

PF Formation Pty Ltd

Groundwater Report: Old Telegraph Road Pit 4, Maroota Lot 2, DP 748820 Annual Groundwater Management Plan 2020-2021

Report E2W-0224 R003c (v3)

6 September 2021

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Client: PF Formation Pty Ltd

Project: Groundwater Report
Pit 4; Old Telegraph Road, Maroota, NSW
(Lot 2, DP 748820)
2020-2021 Annual Groundwater Management Plan

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1 INTRODUCTION

Earth2Water Pty Ltd (E2W) was engaged by PF Formation Pty Ltd (PFF) to provide the Groundwater Report (Maroota 2020-2021 Annual Groundwater Management Plan) for the property on Old Telegraph Road, Maroota (Lot 2, DP 748820), Maroota, NSW (Figure 1, known as Pit 4). The groundwater sampling and water level gauging of the three wells (PFPit4MW-1, PFPit4MW-2, PFPit4MW-3) was conducted by E2W (Dino Parisotto) in consultation with Melissa Mass (South East Environmental Pty Ltd) and Joshua Graham (PFF) on 14 July and 16 August 2021. The former Solinst data loggers (aged) at the three wells were decommissioned during 2017 to 2019 and supplemented with monthly water level gauging by Melissa Mass[1].

A new Solinst (SN 2122025) level logger installed at well (PFPit4MW-1, 17 August 2020) was downloaded on 14 July 2021 by E2W to continue recording the daily groundwater readings at Pit 4.

URS Australia Pty Ltd (URS) was previously retained by PFF to prepare the groundwater component of the report (up to 2013). PF Formation (PFF) is required under the Development Consent conditions set for the property located at Old Telegraph Road, Maroota, (Lot 2, DP 748820) to prepare an annual Environmental Management Plan (EMP) under the Approval. Condition 90 of development consent (342/1998/G) for the site requires an EMP which was revised in May 2021. The annual groundwater management plan is part of the 2020-2021 Annual Environmental Management Review for the site.

This groundwater report (2020-2021) prepared by E2W addresses the groundwater aspects of the sand extraction activities at the site. The following groundwater report for the year 2020 to 2021 incorporates the monitoring data collected for the previous owner of the site from 1999 to 2009.

2 GROUNDWATER MONITORING NETWORK

At the Pit 4 site, groundwater has been monitored in the Hawkesbury Sandstone aquifer since October 1997 by the previous owner in Bores VEL-MW1, VEL-MW2 and VEL-MW3. Bore VEL-MW2 has been renamed PFPIT4MW-2 and Bore VEL-MW3 has been renamed PFPIT4MW-3. In November 2005, Bore VEL-MW1 was replaced by Bore VEL-MW1A (re-named PFPIT4MW-1), due to the expansion of the quarry area. The location of the monitoring bores is presented in Figure 1. The inferred groundwater flow regime and hydrogeological section for the site is presented in Figures 2 & 3.

In January 1999, the bores were equipped with a Dataflow automatic datalogger, subsequently replaced in June 2006 by Solinst Level Loggers, model 3001, capable of recording up to 10,000 readings and which have a battery life of 10 years at the rate of one daily reading. The Solinst units measure the head of water above the sensor and temperature variations.

E2W attempted to download the 3 loggers on 18 July 2017, however the data was not collected due to the age of the loggers (>10 years). Two loggers at PFPit4MW-1 and PFPit4MW-3 have

[1] E2W installed a Solinst Level Logger at well (PFPit4MW-1) on 17 August 2020.

been decommissioned (2017/2018). The logger a PFPit4MW-2 was last operational in 2018, and unable to be downloaded on 30 July 2019.

Water levels from the three bores (PFPit4MW-1,2,3) have been measured monthly using an acoustic water level probe by Melissa Mass (SEE) to supplement the groundwater assessment for the site (Appendix D).

Field chemistry (EC, PH, T, DO, Redox) was measured using a calibrated field chemistry meter (YSI professional series, hired from AES Pty Ltd) by Melissa Mass on 16 August 2021. Refer to Table 2.

Between January 1999 and June 2009, groundwater quality was monitored only for field parameters, such as pH, EC, Temperature and Redox potential. The chemical parameters were plotted by URS on individual graphs to assess possible trends over time.

