Larry Cook Consulting Pty Ltd

GROUNDWATER MONITORING, SAMPLING AND TESTING JULY 2015

‘Ardmore Park’ Quarry

Lot 24 in DP1001312

5152 Oallen Ford Road, Bungonia

PREPARED FOR: **MULTIQUIP QUARRIES**

PROJECT NO: **15076**

DATE: **16TH AUGUST 2015**

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1. INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

Larry Cook Consulting Pty Ltd was commissioned by *Multiquip Quarries* to carry out water level measurements and water quality sampling and testing, and prepare a report documenting water quality test results and comparing the results against the Protection of Freshwater Aquatic Ecosystems (ANZECC 2000) and Drinking Water Guidelines: National Water Quality Management Strategy 2004 (the Guidelines).

This report documents the results of scheduled water level monitoring and water quality testing carried out on 28th July 2015.

1.2 RELEVANT GUIDELINES AND STANDARDS

A summary of the relevant guidelines and industry standards relating to monitoring, sampling and testing of groundwater are detailed below:

- Approved Methods for Sampling and Analysis of Water Pollutants in NSW (EPA 1998);
- Handbook: Groundwater. Volume II: Methodology (USEPA 1991);
- Minimum Construction Requirements for Water Bores in Australia (2003) (Land and Water Biodiversity Committee);
- Protection of Freshwater Aquatic Ecosystems (ANZECC 2000); and
- Drinking Water Guidelines: National Water Quality Management Strategy 2004.

2. SITE DETAILS

The Property is located adjacent to and on the eastern side of, sealed Oallen Ford Road approximately four kilometres due south of the village of Bungonia and about 25 kilometres southeast of the major regional commercial centre of Goulburn. The Property is nestled within largely cleared rolling hills on the western side of the rugged pristine Bungonia State Recreation Area and Morton National Park. Access to the Property is due south from Bungonia along Oallen Ford Road for approximately four kilometres with the entrance to the Property at the intersection of Oallen Ford Road and Lumley Road.

The location of the Property is shown in **Figure 1**. The topographic map sheet covering the Property is Kooringaroo, 1:25,000 scale 8828-II-S (1983). The approximate AMG coordinates of the centre of the Property are Easting 769400m Northing 6134250m.

The Property straddles part of a broad east-southeast trending ridge system, which broadly coincides with a basalt flow and forms a distinct watershed for drainages flowing north-northeast into the Limekiln and Inverary creek systems. Drainages to the south of the ridge system flow into the Jacqua Creek system. The top of the ridge system is at an average elevation of approximately 640m Average Height Datum (AHD) with the highest point on the Property being Chapman Trig Station at 676m AHD elevation, located in the central western part of the Property.

The key features required to identify the Site are summarised in **Table 1**.

Table 1: Site Identification Details

Site	Description
Site Name	Ardmore Park Quarry
Site Owner	Multiquip Quarries
Address	5152 Oallen Ford Road, Bungonia NSW 2580
Title Plan	Lot 24 in DP1001312
LGA	Greater Argyle

3. GROUNDWATER MONITORING SITES

A network of monitoring sites was established on the Site and off-site in 2004. These included a network of 'hardrock' production and monitoring bores, a strategically positioned network of sand monitoring bores and two springs.

The locations of the hardrock monitoring bores are shown in **Figure 2**, sand monitoring bores in **Figure 3** and the two groundwater springs in **Figure 4**. The locations were strategically selected to intercept any potential contaminants that may be migrating in the groundwater system down gradient of the quarry.

A register of the monitoring sites with specifications is provided in **Table 2**.

Table 2 Register of Groundwater Monitoring Sites

	Coordinates (MGA Grid)		Elevation Ground Level (m AHD)	Depth of Hole (m BGL)	SWL 28.7.15 (m BGL)
Monitoring Site	**Easting (m)**	**Northing (m)**			
Hardrock Bores					
BHAP 1	770000	6134780	633.3	114.0	8.18
BHAP 5	770520	6134505	634.5	72.0	21.77
BHAP 6	769910	6134252	640.0	124.0	58.07
BHAP 7	769960	6133780	633.0	112.0	Bore Missing
BHAP 10	769340	6134480	637.5	52.0	28.55
Sand Bores					
BH 1	769512	6133541	631.5	10.4	Bore Destroyed
BH 2	769395	6133324	623.0	12.0	Bore rediscovered but requires redevelopment
BH 5	769687	6133259	622.5	12.5	Bore rediscovered but requires redevelopment
BH 7	770102	6133253	630.8	8.0	Bore Destroyed
Groundwater Springs					
Southern Spring	-	-	615.0	N/A	Approx. 0.1 L/s
Phil's Spring	-	-	620.0	N/A	Approx. 0.1 L/s

Reference: AHD: Australian Height Datum
BGL: Below Ground Level
SWL: Standing Water Level

4. GROUNDWATER SAMPLING

Groundwater sampling in the nominated hardrock bores was conducted using either a stainless steel bailer which was decontaminated between bores using a *Decon 90* solution or using the equipped pump (BHAP6). Suitable purging of the water column was undertaken prior to sampling. Field measurements of pH, Electrical Conductivity (EC), temperature, Redox Potential (Eh) and Dissolved Oxygen (DO) was undertaken during the purging process to determine at what time representative samples could be taken. Sampling of the nominated groundwater springs was achieved using a container.

