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16th December 2018
REF: 18152-A

SUBJECT: REVIEW OF TWO WRITTEN RESPONSES RE POTENTIAL GROUNDWATER IMPACTS FROM 'ARDMORE PARK' QUARRY - LOT 24 IN DP1001312

It is understood that written responses were recently received by the Department of Planning and Environment from two property owners peripheral to 'Ardmore Park'. Details of the responses are summarised in **Table 1**.

Table 1
Summary of Responses

Property Details	**Response**
Lot 2 DP1095479 590 Inverary Road Bungonia (**see Figure 1**)	• Lot 2 has one licensed 'stock & domestic' bore: 10WA115089 • The owner is concerned about the potential impact from the 'Ardmore Park' quarry on groundwater supply. • The owner is aware of a drop in (water levels) in several neighbouring bores. • Measurements of water levels in the property bore dating back to 2003 show a drop of over a metre. • A natural spring has almost dried up, for the first time on record. • Nine water level measurements are provided between May 2003 and November 2018 with a total recorded drop of 1.06 m. • The owner opposes any suggestion that the quarry should be allowed to increase the production of water from its groundwater bore.

Lot 5 DP865000 5025 Oallen Ford Road Bungonia (**see Figure 1**)	• Lot 2 has one licensed 'stock & domestic' bore: 10WA115255 • The owner notes that the water level in the bore was at ground level when completed in 2003. • A steady decline in the water level reportedly commenced when the production bore on 'Ardmore Park' was pump tested in 2004 with a recorded fall of 1m. • A further drop of 1 m was recorded in 2007. • The bore has not been used since 2008. The water level has been measured on a monthly basis since 2008 and recorded a steady decline to a level in December 2017 of 4 m below ground level. • A further drop in water level to 4.8 m below ground was noted in mid-2018 about the time when sand extraction commenced on 'Ardmore Park'. • The owner measures the water level on a weekly basis and reports that the water level is now 4.9 m below ground level. • The owner notes that there was a 'slight' rise in the water level over some weeks but the overall trend is apparently down.

Potential impacts on local groundwater users and springs were addressed in detail in the Hydrogeological Assessment for the proposed expansion of the 'Ardmore Park' quarry prepared by Larry Cook Consulting in November 2017. Potential impacts on a spring system on 550 Inverary Road ('Inverary Park') were also addressed on a hydrogeological assessment report prepared by Larry Cook Consulting in July 2018. The assessments conclude that the extraction of groundwater from the deep fractured hard rock aquifer system in the production bore on 'Ardmore Park' is not impacting local spring systems or local groundwater users in the area.

The following key elements are considered relevant.

- The rationale behind the selection of the location of the production bore on 'Ardmore Park' was to extract groundwater from a significant sub-vertical geological structural source not intersected by other neighbouring water users (including basic rights bores) thus minimising any potential adverse impacts and maximise the distance from other neighbouring water users in order to minimise any potential adverse impacts.

  The 124 m-deep production bore extracts groundwater from a deep 'confined' hard rock aquifer hosted by a regionally-significant regional fault dissecting steeply-dipping and deformed Devonian age metasedimentary rocks. The location of the production bore (BHAP6) is shown in **Figure 1**. A profile of the bore showing the geophysical signature and geology encountered is shown in **Figure 2**. The aquifers are located approximately 65 m below the contact with the overlying alluvial sequence at 35 m depth.

  The distances between the production bore on 'Ardmore Park' and Bore 10WA15089 on Lot 2 and Bore 10WA115255 on Lot 5 are 1.9 and 1.8 km respectively. This separation distance significantly exceeds the conservative and 'safe' separation distances that

WaterNSW often sets for works approval bores (irrigation/commercial/industrial) in some of their Water Sharing Plan areas.

- Manual water level monitoring has been carried out in Bore 10WA115255 on Lot 5 by the environmental officer at 'Ardmore Park' since October 2018 to establish a baseline level. The water level recorded over six monitoring rounds ranges between 4.02 m and 4.13 m Below Ground Level (BGL). The measurements are summarised in **Table 2**.

Table 2
Summary of Responses

Date	Depth to Water Level (m BGL)
11/10/18	4.08
26/10/18	4.09
03/11/18	4.05
11/11/18	4.10
25/11/18	4.02
10/12/18	4.13

Note: BGL denotes Below Ground Level

As can be seen, the water level has remained relatively constant since monitoring commenced. During this monitoring period, approximately 5.6 ML was pumped from the production bore on 'Ardmore Park'.