This groundwater monitoring event was conducted by SEE[2] (Melissa Mass, 16 August 2021), E2W (14 July 2021) and in consultation with PFF (Joshua Graham). Water samples were collected from the three bores and submitted for chemical analysis under Chain of Custody procedures to Australian Laboratory Services Pty Ltd. The laboratory reports are presented in Appendix B.

The analytical list, which was discussed and previously agreed upon with the DIPNR (now Water NSW), includes:

- pH, Electrical Conductivity, and Total Dissolved Solids;
- Calcium, Magnesium, Sodium, and Potassium;
- Chloride, Sulphate and Bicarbonate; and
- Oil and Grease.

Water level gauging was conducted using an acoustic water level probe, with field chemistry (pH, EC, DO, Eh, T) measurements conducted using a YSI professional series meter as part of the sampling on 16 August 2021. Additional groundwater level monthly measurements are available from July 2017 to July 2021 (Appendix D, and Table 2).

All historical water level data since November 1999 for Bores VEL-MW2 (now PFPIT4MW-2) and VEL-MW3 (now PFPIT4MW-3) have been combined (Appendix C, Figures 4 & 5 respectively, together with rainfall records by PFF/BOM Station No. 67014). For historical continuity, a hydrograph of Bore VEL-MW1 (abandoned) is included in Appendix C, Figure 2.

Surface water samples (creek) were also collected by Melissa Mass after significant rainfall at the Pit 4 creek (i.e. provided in separate documentation[3]).

3 GROUNDWATER DATA ASSESSMENT

The groundwater assessment for the site has been conducted by E2W in collaboration with PFF (Josh Graham) and Melissa Mass (South East Environmental Pty Ltd, SEE). The analytical

[2] Groundwater sample collection (pH, TDS, major ions, Oil & Grease) was undertaken at existing wells on 5 August 2020 by Melissa Mass of South East Environmental Pty Ltd

[3] Creek samples (quarterly) at Pit 4 were collected on; 23 September 2020, 14 December 2020, 23 March 2021 and 23 June 2021.

reports by ALS Environmental are presented in Appendix B, whilst the monthly water level measurements by SEE are included in Appendix D.

The hydrochemical diagrams (expanded Durov & piper trilinear) for the three bores (PFPIT4MW-1,2,3) are presented in Appendix E. The three bores tap into the sandstone aquifer and have a similar water type and hydrochemistry.

3.1 Groundwater Levels

Groundwater levels in the Hawkesbury Sandstone measured in the three monitoring bores indicates that water levels respond in a subdued manner to the rainfall recharge. The trend in late 2013 and 2014 indicate a slight deepening of the water table with a below average rainfall in 2013-2014. A slight rising of the water table occurs in the three bores (PFPIT4MW-1,2,3) with the higher rainfall period in 2014-2015 (1321 mm/year), followed by a slight deepening (0 to <1m variation) with the lower rainfall during 2015-2016 (1176 mm/year).

The high annual rainfall for 2016-2017 (957.4 mm/year), are followed by several low rainfall years (2017-2018 =473mm, 2018-2019=557.4 mm, and 2019-2020 =559 mm). The previous drought conditions caused a lowering of the groundwater levels, whilst the above annual rainfall for 2020-2021 (1264.4 mm) stabilised levels at around 169 mAHD.

Logger data from 1 bore (PFPit4MW-2) is available from 2017 to 2018 (excluding 2018-2019), whilst monthly water levels are available for the 3 bores from 2017 to 2021 (Figure G-4). Logger data is available for PFPit4MW-1 for the past year (2020-2021), whilst the available logger data for PFPit4MW-2 & MW3 (2013-2016) is included in Figures G-1, G-2 and G-3.

The inferred groundwater flow regime (16 August 2021) and hydrogeology is presented in Figures 2 and 3. The maximum extraction depth for the eastern (173.8 mAHD) and western pits (174 m AHD) are at similar elevations.

The east and west extraction pits are inferred to be at least 2m above the groundwater table (Figure 3). The water level at the nearby upgradient well (PFPitMW-1) is approximately 168.81 mAHD (July 2021), whilst the downgradient side is 152.87 mAHD (July 2021 @ PFPitMW-2, Appendix D) which relates to the lower downgradient elevations along the creek.

3.2 Bore PFPIT4MW-1

Since October 2010, the water level in this bore has been steadily rising due to the above average rainfall received in the area since that time (Figure G-1).

