Sydney Office
Suite 802, Level 8, 181 Miller Street
North Sydney NSW 2060, Australia

1300 657 402

www.adgce.com

Planning Assessment

Rockdale City Council
PO Box 21
Rockdale NSW 2216

Our Ref: 18623 C L003
9 March 2016
AM / hd
Sydney Office

Re: 119 BARTON STREET, MONTEREY
LOTS 7 & 8 ON SEC4 DP401 AND LOT 10 ON DP21626
STORMWATER MANAGEMENT OVERVIEW

ADG Engineers (Aust) Pty Ltd have been engaged by Heymann-Cohen Pty Ltd to prepare a stormwater management overview for submission to Rockdale City Council (Council) as additional information in support of a Development Application for a planning proposal to modify the approved use for the property (rezone land to R3 Medium Density Residential) located at 119 Barton Street, Monterey.

An indicative development proposal concept is described in the Rothe Lowman architectural drawings (dated December 2015).

Refer to the architectural drawings in **Appendix A** for further information.

All relevant standards and guidelines are addressed in the report including the requirements of criteria from the Councils DCP and Technical Specification.

Existing Drainage

As identified form a site visit undertaken by ADG Engineers, there is no existing stormwater drainage within connectable proximity to the subject site.

As identified from the detailed survey by Project Surveyors (**Appendix B**), the ground surface within the site falls from the site boundaries towards the centre of the site. Although multiple inlet pits were identified within the existing carpark, no formalised drainage system that conveys runoff off site has been identified. Stormwater runoff generated within the subject site is contained wholly within the boundaries of the site and is discharged gradually via infiltration to the sandy soils beneath.

External Catchments

No external catchments have been identified to impact the subject site.

Flooding Considerations

Council has advised that the subject site has not been identified as flood affected.

Stormwater Quantity Assessment

The stormwater quantity objective was to demonstrate that there is no increase in peak discharges from the subject site. The purpose of this objective is to ensure that the existing infrastructure and/or downstream properties are not adversely affected.

Councils 'Technical Specification: Stormwater Management' has identified that on-site retention and/or detention will be required for all developments to mitigate any increase in stormwater quantity. ADG Engineers recommend that an on-site retention system in the form of an absorption system be installed to mitigate stormwater quantity.

Appendix F of Council's Technical Specification: Stormwater Management provides the methodology for calculating the required absorption volume for developments within the city of Rockdale. The key variable in determining a suitable absorption volume is the Nominal Absorption Rate (AR_n) at the location of the absorption system. A geotechnical investigation has been undertaken by Douglas Partners Pty Ltd and the corresponding report has been provided in **Appendix D.** The geotechnical investigation has assessed multiple locations across the site and has identified a Nominal Absorption Rate (AR_n) of between 0.1 to 1.1L/s/m^2. In the proposed location of the absorption tank, two geotechnical tests were undertaken which will hereby by referred to as BH1 & BH2. The tests at these locations returned an AR_n of 0.4L/s/m^2 and 1.1L/s/m^2 for BH1 and BH2 respectively. As a conservative approach, ADG propose to use the lesser figure of 0.4L/s/m^2 for the absorption pit calculations.

The size of the absorption pit has been calculated in accordance with Section 5.4 of Councils Technical Specification: Stormwater Management. A design spreadsheet has been provided by Council and can be found in **Appendix C.**

Table 1 below displays a summary of the calculation sheet provided in Councils Technical Specification.

Table 1: Absorption Pit Calculation Summary

Contributing Impervious Area (m^2)	Nominal Absorption Rate (L/s/m^2)	Required Tank Storage (m^3)
4845	0.4	173.4

To achieve the required storage volume, ADG recommends to install an infiltration tank with dimensions 25.5m (L) x 8.5m (W) x 0.8m (D) at the location identified in ADG's conceptual stormwater management sketch in **Appendix E**. With the incorporation of the absorption system to control the release of peak flow discharge to permissible limits, ADG Engineers expects that the stormwater quantity control solution shall be supported by Council.

Refer to **Appendix C** for the City of Rockdale Absorption Pit Design Calculation Sheet.

Stormwater Quality Assessment

Currently no stormwater quality management measures are in place for the subject site. Stormwater quality requirements will be achieved through the infiltration of stormwater runoff to the soil via the absorption tank. As per Section 7.2.1 of Councils Stormwater Management Technical Specification (2011), a BASIX certificate will be supplied at a later date which may provide the provision of a minimum rainwater tank volume to further reduce potable water demand and increase stormwater quality.

As a pre-treatment solution, ADG propose that litter baskets be installed in all field inlet pits upstream of the infiltration tank. The litter baskets will aid in preventing solid pollutants from entering the infiltration tank.

Stormwater Management Strategy

Assuming a future BASIX certificate provides a minimum rainwater reuse volume, ADG anticipate that stormwater runoff collected within the roof area of the proposed development will initially be directed towards the rainwater re-use tank/s for retention. Overflow from the re-use tanks will be conveyed to the proposed 173.4m^3 infiltration system where stormwater runoff will be allowed to infiltrate into the ground. Should the future BASIX report not include a provision for rainwater reuse tanks, runoff from the roof area of the proposed development will be conveyed directly to the infiltration system. In accordance with Section 7.5.4 of Councils Technical Specification: Stormwater Management, should the proposed layout result in over 10 parking spaces, the incorporation of an oil and grit separator prior to the infiltration tank will be required.

A preliminary sketch of the proposed stormwater management strategy has been prepared by ADG and is attached within **Appendix E** of this overview.

Should you wish to discuss further, please feel free to contact myself on 1300 657 402.