Latex disposable gloves were used and samples stored in laboratory-supplied labelled bottles and chilled in an esky. The samples were submitted to NATA accredited laboratory Sydney Analytical Laboratories, Sydney (SAL) for a suite of tests and determinations proposed in the Groundwater Impact Assessment in order to characterise the chemistry of the groundwater and reveal any potential contamination. The samples were transported under our Chain of Custody (COC) protocol.

Groundwater samples were submitted for a suite of indicator analytes and tests as listed in **Table 3**. Additional analytes were included to characterise the groundwater.

Table 3
List of Analytes and Tests

pH	Carbonate Alkalinity (as CaCO3)
Electrical Conductivity (EC)	Bicarbonate Alkalinity (as CaCO3)
Sodium (Na)	Total Phosphorus (Total P)
Calcium (Ca)	
Potassium (K)	
Magnesium (Mg)	
Chloride (Cl)	
Sulphate (SO4)	

5. QUALITY ASSURANCE & QUALITY CONTROL

5.1 DATA QUALITY OBJECTIVES

The data quality objectives of the investigation were to obtain sufficient representative data to allow a high quality groundwater assessment including:

- Characterisation of groundwater quality; and
- Identification of any risks posed to the environment.

The assessment was conducted to a standard consistent with generally accepted and current professional consulting practice for such an investigation. The evaluation criteria (Decision Rules) adopted for the investigation are summarised in **Table 4.**

Table 4 Data Quality Objectives	
DQO	**Evaluation Criteria**
Documentation completeness	Completion of calibration records, chain of custody documentation, laboratory test certificates from NATA-accredited laboratory
Data comparability	Use of appropriate techniques for the sampling, storage and transportation of samples. Use of NATA accredited laboratory.
Data representativeness	Adequate sampling coverage of all areas of environmental concern at the site, and selection of representative samples
Precision and accuracy for sampling and analysis	Use properly trained and qualified field personnel. Achieve laboratory QC criteria.

5.2 FIELD QA/QC

The Quality Assurance and Quality Control QA/QC protocols used during the fieldwork are listed in **Table 5.**

Table 5 Field QA/QC	
Protocol	**Description**
Sampling Team	The fieldwork was managed by Larry Cook, Senior Hydrogeologist. Project personnel comprised professionals and technicians trained in conducting groundwater investigations.
QA/QC System	All fieldwork was conducted in accordance with the Larry Cook Consulting Standard Sampling Procedure by professionals and trained technicians.
Chain of Custody Forms	All samples were logged and transferred under appropriately completed Chain of Custody (COC) Forms.
Preservation	All samples were delivered to the project laboratory in appropriately preserved containers, with preservation consisting of packing samples in eskies with ice.
Blind Field Duplicates	Duplicate testing was not carried out for this assessment.

5.3 LABORATORY QUALITY ASSURANCE AND QUALITY CONTROL

The project laboratory (*Envirolab Services*) used for the chemical analysis of samples is NATA accredited for the selected analysis. Laboratory QA/QC standards and results are documented in the laboratory certificates of analysis reports.

6.0 RESULTS

6.1 INTRODUCTION

Laboratory results are summarised in **Table 6**. A copy of the laboratory certificates are provided in **Annexure 1**. Laboratory QA/QC results are also detailed in the laboratory report provided in **Annexure 1**.

In summary:

Hardrock Bores

The groundwater sampled in hardrock bores is slightly acidic to slightly alkaline but overall near-neutral with moderate to high salinity recorded.

Sand Bores

Two of the nominated sand bores (BH2 and BH5) were rediscovered but require redevelopment when ground conditions allow access. However, Bores BH1 and BH7 remain lost and will be reinstalled in August 2015 subject to 'dry weather' access. Two attempts to access the sites in late July 2015 were unsuccessful due to significantly wet ground conditions.

Groundwater Springs

The groundwater sampled in the two spring systems is slightly alkaline with moderate salinity.

6.2 MEASUREMENTS OF PH

The pH of the hardrock groundwater samples measured in the project laboratory range from a low of 6.3 in Monitoring Bore BHAP1 to 8.3 recorded in Bore BHAP5. This indicates that the groundwater is slightly acidic to moderately alkaline.

The pH of the groundwater spring samples measured in the project laboratory range from a low of 7.1 in Southern Spring to 7.4 recorded in Phil's Spring. This indicates that the shallow groundwater in the discharge zones is slightly alkaline.

