.16	203	5.91	17.0	623		
	4-Oct-01	1048	7.17	230	**	16.0	681		
	20-Nov-01	721	7.06	320	6.07	16.1	469		
	17-Dec-01	1025	5789879.07	190	9.78	18.8	666		
	22-Feb-02	1054	7.36	173	5.28	22.7	685		
	12-Jun-02	946	6.88	8	4.68	14.7	615		
	30-Jan-03	1260	7.21	43	5.98	19.7	819		
	27-Jun-03	1127	7.08	208	6.10	10.6	733		
	21-Jul-04	988	7.57	305	**	12.1	642		
	12-Mar-09	1140	7.11	-	-	-	741		Main irrigation spring, flow ~1.2L/min, sampled from tank inlet
	25-Jun-10	1076	7.80	-	-	-	699		Parameters gauged at source, flow ~3 L/min
	28-Mar-12	1049	***	-	-	19.3	682		
	25-Jun-13	947	7.58	79.9	10.39	14.4	616		
	15-May-14	1043	7.60	18	9.3	15.8	678		Clear, moderate flow
	26-Feb-16	1674	6.42	105	0.25	16.6	1088		Clear, water flow into tank ~4L/s. Wheelie bin where water collects was half full of water
	18-Jan-17	1156	7.99	73	4.33	20.3	751		Clear, no odour. Water is collected in wheelie bin prior to discharge.
	9-Oct-17	1120	6.99	167	6.16	14.9	728	2.0	Vegetation in area in very healthy condition, weeds growing over bin lid. Very boggy in area. Water had been extracted from the tank during the morning and therefore it was recharging. Flowing quickly into tank at approximately 250 mL / 10 seconds. Water clear with suspended solids.
	3-Jul-18	1470	7.01	197	5.70	12.3	956	5.0	Vegetation in area in very healthy condition. Very boggy in area. Flowing from Spring via pipe into tank quickly at approximately 250 mL / 4 seconds.
	8-Jan-19	1323	7.38	73.8	6.15	16.1	860		Grey, no odour, medium turbidity, very overgrown
	18-Jul-19	1218	7.44	71	7.15	12.9	792		Clear, low turbidity, no odour, moderate flow into tank.
	16-Dec-19	1200	7.54	37.2	7.37	15.3	780		Thick vegetation. Flowing water in bin.
	6-Nov-20	814	7.26	20.1	5.92	14.6	529		Overgrown. Flowing into bin. Sign at spring reads Spring 3.
	17-Jun-21	908	7.46	28.2	7.4	13.6	590		Overgrown. Water flowing into bin. Fence maintained. Sign reads Spring 3.
	20-Dec-21	755	7.63	23	5.7	14.8	491	9.0	~100mL/s flowing into bin. (8640 L/day)
	17-Jun-22	928	7.62	-26.4	5.94	14.4	603	10.0	113mL/s flowing from spring (9,792 L/day)
	21-Dec-22	753	7.84	12.8	7.88	13.7	489	19.0	Water flowing into bin, losing some water which misses the capture system. Flow rate = 10L/45 secs
	15-Jan-24	724	6.96	230.6	6.96	17.66	471	10.3	Water flowing into bin - losing some water which misses capture system
	12-Dec-24	758	6.98	48.2	66.70%	16	493	4.7	Water flows into bin. Due to location of bin, not all water captured in bin. Flow meter installed 1 November 2024 at tank below spring. Flow meter reading - 262 m3. Assuming an initial flow meter reading of 0 m3, this suggests an approximate daily flow rate of 6.4 m3
SP02	13-Feb-01	3240	8.01	166	-	20.8	2106		
	6-Apr-01	3090	7.24	219	0.00	19.4	2009		
	7-May-01	3030	7.78	187	4.18	13.8	1970		
	15-Jun-01	2450	8.66	130	7.39	14.5	1593		
	11-Jul-01	2510	7.95	166	**	12.5	1632		
	13-Aug-01	2650	8.08	202	7.68	14.2	1723		
	17-Sep-01	2600	8.38	135	8.03	16.4	1690		
	4-Oct-01	2480	7.83	168	**	14.7	1612		
	20-Nov-01	2630	8.32	139	6.14	18.1	1710		
	17-Dec-01	2270	7.07	197	6.87	18.0	1476		
	22-Feb-02	2660	7.04	191	2.02	21.9	1729		
	12-Jun-02	1813	7.41	201	4.59	12.0	1178		
	30-Jan-03	4320	7.15	-40	1.28	21.7	2808		
	27-Jun-03	3230	7.63	183	7.68	10.3	2100		
	21-Jul-04	1829	8.20	311	**	9.9	1189		
	12-Mar-09	2990	7.56	-	-	-	1944		Low flow, sample taken from grassy pool / dam
	25-Jun-10	2209	8.15	-	-	-	1436		Low flow, parameters taken from dam
	28-Mar-12	2342	***	-	-	21	1522		
	25-Jun-13	2029	8.09	106.3	11.09	12.5	1319		
	15-May-14	2140	7.65	39	12.8	12.3	1391		No flow
	26-Feb-16	3130	6.41	199	7.34	17.8	2035		Clear-brown, strong flow with potential to break through wall. Water fed through pipes to trough down slope.
	18-Jan-17	2456	7.38	-18	2.26	20.2	1596		Organic odour. Large pond; water levels managed to prevent bund from collapsing.
	9-Oct-17	2405	7.02	52	2.72	15	1563		Difficult to locate due to healthy vegetation and thick cover of duckweed on pond surface. Troughs that are fed by the spring are full. Pond is deep, no flow
	3-Jul-18	2290	6.05	243	5.66	7.8	1489		Deep pond with large amount of duckweed. This Spring directly feeds into trough and a tank. The flow downhill into the tank was approx. 250ml / 3 sec until was reduced the flow to roughly 250ml / 6 sec
	8-Jan-19	2829	7.19	-107	6.11	17.5	1839		Black, organic odour, medium-high turbidity, overgrown
	18-Jul-19	2070	7.46	86.8	6.26	8.4	1346		No flow, brown, low turbidity, no odour
	16-Dec-19	2838	7.24	41.6	4.87	15.5	1845		Thick grass. Standing water within grass. No visible flow.
	6-Nov-20	2143	7.19	52	-	13.1	1393		Overgrown. Standing water.
	17-Jun-21	2259	7.48	-6.8	12.73	8.3	1468		Fenced off, no cattle access evident. Vegetation healthy. Flow on slope above, no overflow observed.
	20-Dec-21	2420	7.33	-3	0.36	14	1573		Thick vegetation. Standing water. No flow observed.
	17-Jun-22	1995	7.6	-55.1	8.93	10.3	1297	2.3	Thick vegetation. Flow measured at tank downhill - 27mL/s (2,333L/day)
	21-Dec-22	2265	7.23	-60.5	0.39	17.6	1472	2.5	Flow rate 5L/171 secs from second trough outflow, thick veg around spring
	15-Jan-24	1892	7.04	215.3	4.27	20.05	1230	15.1	Audible flow, healthy vegetation
	12-Dec-24	1922	7.44	17.5	43.40%	17.2	1249	1.3	Spring is fenced. Lush healthy vegetation. Flow meter installed between spring and water tank on 4 December 2024. Flow meter reading -10 m3. Assuming an initial flow meter reading of 0 m3, this suggests an approximate daily flow rate of 0.9 m3 Meter to be read weekly by Holcim.
	21-Nov-01	540	6.80	242	0.12	18.2	351		