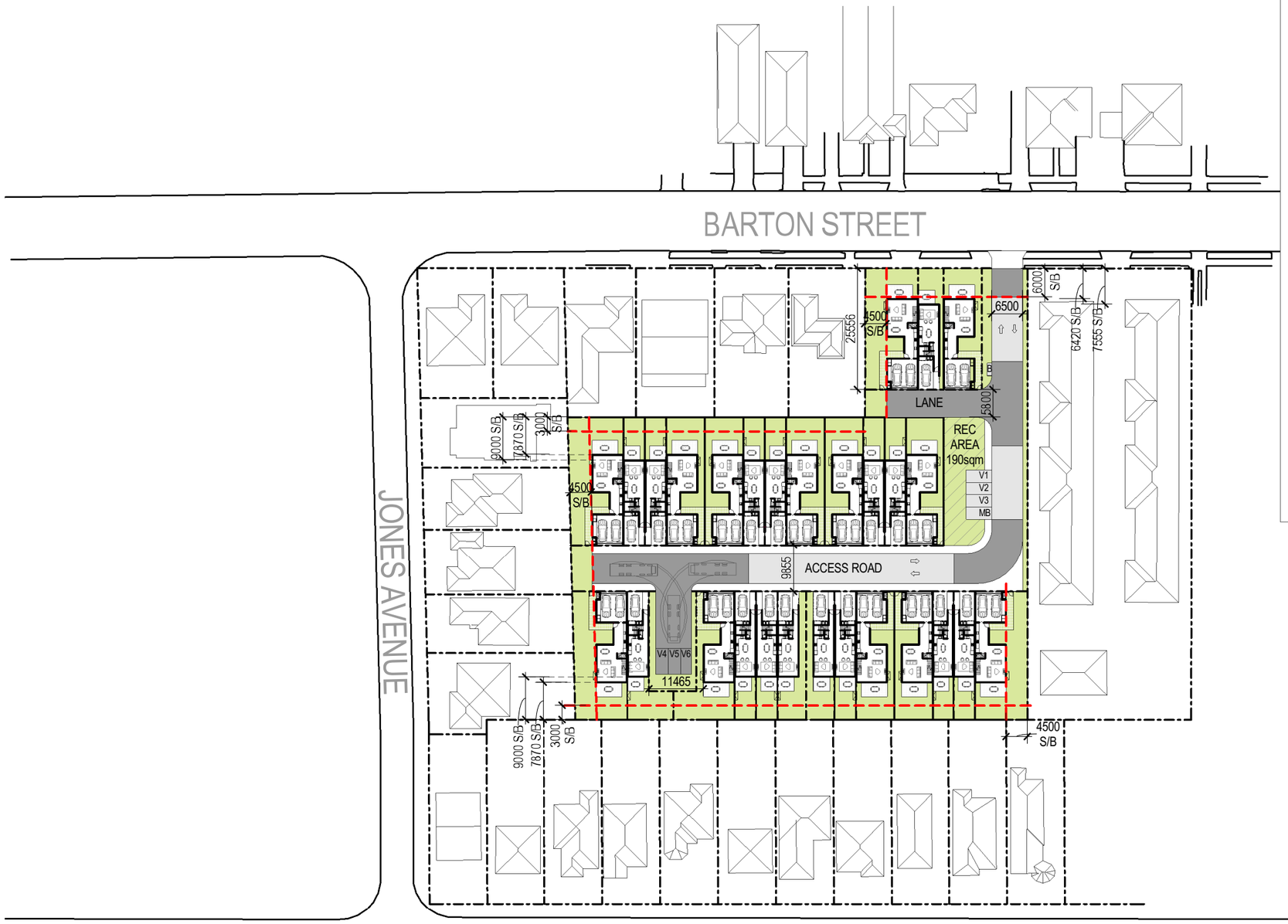
Regards,

ADG ENGINEERS (AUST) PTY LTD

ADAM MOLINA

Senior Civil Engineer

Appendix A
Rothe Lowman Site Plan



TOWN PLANNING REQUIREMENTS

	COMPLIES
4.3.1 (8) OPEN SPACE & LANDSCAPE DESIGN 25%	YES
TYPE A 8.1m x 27m LOT = 219sqm x 0.25 = 56 sqm REQ. (ACTUAL OPEN SPACE PROVIDED = 108 sqm)	YES
TYPE B 4.5m x 27m LOT = 121.5 sqm x 0.25 = 30 sqm (ACTUAL OPEN SPACE PROVIDED = 40.5 sqm)	YES
(9) AT LEAST 20% OF THE FRONT SETBACK AREA TO BE LANDSCAPED AREA	YES
4.3.2 PRIVATE OPEN SPACE	
2 BEDROOM: 40 sqm	YES
3 BEDROOM: 50 sqm	YES
4.3.3 COMMUNAL OPEN SPACE	
5sqm PER DWELLING	YES
MIN. AREA OF 40% SUNLIGHT AT 1PM 21 JUNE	YES

PARKING

3 BED: 2 CAR SPACES PER TOWNHOUSE REQUIRED	YES
2 BED: 1 CAR SPACE PER TOWNHOUSE REQUIRED	YES
VISITOR CAR PARKS: 1 PER 5 DWELLINGS REQ.	YES
BICYCLE: 1 SPACE / 10 DWELLINGS	YES
MOTORCYCLE: 1 SPACE / 15 DWELLINGS	YES

DEVELOPMENT SUMMARY

TOTAL SITE AREA:	7218 m2
TOTAL TOWNHOUSES:	28
	13 TYPE A (46%) 3 BED 15 TYPE B (54%) 2 BED
HEIGHT:	2 STOREYS
FSR: 0.6:1	= 7218 m2 x 0.6 = 4330 m2 MAX. GFA /28 = 154 m2 AVE. GFA PER TOWNHOUSE

18/12/2015 11:30:47 AM

REVISIONS

No	Date	Description	By
P1	17/12/15	PRELIMINARY ISSUE	JF

N

PROJECT TITLE
TOWNHOUSE DEVELOPMENT
119 Barton Street, Monterey, NSW

DRAWING TITLE
GROUND FLOOR/LEVEL 1 MASTERPLAN

SCALE: @ A3 1 : 1000
PROJECT No: 215416
DATE: 17/12/15
DRAWN BY: JF
DWG No: SK00.02
REV P1

PRELIMINARY

SYDNEY
LEVEL 2/171 WILLIAM STREET
DARLINGHURST NSW 2010
AUSTRALIA
T 02 8645 2600
www.rothelowman.com.au ACN 005 783 997

ROTHELOWMAN

Appendix B
Detail Survey

* THE SUBJECT TITLE NOTES
1. RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)

A1

NOTES :

* BOUNDARIES HAVE NOT BEEN DEFINED BY SURVEY AND ARE DIAGRAMMATIC ONLY.
* LAND DIMENSIONS AND AREAS HAVE BEEN COMPILED FROM PLANS OBTAINED FROM LPMA.
* BEARINGS RELATE TO ISG NORTH ORIGINATING FROM DP857520
* LEVEL DATUM IS AHD ORIGINATING FROM SSM171745 RL 4.284 LOCATED AT BARTON STREET.
* VISIBLE, ACCESSIBLE SERVICES ONLY HAVE BEEN LOCATED. THIS PLAN DOES NOT PURPORT TO SHOW UNDERGROUND SERVICES.
* THE EXISTENCE OF UNDERGROUND SERVICES HAS NOT BEEN ESTABLISHED.
* EXISTENCE OF SERVICES MUST BE VERIFIED BY CONTACTING DIAL BEFORE YOU DIG (DBYD) 1100.COM.AU CRITICAL SERVICES MUST BE EXPOSED AND LOCATED
* NEIGHBOURING HOUSES , WINDOWS AND ROOF POSITIONS ARE APPROXIMATE ONLY.
* FLOOR LEVELS GENERALLY SURVEYED AT DOOR THRESHOLDS. INTERNAL ROOMS NOT SURVEYED.
* CONTOURS SHOWN ARE INDICATIVE OF LAND FORM. SPOT LEVELS SHOULD TAKE PRECEDENCE.
* REFER TO FACE OF PLAN FOR SUBJECT TITLE NOTATIONS.
* THIS TITLEBLOCK IS AN INTEGRAL PART OF THIS DRAWING AND SHOULD NOT BE REMOVED.

LEGEND

ELP - ELECTRIC LIGHT POLE
HYD - HYDRANT
TW - TOP WALL
TK - TOP KERB
TG - TOP GUTTER
PP - POWER POLE
SMH - SEWER MANHOLE
SP - SIGN POST
SV - STOP VALVE
TEL - TELSTRA PIT
VC - VEHICLE CROSSING
WM - WATER METER

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REV		DATE
A	CONTOURS & SERVICES ADDED	11.09.15
REV	AMENDMENTS	DATE

CLIENT: HEYMAN COHEN

PLAN OF: 119 BARTON STREET MONTEREY

BEING: LOT 2 IN DP 857520

SHOWING: GENERAL DETAIL AND SITE LEVELS

PURPOSE: ARCHITECTURAL DESIGN COUNCIL SUBMISSION

SHEET 1 0F 4

SCALE 1:400

0 10 20 30 40

SURVEYOR :	KURT F
DATUM :	AUSTRALIAN HEIGHT DATUM
ORIGIN :	SSM131745 RL 4.284
JOB REF. :	B1968
DRAWING No.	B1968–1
CHECKED :	AB
DATE OF SURVEY:	26 AUGUST 2015
REDUCTION RATIO :	1:400

MACQUARIE PARK

PO Box 4004
MACQUARIE CENTRE NSW 2113

SUITE 404, LEVEL 4
No13–15 LYON PARK ROAD,
MACQUARIE PARK NSW 2113

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PROJECT SURVEYORS
Professional Innovative… Results.