6.3 MEASUREMENTS OF ELECTRICAL CONDUCTIVITY (EC)

The EC of the hardrock groundwater samples range from a low of 680 µS/cm in Bore BHAP5 to 2,500µS/cm recorded in the Production Bore BHAP10. This indicates that the groundwater is moderately to highly saline.

The EC of the groundwater spring samples is similar and ranges from a low of 530 µS/cm in Southern Spring to 1,100 µS/cm recorded in Phil's Spring. This indicates that the shallow groundwater in the discharge zones is moderately saline.

Table 6 Summary of Water Quality Analytical Results

SAMPLE		Guidelines		Method Detection Limit	*BHAP/1*	*BHAP/5*	*BHAP/6*	*BHAP/10*	*South Spring*	*Phil's Spring*
DESCRIPTION		Drinking Water - Health Guidelines [1]	Trigger Value for the Protection of Freshwater Aquatic Ecosystems [2]		*Monitoring Bore*	*Monitoring Bore*	*Monitoring Bore*	*Monitoring Bore*	*Monitoring Bore*	*Monitoring Bore*
DATE					Jul-15	Jul-15	Jul-15	Jul-15	Jul-15	Jul-15
ANALYTE	**UNIT**									
pH (lab)	pH Units	ISD			6.3	8.3	7.1	6.8	7.1	7.4
Electrical Conductivity (lab)	µS/cm			1.0	760	680	2,100	2,500	530	1,100
Cations										
Sodium Na+	mg/L	180		0.5	130	20	230	400	50	87
Calcium Ca++	mg/L			0.5	18	19	140	69	21	50
Potassium K+	mg/L			0.5	1.3	0.9	3.3	8.0	1.1	0.7
Magnesium Mg++	mg/L			0.5	13	72	70	96	30	81
Anions										
Chloride Cl-	mg/L	250		1	230	52	500	670	86	150
Sulphate SO4--	mg/L	500		1	6	19	25	59	<1	16
Bicarbonate HCO3-	mg/L			5	18	230	350	330	170	420
Carbonate CO3--	mg/L			5	<5	<5	<5	<5	<5	<5
Total Phosphorus	mg/L			0.05	0.1	0.2	0.1	0.30	1.4	0.2

[1] **Drinking Water Guidelines**: National Water Quality Management Strategy 2004

note : ISD denotes insufficient data to set a guideline value based on health considerations

[2] **Protection of Freshwater Aquatic Ecosystems** (ANZECC 2000)

6.4 SELECTED ANIONS AND CATIONS

- **Sodium** levels in the hardrock groundwater samples range from a low of 20 mg/L recorded in Bore BHAP5 to 400 mg/L in BHAP10.

  Sodium levels in the shallow spring water samples range from 50 mg/L in Southern Spring to 87 mg/L recorded in Phil's Spring.

  Chloride concentrations are generally in proportion with the sodium levels in the same monitoring sites and, in the hardrock bores, range from a low of 52 mg/L in Bore BHAP5 to 670 mg/L in Production Bore BHAP10.

  Chloride levels in the shallow spring water samples range from a low of 86 mg/L recorded in Southern Spring to 150 mg/L in Phil's Spring.

  Elevated sodium and chloride levels are believed to be largely associated with the composition of the host geology and are the dominant species causing elevated and anomalous measurements of electrical conductivity (EC).

- The higher levels of **magnesium** in hardrock aquifers were recorded in Bores BHAP6 (70 mg/L), Bore BHAP5 (72 mg/L) and Bore BHAP10 (96 mg/L). The concentrations recorded in Southern Spring and Phil's Spring were 30 mg/L and 81 mg/L respectively.

- Concentrations of **sulphate** varied between 6 mg/L and 59 mg/L in the hardrock aquifers and from less than the LOR and 16 mg/L in the spring systems.

- An elevated level of **bicarbonate** was recorded in hardrock Production Bore BHAP6 (350 mg/L) with a relatively low level in BHAP1 (18 mg/L). Similar relatively high levels of bicarbonate were recorded in the two spring systems (170 and 420 mg/L). Levels of carbonate in hardrock bores and springs were all recorded less than the Limit of Reporting (LOR).

6.5 NUTRIENTS

Total Phosphorus levels in hardrock groundwater samples range from 0.10 mg/L in Production Bores BHAP1 and BHAP6 to 0.3 mg/L in BHAP10.

The concentrations of Total Phosphorus recorded in Southern Spring and Phil's Spring were an anomalous level of 1.4 mg/L and 0.2 mg/L respectively.

7. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the groundwater testing, the following discussion, conclusions and recommendations are provided.

Natural pH values are near neutral and EC levels are considered to reflect the composition of the host geological formation. The moderate salinity of the springs reflects the relative close proximity to the remnant basalt layers in the area.