Rainfall for the year July 2013- June 2014 was 595.5 mm, whilst 1321.5 mm (June-July 2015) indicating an above average rainfall for year (Note: rainfall data are reported from the BOM weather station No. 67014 located on Old Telegraph Road). Approximately 422 mm of rainfall occurred in April 2015, which is reflected in the rising water levels from April to December 2015. The above average rainfall which occurred in March 2017 (276.8mm) is likely to have recharged the groundwater in a similar way to April 2015.

In June 2012 the water level in this bore rose to a level above the range of the datalogger pressure sensor and, as a result, no data are available for most of the year, with exception of the period December 2012 to February 2013. Since February 2013 to approximately November

2014, the water level decreased steadily to approximately 170.5 mAHD, and then rose steadily to June 2015 (172.5 mAHD) in June 2015 correlating with the higher rainfall period (2014-2015, especially in April 2015). The water levels during November and December 2015 reached 173 mAHD before decreasing steadily to ~171.4 mAHD in June 2016. The water levels relate to the elevated topography (i.e. 187 mAHD, Figure 3).

Water levels in the Hawkesbury Sandstone aquifer vary slightly with rainfall, with the greatest variations observed in Bore PFPIT4MW-1 (approximately 1.7 m over 12 months during 2015 and 2016). The water levels measured in August 2016, June and July 2017 indicate relatively stable levels during 2016 to 2017 (i.e. 171.14 mAHD to 171.01 mAHD).

The water levels show a consistent declining trend and range from 171.01 in June 2017 to 168.85 m AHD in August 2018. Water levels fluctuated slightly (168.57 to 169.21 m AHD) during from July 2018 to August 2019 period (Figure G-4, appendix D).

Slight water level fluctuations also occur during 2019 to 2020 and range from 168.2 to approximately 169 mAHD. The water level on 22 July 2020 was calculated at 168.74 mAHD, whilst on 22 July 2021 was 168.81 mAHD. Water levels during 2020 to 2021 continued to be relatively stable with minor variation (i.e. approximately 169 mAHD).

3.3 Bore PFPIT4MW-2

The water level in this bore has risen to the highest level (153.6 m AHD) in March 2012, after which time it rose and declined in response to the rainfall following similar patterns over the Maroota area. The water levels have been relatively stable since 2013-2014 (approximately 153 mAHD in August 2014) with only minor fluctuations (<0.5m) over the 2014-2015 (~153.2 mAHD in June 2015) and 2015-2016 monitoring periods (~153 m AHD in June 2016, Figure G-2). The groundwater levels are lower at the downgradient area (PFPit4MW-2) due to lower steep slopes near the creek (i.e. 158.7 m AHD, Figure 1).

The groundwater level is measured at 152.41 m AHD on 30 July 2019, and 152.55 mAHD on 22 July 2020. The recent levels are similar to the previous water table elevations (i.e. 153.25 m AHD = 18 July 2017, 14 August 2016 =153.24 m AHD).

The groundwater level declines over the year and ranges from approximately 153.2 mAHD in July 2017 to 152.17 m AHD in August 2018. Water levels fluctuate slightly during 2018 to 2019 (152.02 to 152.47 m AHD), and during 2020 (151.8 to 152.9 mAHD).

The water levels during July 2019, July 2020 and July 2021 are relatively similar (i.e. 152.26 mAHD =30 July 2019, and 152.55 mAHD = 22 July 2020, and 22 July 2021= 152.87 mAHD), with a slight inclining trend over the past 6 months. Refer to Figure G-4 and appendix D.

3.4 Bore PFPIT4MW-3

Bore PFPIT4MW-3 is in a remote area from the quarry area and, therefore, considered to be substantially unaffected by the current sand extraction operations. The bore was installed in October 1997, but not equipped with a datalogger until November 1999 (Appendix C, Figure 6 & 7). From October 1997, the water level at this site has been rising steadily by approximately 4 m to August 2008 (URS, 2013).

The sudden drop in the water level visible at this site is the result of cleaning work carried out in this bore to remove fine rootlets which entered the bore through the screened section. The following data show the slow recovery of the watertable after those operations. After a period of relative stability, the water level has, since November 2010, risen to 171.3 m in March 2012, followed by a slight fall and levelling out.

The water level falls slightly (erratic fashion) during 2013-2014 (approximately 171.5 mAHD in August 2014) which is like previous years (Figure G-3).