Appendix C
Absorption Tank Calculation Spreadsheet

ABSORPTION PIT DESIGN
ROCKDALE CITY COUNCIL

TANK STYLE ABSORPTION

Fill in only those boxes that appear as:

Width (m)	Length (m)	= Base Area		
8.5	25.5	216.75	Base Thickness (m) =	0.1
Height	0.8		Tank Storage=	173.4

Available Storage (m^3) = 177.735

Calculating Inflows, Outflows and Storages

Contributing Impervious Area (m^2)= 4845 F_R= 0.75

Nominal Absorption Rate (l/s/m^2) = 0.4

Design Absorption Rate (l/s/m^2) = 0.3 Outflow (l/s) = 65.025

Time (min)	Intensity (mm/hr)	Inflow (l/s)	Inflow Vol (m^3)	Ouflow Vol (m^3)	Required Vol (m^3)	Avail-Requd (m^3)
5	238	320.31	96.09	19.51	76.59	101.15
6	223	300.12	108.04	23.41	84.63	93.10
7	211	283.97	119.27	27.31	91.96	85.78
8	202	271.86	130.49	31.21	99.28	78.46
9	194	261.09	140.99	35.11	105.88	71.86
10	186	250.33	150.20	39.02	111.18	66.56
11	180	242.25	159.89	42.92	116.97	60.77
12	174	234.18	168.61	46.82	121.79	55.95
13	169	227.45	177.41	50.72	126.69	51.05
14	164	220.72	185.40	54.62	130.78	46.95
15	160	215.33	193.80	58.52	135.28	42.46
20	142	191.11	229.33	78.03	151.30	26.44
25	129	173.61	260.42	97.54	162.88	14.85
30	118	158.81	285.86	117.05	168.81	8.93
40	102	137.28	329.46	156.06	173.40	4.34
45	96	129.20	348.84	175.57	173.27	4.46
50	90.6	121.93	365.80	195.08	170.72	7.01
55	85.8	115.47	381.06	214.58	166.48	11.26
60	81.7	109.95	395.84	234.09	161.75	15.99
65	77.9	104.84	408.88	253.60	155.28	22.45
70	74.6	100.40	421.68	273.11	148.57	29.16
75	71.5	96.23	433.02	292.61	140.41	37.33
80	68.7	92.46	443.80	312.12	131.68	46.05
85	66.2	89.09	454.38	331.63	122.75	54.98
90	63.9	86.00	464.39	351.14	113.26	64.48
100	59.8	80.48	482.89	390.15	92.74	85.00
120	44.7	60.16	433.14	468.18	-35.04	212.77
						4.34

Rainwater Tank

Vol of Tank (m^3)	Offset Applies	Offset Allowance	
0	**N**	**0**	4.3350

NOTE THAT COLUMN 'Avail-Requd' MUST BE POSITIVE FOR ALL VALUES.

THE DESIGN IS: SATISFACTORY

Appendix D
Douglas Partners Geotechnical Report

Douglas Partners Pty Ltd
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Phone (02) 9809 0666
Fax (02) 9809 4095

Monterey Equity Pty Limited
c/- Heymann-Cohen Pty Ltd
Level 1/14 Martin Place
SYDNEY NSW 2000

Project 85348.00
4 March 2016
R.001.Rev0
PAV:dh

Attention: Mr Richard Pajor

Email: richard.pajor@dcwc.com.au

Dear Sirs

Geotechnical Assessment of Nominal Absorption Rate
Proposed Residential Development
119 Barton Street, Monterey

1. Introduction

This letter report describes the results of a geotechnical assessment undertaken by Douglas Partners Pty Ltd (DP) at 119 Barton Street, Monterey. The investigation was commissioned by Monterey Equity Pty Limited.

It is understood that the proposed development will include the construction of townhouses, which will include a stormwater management system.

The assessment included eight boreholes and constant-head permeability tests to assess the subsurface profile and soil permeability at potential locations of the absorption pits. The permeability testing was carried out in accordance with the requirements of Section 5.2 of Rockdale City Council's Technical Specification: Stormwater Management, dated 2011. Details of the field work are provided together with comments on stormwater management.

2. Site Description and Geology

The site is currently occupied by Francis Drake Bowling Club, which includes a single-storey building (club house), two synthetic grass bowling greens, grassed areas, garden beds and an on-grade asphaltic concrete car park. One and two-storey buildings surround the site, except where the car park adjoins Barton Street.

The ground surface slopes gently down from the site boundaries towards the central area of the site, with reduced levels ranging from approximately RL 4.9 m to RL 3.7 m relative to Australian Height Datum (AHD).

Reference to the Sydney 1:100 000 Geological Series Sheet indicates that the site is located in an area underlain by wind-blown sand (Aeolian), with some silt and shells also present.

3. Field Work

3.1 Field Work Methods

The field work for the investigation comprised:

- Eight boreholes drilled to 3 m depth or prior refusal or hole collapse using a 100 mm diameter hand-auger. The boreholes were located at the possible locations for absorption pits, as nominated by Heymann-Cohen Pty Ltd;
- Logging and collection of soil samples and observation of the soil moisture condition;
- Eight constant-head permeability tests at depths of 0.5 m or 0.55 m within each borehole and carried out in accordance with Australian Standard *AS 1547 On site domestic waste water management - 2012 - Appendix G*. For the constant-head test, the borehole was initially filled with water to saturate the soil prior to testing. A water-filled standpipe (permeameter) was then inserted into the water-filled borehole to maintain a constant head of 0.3 – 0.35 m above the base of the borehole. The water level in the standpipe was measured and recorded at regular time intervals until total water loss from the permeameter had occurred.

Surface levels at the test locations were interpolated from Survey Drawing No. B1968-1, dated 11 September 2015, by Project Surveyors Pty Ltd. The locations of the tests are shown on the attached Drawing No. 1.

3.2 Field Work Results

The detailed borehole logs and permeability test results are attached, together with notes defining classification methods and descriptive terms.

3.2.1 Boreholes

The ground conditions encountered in the boreholes can be summarised as follows:

- **Artificial Grass** – 0.01 m thick in BH1 and BH2;
- **Filling (Topsoil)** – 0.1 m thick root-affected silty sand topsoil layer in BH5 to BH8;
- **Filling** – predominantly sand and silty sand filling extending to depths of between 0.6 m and 1.2 m in all boreholes. Gravel and cobble sized inclusions of sandstone, charcoal and slag were encountered in the filling. Borehole BH4 was discontinued at 1.2 m depth due to practical refusal of the hand auger on buried concrete;

- **Sand/Sandy Gravel** – medium to coarse grained sand with traces of shells extending to the final depths (i.e. 2.7 m to 3 m) of boreholes BH1, BH3 and BH5 to BH8. Borehole BH2 had sand to 2.4 m depth underlain by sandy gravel, with auger refusal at 2.5 m depth.

Above the groundwater table, the moisture condition of the filling and natural soil was variably humid to wet, with the degree of saturation generally increasing with depth. Free groundwater was observed in BH1, BH3 and BH5 to BH8 at depths of between 2.5 m and 2.8 m.

3.2.2 Permeability Tests

The saturated hydraulic conductivity (K_{sat}) results of the eight constant-head permeability tests are summarised in Table 1.

Table 1: Results of Constant Head Permeability Tests

Permeability Test Location	Hydraulic Conductivity (K_{sat}) (m/s)
BH1	4.2×10^{-4}
BH2	1.1×10^{-3}
BH3	8.7×10^{-5}
BH4	3.5×10^{-4}
BH5	4.2×10^{-4}
BH6	7.0×10^{-4}
BH7	2.3×10^{-4}
BH8	7.0×10^{-4}

4. Comments

4.1 Proposed Development

It is understood that the proposed development will include the construction of townhouses, which will include a stormwater management system. The feasibility and potential locations of absorption pits for the stormwater system is being assessed for the development.

4.2 Soil Category and Nominal Absorption Rate

Based on the results of the constant-head tests, the 'soil category' has been correlated in accordance with Table 5.1 of AS 1547 – 2012. For all eight tests, the soil texture correlates to 'Gravels and Sands' and the (soil horizon) structure correlates to 'Structureless (Massive)'.