- Adequate protection measures are in place in the existing State government-approved groundwater monitoring network on 'Ardmore Park' documented in the Water Management Plan to predict, identify and assess any potential impacts on any local groundwater users. The locations of the monitoring bores are shown in **Figure 1**. The water levels regularly recorded in the approved network of monitoring bores on 'Ardmore Park' do not reveal any significant drops (see Figure 7 in the 2017-2018 AEMR).
- There appears to be a significant geological and hydrogeological (hydraulic) disconnect between the deeper 'fracture-controlled' hard rock aquifers hosted by the 'old' deformed rock basement sequence and the relatively shallow and younger 'unconfined' alluvial sand aquifer. It is concluded that the hard rock aquifer system hosted by the fractured Devonian metasedimentary basement rocks is not directly connected to the shallow palaeo sand-hosted aquifer hosting the spring systems.
- The details of the bore licence on 'Ardmore park' and work approval are listed in **Table 3**.

Table 3 Summary of Responses	
Work Approval	10CA117207
Approval Date	4.10.11
Water Access License	WAL 30111
Reference No.	10AL117206
Water Entitlement	110 units (110ML)

The licensed production bore on 'Ardmore Park' was drilled in 2003 but not operated until 2007 with very intermittent pumping through to 2011 for stock watering. The pump was inoperable between 2011 and late 2013 then pumped on an intermittent basis till early 2014 to supply water for road works (Bungonia bypass road). It is understood that no pumping was carried out between early 2014 and late 2015.

The bore was then pumped intermittently between late 2015 and mid-2016 to supply water for miscellaneous road works. No pumping occurred between mid-2016 and early 2017 due to 'very much above average' rains. Between early 2017 and present, the bore has been operating on a regular basis to supply water for dust suppression and sand washing.

The 2018 production to 17th December is approximately 60.4 ML which equates to about 55% of the approved 110 ML annual water entitlement. A summary of the operation of the production bore is provided in **Table 4**.

Table 4 Summary Bore Pumping Production Bore APBH6	
Time Line	**Activity**
24th July 2003	Bore Drilled to 124 m depth
8th April 2004	Pump testing (45 hrs@13 L/s)
July 2004 – early 2007	No pumping
2007	• Limited intermittent pumping for stock watering. • Estimate < 2ML pumped during 2007
2008	• Limited intermittent pumping for stock watering. • Less pumping than 2007. • Estimate < 1ML pumped during 2008
Early 2009 – late 2013	• 'Ardmore Park' rarely visited in this five-year period due to activities on a significant company project near Picton. • Bore rarely pumped during 2009 - 2011 to supplement proximal dam storage for stock watering. • Pump seized in about 2011 due to inactivity. • Attempts in mid-2013 to extract pump failed. Pump stuck. • Pump eventually retrieved in September 2013 and replaced. Bore cleaned in October 2013 and new pump installed.
Nov 2013 – Jan 2014	Bore pumped intermittently to supply water for road works – Bungonia bypass road.
Jan 2014 – late 2015	No pumping

Late 2015 – mid 2016	Bore pumped intermittently to supply water for miscellaneous road works.
Mid 2016 – early 2017	• No pumping. • 'Very much above average' rain in 2016. A total of 834.2 mm was recorded in the BOM Bungonia Station 70012 on 'Inverary Park' which is understood to be highest rainfall recorded in this district since 1974.
Early 2017 - present	• Bore pumped for road works and sand washing.

The pumping regimes are summarised in **Figure 3** which shows daily rainfall recorded on 'Inverary Park' charted against the flow in 'Phil's Spring' on the same property. Annual rainfall recorded on 'Inverary Park' is charted in **Figure 4**.

- Sand extraction commenced on 'Ardmore Park' in early 2018. However, the aquifer hosted by the sand resource was not intercepted. It is noted that the reported gradual decline of spring flow in the area pre-dates any sand extraction on 'Ardmore Park'.
- Fluctuations in the water levels in hard rock aquifers are not considered unusual. Fluctuations can be associated with seasonal and long-term climate changes and possibly third-party pumping interference. For example, State government groundwater monitoring in the Southern Highlands recorded significant decline in water levels during and following the severe drought in NSW in the mid-2000s.