Spring Number	Date	Electrical Conductivity	pH	Redox Potential	Dissolved Oxygen	Temperature	TDS*	Flow rate (m3/day)	Observations
		µS/cm		mV	mg/L	°C	mg/L		
SP03	17-Dec-01	696	7.32	177	5.01	17.9	452		
	22-Feb-02	592	7.38	187	2.38	22.6	385		
	12-Jun-02	696	7.55	192	2.42	12.7	452		
	30-Jan-03	758	8.57	153	6.28	20.7	493		
	27-Jun-03	727	6.85	203	7.82	12.3	473		
	21-Jul-04	713	7.86	295	**	11.9	463		
	12-Mar-09	899	7.16	-	-	-	584		Low flow, degraded/eroded by cattle, organic material
	25-Jun-10	599	7.62	-	-	-	389		Parameters taken from dam below the discharge point
	28-Mar-12	599	***	-	-	11.3	389		
	25-Jun-13	589	7.91	72.1	7.86	12.6	383		
	15-May-14	552	8.50	39.5	4.05	13.9	359		Low flow, cattle prints evident
	26-Feb-16	1022	6.37	84	7.34	17.6	664		Large pool spilling down slope, duckweed, cow hoof imprints, water brown-clear
	18-Jan-17	674	7.88	52	2.55	19.7	438		Large pool, no flow observed. Water pooled in cow hoof prints to half way down slope.
	9-Oct-17	655	6.97	101	7.30	14.5	426		Vegetation and spring both appear very healthy as per last time. Large pool and boggy in area. Cattle trough full so no flow observed.
	3-Jul-18	669	7.8	200	8.31	10.4	435		Large pool and boggy in area. Cattle trough full so no flow observed.
	8-Jan-19	784	7.39	-430	5.10	18.2	510		Black/clear, no odour, low-medium turbidity
	18-Jul-19	775	7.14	-40.1	1.33	9.8	504		Cow in Springs. No odour, grey, low turbidity
	16-Dec-19	812	7.87	-17.1	2.36	14.5	528		Tall grass and floating vegetation. No flow.
	6-Nov-20	697	7.79	-24.1	-	13.4	453		Standing water. Seeping down slope. Sign reads Spring 4
	17-Jun-21	452	7.46	-25.3	6.20	9.5	294		Bin installed to manage overflow. Some flow into bin.
	20-Dec-21	694	7.98	32.2	8.05	13.5	451		~100mL/s flowing out of bin
	17-Jun-22	662	7.83	-79.4	5.93	12.8	430		Healthy vegetation. Sunken bin leading to only intermittent flow from spring. Unable to gauge during visit but trough filled from spring lower down slope full.
	21-Dec-22	673	7.66	-3.1	4.58	17.6	437	3.0	Flow rate 5L in 142 Secs, healthy veg, flow into bin with some seepage
	15-Jan-24	768	7.51	205.8	1.65	19.31	499	0.3	Water flowing around bin
	12-Dec-24	557	-	50.6	0.91	16	362	2.5	Spring is fenced. Lush healthy vegetation. Water flows into wheelie bin. Small drainage line upslope of spring. Water also allowed to flow into small tank directly below spring. PVC pipe needs to be disconnected for some time to allow for surges in water to cease, i.e. prior to measuring flow rate.
SP04	17-Dec-01	1206	7.11	196	2.05	17.1	784		
	22-Feb-02	928	7.08	185	3.75	21.8	603		
	12-Jun-02	Could not find any signs of flow, ground wet in this area.							
	30-Jan-03	1359	7.58	145	6.08	18.1	883		
	27-Jun-03	1096	7.89	176	8.07	11.5	712		
	21-Jul-04	1031	8.84	296	**	11.6	670		
SP04(N)	12-Mar-09	1469	7.43	-	-	-	955		Northern discharge point, low to no flow
SP04 (S)	12-Mar-09	1342	7.69	-	-	-	872		Southern discharge point, low flow
	25-Jun-10	1080	6.75	-	-	-	702		Low flow, parameters taken from groundwater discharge pooling in hoof impressions
	28-Mar-12	1099	***	-	-	19.5	714		
	25-Jun-13	1414	7.39	15.5	0.00	14.9	919		
	15-May-14	875	7.43	-43	4.05	12.7	569		No measurable flow, stagnant
	26-Feb-16	1078	6.80	97	1.24	17.8	701		Small puddle of water (<30cm^2, and <5cm deep), wet, marshy grass, water clear
	18-Jan-17	1004	7.92	65	4.33	20.3	653		Small puddle; clear, marshy, overgrown and boggy; around 30 cm2 x 5 cm deep.
	9-Oct-17	1498	6.89	232	3.33	14.5	974		Shallow pool (~5cm) and very boggy in area. Vegetation healthy.
	3-Jul-18	Spring dry. Vegetation healthy.							Dry Spring, vegetation healthy
	8-Jan-19	Spring dry. Vegetation healthy.							Dry
	18-Jul-19	Spring dry. Vegetation healthy.							Dry Spring, vegetation healthy though overgrown
	16-Dec-19	Spring dry. Vegetation healthy.							Slightly damp seep observed.
	6-Nov-20	Spring dry. Vegetation healthy.							Thicker vegetation. Sign reads Spring 3
	17-Jun-21	Unable to be accessed.							
	20-Dec-21	Spring dry. Vegetation healthy.							
	17-Jun-22	Spring dry. Vegetation healthy.							
	21-Dec-22	1232	7	-102	4	18	801		Thick vegetation, clear water, algae, no flow from spring. Audible flow on bank above spring but not visible through vegetation.
	15-Jan-24	1041	6.81	227.4	6.81	19.7	677		Audible flow upslope
	12-Dec-24	Spring dry							Heavy weed growth including blackberries and thistles at spring. Spring appears to have been historically fenced but evidence of livestock at spring now observed. Spring currently dry, but flows have been historically reported. Trace moisture at located immediately above spring.
SP05	21-Nov-01	434	6.93	107	5.04	16.6	282		
	17-Dec-01	2350	6.92	206	5.24	17.3	1528		
	22-Feb-02	487	6.76	207	1.77	22.0	317		
	12-Jun-02	Could not find any signs of flow, ground wet in this area.							
	30-Jan-03	No obvious water even with digging, but area green							
	27-Jun-03	612	7.85	212	6.01	10.2	398		
	21-Jul-04	280	7.34	280	**	9.9	182		
	12-Mar-09	Could not locate, no obvious flow							
	25-Jun-10	Could not locate, no obvious flow							No flow
	28-Mar-12	Could not find signs of flow							
	25-Jun-13	Could not be located							
	15-May-14	Spring dry							
	26-Feb-16	Spring dry							
	18-Jan-17	No parameters could be taken.							Muddy and minor water pooling in cow hoof prints.
	9-Oct-17	Spring dry							Very boggy in area, no large pool observed. Large boggy area with the only pooling in cattle hoof depressions. Unable to get a large enough pool to take reliable parameters.
	3-Jul-18	Spring dry. Vegetation healthy.							Dry Spring, vegetation healthy
	8-Jan-19	Spring dry. Vegetation healthy.							Dry
	18-Jul-19	Spring dry. Vegetation healthy.							Dry Spring, vegetation healthy though overgrown
	16-Dec-19	Spring dry. Vegetation healthy.							Tall vegetation. No damp ground observed.
	6-Nov-20	Spring dry. Vegetation healthy.							Thicker vegetation. Sign reads Spring 1.
	17-Jun-21	Spring dry. Vegetation healthy.							Vegetation healthy. Sign reads Spring 1.