In accordance with Section 5.2 of Rockdale City Council's Technical Specification: Stormwater Management, dated 2011, the hydraulic conductivity for each permeability test has been calculated in terms of a nominal absorption rate (litres/square metre/second), as shown in Table 2. The nominal absorption rate has been calculated by assuming a hydraulic gradient of 1 for sandy soil. The calculated results have been rounded to the nearest 0.1 of a decimal place.

Table 2: Nominal Absorption Rate

Permeability Test Location	Nominal Absorption Rate (L/s/m^2)
BH1	0.4
BH2	1.1
BH3	0.1
BH4	0.4
BH5	0.4
BH6	0.7
BH7	0.2
BH8	0.7

5. Conclusion

Council's Specification indicates that absorption may not be practical where the nominal absorption rate is less than 0.05 L/s/m^2 or where physical limitations such as a high water table, bedrock close to ground surface or contaminated soils exist.

It should be noted that the hydraulic conductivity is dependent on the density and the degree of saturation of the soil, and therefore, it is likely to decrease with depth and vary according to weather conditions. The nominal absorption rate is also dependent upon the hydraulic gradient, that is, the rate will change with changes of the depth to the underlying water table.

Based on the permeability test results, the nominal absorption rates are greater than Council's nominal absorption rate of 0.05 L/s/m^2 and as such the use of on-site absorption pits is considered to be feasible from a hydrogeoligical point of view. It is noted that an impermeable layer such as bedrock was not encountered within the depths of the boreholes (up to 3 m deep). A relatively shallow groundwater table, however, was encountered 2.5 m to 2.8 m below the current ground surface levels. DP has not carried out a contamination assessment of soils for this site.

6. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 119 Barton Street, Monterey in accordance with DP's proposal (SYD160043.P.001.Rev1 dated 1 February 2016 and acceptance received from Monterey Equity Pty Limited dated 9 February 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Monterey Equity Pty Limited and their agents for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of

potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

Peter Valenti
Geotechnical Engineer

Reviewed by

Bruce McPherson
Principal

Attachments: About this Report
Borehole Logs
Constant Head Test Results
Drawing No. 1 – Location of Tests

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

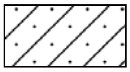
Soils


Topsoil

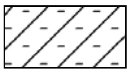

Peat


Clay

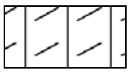

Silty clay

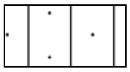

Sandy clay

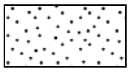

Gravelly clay

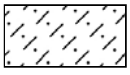

Shaly clay

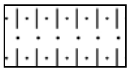

Silt


Clayey silt


Sandy silt

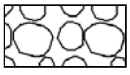

Sand

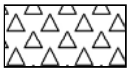

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

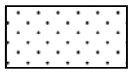

Talus

Sedimentary Rocks

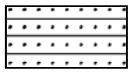

Boulder conglomerate

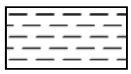

Conglomerate


Conglomeratic sandstone

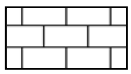

Sandstone


Siltstone


Laminite

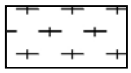

Mudstone, claystone, shale

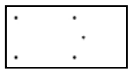

Coal


Limestone

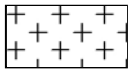
Metamorphic Rocks

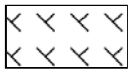

Slate, phyllite, schist

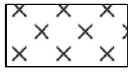

Gneiss

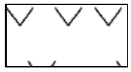

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Monterey Equity Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 119 Barton Street, Monterey

SURFACE LEVEL: 3.7 AHD
EASTING: 329004
NORTHING: 6239143
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 85348.00
DATE: 15/2/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	ARTIFICIAL GRASS		A	0.05				
		FILLING - brown, fine, gravelly, medium to coarse sand filling, humid			0.1				
		0.07m: becoming light yellow-brown		A	0.3				
		0.22m: becoming grey			0.4				
	0.45			A	0.45				
		FILLING - dark brown, medium to coarse silty sand filling with some fine to medium gravel, damp			0.5				
		0.8m: with some medium to coarse slag gravel							
	1.0	SAND - brown, medium to coarse sand with some silt, damp		A	1.1				
					1.2				
				A	1.9				
					2.0				
	2.3	SAND - light grey-brown and orange, medium to coarse sand, wet becoming saturated		A	2.4			▼	
					2.5				
	2.75	Bore discontinued at 2.75m - hole collapsed							

RIG: Hand tools **DRILLER:** MB/JS **LOGGED:** MB/JS **CASING:** Uncased

TYPE OF BORING: Hand augered to 2.75m

WATER OBSERVATIONS: Free groundwater observed at 2.55m

REMARKS: Permeability test carried out at 0.55m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Monterey Equity Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 119 Barton Street, Monterey

SURFACE LEVEL: 3.7 AHD
EASTING: 328999
NORTHING: 6239113
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 85348.00
DATE: 15/2/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	ARTIFICIAL GRASS		A	0.05				
		FILLING - brown, fine, gravelly, medium to coarse sand filling, humid			0.1				
		0.07m: becoming light yellow-brown							
		0.22m: becoming grey		A	0.4				
					0.5				
	0.6	SAND - brown, medium to coarse sand with some fine gravel and silt, damp		A	0.6				
					0.7				
		1.4m: becoming light grey-brown		A	1.5				
					1.6				
	1.8	SAND - light brown, medium to coarse sand, damp							
				A	2.1				
					2.2				
	2.4	SANDY GRAVEL - dark grey and brown, medium to coarse, sandy, fine to medium gravel with some shells		A	2.4				
	2.5	Bore discontinued at 2.5m - practical refusal on medium to coarse gravel			2.5				

RIG: Hand tools **DRILLER:** MB/JS **LOGGED:** MB/JS **CASING:** Uncased

TYPE OF BORING: Hand augered to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Permeability test carried out at 0.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Monterey Equity Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 119 Barton Street, Monterey

SURFACE LEVEL: 4.1 AHD
EASTING: 328935
NORTHING: 6239114
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 85348.00
DATE: 15/2/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
4		FILLING - dark brown-grey, medium to coarse silty sand filling with some rootlets, humid		A	0.1				
					0.2				
		0.3m: with some fine to medium sandstone and charcoal gravel							
		0.4m: becoming moist		A	0.5				
					0.6				
3	1 1.0	SAND - brown, medium to coarse sand with some shells, moist		A	1.0				1
					1.1				
				A	1.4				
					1.5				
2	2			A	1.9				2
					2.0				
				A					
	2.6	SAND - light brown, medium to coarse sand, wet becoming saturated						▼	
1	3 3.0	Bore discontinued at 3.0m - target depth reached			3.0				3
0	4								4

RIG: Hand tools **DRILLER:** MB/JS **LOGGED:** MB/JS **CASING:** Uncased

TYPE OF BORING: Hand augered to 3.0m

WATER OBSERVATIONS: Free groundwater observed at 2.7m

REMARKS: Permeability test carried out at 0.55m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Monterey Equity Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 119 Barton Street, Monterey

SURFACE LEVEL: 4.3 AHD
EASTING: 328935
NORTHING: 6239105
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 85348.00
DATE: 15/2/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - dark brown-grey, medium to coarse silty sand filling with some rootlets, humid			0.1				
				A	0.2				
					0.4				
				A	0.5				
		0.8m: with some charcoal gravel							
	1	0.9m: becoming light brown			0.9				1
				A	1.0				
					1.1				
	1.2			A	1.2				
		Bore discontinued at 1.2m - refusal on buried concrete							
	2								2
	3								3
	4								4

RIG: Hand tools **DRILLER:** MB/JS **LOGGED:** MB/JS **CASING:** Uncased
TYPE OF BORING: Hand augered to 1.2m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Permeability test carried out at 0.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Monterey Equity Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 119 Barton Street, Monterey