Concentrations of cations and anions were similar to those recorded in the last monitoring round (January 2015). An exception is the anomalously high concentration of Total Phosphorus recorded in the Southern Spring (30 mg/L) during the last monitoring round in January 2015. This result was not replicated in the current July 2015 testing.

Scheduled regular follow-up monitoring will provide useful data that will be analysed to detect any trends and assessed for any potential adverse impacts from the quarry operations on the groundwater system. Charting of water level data, water quality results and analysis of any trends will be undertaken following accumulation of sufficient data. Charting will recommence following receipt of results obtained from the next monitoring and testing round.

Recommendations

- Attempt to again reinstall the destroyed sand monitoring bores BH1 and BH7 when ground conditions allow
- Redevelop recently rediscovered sand monitoring bores BH2 and BH5, and other sand bores in the network
- Continue the search for Hardrock Bore BHAP7
- Reinstall automated water level data loggers in designated hardrock bores. New generation pressure transducers and telemetry are proposed
- Attempt to again install automated flow monitoring in the two spring systems when ground conditions allow safe access
- Carry out the next routine (quarterly) groundwater monitoring in the network of monitoring sites in late August 2015 in accordance with the minimum requirement for quarterly sampling and testing;
- Submit groundwater samples from the next sampling and testing round in late August 2015 to the project laboratory for analysis, assess any trends and exceedances and, if required, implement a response and action plan in accordance with the guidelines; and
- Prepare a report giving the results of the August 2015 monitoring round and an assessment of any trends and potential impacts. This will include an ongoing assessment of pH (acidity), EC and nutrient levels.

ANNEXURES

Annexure 1

Laboratory Certificate and COC Documentation

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 132754

Client:

Larry Cook Consulting
PO Box 8146
Tumbi Umbi
NSW 2261

Attention: Larry Cook

Sample log in details:

Your Reference:	**Ardmore Park**		
No. of samples:	6 Waters		
Date samples received / completed instructions received	14/08/2015	/	14/08/2015

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	21/08/15	/	19/08/15
Date of Preliminary Report:	Not Issued		

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

Ion Balance Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	132754-1 BHAP 1 28/07/2015 Water	132754-2 BHAP 5 28/07/2016 Water	132754-3 BHAP 6 28/07/2017 Water	132754-4 BHAP 10 28/07/2018 Water	132754-5 Phils Spring 28/07/2019 Water
Date prepared	-	14/08/2015	14/08/2015	14/08/2015	14/08/2015	14/08/2015
Date analysed	-	14/08/2015	14/08/2015	14/08/2015	14/08/2015	14/08/2015
Calcium - Dissolved	mg/L	18	19	140	69	50
Potassium - Dissolved	mg/L	1.3	0.9	3.3	8.0	0.7
Sodium - Dissolved	mg/L	130	20	230	400	87
Magnesium - Dissolved	mg/L	13	72	70	96	81
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	18	230	350	330	420
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	18	230	350	330	420
Sulphate, SO4	mg/L	6	19	25	59	16
Chloride, Cl	mg/L	230	52	500	670	150
Ionic Balance	%	6.0	9.7	2.6	4.3	-0.13

Ion Balance Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	132754-6 Southern Spring 28/07/2020 Water
Date prepared	-	14/08/2015
Date analysed	-	14/08/2015
Calcium - Dissolved	mg/L	21
Potassium - Dissolved	mg/L	1.1
Sodium - Dissolved	mg/L	50
Magnesium - Dissolved	mg/L	30
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	170
Carbonate Alkalinity as $CaCO_3$	mg/L	<5
Total Alkalinity as $CaCO_3$	mg/L	170
Sulphate, SO4	mg/L	<1
Chloride, Cl	mg/L	86
Ionic Balance	%	-0.86

Metals in Waters - Total						
Our Reference:	UNITS	132754-1	132754-2	132754-3	132754-4	132754-5
Your Reference	----------	BHAP 1	BHAP 5	BHAP 6	BHAP 10	Phils Spring
Date Sampled	----------	28/07/2015	28/07/2016	28/07/2017	28/07/2018	28/07/2019
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	17/08/2015	17/08/2015	17/08/2015	17/08/2015	17/08/2015
Date analysed	-	17/08/2015	17/08/2015	17/08/2015	17/08/2015	17/08/2015
Phosphorus - Total	mg/L	0.1	0.2	0.1	0.3	0.2

Metals in Waters - Total		
Our Reference:	UNITS	132754-6
Your Reference	----------	Southern Spring
Date Sampled	----------	28/07/2020
Type of sample		Water
Date prepared	-	17/08/2015
Date analysed	-	17/08/2015
Phosphorus - Total	mg/L	1.4