During 2014-2015 the water levels show sharp (less than 1m) responses to rainfall and drainage, with water level rising over past 6 months due to the above average rainfall (approximately 170.9 mAHD in June 2015). Water levels decline and rise in an erratic fashion (+/- 1m) following June 2015 to June 2016 (approximately 160.9 mAHD in June 2016). The hydraulics of the sandstone outcrop (& iron hydrochemistry/clogging) is interpreted to affect the logger responses (logger is stained with iron indicating some well screen clogging).

The changes in water levels over time is interpreted to reflect rainfall recharge in the fractured sandstone (sandstone outcrop visible at surface).

The groundwater level is calculated at 170.85 mAHD on 18 July 2017, and slightly higher relative to August 2016 (170.59 mAHD). The groundwater level is at 170.88 mAHD in June 2017 and varies slightly (maximum of 0.3m) during the 2017-2018 period (March 2018= 170.62 mAHD and 170.8 mAHD in August 2018).

Water levels fluctuate slightly from July 2018 to July 2019 (170.8 to 171.52 m AHD) and show a slight rise (<1 m) from July 2019 to July 2020. The water level was at 171.20 mAHD on 30 July 2019 which is similar to levels (171.51 mAHD) measured on 22 July 2020 (Figure G-4, and Appendix D). The groundwater levels have increased gradually since early 2020 to mid 2021. The groundwater level was measured at 172.05 mAHD on 22 July 2021.

3.5 Production Extraction Bore (Pit 4 bore)

The location of the production bore (Lic No. 10BL161390, Approval No.10WA109441) is illustrated in Figure 1. No pumping occurred during the 2016-2017 monitoring period (allocation is 30 ML). During the 2015-2016 period, groundwater extraction occurred and totalled 5.074 ML. Minimal pumping of Pit 4 bore occurred during 2017-2018 (0.472 ML) and during 2018-2019 reporting period (i.e. 0.487 ML, Appendix E).

No pumping of Pit 4 occurred during the 2019 -2020 and 2020-2021 monitoring periods. All previous amounts extracted are below the 30 ML allocation over the 12 month period.

3.6 Groundwater Quality

Analytical laboratory results for the three wells (PFPIT4MW-1,2,3) are summarised in Tables 3.1, 3.2 & 3.3, and presented in the multi-parameter time series graphs (Graphs 1, 2 & 3). The laboratory reports for 16 August 2021 are presented in Appendix B.

The groundwater in all bores is fresh, with a characteristic rainfall composition, low (slightly acidic) pH and low TDS. Water is of a Sodium-Chloride type and shows consistency over a full seasonal cycle.

The three groundwater samples were also analysed for Oil & Grease to monitor the possible effect of the sand extraction operations. Water samples from PFPIT4MW-1,2 & 3 reported an absence of Oil & Grease (O&G) on 16 August 2021.

Overall, the quality of the groundwater at this site has remained constant, with only minor fluctuations as expected from a dynamic groundwater system.

3.7 Quality Control

The laboratory quality control samples (laboratory duplicates, procedure blanks and control spikes) returned results within the required limits and acceptance criteria. The quality control data generated by the laboratory are presented with the laboratory certificates in Appendix B.

Based on the evaluation of the data, it is assessed that the accuracy and precision of the analytical data generated in the sampling round, as reported by the analytical laboratory, are acceptable as a basis for interpretation.

It is noted that PH analyses (laboratory) has exceeded the prescribed short holding time (few hours, ALS report in Appendix B), however this is considered impractical to achieve (samples were delivered to the laboratory on the same day as sample collection and is considered satisfactory). The PH was also measured in the field by Melissa Mass (SEE) using a calibrated multi-parameter meter (YSI professional series) on 16 August 2021 to supplement the laboratory results (Table 2).

4 CONCLUSIONS

An assessment of the groundwater data collected at the Old Telegraph Road, Maroota (Pit 4) from 1997 to August 2021, indicate that:

- Water levels in the Hawkesbury Sandstone aquifer vary slightly with rainfall. Water levels have fluctuated slightly in the three bores (PFPIT4MW-1, PFPIT4MW-2 and PFPIT4MW-3) which relate to several years of dry rainfall (i.e. 2018-2019 =557.4 mm, 2019-2020=559 mm), and above average annual rainfall during 2020-2021 (1264.4 mm).
- Water quality in the aquifer has shown to be consistent over a full seasonal cycle and since the start of monitoring.
- Groundwater was not extracted from the Pit 4 production bore (Lic No. 10BL161390, Approval No.10WA109441) during the reporting period (2020-2021). The production bore has a 30 ML/year license condition.
- The inferred maximum extraction depth of the eastern and western extraction pits (~RL=174 mAHD) is at least 2m above the groundwater table which is approximately 168.81 mAHD at PFPit4MW-1 (upgradient well, 22 July 2021), and 152.87 mAHD at PFPitMW-2 (downgradient well).
- Current sand extraction activities at the Pit 4 area do not appear to have any adverse impact upon the groundwater sustainability and meet the Development Consent Conditions.