SURFACE LEVEL: 4.2 AHD
EASTING: 328922
NORTHING: 6239137
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 85348.00
DATE: 16/2/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - dark brown, silty, fine to medium sand filling with trace of rootlets, humid (topsoil to 0.1m)		A	0.1 0.2				
		0.5m: becoming grey-brown		A	0.5 0.6				
	1.0	SAND - pale brown, medium to coarse sand with trace of shells, moist		A	1.1 1.2				
	2.5	SAND - dark brown mottled red-brown, medium to coarse sand with trace of shells, saturated		A	2.5 2.6			▼	
	2.7	Bore discontinued at 2.7m - hole collapsed							

RIG: Hand tools **DRILLER:** MB/JS **LOGGED:** MB/JS **CASING:** Uncased

TYPE OF BORING: Hand augered to 2.7m

WATER OBSERVATIONS: Free groundwater observed at 2.5m

REMARKS: Permeability test carried out at 0.55m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Monterey Equity Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 119 Barton Street, Monterey

SURFACE LEVEL: 4.0 AHD
EASTING: 328927
NORTHING: 6239160
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 85348.00
DATE: 16/2/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
4		FILLING - dark brown, silty, fine to medium sand filling with trace of rootlets, humid (topsoil to 0.1m)			0.1				
				A	0.2				
		0.5m: becoming grey-brown							
	0.8	SAND - pale brown, medium to coarse sand with traces of shells, moist			0.8				
3	1			A	0.9				1
		1.4m: becoming grey			1.4				
				A	1.5				
2	2	2.4m: becoming pale brown mottled red							2
	2.8	SAND - pale brown mottled red, medium to coarse sand with trace of shells, saturated						▼	
1	3	3.0 Bore discontinued at 3.0m - target depth reached							3
0	4								4

RIG: Hand tools **DRILLER:** MB/JS **LOGGED:** MB/JS **CASING:** Uncased

TYPE OF BORING: Hand augered to 3.0m

WATER OBSERVATIONS: Free groundwater observed at at 2.8m

REMARKS: Permeability test carried out at 0.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Monterey Equity Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 119 Barton Street, Monterey

SURFACE LEVEL: 4.0 AHD
EASTING: 328951
NORTHING: 6239158
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 85348.00
DATE: 16/2/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
4		FILLING - dark brown, silty, fine to medium sand filling with trace of rootlets, humid (topsoil to 0.1m)		A	0.1 0.2				
		0.25m: with some fine to medium slag and sandstone gravel							
		0.4m: becoming grey-brown							
	0.6	SAND - light grey, medium to coarse sand, moist		A	0.7 0.8				
3	1								1
		1.2m: becoming brown							
		1.7m: becoming yellow-brown							
2	2								2
		2.5m: becoming light brown-grey		A	2.4 2.5				
	2.7	SAND - light brown-grey, medium to coarse sand, saturated						▼	
1	3	3.0 Bore discontinued at 3.0m - target depth reached							3
0	4								4

RIG: Hand tools **DRILLER:** MB/JS **LOGGED:** MB/JS **CASING:** Uncased

TYPE OF BORING: Hand augered to 3.0m

WATER OBSERVATIONS: Free groundwater observed at 2.7m

REMARKS: Permeability test carried out at 0.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Monterey Equity Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 119 Barton Street, Monterey

SURFACE LEVEL: 3.9 AHD
EASTING: 328977
NORTHING: 6239157
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 85348.00
DATE: 16/2/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - dark brown, silty, fine to medium sand filling with trace of rootlets, humid (topsoil to 0.1m)		A	0.1 0.2				
		0.2m: with some fine to medium sandstone gravel and brick fragments							
		0.4m: becoming grey-brown							
	0.8	SAND - brown, medium to coarse sand, moist		A	0.8 0.9				
		1.3m: becoming light brown grey							
				A	2.5 2.6				
	2.8	SAND - light brown-grey, medium to coarse sand, saturated						▼	
	3.0	Bore discontinued at 3.0m - target depth reached							

RIG: Hand tools **DRILLER:** MB/JS **LOGGED:** MB/JS **CASING:** Uncased

TYPE OF BORING: Hand augered to 3.0m

WATER OBSERVATIONS: Free groundwater observed at 2.8m

REMARKS: Permeability test carried out at 0.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Constant Head Permeameter Test Report [AS1547:2012 App G]

Client:	Monterey Equity Pty Ltd	Project No:	85348
Project:	Proposed Residential Development	Date:	15/2/16
Location:	119 Barton Street, Monterey	Tested by:	MB

Test Location

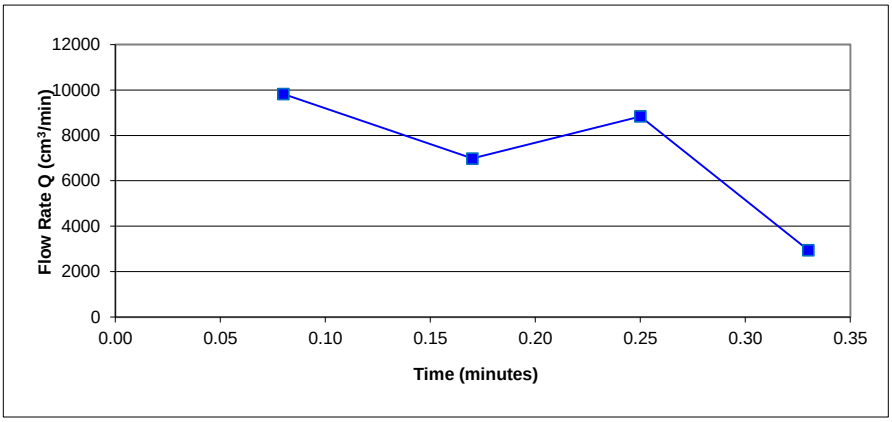
Description:	Bowling Green	**Test No.**	BH1	
Material type:	Sand Filling	Easting:	329004	m
Condition of ground surface before test: Artificial Grass		Northing	6239143	m
Weather during test: 29º, Cloudy		Surface Level:	3.7	m AHD

Details of Bore Installation

Depth of augered hole	550	mm	Depth to impermeable layer	>3	m
Depth of constant water below permeameter	350	mm	Time from filling to start	0	minutes
Diameter of hole	100	mm			

Test Results

Time (minutes)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/min)
0.00	300		
0.08	200	785	9817
0.17	120	628	6981
0.25	30	707	8836
0.33	0	236	2945
Average		589	7145



Saturated Hydraulic Conductivity - Over total duration of test

k =	**2.54E+00**	cm/min	where $K = 4.4Q[0.5 \sinh^{-1}(H/2r)-\sqrt{[(r/H^2)+0.25]}+r/H]/2\pi H^2$
=	**4.23E-04**	m/sec	ref. AS1547-2012 App G
=	**36.56**	m/day	

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Constant Head Permeameter Test Report [AS1547:2012 App G]

Client:	Monterey Equity Pty Ltd	Project No:	85348
Project:	Proposed Residential Development	Date:	15/2/16
Location:	119 Barton Street, Monterey	Tested by:	MB

Test Location

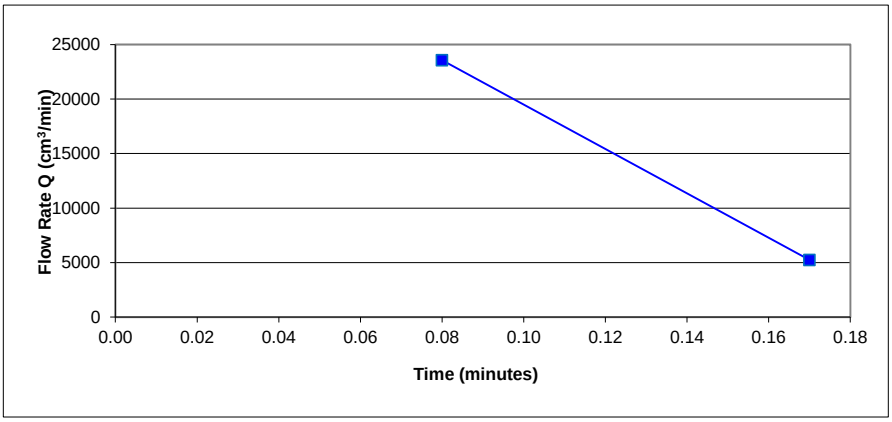
Description:	Bowling Green	**Test No.**	BH2	
Material type:	Sand Filling	Easting:	328999	m
Condition of ground surface before test: Artificial Grass		Northing	6239113	m
Weather during test: 29°, Cloudy		Surface Level:	3.7	m AHD