Spring Number	Date	Electrical Conductivity	pH	Redox Potential	Dissolved Oxygen	Temperature	TDS*	Flow rate (m3/day)	Observations
		µS/cm		mV	mg/L	°C	mg/L		
	20-Dec-21	Spring dry. Vegetation healthy.							Vegetation healthy. Sign reads Spring 1.
	17-Jun-22	Spring dry. Vegetation healthy.							Vegetation healthy. Sign reads Spring 1.
	21-Dec-22	Spring dry. Vegetation healthy.							Vegetation healthy. Confirmed with Holcim that all signs has been fixed
	15-Jan-24	Spring dry. Vegetation healthy.							Spring dry, wet ground, water present on upper bank
	12-Dec-24	Spring dry							Location dry, but areas of healthy vegetation observed. Holcim indicates this location was historically wet but has remained largely dry for at least four years
	4-Oct-01	574	7.65	174	**	16.5	373		
	21-Nov-01	477	7.19	135	6.39	20.9	310		
	17-Dec-01	638	7.04	195	3.22	21.5	415		
	22-Feb-02	701	7.41	170	2.17	24.3	456		
	30-Jan-03	720	8.01	103	5.75	17.0	468		
	27-Jun-03	785	6.54	234	5.86	10.5	510		
	21-Jul-04	463	8.01	315	**	11.7	301		
	12-Mar-09	No flow							Dry, some subsurface flow assumed
	25-Jun-10	660	7.07	-	-	-	429		
	28-Mar-12	No flow							
	25-Jun-13	388	7.12	51.9	5.30	16.6	252		
	15-May-14	527	7.58	-40.5	13.00	13.6	343		No measurable flow, stagnant
	26-Feb-16	846	6.98	143.0	3.86	22.2	550		Pool of water, 10x5m, duckweed, water clear to moderate turbidity
	18-Jan-17	457	8.29	58	8.70	25.4	297		Pool of water, 10 x 5 m, with duckweed.
	9-Oct-17	Not able to be accessed							
SP06	3-Jul-18	543	7.32	222	8.52	9.8	353		Stagnate water, very boggy and pool approx. 15-20m2 and 0.5 deepest point.
	8-Jan-19	592	8.1	38.7	10.62	22.3	385		Brown, no odour, low-medium turbidity
	18-Jul-19	417.9	7.68	36.1	9.01	9.4	272		Brown, no odour, low turbidity, boggy
	16-Dec-19	437.5	7.88	49.3	7.64	17.5	284		Standing water. Livestock pugging evident.
	6-Nov-20	386	7.67	18.3	-	15	251		Standing water. Livestock pugging evident.
	17-Jun-21	512	7.42	-34.4	4.88	9.5	333		Water light brown. Cows entering water.
	20-Dec-21	668	7.85	-25.3	1.51	16.3	434		Brown water, medium turbidity. No outflow.
	17-Jun-22	444	8.22	-16.6	11.53	12	288		Brown, medium turbidity. Cattle pugging evident. No outflow visible.
	21-Dec-22	474.8	7.52	-67.8	3.7	21.3	309		Light brown, medium turbidity, healthy veg. Standing water with audible slope flow beneath spring, not visible through vegetation.
	15-Jan-24	397	6.55	185.7	3.35	23.5	258.05		Heavily vegetated, ground below spring saturated
	12-Dec-24	493	7.69	41.3	96.40%	20.9	320.45		Spring not fenced. Accessible by livestock. Landowner has historically damned the spring. Potential seepage through dam wall into local gully. Wet ground upslope of spring, lush vegetation below spring. Turbid/ murky water. Water level lower than that recorded in January 2024
	4-Oct-01	758	7.74	166	**	15.4	493		
	21-Nov-01	406	7.05	110	7.03	21.1	264		
	12-Jun-02	627	7.04	218	3.45	13.2	408		
	12-Mar-09	No flow							Dry, some subsurface flow assumed
	25-Jun-10	493	6.14	-	-	-	320		Significant pooling in valley floor
	28-Mar-12	831	***	-	-	16.4	540		
	25-Jun-13	251	7.56	98.9	10.55	14.6	163		
	15-May-14	No flow							No flow, very shallow/small ponds, parameters not possible
	26-Feb-16	Dry							
	18-Jan-17	Dry							
SP07	9-Oct-17	Not able to be accessed							
	3-Jul-18	Not able to be accessed							
	8-Jan-19	Not able to be accessed							-
	18-Jul-19	Dry							Dry and no sign of water in valley going towards dam. Large amounts of blackberry plants and some dumped rubbish in valley.
	16-Dec-19	Dry / Not identified							No damp ground observed.
	6-Nov-20	Dry / Not identified							Damp patches. No spring positively identified.
	17-Jun-21	Unable to be accessed.							
	20-Dec-21	Dry / Not identified							
	17-Jun-22	Dry / Not identified							
	21-Dec-22	Reclassified as seep							
	12-Dec-24	No access							
	21-Nov-01	1748	7.12	118	4.60	17.9	1136		
	17-Dec-01	642	7.11	194	2.95	19.2	417		
	22-Feb-02	611	7.81	131	7.83	25.2	397		
	12-Jun-02	731	7.36	201	3.61	12.6	475		
	30-Jan-03	880	7.60	122	4.76	18.4	572		
	27-Jun-03	1103	6.73	232	6.98	9.6	717		
	21-Jul-04	572	8.02	323	**	11.7	372		
	12-Mar-09	No flow							Dry, no indication of recent flow
	25-Jun-10	No flow							No flow
	28-Mar-12	706	***	-	-	16.4	459		
	25-Jun-13	457	7.57	100.3	10.42	14.6	297		
	15-May-14	606	7.88	32	13	13	394		No measurable flow, stagnant. Cattle prints evident
	26-Feb-16	1369	6.29	116	4.7	22.1	890		Hoof indentations, area marshy.
	18-Jan-17	675	7.82	64	6.16	25.4			Water pooling in dozens of small locations, with minor flow in parts.
	9-Oct-17	Not able to be accessed							
	3-Jul-18	504	6.62	222	5.76	8.6	328		Large wetland with alot of reeds, clear/orange tinge, water, no odour and suspended solids.
	8-Jan-19	1103	7.79	86.2	6.98	21.7	717		Overgrown, brown/clear, no odour, low-medium turbidity
SP08	18-Jul-19	396.4	7.36	42.1	8.31	10.3	258		Reeds, no odour, low turbidity, clear
	16-Dec-19	631	7.94	46.9	9.61	16.9	410		Standing water in pond. Low flow down slope. Oxidised iron apparent in stream.
	6-Nov-20	655	7.51	-54.7	-	14	426	8.6	Flowing approx 0.1-0.2L/s. Standing water.
	17-Jun-21	692	7.64	-106.3	3.8	6.9	450		Water clear and flowing. Cattle entry to stream evident.
	20-Dec-21	612.5	8.02	60.8	7.75	14.2	398	26.0	Extensive cattle pugging in former channel. Parameters measured over fence in riding club grounds where flowing water (200-300 mL/s) was present
	17-Jun-22	612	8.14	16.4	9.45	12.3	398	9.0	Measured in riding club grounds. Water flowing diffusely, unable to gauge accurately. 100-200 mL/s estimated.
	21-Dec-22	640	8.21	41.5	8.22	14.7	416	9.0	1L/10sec, consistent flow. Healthy vegetation. Recommendation to install means of measuring flow such as v-notch or elevated pipe.