The data collected during the year are available to the Water NSW for their continued study in the area

FIGURES

earth2water Pty Ltd
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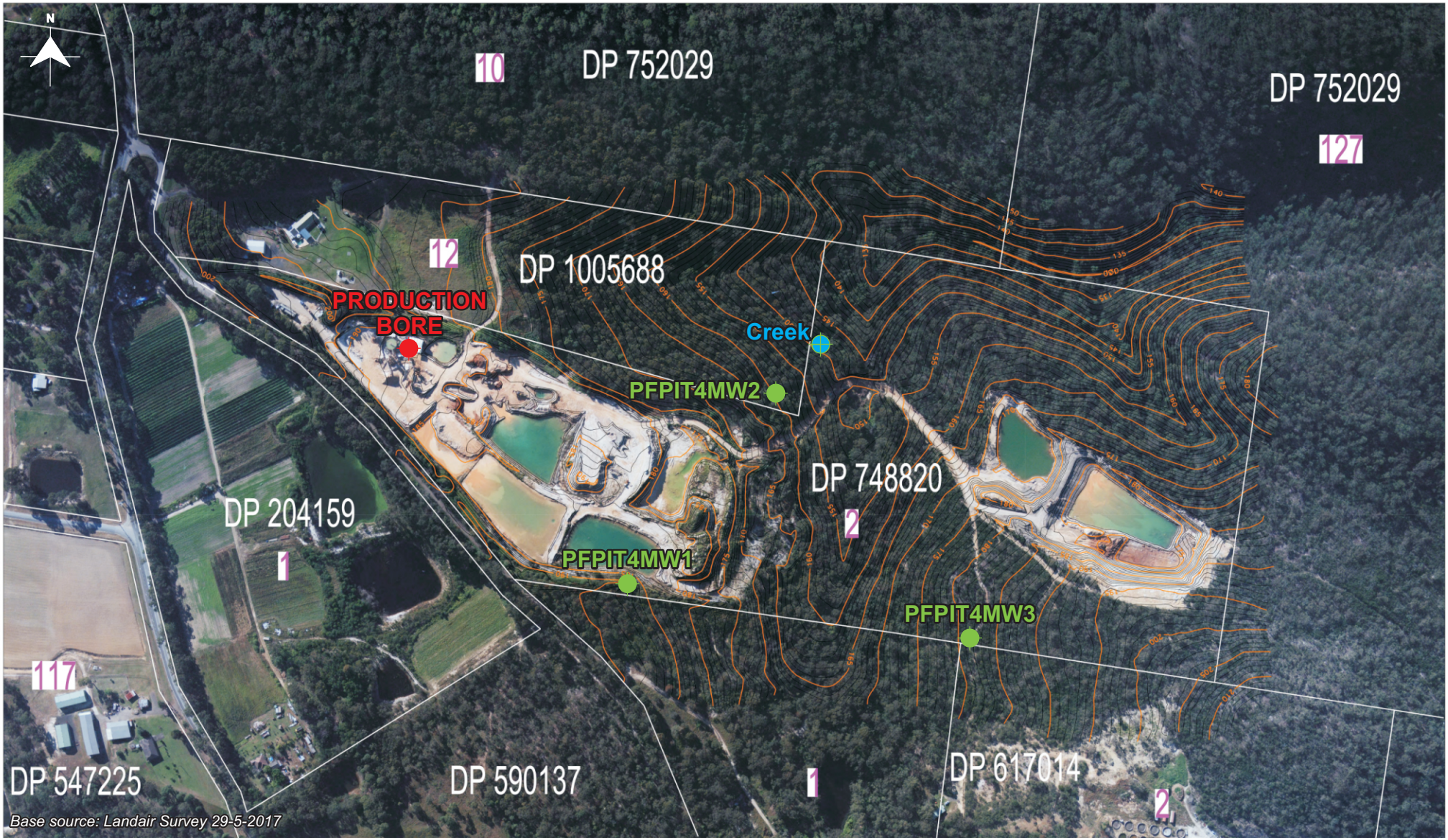