Details of Bore Installation

Depth of augered hole	500	mm	Depth to impermeable layer	>3	m
Depth of constant water below permeameter	300	mm	Time from filling to start	0	minutes
Diameter of hole	100	mm			

Test Results

Time (minutes)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/min)
0.00	300		
0.08	60	1885	23562
0.17	0	471	5236
Average		1178	14399



Saturated Hydraulic Conductivity - Over total duration of test

k =	**6.39E+00**	cm/min	where $K = 4.4Q[0.5 \sinh^{-1}(H/2r)-\sqrt{[(r/H^2)+0.25]}+r/H]/2\pi H^2$
=	**1.07E-03**	m/sec	ref. AS1547-2012 App G
=	**92.02**	m/day	

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Constant Head Permeameter Test Report [AS1547:2012 App G]

Client:	Monterey Equity Pty Ltd	Project No:	85348
Project:	Proposed Residential Development	Date:	15/2/16
Location:	119 Barton Street, Monterey	Tested by:	MB

Test Location

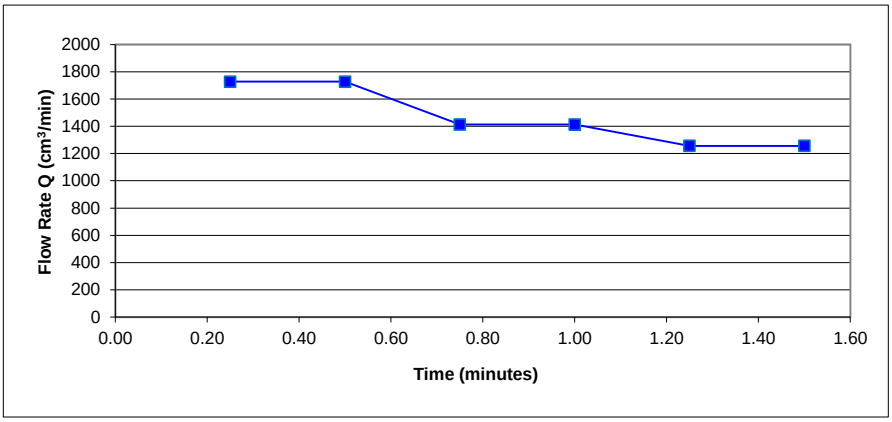
Description:	Lawn	**Test No.**	BH3	
Material type:	Silty Sand Filling	Easting:	328935	m
Condition of ground surface before test: Topsoil		Northing	6239114	m
Weather during test: 29°, Cloudy		Surface Level:	4.1	m AHD

Details of Bore Installation

Depth of augered hole	550	mm	Depth to impermeable layer	>3	m
Depth of constant water below permeameter	350	mm	Time from filling to start	0	minutes
Diameter of hole	100	mm			

Test Results

Time (minutes)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/min)
0.00	300		
0.25	245	432	1728
0.50	190	432	1728
0.75	145	353	1414
1.00	100	353	1414
1.25	60	314	1257
1.50	20	314	1257
Average		367	1466



Saturated Hydraulic Conductivity - Over total duration of test

k =	**5.21E-01**	cm/min	where $K = 4.4Q[0.5 \sinh^{-1}(H/2r)-\sqrt{[(r/H^2)+0.25]}+r/H]/2\pi H^2$
=	**8.68E-05**	m/sec	ref. AS1547-2012 App G
=	**7.50**	m/day	

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Constant Head Permeameter Test Report [AS1547:2012 App G]

Client:	Monterey Equity Pty Ltd	Project No:	85348
Project:	Proposed Residential Development	Date:	15/2/16
Location:	119 Barton Street, Monterey	Tested by:	MB

Test Location

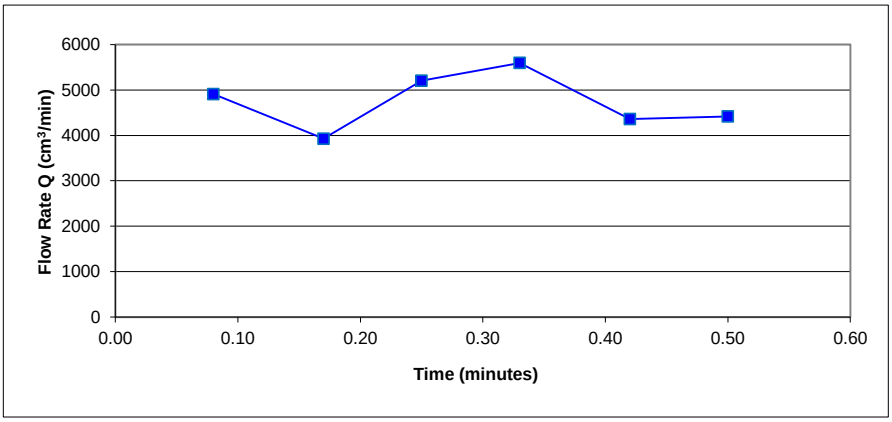
Description:	Lawn	**Test No.**	BH4	
Material type:	Silty Sandy Filling	Easting:	328935	m
Condition of ground surface before test: Topsoil		Northing	6239105	m
Weather during test: 29°, Cloudy		Surface Level:	4.3	m AHD

Details of Bore Installation

Depth of augered hole	500	mm	Depth to impermeable layer	>3	m
Depth of constant water below permeameter	300	mm	Time from filling to start	0	minutes
Diameter of hole	100	mm			

Test Results

Time (minutes)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/min)
0.00	300		
0.08	250	393	4909
0.17	205	353	3927
0.25	152	416	5203
0.33	95	448	5596
0.42	45	393	4363
0.50	0	353	4418
Average		393	4736



Saturated Hydraulic Conductivity - Over total duration of test

k =	**2.10E+00**	cm/min	where $K = 4.4Q[0.5 \sinh^{-1}(H/2r)-\sqrt{[(r/H^2)+0.25]}+r/H]/2\pi H^2$
=	**3.50E-04**	m/sec	ref. AS1547-2012 App G
=	**30.27**	m/day	

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Constant Head Permeameter Test Report [AS1547:2012 App G]

Client:	Monterey Equity Pty Ltd	Project No:	85348
Project:	Proposed Residential Development	Date:	16/2/16
Location:	119 Barton Street, Monterey	Tested by:	MB

Test Location

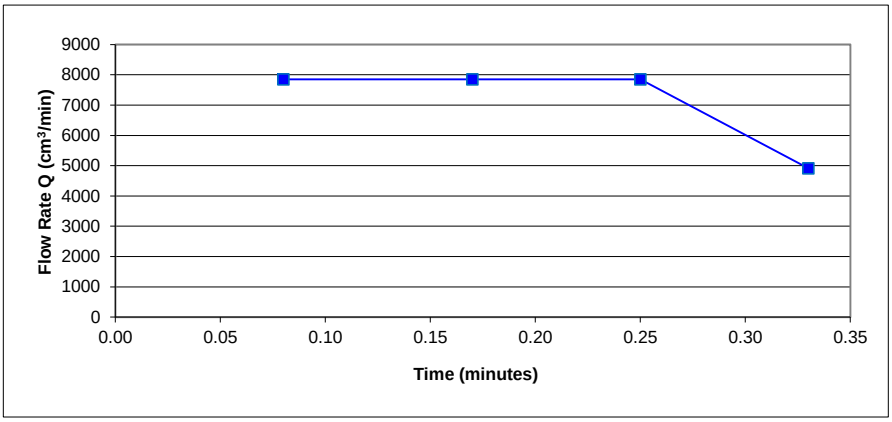
Description:	Lawn	**Test No.**	BH5	
Material type:	Silty Sandy Filling	Easting:	328922	m
Condition of ground surface before test:	Topsoil	Northing	6239137	m
Weather during test:	28°, Sunny	Surface Level:	4.2	m AHD