Miscellaneous Inorganics						
Our Reference:	UNITS	132754-1	132754-2	132754-3	132754-4	132754-5
Your Reference	----------	BHAP 1	BHAP 5	BHAP 6	BHAP 10	Phils Spring
Date Sampled	----------	28/07/2015	28/07/2016	28/07/2017	28/07/2018	28/07/2019
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	14/08/2015	14/08/2015	14/08/2015	14/08/2015	14/08/2015
Date analysed	-	14/08/2015	14/08/2015	14/08/2015	14/08/2015	14/08/2015
pH	pH Units	6.3	8.3	7.1	6.8	7.4
Electrical Conductivity	µS/cm	760	680	2,100	2,500	1,100

Miscellaneous Inorganics		
Our Reference:	UNITS	132754-6
Your Reference	----------	Southern Spring
Date Sampled	----------	28/07/2020
Type of sample		Water
Date prepared	-	14/08/2015
Date analysed	-	14/08/2015
pH	pH Units	7.1
Electrical Conductivity	µS/cm	530

Method ID	Methodology Summary
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.
Inorg-041	Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment & Lyons.

QUALITY CONTROL Ion Balance	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			14/08/2015	132754-1	14/08/2015 || 14/08/2015	LCS-W1	14/08/2015
Date analysed	-			14/08/2015	132754-1	14/08/2015 || 14/08/2015	LCS-W1	14/08/2015
Calcium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	132754-1	18 || [N/T]	LCS-W1	104%
Potassium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	132754-1	1.3 || [N/T]	LCS-W1	106%
Sodium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	132754-1	130 || [N/T]	LCS-W1	105%
Magnesium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	132754-1	13 || [N/T]	LCS-W1	106%
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	5	Inorg-006	<5	132754-1	<5 || <5	[NR]	[NR]
Bicarbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	132754-1	18 || 18 || RPD: 0	[NR]	[NR]
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	132754-1	<5 || <5	[NR]	[NR]
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	132754-1	18 || 18 || RPD: 0	LCS-W1	103%
Sulphate, SO4	mg/L	1	Inorg-081	<1	132754-1	6 || 6 || RPD: 0	LCS-W1	99%
Chloride, Cl	mg/L	1	Inorg-081	<1	132754-1	230 || 230 || RPD: 0	LCS-W1	97%
Ionic Balance	%		Inorg-041	[NT]	132754-1	6.0 || [N/T]	[NR]	[NR]

QUALITY CONTROL Metals in Waters - Total	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			17/08/2015	132754-1	17/08/2015 || 17/08/2015	LCS-W2	17/08/2015
Date analysed	-			17/08/2015	132754-1	17/08/2015 || 17/08/2015	LCS-W2	17/08/2015
Phosphorus - Total	mg/L	0.05	Metals-020 ICP-AES	<0.05	132754-1	0.1 || 0.1 || RPD: 0	LCS-W2	106%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			14/08/2015	132754-1	14/08/2015 || 14/08/2015	LCS-W1	14/08/2015
Date analysed	-			14/08/2015	132754-1	14/08/2015 || 14/08/2015	LCS-W1	14/08/2015
pH	pH Units		Inorg-001	[NT]	132754-1	6.3 || 6.3 || RPD: 0	LCS-W1	101%
Electrical Conductivity	µS/cm	1	Inorg-002	<1	132754-1	760 || 760 || RPD: 0	LCS-W1	100%

QUALITY CONTROL Metals in Waters - Total	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	132754-2	17/08/2015
Date analysed	-	[NT]	[NT]	132754-2	17/08/2015
Phosphorus - Total	mg/L	[NT]	[NT]	132754-2	108%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