  Daily rainfall recorded on 'Inverary Park' is charted against the flow in 'Phil's Spring' on the same property (see **Figure 3**).

This review concludes:

- The issues raised by the two landowners have been addressed in detail in two recently-prepared hydrogeological assessments for the proposed quarry expansion and spring assessment on 'Inverary Park'.
- The extraction of groundwater from the deep fractured hard rock aquifer system in the production bore on 'Ardmore Park' is not considered to impact local spring systems or local groundwater users in the area.

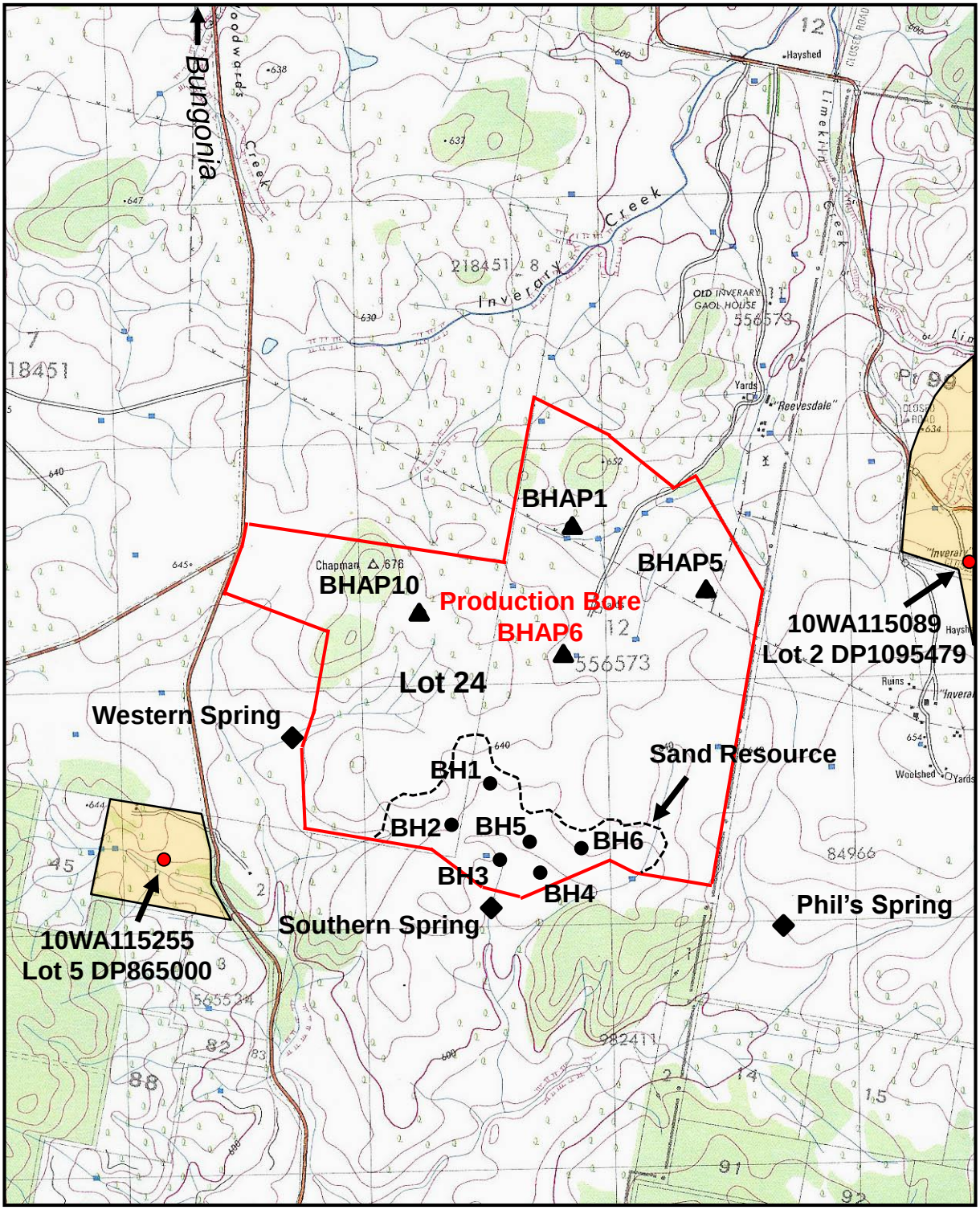
Please do not hesitate to contact Larry Cook if you have any questions or require further information.