Spring Number	Date	Electrical Conductivity	pH	Redox Potential	Dissolved Oxygen	Temperature	TDS*	Flow rate (m3/day)	Observations
		µS/cm		mV	mg/L	°C	mg/L		
	15-Jan-24	431	6.92	177.5	8.22	14.7	280	13.0	Healthy vegetation, medium turbidity.
	12-Dec-24	596	7.95	44.8	87.30%	20.3	387	7.9	Located on private property. Lush vegetation, including reeds surrounding large pool of water. Flow rate measured from small culvert where spring overflows. Holcim indicates that water level in spring remains reasonably consistent over time but flow rates in drainage line respond to rainfall events.
	22-Feb-02	229	6.90	198	6.90	23.3	149		
	12-Jun-02	Could not find any signs of flow, ground wet in this area.							
	30-Jan-03	Could not find any signs of flow, area green.							
	27-Jun-03	759	6.40	142	8.23	10.6	493		
	21-Jul-04	909	7.04	254	4.52	8.9	591		
	12-Mar-09	No flow							Dry, subsurface flow assumed
	25-Jun-10	550	6.66	-	-		358		Low to moderate flow with ponding below at the break of slope, parameters from discharge zone
	28-Mar-12	676	***	-	-	20	439		
	25-Jun-13	899	8.56	133.7	10.06	15.9	584		
	15-May-14	1053	6.68	-40	1.7	15.4	684		Very low flow, doesn't now appear to be a spring
	26-Feb-16	1798	6.40	-22	0.26	22.2	1169		Measurement collected at large pond with reeds, clear. Unlikely that the pond is reflective of seepage only. Will be collecting rainfall and run off also.
	18-Jan-17	860	8.36	65	12.23	22.2	559		Large pond. Spring area cannot be observed.
SP09	9-Oct-17	1185	7.33	85	4.44	16.4	770		Former spring 9 is now a small wetland. Wetland full with water. Highest water level observed in the area. Vegetation very healthy and wildlife.
	3-Jul-18	1169	5.16	199	6.47	10.8	760		Small wetland full of water. Vegetation very healthy due to large amount of water
	8-Jan-19	1163	7.63	86.7	6.58	21.5	756		Black/clear, no odour, low-medium turbidity
	18-Jul-19	780	7.53	-8.8	10.24	9.4	507		Large pond, cloudy/grey no-odour, low turbidity
	16-Dec-19	1231	7.59	-2	6.81	18.4	800		Wetland. Reeds and other vegetation healthy.
	6-Nov-20	556	6.96	-2	8.26	14.2	361		Vegetated wetland. Standing water. Sign reads Spring 10
	17-Jun-21	675	7.53	59.7	13.74	8.1	439		Wetland.
	20-Dec-21	957	7.8	55.9	6.32	18.2	622		Wetland.
	17-Jun-22	770	7.72	-119.3	2.33	11.2	501	26.0	Wetland. Reeds and other vegetation healthy. Outflow at pipe measured at 0.311 L/s. Signed has been replaced to read Spring 9
	21-Dec-22	776	8.03	-18	2.67	17.3	504	1.2	2.5L/3min. Thick veg, clear water
	15-Jan-24	457	7.06	205.3	1.28	20.46	297	21.6	Healthy vegetation, many frogs
	12-Dec-24	924	6.89	33.8	45.20%	18.5	601	-	Spring located on Holcim land. No access for livestock. Large spring, heavily vegetated. Trickle of water only in overflow/ discharge pipe. Insufficient to accurately measure flows. Holcim indicates area is always wet.
	19-Apr-02	2819	6.15	260	9.52	17.4	1832		
	12-Jun-02	2640	6.80	230	7.20	10.6	1716		
	30-Jan-03	2292	7.43	43	6.15	24.6	1490		
	27-Jun-03	1167	6.52	137	8.63	10.6	759		
	21-Jul-04	374	7.71	282	9.13	9.2	243		
	12-Mar-09	No flow							Spring dry, sample taken from dam fed by spring
	25-Jun-10	790	7.03	-	-	-	514		Low flow, parameters from discharge pooling in cattle hoof impression
	28-Mar-12	1207	***	-	-	19.8	785		
	25-Jun-13	578	7.37	29.8	6.99	11.3	376		
	15-May-14	Spring dry							
	26-Feb-16	1616	6.34	73	8.48	19.7	1050		Hoof indentations with water pooling in them- about 5cm deep, water clear.
	18-Jan-17	Spring dry							Dry- spring area cannot be observed.
SP10	9-Oct-17	Water as per SP09							Boggy area that feeds the wetland at the location of former Spring 9. Vegetation healthy and very wet and boggy. No parameters taken and water only pooled in small amounts and the same water feeds spring 9 wetland.
	3-Jul-18	No parameters could be taken.							Boggy area that feeds the wetland at the location of former Spring 9. Vegetation healthy and very wet and boggy. No parameters taken and water only pooled in small amounts and the same water feeds spring 9 wetland
	8-Jan-19	Spring dry							Dry
	18-Jul-19	Spring dry							Dry. Vegetation healthy
	16-Dec-19	Spring dry							Damp seep in embankment.
	6-Nov-20	Spring dry							Damp seep in embankment.
	17-Jun-21	Spring dry							Damp seep in embankment.
	20-Dec-21	Spring dry							Damp seep in embankment.
	17-Jun-22	Spring dry							Damp seep in embankment.
	21-Dec-22	Spring dry							Damp seep in embankment. Reclassified as seep.
	21-Dec-22	Spring dry							Damp seep in embankment. Reclassified as seep.
	12-Dec-24	Spring dry							Minor seepage identified adjacent gate.
	15-Jan-24	-	-	-	-	-	-		Insufficient water to allow parameters to be taken
SP11	12-Dec-24	-	-	-	-	-	-		Identified in 2023 by landholder as a wet patch and lush vegetation in an otherwise dry area. Insufficient water to sample Not fenced. Damp/ soft ground. Water pooling where disturbed by livestock.
Max		4320	5789879	323	14	25	2808		
Min		229	5	-430	0	7	149		