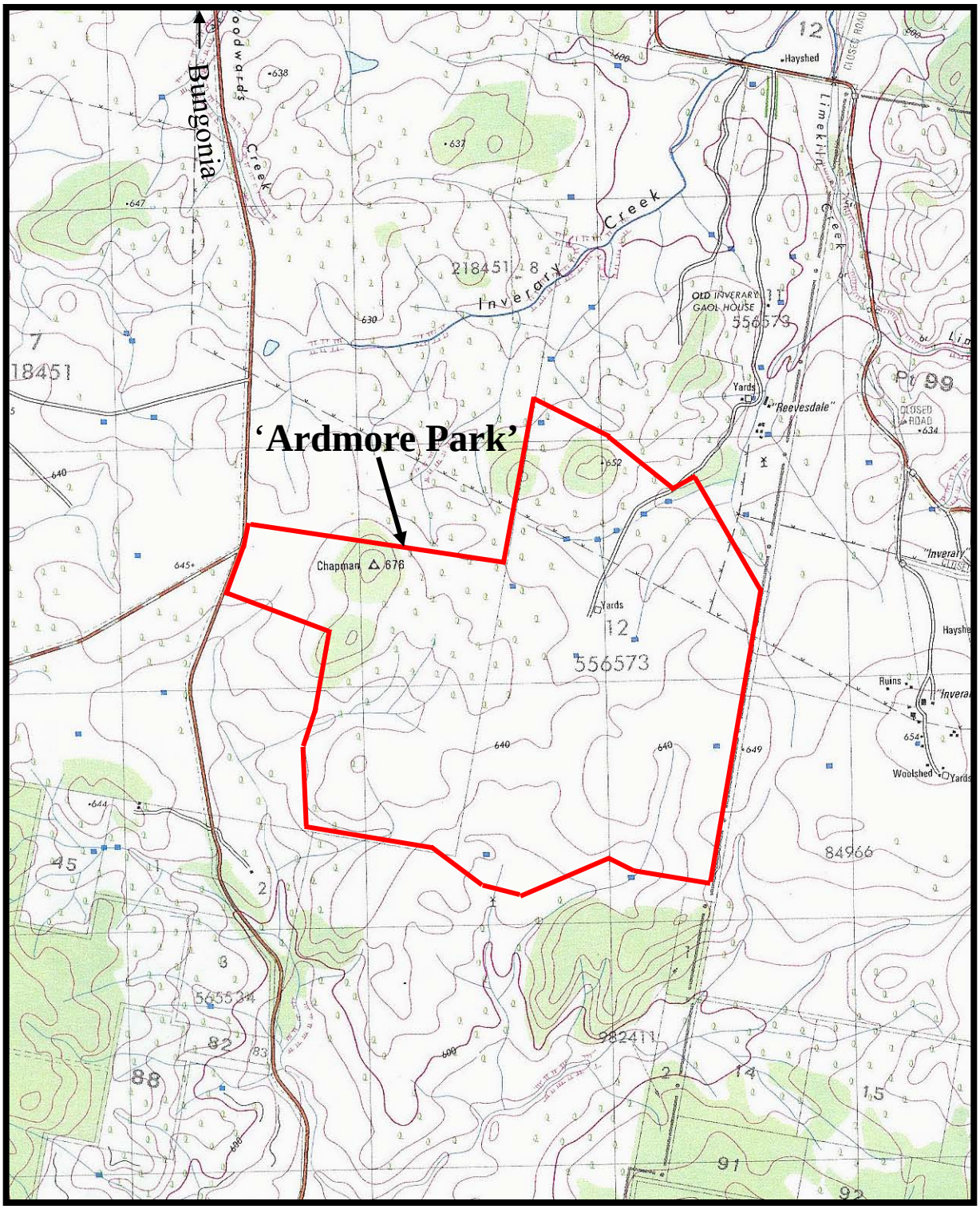
Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

FIGURES



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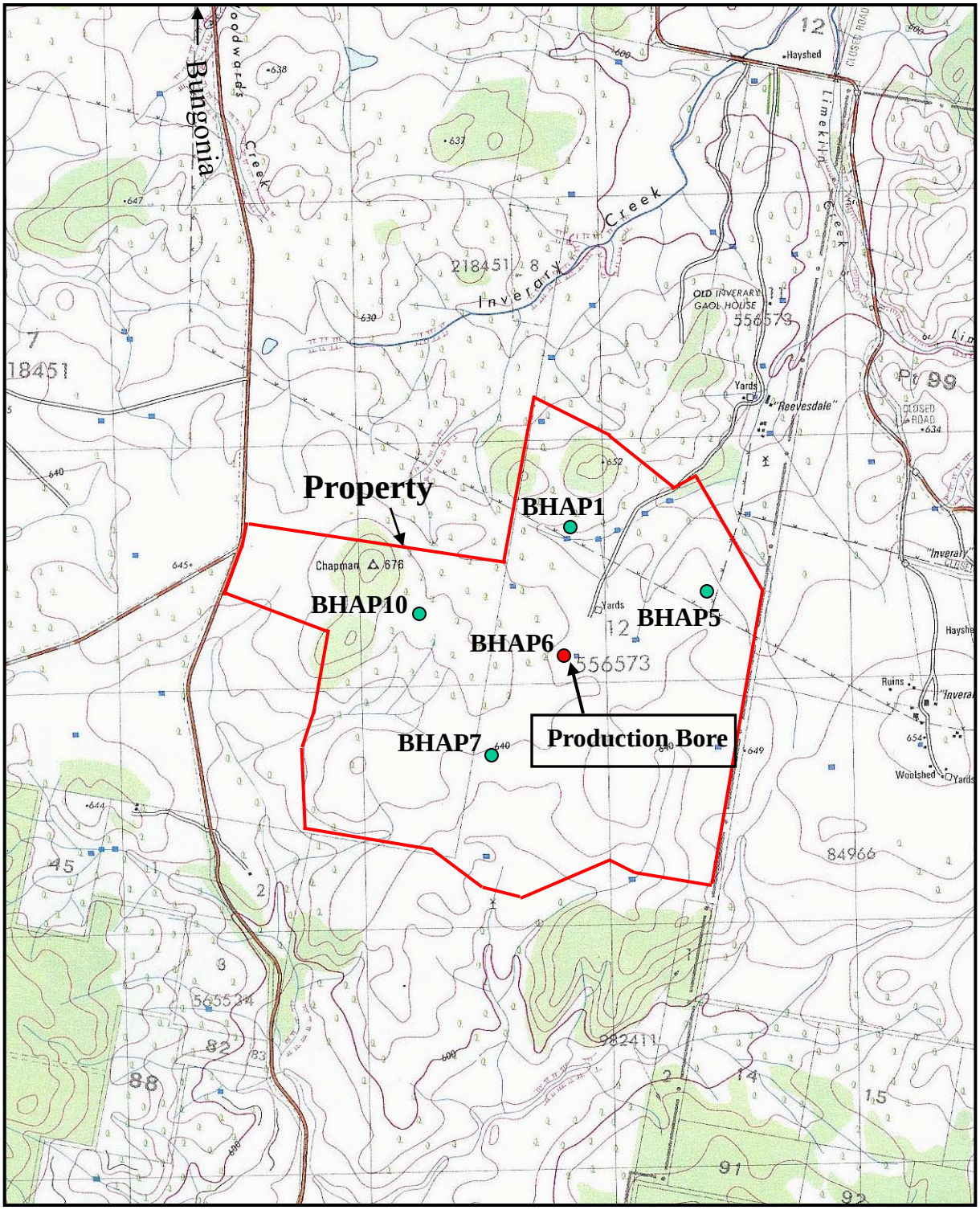
	Lot 24 DP1001312 - 'Ardmore Park' Location of Property	**FIGURE 1**