For and on behalf of
Larry Cook Consulting

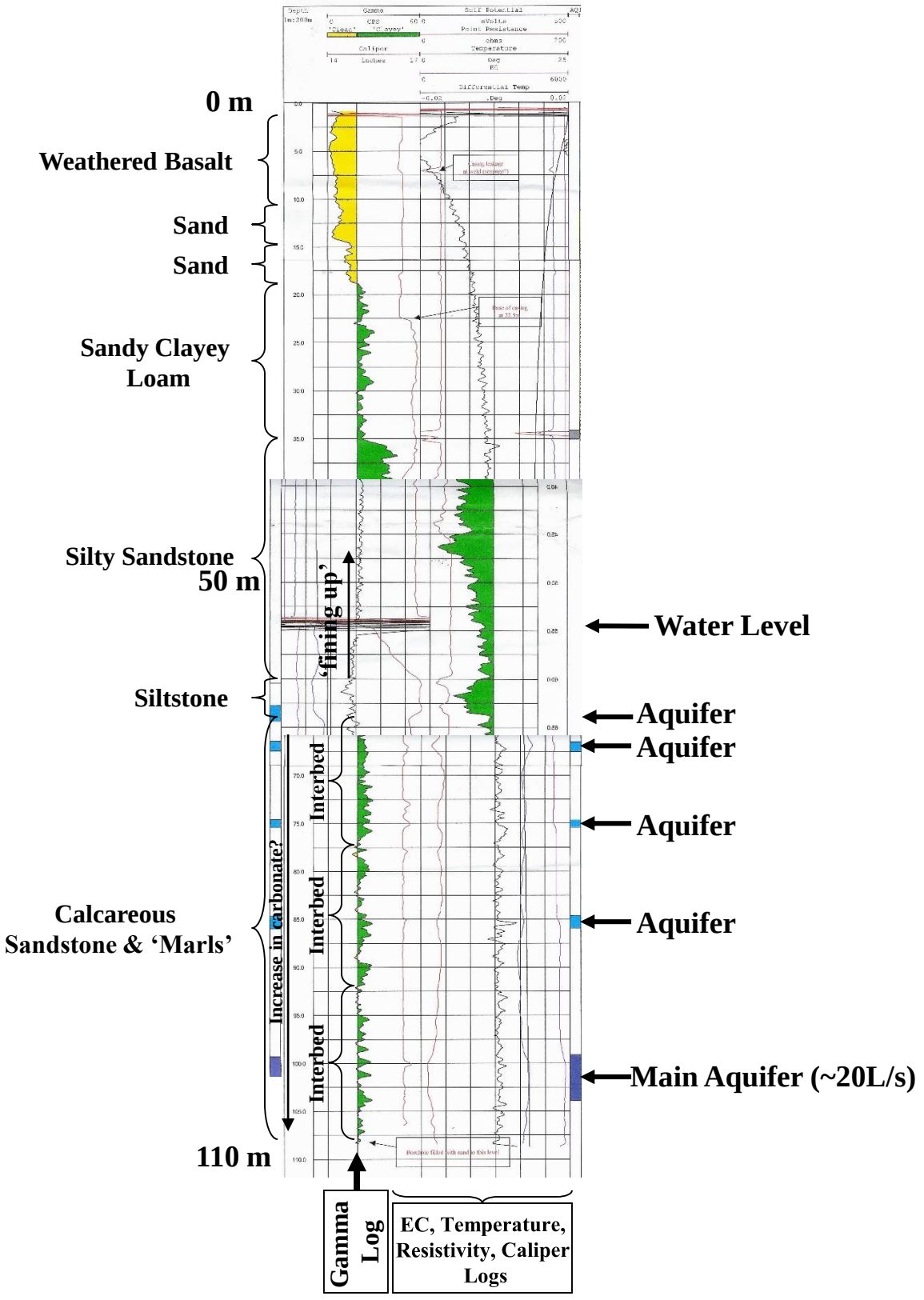
Larry Cook

Larry Cook (BSc, MSc)
Hydrogeologist

Attachments: Figures 1 - 4



Larry Cook Consulting **PO Box 8146** **Tumbi Umbi NSW 2261** **Ph 02 4340 0193**	**Hydrogeological Assessment**	Scale: As shown
	Lot 24 DP1001312 - 'Ardmore Park' Location of Monitoring Sites	**FIGURE 1**