* TDS estimated by electrical conductivity x 0.65
**Dissolved Oxygen not recorded as probe malfunctioning
***pH readings not reported due to probe error

Spring Flow Summary (compiled by GHD from various published sources)

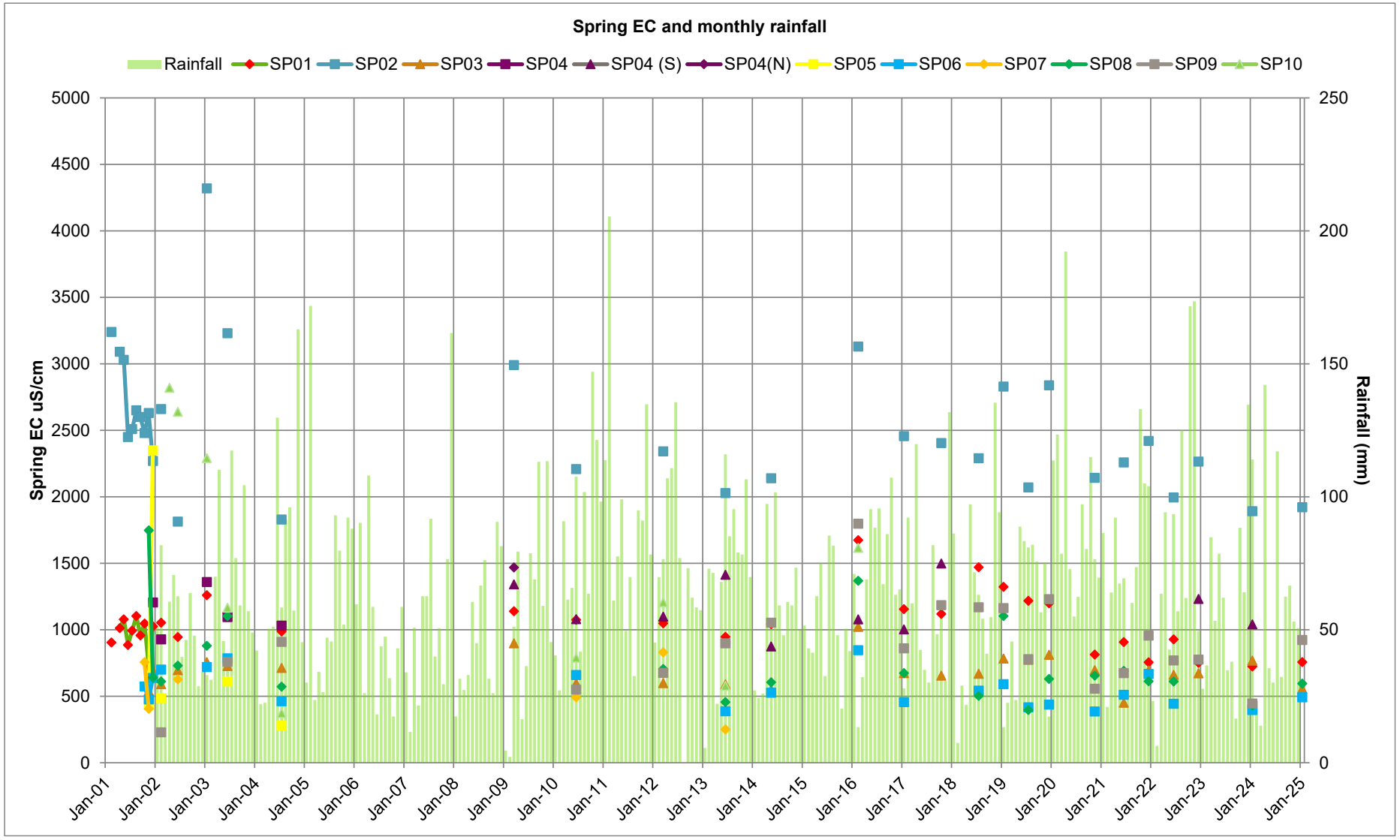
Spring ID	RL mAHD estimate(1)	Location relative to the quarry	Approximate Distance from quarry face (m)	Flow data	Estimated flow /level observations																				min	max
					Dec-01	Mar-09	Jun-10	Mar-12	Jun-13	May-14	Feb-16	Jan-17	Oct-17	Jul-18	Jan-19	Jul-19	Dec-19	Nov-20	Jun-21	Dec-21	Jun-22	Dec-22	Jan-24	Dec-24	minimum flow (L/min)	maximum flow (L/min)
Relative Climate note						dry	wet	wet	wet	dry	ave/wet	dry	dry	dry	dry	dry	dry	wet	wet	wet	wet	wet	wet	dry		
SP01	150	West	240	Recorded	250ml/10 sec	1.2 L/min	3 L/min	? No obs comments	? No obs comments	moderate flow	4L/sec	discharge	250ml/10 sec	250ml/4 sec	? No flow comments	moderate flow into tank	flowing water in bin	flowing water in bin	flowing water in bin	100 ml/sec	113 ml/sec	10l/45 sec	water flowing into bin	water flowing into bin		
				L/min	1.5	1.2	3			?	240	?	1.5	3.75		?	?	?	?	6	6.8	13.3	7.2	3.3	1.2	240
				Water Level (m AHD)																				155.438		
SP02	155	Southwest	220	Recorded	100ml/30sec	Low flow	low flow	? No obs comments	? No obs comments	No flow	strong flow	Large pond	no flow but deep pond	250ml/3 sec	? No flow comments	No flow	No visible flow	standing water	Flow on slope above, no overflow observed.	Standing water. No flow observed.	27 ml/sec	5L/171 sec	Audible flow				
				L/min	0.2 L/min	?	?			0				5	sampling error	sampling error	sampling error	sampling error	sampling error	sampling error	1.6	1.7	10.5	0.9	0	10.5
				Water Level (m AHD)																				145.471		
SP03	165	West	220	Recorded	irregular flow, no estimate of flow could be made	low flow				low flow	large pool spilling down slope	Large pool, no flow observed.	Large pool and boggy in area. Cattle trough full so no flow observed.	Large pool and boggy in area. Cattle trough full so no flow observed.	? No flow comments	? No flow comments	No flow	standing water, seeping down slope	some flow into bin	~100mL/sec	Sunken bin leading to only intermittent flow from spring. Unable to gauge	5L / 142 sec	Water flowing around bin	Flowing into bin		
				L/min	?	?				?	?	0	0	0			0	?	?	6	?	2.1	0.2	1.7	0	6
				Water Level (m AHD)																				160.337		
SP04	155	North	320	Recorded	100ml/90 sec	low to no flow	low flow	? No obs comments	? No obs comments	No measurable flow	small puddle of water	small puddle of water	shallow pool	Dry	Dry	Dry	damp seep observed	? No flow comments	no access	dry	dry	Audible flow on bank above spring but not visible through vegetation. No flow out of spring	Audible flow upslope	Trace moisture only		
				L/min	0.06	?	?			?	0	0	0	0	0	0	?							0	0	0.06
				Water Level (m AHD)																						
SP05	165	South	200	Recorded	No visible flow at surface. Damp patch of ground only	No obvious flow	no flow	no flow	not located	dry	dry	minor water pooling	large boggy area with the only pooling in cattle hoof depressions.	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry		