Details of Bore Installation

Depth of augered hole	550	mm	Depth to impermeable layer	>3	m
Depth of constant water below permeameter	350	mm	Time from filling to start	0	minutes
Diameter of hole	100	mm			

Test Results

Time (minutes)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/min)
0.00	300		
0.08	220	628	7854
0.17	130	707	7854
0.25	50	628	7854
0.33	0	393	4909
Average		589	7118



Saturated Hydraulic Conductivity - Over total duration of test

k =	**2.53E+00**	cm/min	where $K = 4.4Q[0.5 \sinh^{-1}(H/2r)-\sqrt{[(r/H^2)+0.25]}+r/H]/2\pi H^2$
=	**4.22E-04**	m/sec	ref. AS1547-2012 App G
=	**36.42**	m/day	

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Constant Head Permeameter Test Report [AS1547:2012 App G]

Client:	Monterey Equity Pty Ltd	Project No:	85348
Project:	Proposed Residential Development	Date:	16/2/16
Location:	119 Barton Street, Monterey	Tested by:	MB

Test Location

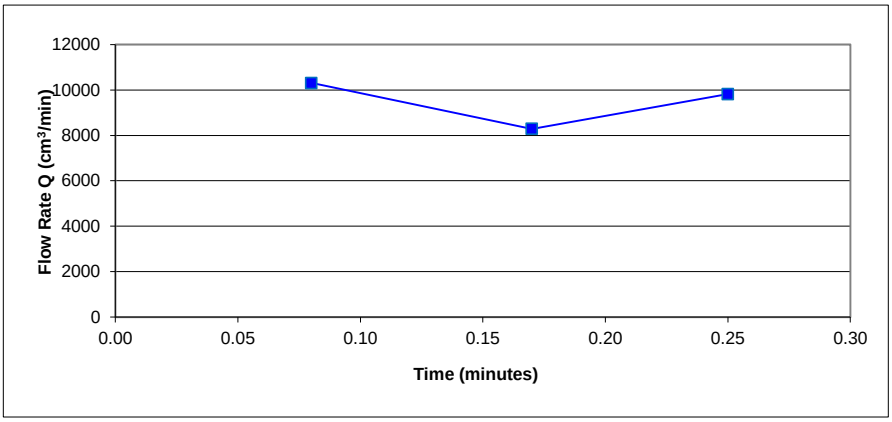
Description:	Lawn	**Test No.**	BH6	
Material type:	Silty Sandy Filling	Easting:	328927	m
Condition of ground surface before test:	Topsoil	Northing	6239160	m
Weather during test:	28°, Sunny	Surface Level:	4	m AHD

Details of Bore Installation

Depth of augered hole	500	mm	Depth to impermeable layer	>3	m
Depth of constant water below permeameter	300	mm	Time from filling to start	0	minutes
Diameter of hole	100	mm			

Test Results

Time (minutes)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/min)
0.00	300		
0.08	195	825	10308
0.17	100	746	8290
0.25	0	785	9817
Average		785	9472



Saturated Hydraulic Conductivity - Over total duration of test

k =	**4.20E+00**	cm/min	where $K = 4.4Q[0.5 \sinh^{-1}(H/2r)-\sqrt{[(r/H^2)+0.25]}+r/H]/2\pi H^2$
=	**7.01E-04**	m/sec	ref. AS1547-2012 App G
=	**60.53**	m/day	

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Constant Head Permeameter Test Report [AS1547:2012 App G]

Client:	Monterey Equity Pty Ltd	Project No:	85348
Project:	Proposed Residential Development	Date:	16/2/16
Location:	119 Barton Street, Monterey	Tested by:	MB

Test Location

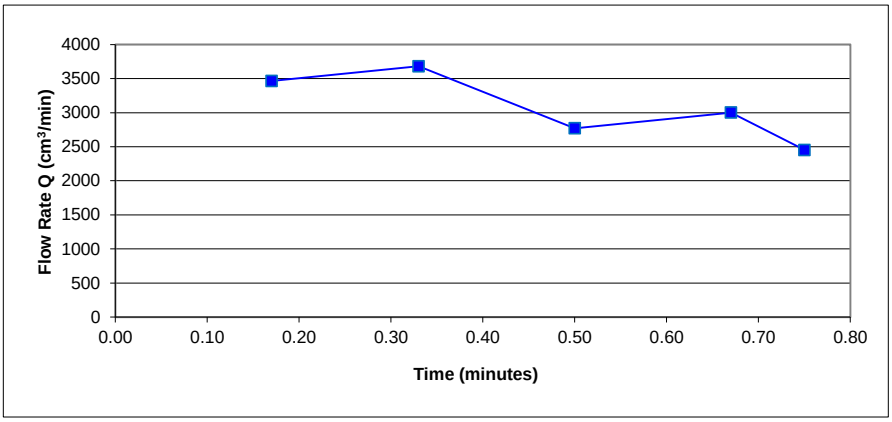
Description:	Lawn	**Test No.**	BH7	
Material type:	Silty Sandy Filling	Easting:	328951	m
Condition of ground surface before test:	Topsoil	Northing	6239158	m
Weather during test:	28°, Sunny	Surface Level:	4	m AHD

Details of Bore Installation

Depth of augered hole	500	mm	Depth to impermeable layer	>3	m
Depth of constant water below permeameter	300	mm	Time from filling to start	0	minutes
Diameter of hole	100	mm			

Test Results

Time (minutes)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/min)
0.00	300		
0.17	225	589	3465
0.33	150	589	3682
0.50	90	471	2772
0.67	25	511	3003
0.75	0	196	2454
Average		471	3075



Saturated Hydraulic Conductivity - Over total duration of test

k =	**1.36E+00**	cm/min	where $K = 4.4Q[0.5 \sinh^{-1}(H/2r)-\sqrt{[(r/H^2)+0.25]}+r/H]/2\pi H^2$
=	**2.27E-04**	m/sec	ref. AS1547-2012 App G
=	**19.65**	m/day	

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Constant Head Permeameter Test Report [AS1547:2012 App G]

Client:	Monterey Equity Pty Ltd	Project No:	85348
Project:	Proposed Residential Development	Date:	16/2/16
Location:	119 Barton Street, Monterey	Tested by:	MB

Test Location

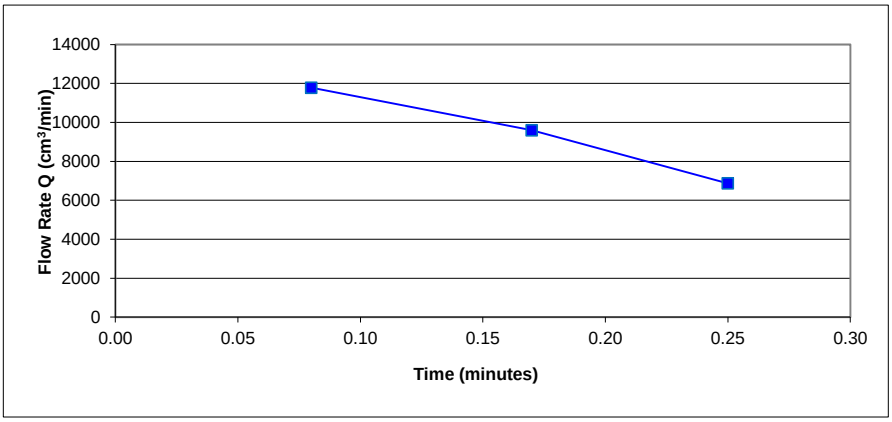
Description:	Flower Bed	**Test No.**	BH8	
Material type:	Silty Sandy Filling	Easting:	328977	m
Condition of ground surface before test:	Topsoil	Northing	6239157	m
Weather during test:	28°, Sunny	Surface Level:	3.9	m AHD