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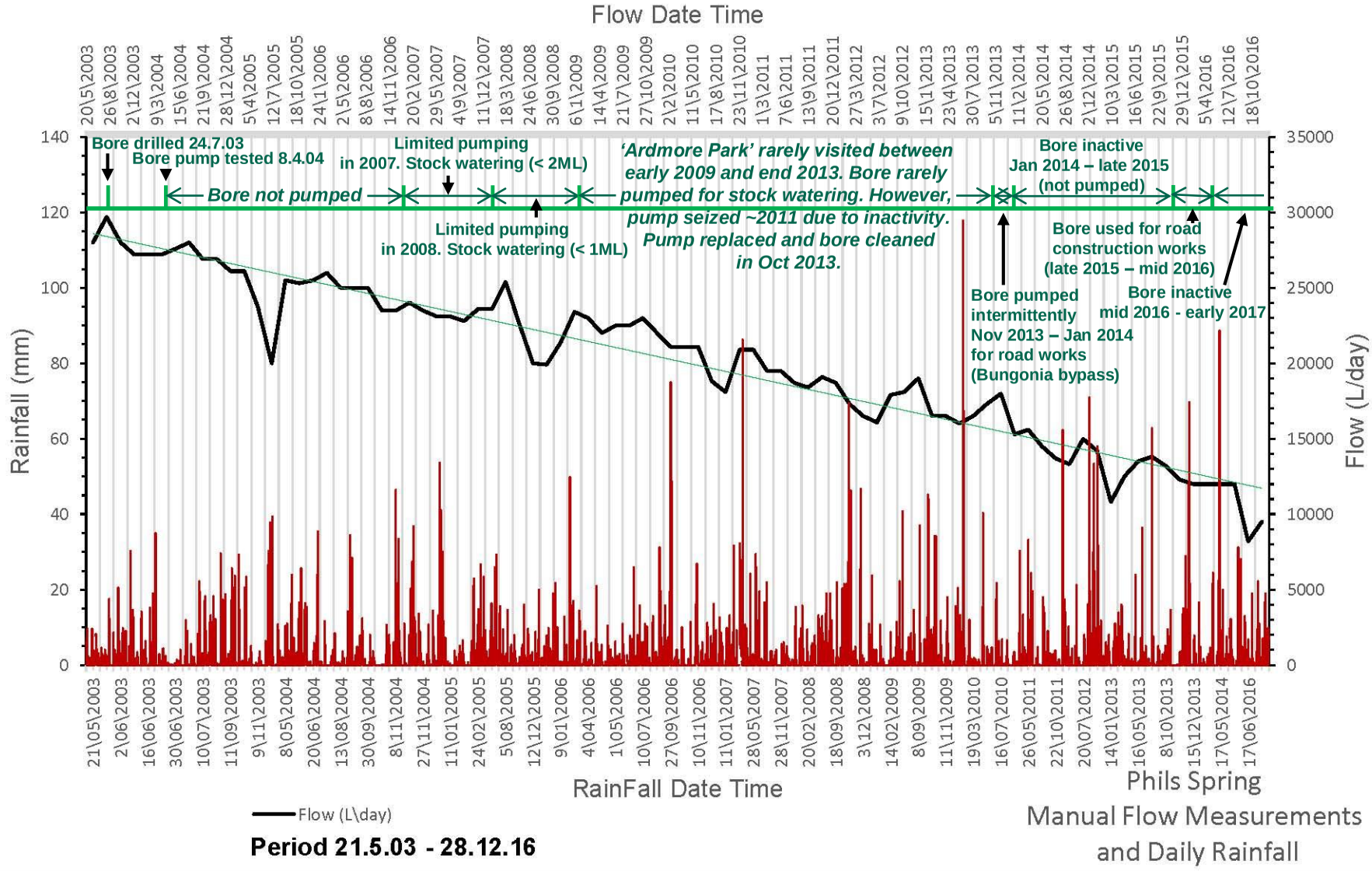
	Lot 24 DP1001312 - 'Ardmore Park' Geophysical Bore Log – BHAP6	**FIGURE 2**