				L/min	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Water Level (m AHD)																						
SP06	170	North	350	Recorded	30ml/10 min	No flow. Dry, some subsurface flow assumed	? No obs comments	No flow (dry as no sample)	? No obs comments (but water sampled)	No measurable flow, stagnant	pool of water	pool of water	No access	stagnant water, pool	? No obs comments (but water sampled)	boggy	standing water	standing water	water	water, no ouflow	water, no ouflow visible	Standing water with audible slope flow beneath spring, not visible through vegetation.		Spring present but no flow		
				L/min	0.003	0		0		0	?	?		?		?				0	0	?		0	0	0.003
				Water Level (m AHD)																				165.517		
SP07	110	North	640	Recorded	No visible flow at surface. Damp patch of ground only	Dry	signifcant pool in valley floor			No flow	dry	dry				dry	Dry / Not identified	Dry / Not identified		Dry / Not identified	Dry / Not identified			No access		
				L/min	0	0				0	0	0				0	0	0		0	0				0	0
				Water Level (m AHD)																						
SP08	160	North	500	Recorded	Difficult to get flow rate as dam fed	dry	No flow	? No obs comments (but water sampled)	? No obs comments (but water sampled)	No measurable flow, stagnant. Cattle prints evident	? No obs comments (but water sampled)	Water pooling in dozens of small locations, with minor flow in parts.	no access	large wetland	overgrown	reeds	Standing water in pond. Low flow down slope	Flowing approx 0.1-0.2L/s. Standing water.	Standing water in pond. Low flow down slope	flowing water (200-300 mL/s)	. Water flowing diffusely, unable to gauge accurately. 100-200 mL/s estimated.	1L/10sec		Flowing in culvert		
				L/min	?	0	0			0	?	?	?	?	?		?	12	?	12 to 18	6 to 12	6	9	5.5	0	12
				Water Level (m AHD)																						
SP09	160	East	320	Recorded	Damp patch of ground, potentially caused by seepage from Donazzans Dam, No visible flow, damp pacth of ground only	Dry, subsurface flow assumed	Low to moderate flow with ponding below at the break of slope, parameters from discharge zone	? No obs comments (but water sampled)	? No obs comments (but water sampled)	Very low flow	Measurement at large pond with reeds	Large pond . Spring area cannot be observed	Former spring 9 is now a small wetland. Wetland full with water. Highest water level observed in the area	Small wetland full of water		Large pond	wetland	Vegetated wetland. Standing water	wetland	wetland	wetland, Flow at 0.311 L/sec	2.5 L/3min		Trickle of water ony		
				L/min	0	?	?			?		?	?								18.6	0.8		0	0	18.6
				Water Level (m AHD)																						
SP10	170	East	220	Recorded	Damp area of ground extends approximatley 5m and dicharges into Donazzans Dam	Spring dry	low flow				Hoof indentations with water pooling in them- about 5cm deep, water clear.	Dry	boggy only small pools (no sample could be taken)	boggy only small pools (no sample could be taken)	Spring dry	Spring dry	Spring dry	Spring dry	Spring dry	Spring dry	Spring dry	Spring dry		Seepage only		
				L/min	?		?					0	0	0										0	0	0
SP11		West																						Spring identifedi in 2023 Hoof indentations with water pooling in them	0	0
																							0	0		