Details of Bore Installation

Depth of augered hole	500	mm	Depth to impermeable layer	>3	m
Depth of constant water below permeameter	300	mm	Time from filling to start	0	minutes
Diameter of hole	100	mm			

Test Results

Time (minutes)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/min)
0.00	300		
0.08	180	942	11781
0.17	70	864	9599
0.25	0	550	6872
Average		785	9418



Saturated Hydraulic Conductivity - Over total duration of test

k =	**4.18E+00**	cm/min	where $K = 4.4Q[0.5 \sinh^{-1}(H/2r)-\sqrt{[(r/H^2)+0.25]}+r/H]/2\pi H^2$
=	**6.97E-04**	m/sec	ref. AS1547-2012 App G
=	**60.18**	m/day	

Locality Plan

NOTE:

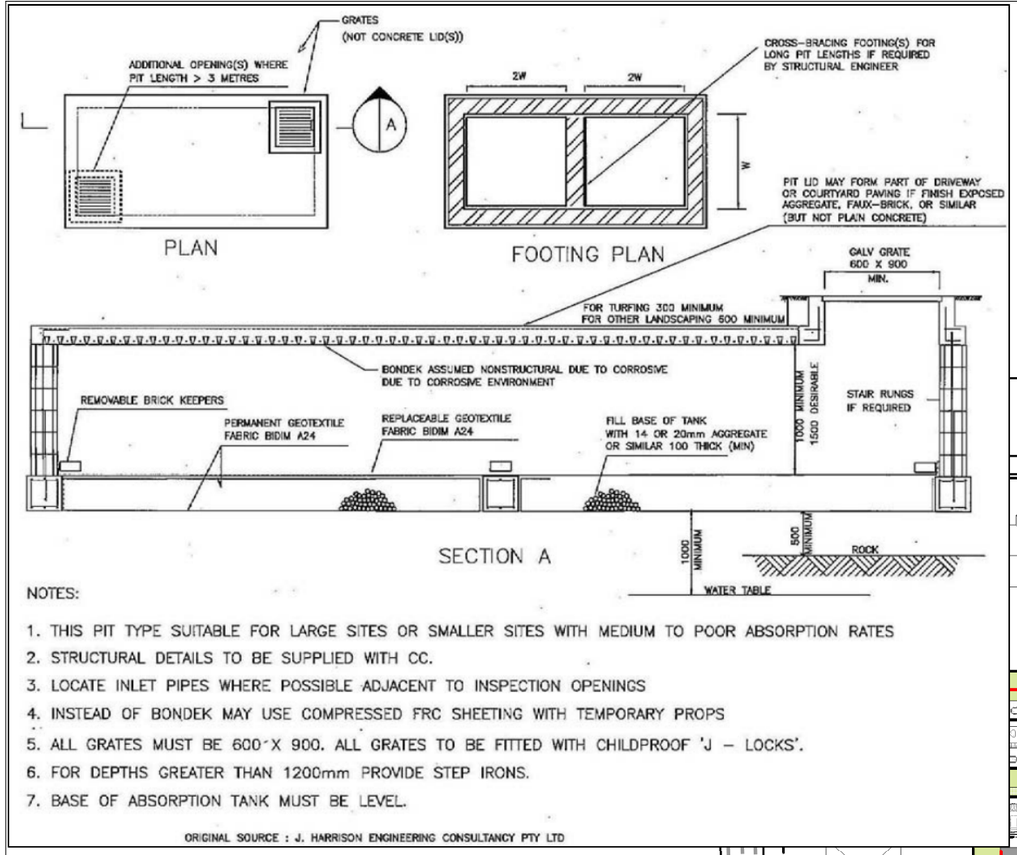
1: Base drawing from Project Surveyors (Dwg B1968-1, dated 11.9.2015)
2: Test locations are approximate only and are shown with reference to existing features.

LEGEND

Borehole and Soil Permeabilty Test Location

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Monterey Equity Pty Limited	TITLE: **Location of Tests** **Proposed Residential Development** **119 Barton Street, Monterey**	PROJECT No: 85348.00
	OFFICE: Sydney / DRAWN BY: PSCH		DRAWING No: 1
	SCALE: 1:800 @ A3 / DATE: 22.2.2016		REVISION: 0

Appendix E
ADG Conceptual Stormwater Management Layout Plan



NOTES:

1. THIS PIT TYPE SUITABLE FOR LARGE SITES OR SMALLER SITES WITH MEDIUM TO POOR ABSORPTION RATES
2. STRUCTURAL DETAILS TO BE SUPPLIED WITH CC.
3. LOCATE INLET PIPES WHERE POSSIBLE ADJACENT TO INSPECTION OPENINGS
4. INSTEAD OF BONDEK MAY USE COMPRESSED FRC SHEETING WITH TEMPORARY PROPS
5. ALL GRATES MUST BE 600 X 900. ALL GRATES TO BE FITTED WITH CHILDPROOF 'J – LOCKS'.
6. FOR DEPTHS GREATER THAN 1200mm PROVIDE STEP IRONS.
7. BASE OF ABSORPTION TANK MUST BE LEVEL.

ORIGINAL SOURCE : J. HARRISON ENGINEERING CONSULTANCY PTY LTD

COVERED TANK ABSORPTION PIT

SITE PARAMETERS –
CONTRIBUTING IMPERVIOUS AREA = 4845m2
NOMINAL ABSORPTION RATE = 0.4L/s/m2

TOWN PLANNING REQUIREMENTS

	COMPLIES
4.3.1 (8) OPEN SPACE & LANDSCAPE DESIGN 25%	YES
TYPE A 8.1m x 27m LOT = 219sqm x 0.25 = 56 sqm REQ. (ACTUAL OPEN SPACE PROVIDED = 108 sqm)	YES
TYPE B 4.5m x 27m LOT = 121.5 sqm x 0.25 = 30 sqm (ACTUAL OPEN SPACE PROVIDED = 40.5 sqm)	YES
(9) AT LEAST 20% OF THE FRONT SETBACK AREA TO BE LANDSCAPED AREA	YES
4.3.2 PRIVATE OPEN SPACE	
2 BEDROOM: 40 sqm	YES
3 BEDROOM: 50 sqm	YES
4.3.3 COMMUNAL OPEN SPACE	
5sqm PER DWELLING	YES
MIN. AREA OF 40% SUNLIGHT AT 1PM 21 JUNE	YES
PARKING	
3 BED: 2 CAR SPACES PER TOWNHOUSE REQUIRED	YES
2 BED: 1 CAR SPACE PER TOWNHOUSE REQUIRED	YES
VISITOR CAR PARKS: 1 PER 5 DWELLINGS REQ.	YES
BICYCLE: 1 SPACE / 10 DWELLINGS	YES
MOTORCYCLE: 1 SPACE / 15 DWELLINGS	YES

DEVELOPMENT SUMMARY

TOTAL SITE AREA:	7218 m2
TOTAL TOWNHOUSES:	28
	13 TYPE A (46%) 3 BED 15 TYPE B (54%) 2 BED
HEIGHT:	2 STOREYS
FSR: 0.6:1	= 7218 m2 x 0.6 = 4330 m2 MAX. GFA /28 = 154 m2 AVE. GFA PER TOWNHOUSE

Rev	Date	Description
01	09.03.2016	ISSUED FOR DA APPROVAL

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Client	HEYMANN-COHEN PTY LTD
Project Name	119 BARTON STREET, MONTEREY
Discipline	CIVIL
Status	PRELIM
Designed By	HD
Checked By	AM
Approved By	
Project No.	18623
Drawn By	HD
Scale	1:1000 (at A3)

Title	CONCEPTUAL STORMWATER MANAGEMENT SKETCH
Drawing No.	SK01
Revision	01

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