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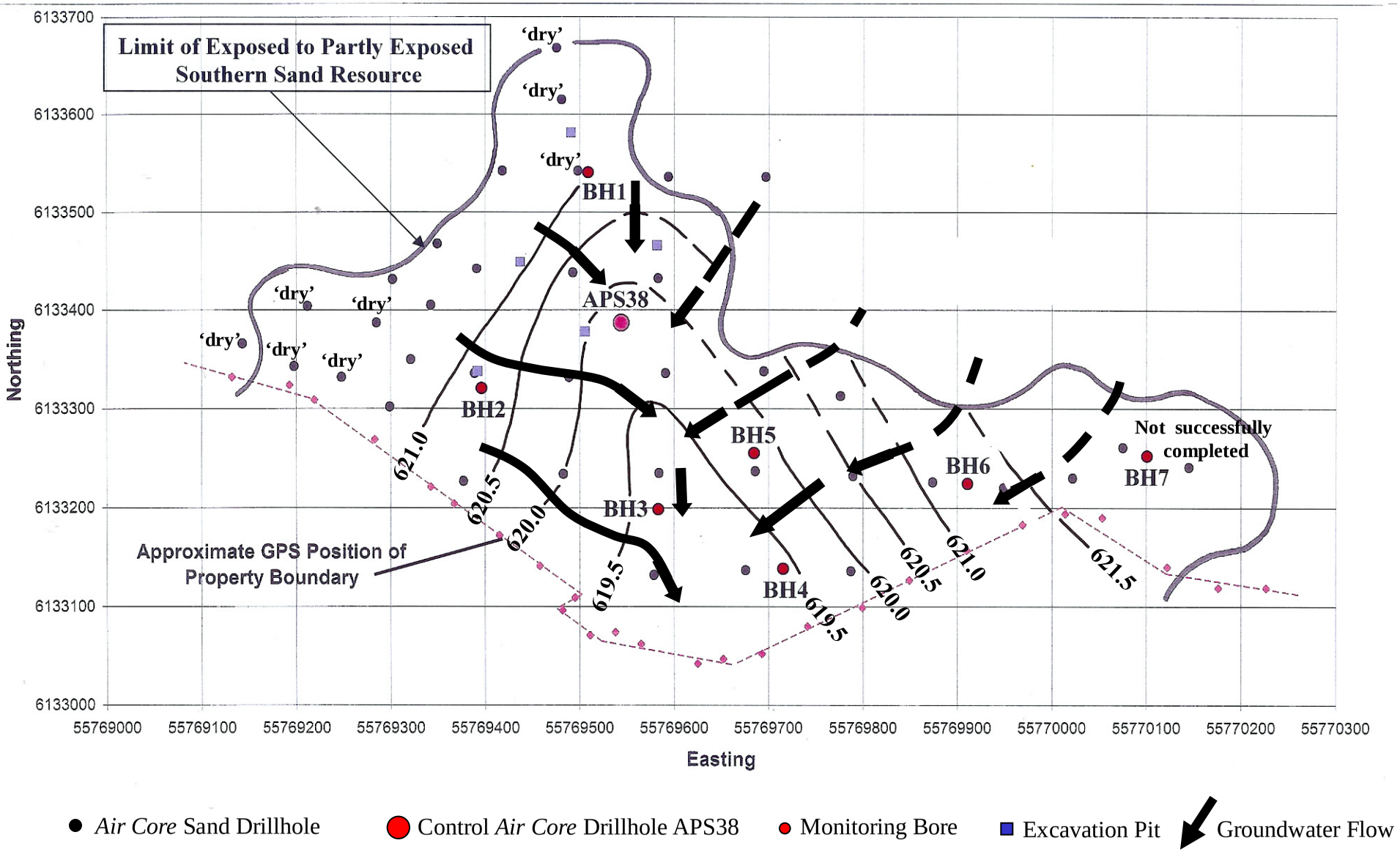
	Lot 24 DP1001312 - 'Ardmore Park' Location of Hardrock Bores	**FIGURE 2**