Appendix G

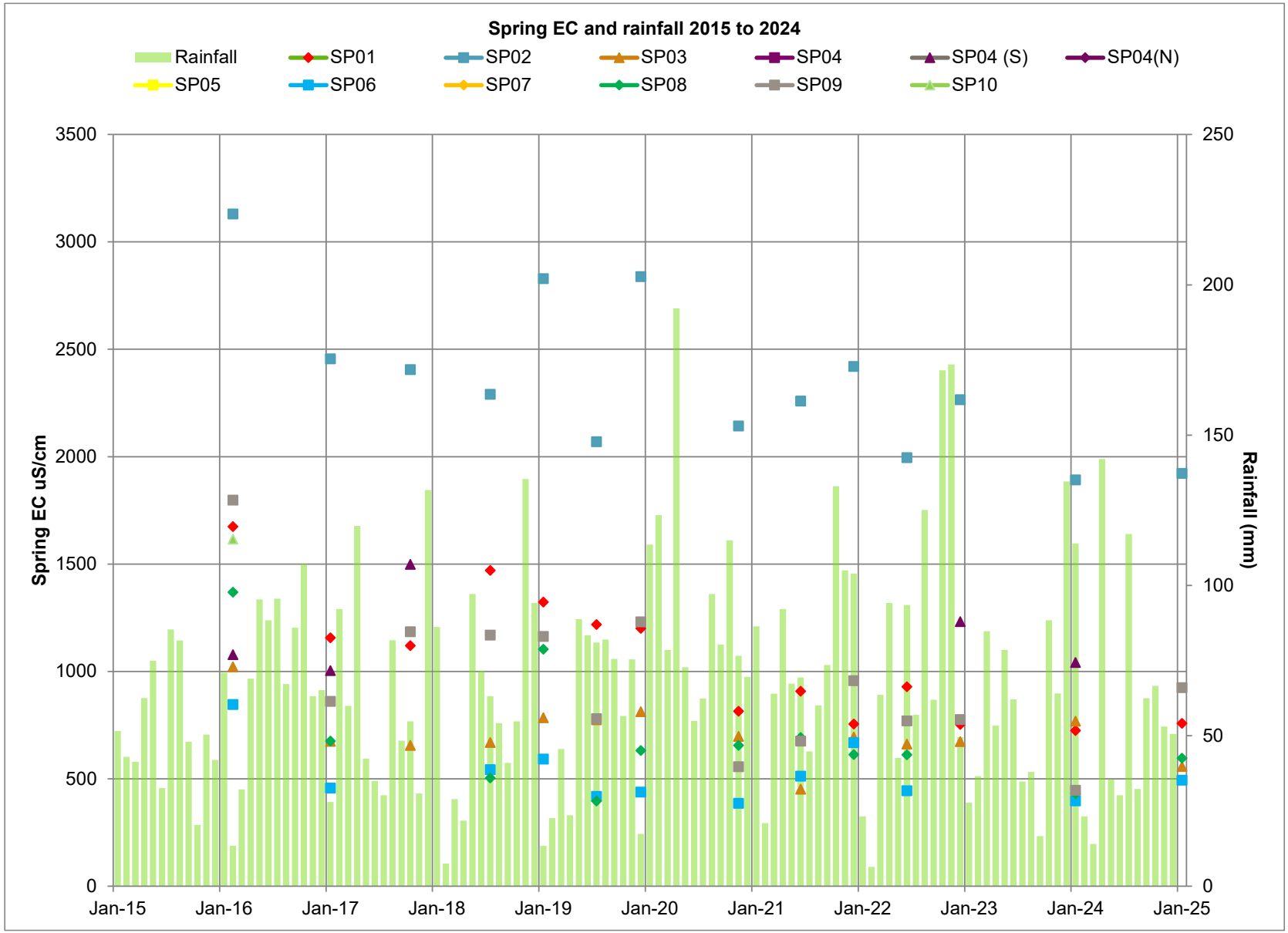
Mt Shamrock spring rainfall and EC

Spring EC and rainfall records

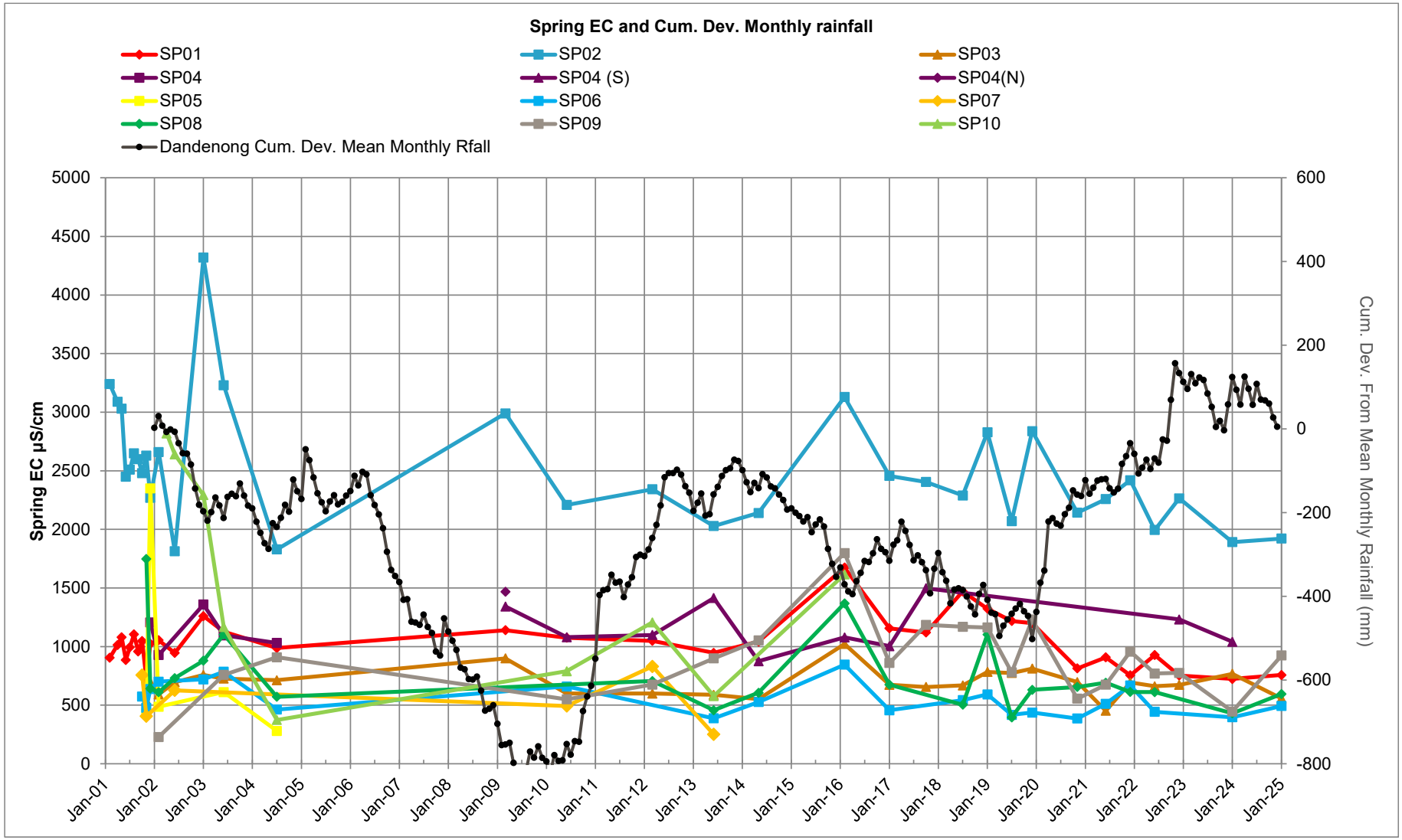
Spring EC and rainfall, 2002 - 2024



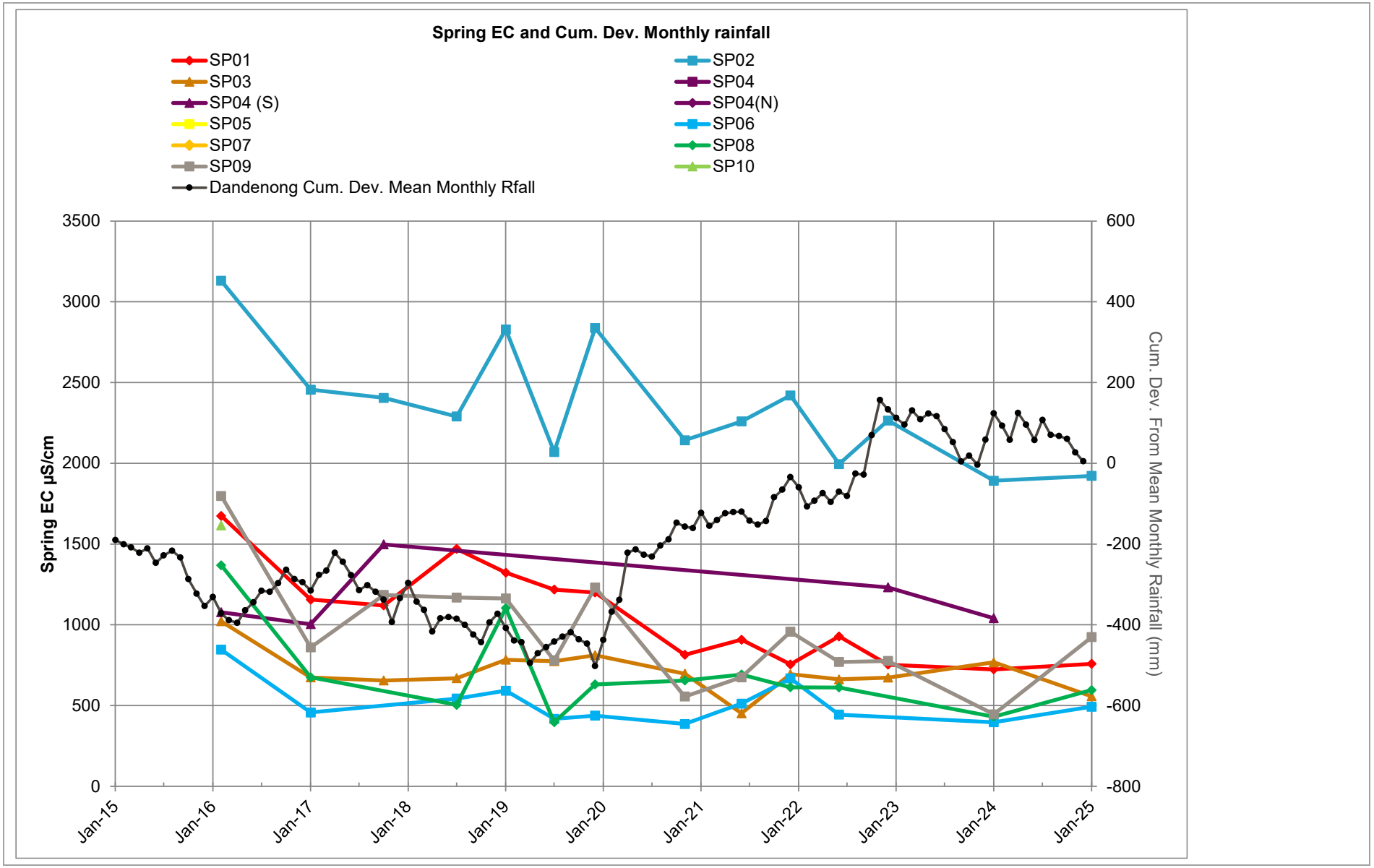
Spring EC and rainfall, 2015 - 2024



Spring EC and Cum. Dev. Monthly rainfall, 2002 - 2024



Spring EC and Cum. Dev. Monthly rainfall, 2015 - 2024


Spring EC and Cum. Dev. Monthly rainfall
SP01
SP02
SP03
SP04
SP04 (S)
SP04(N)
SP05
SP06
SP07
SP08
SP09
SP10
Dandenong Cum. Dev. Mean Monthly Rfall
Spring EC µS/cm
Cum. Dev. From Mean Monthly Rainfall (mm)
3500
3000
2500
2000
1500
1000
500
0
600
400
200
0
-200
-400
-600
-800
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25

Appendix H

Spring and monitoring bore photographic record, December 2024

December 2024 Spring photographic record

SP01

SP01 with bin in centre of spring

SP01. Flow meter reading of 262 m^3

SP01 – estimating spring flow rates at water tank

	
SP02	SP02
	
SP02	SP02. Flow meter reading of 10 m^3
	
SP03	SP03 – bin in spring. Small drainage is present to the right of the picture

	
SP03 – measuring flows	SP03 – small drainage slightly upslope of spring
	
SP04 – dry in December 2024	SP04 – dry in December 2024

	
SP06. Spring dammed by landholder	SP06. Spring dammed by landholder
	
SP08. Surrounded by reeds	SP08. Surrounded by reeds
	
SP08. Measuring flows	SP08. Measuring water height

	
SP09. Large spring in Holcim land	SP09. Large spring in Holcim land
	
SP10. Reclassified as a seep. Trace seepage in base of drainage line.	SP10. Reclassified as a seep. Trace seepage in base of drainage line.
	