0 100 200
Scale (metres)

Site Layout & Well Locations (2021)

Date: *30 Aug 2021*

Reference: *E2W_224_18.cdr*

PF FORMATION -Old Telegraph Rd, Maroota (Pit 4 Site)

Figure 1

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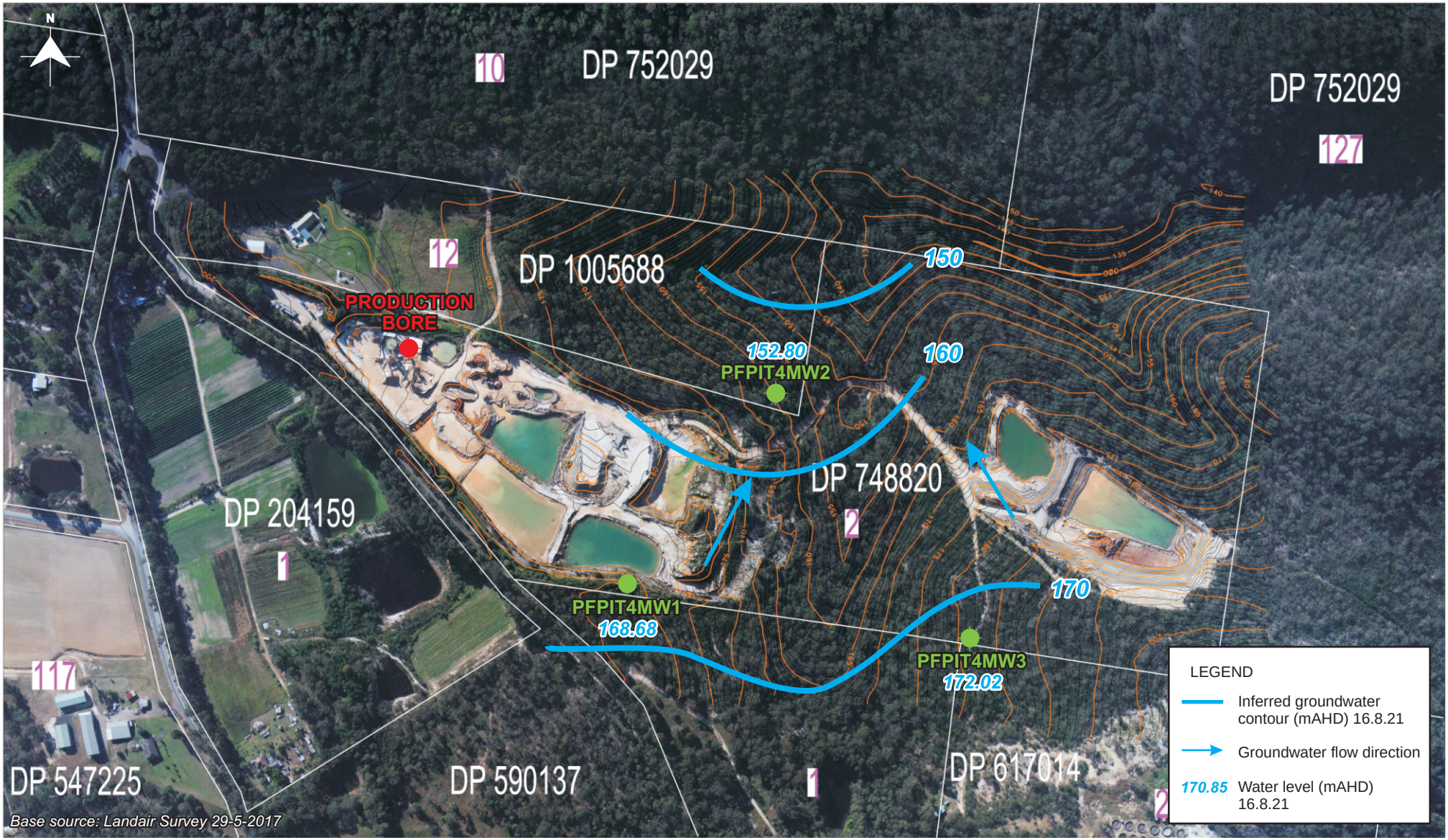

0 100 200
Scale (metres)