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Hydrogeological Assessment

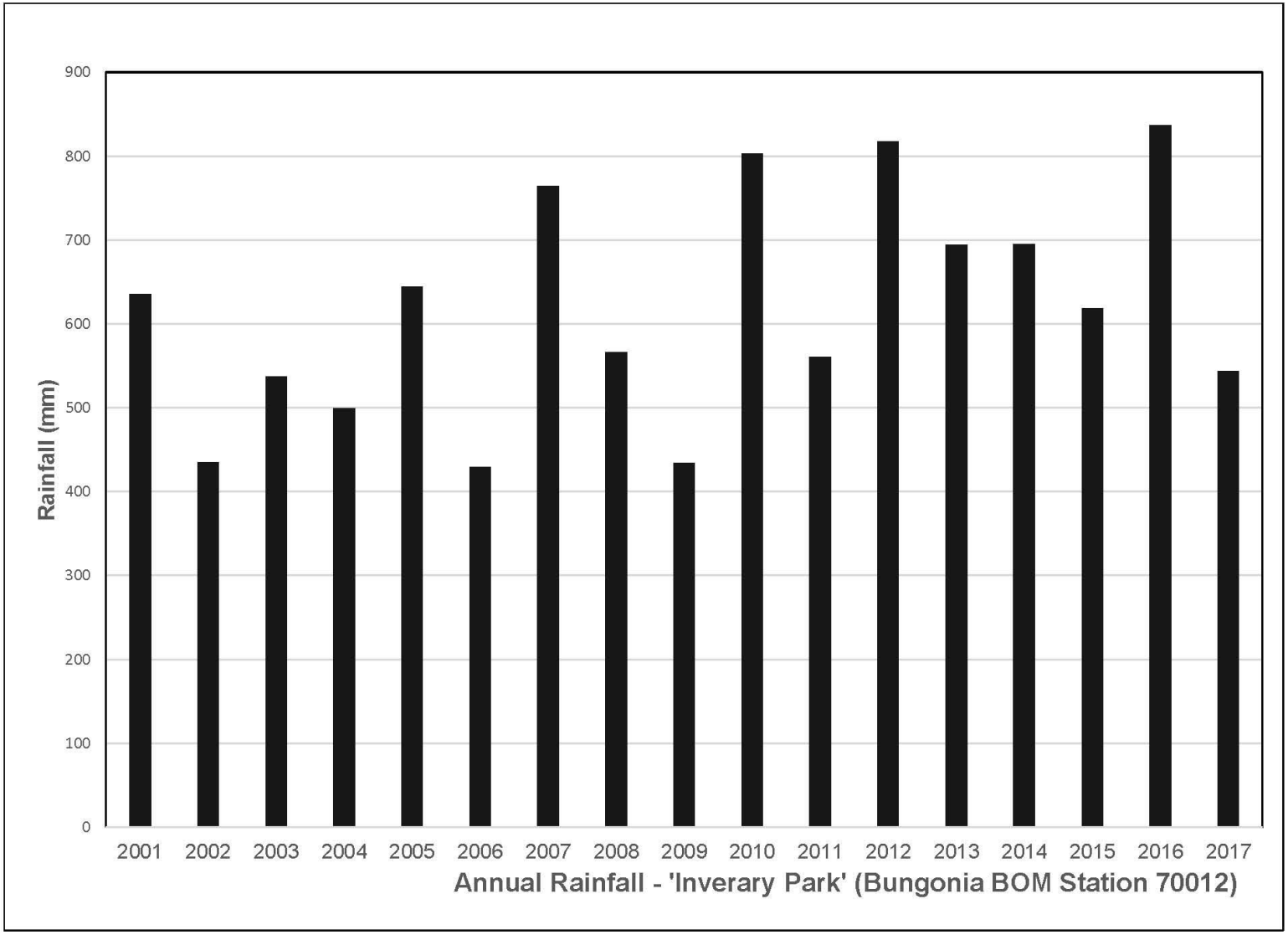
Lot 24 DP1001312 - 'Ardmore Park'

Manual Flow measurements and Daily Rainfall – Phil's Spring

N

Scale: As shown

FIGURE 3



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Hydrogeological Assessment

Lot 24 DP1001312 - 'Ardmore Park'

Annual Rainfall – 'Inverary Park' 2001 - 2017

N

Scale: As shown

FIGURE 4