New spring SP11 under fallen tree	New spring SP11. Pooled water where livestock have walked through

December 2024 monitoring bore photographic record

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Bore MB01 located at top of steep slope. Monument cover rocks slightly</td><td>Bore MB01 viewed from quarry access track</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Bores MB02 and MB04 on quarry floor</td><td>Bores MB03 and MB05. Long grass encroaching on bore location</td></tr>
<tr><td>  </td><td></td></tr>
<tr><td>Bore MB06. Steel casing is slightly rusted.</td><td></td></tr>
</table>

Appendix I

Tabulated dam water levels

Date	Northern Dam	Southern Dam	Difference
October 2020	173.2	165.2	8.0
February 2021	173.9	165.4	8.5
April 2021	172.6	164.5	8.1
June 2021	173.0	165.2	7.8
Sept 2021	173.1	165.0	8.1
Dec 2021	173.2	165.2	8.0
Apr 2022	172.2	165.0	7.2
July 2022	172.8	165.0	7.8
September 2022	173.2	165.1	8.2
December 2022	172.8	166.4	6.4
April 2023	172.7	165.7	7.0
June 2023	172.9	165.8	7.1
September 2023	172.7	165.8	7.0
October 2023	172.9	165.1	7.8
November 2023	172.7	164.9	7.7
December 2023	172.7	165.5	7.2
Max	173.9	166.4	8.5
Min	172.2	164.5	6.4
Average	172.9	165.3	7.6
Source: AECOM (2024)			

Month of Survey			
January 2024	172.8	165.9	J. Everitt
February 2024		165.6	J. Everitt
April 2024	172.2	165.7	Stegg Civil
May 2024	172.6	165.7	J. Everitt
June 2024	172.6	165.7	J. Everitt
July 2024	173.1	165.8	J. Everitt
August 2024	172.9	165.7	J. Everitt
September 2024	172.7	165.8	J. Everitt
October 2024	172.6	165.7	J. Everitt
November 2024	172.6	165.7	J. Everitt
December 2024	172.6	165.6	J. Everitt
Source: Holcim			

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