Inferred Groundwater Flow Regime (2021)

Date: *August 2021*

Reference: *E2W_224_20.cdr*

PF FORMATION - Old Telegraph Rd, Maroota (Pit 4)

Figure 2

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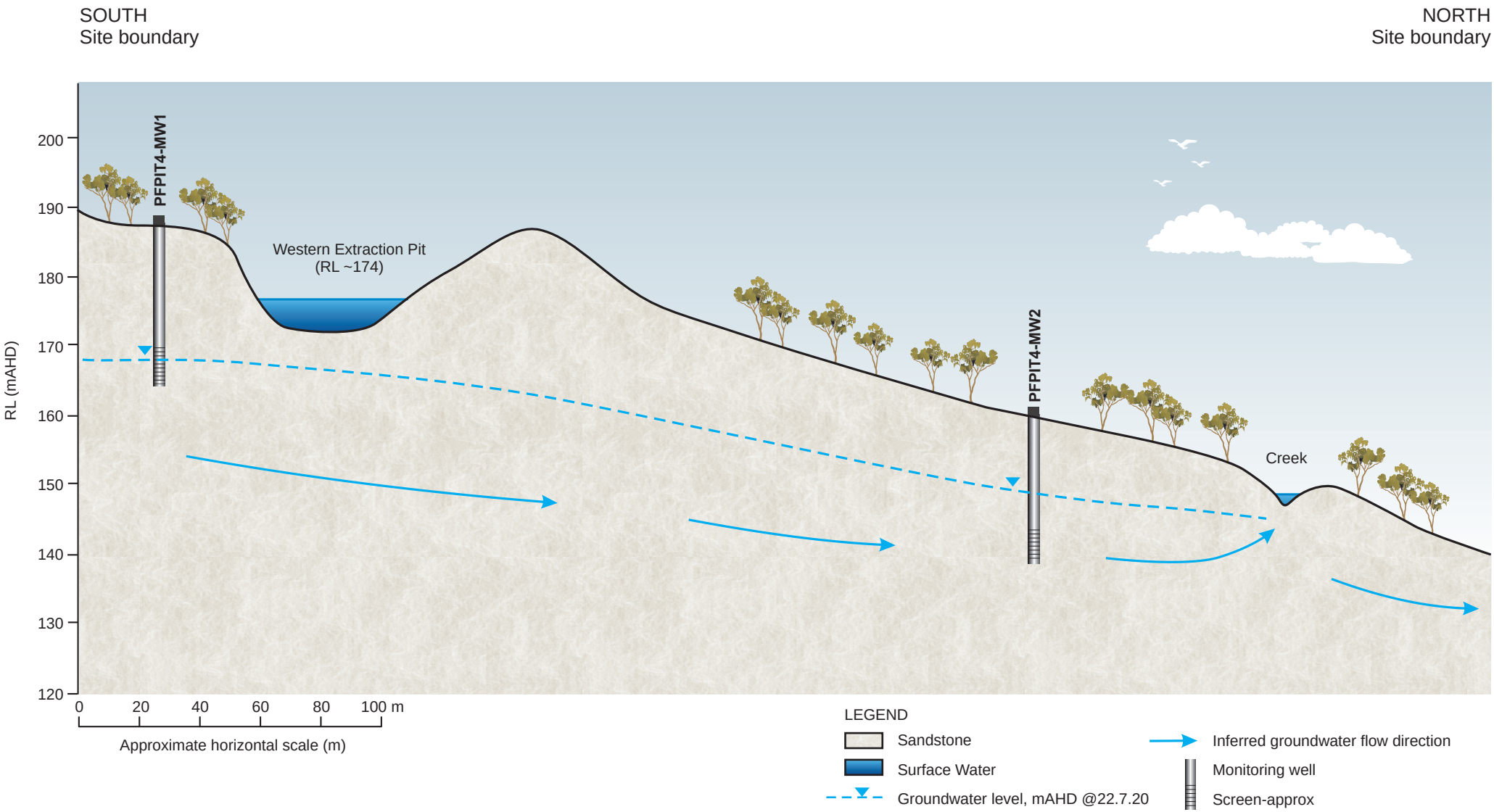

PIT 4 - INFERRED HYDROGEOLOGICAL SECTION (N-S, 2021)

Date: *30 August 2021*

Reference: *E2W_224_19.cdr*

MAROOTA - Old Telegraph Rd (Pit 4)

Figure 3