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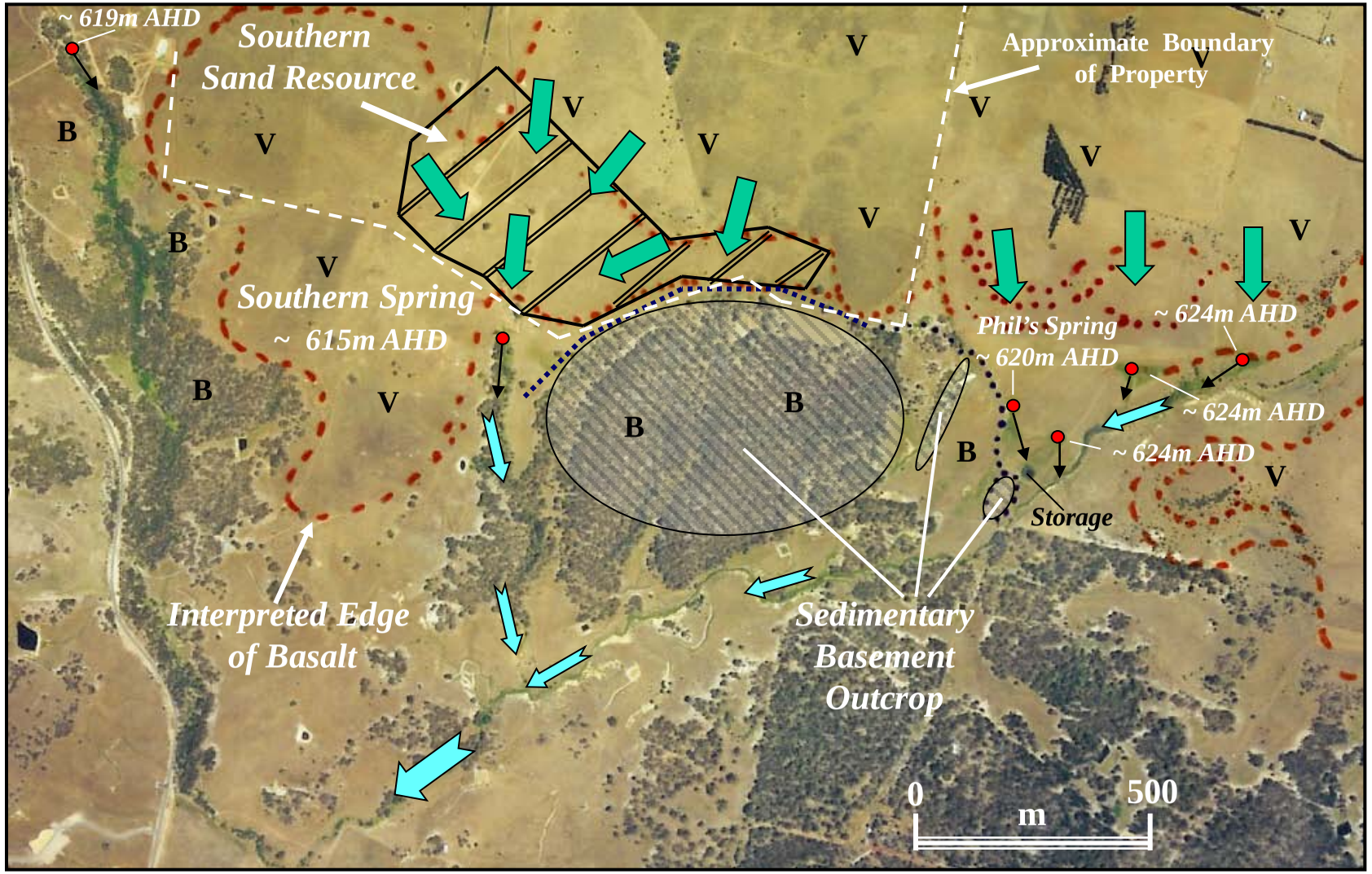
Groundwater Monitoring

Lot 24 DP1001312 - 'Ardmore Park'
Locations of Sand Monitoring Bores

N

Scale: As shown

FIGURE 3



Spring / Direction of Flow **V** Basalt **B** Basement Rocks Interpreted Groundwater Flow Surface Flow

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