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BRINK HOLDINGS PTY. LTD. A.B.N. 75 050 212 710 Trading as: BRINK & ASSOCIATES Geotechnical, Environmental, Hydrogeological, Geological Consultants

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KENMICK GROUP PTY LTD PROPOSED RESIDENTIAL DEVELOPMENT CNR. DERBY AND CASTLEREAGH STREETS <u>PENRITH</u>

GEOTECHNICAL INVESTIGATION REPORT

BRINK HOLDINGS PTY. LTD. A.B.N. 75 050 212 710 Trading as: BRINK & ASSOCIATES Geotechnical, Environmental, Hydrogeological, Geological Consultants

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S04114-A RE:RE 8th June 2004

Kenmick Group Pty Ltd Unit 3 575 Great Western Highway FAULCONBRIDGE NSW 2776

ATTENTION: Mr. Dahdah

Dear Sir,

<u>RE:</u> Proposed Residential Development, Cnr. Derby and Castlereagh Streets, Penrith.

As requested, Brink & Associates visited the above site on the 25th May and 1st June 2004 in order to undertake a geotechnical investigation with the purpose of identifying the site's subsurface conditions and consequently providing recommendations and advice in relation to the design and construction of the proposed residential development.

This report presents the details and results of the investigation undertaken and provides information on the site's surface and subsurface conditions, the geotechnical features present and gives recommended parameters relevant for the project's structural design. Details on footing design and construction are also included.

For and on behalf of

Brink & Associates

Ralph Erni B.Sc. Eng (Civil) Senior Geotechnical Engineer

Reviewed by

R.C. Blinman, BE Civil (Hons) MIEAust CPEng NPER Manager Engineering Services

S04114-A

TABLE OF CONTENTS

Page No.

Document Set ID: 8052900 Version: 1, Version Date: 15/02/2018	

1.0	INTR	RODUCTION	4
2.0	FIEL	D INVESTIGATION	4
3.0	SITE	CONDITIONS	5
	3.1	Location	5
	3.2	Topography	5
	3.3	Surface Details	5
	3.4	Subsurface Condition	7
4.0	DISC	CUSSIONS AND RECOMMENDATIONS	8
	4.1	General	8
	4.2	Footings	11
	4.3	Earthworks	13
	4.4	Excavations and Retaining Walls	13

Field Investigation Results (14 Pages)

Drawing No. S04114-1 Site Plan

APPENDIX A -

S04114-A

3

<u>1.0</u> INTRODUCTION

As requested, Brink & Associates carried out a geotechnical investigation on the 25th May and 1st June 2004 of the combined land known as Lots 14, 15A, 15B, 16A and 16B of DP 1582 and DP 347812 in Penrith ("the site"). The purpose of this investigation was to provide detailed information on the surface and subsurface conditions of the site, to identify any constraints that need to be placed on the development from a geotechnical viewpoint and to provide recommendations and advice in relation to the design and construction of the proposed residential development.

4

We understand that the proposed development for the site is to comprise the demolition of all existing improvements and the subsequent construction of three residential apartment buildings of three to four storeys each, with the inclusion of a double-storey below-ground basement car park. Unreferenced plan and elevation drawings of the proposed development prepared by Adrian Winton Architects and a survey plan, referenced Sheet 1 of 1, prepared by T Grabara & Associates, both dated May 2003, were provided by Kenmick Group Pty Ltd for information purposes. Based on the provided design levels, we infer excavation of the land will be required to a depth of about 6.0m below current ground surface levels as part of the construction of the basement car park.

Specifically required from this investigation was detailed information on the site's subsurface conditions to determine the founding stratum and to verify that this material is suitable as a foundation for the proposed development. Recommended design parameters in relation to the site's geotechnical constraints and suitable footing and retaining wall alternatives were also to be provided. These items are discussed herein.

2.0 FIELD INVESTIGATION

The field investigation was conducted under the direction of one of our Senior Geotechnical Engineers from our Sydney office. In order to investigate the site and provide all necessary information for the design and construction of the development, the following field investigation was undertaken:

• A detailed inspection of the site's surface and surrounds to identify existing site

features and to assess geotechnical/geological consistency with the adjoining land.

- Excavation by truck mounted drill rig of five boreholes (BH1 to BH5) to depths of between 7.2m and 10.4m below the existing surface levels at the locations shown on our Drawing No. S04114-1.
- Standard Penetration Tests (SPT's) at regular intervals throughout all boreholes in order to assess the in-situ strength of the soil profile below the site.
- Collection of several soil samples of the subsurface soils from the boreholes in order to provide potential laboratory test specimens for later testing.

The above investigation was undertaken in order to gain an understanding of the site's geotechnical conditions and to assess subsurface soil strengths. The field investigation results are presented in Appendix A.

3.0 SITE CONDITIONS

3.1 Location

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The site is positioned within a predominantly residential area near the central reaches of Penrith, approximately 500m south of the Penrith Town Centre and 400m east of the Nepean Square Shopping Centre. Furthermore the site forms the north-western corner of the intersection between the kerbed and sealed Derby and Castlereagh Streets.

3.2 Topography

The site is located within and near the eastern extremity of the low-lying terrain that forms the Nepean River Valley. The land within the site and its surrounds is therefore generally flat and exhibits a gentle westward fall of typically between 1° and 3° and a crossfall of about 1° down towards the south.

3.3 Surface Details

The near square-shaped site, which covers an area of about 3600m², has a frontage of about 60m along Derby Street as well as Castlereagh Street. It encompasses five existing lots including Lots 14, 15A, 15B, 16A and 16B of DP 1582 and DP 347812.



At the time of our investigation, the two northern Lots (Lots 14 and 15A) were undeveloped aside from a concrete slab located within the north-eastern region of Lot 15A. Their surface was topped by a thick grass cover and contained a minor mound of building rubble and some compost heaps. Privets and some mature trees formed hedges along the south-western boundaries of Lots 14 and 15A as well as the north-western boundary of Lot 14. A large Wattle tree stump was encountered within the north-western corner of Lot 14.

6

Lot 15B contained within its eastern region a single-storey weatherboard and tile roof cottage that was surrounded to its east by a verandah and a lawn garden and the south by overgrown flowerbeds. Aside from a concrete slab located in the Lot's south-western corner, the remaining western region and northern driveway comprised lawn gardens.

Lot 16A contained within its central to eastern reaches a single-storey cottage of brick wall and tile roof construction. Some visible cracks within the walls are indicative of possible previous moderate foundation movement. Surrounding the building to the east was a lawn garden and to the west a concrete driveway / car parking area. Flowerbeds were located to the south of the building and within the Lot's north-western and southwestern corners. They contained predominantly bushes, some ground foliage and a number of young trees. The north-western flowerbed was surrounded and supported by a Kopper log retaining wall up to 0.5m in height as a result of the previously required filling within the site to obtain a level building platform and pavement.

Lot 16B comprised a single-storey cottage of rendered brick wall and tile roof construction, surrounded to the east and north by a concrete paved access road / car park area and to the south by a gravel topped garden. A brick wall formed the southern property boundary.

Owing to the location of the existing buildings within Lots 16A and 16B, the extensive concrete pavements and their limited accessibility, the investigation within these lots was limited to the flowerbed in the north-western corner of Lot 16A.

The properties to the north and west of the site contained two to three storey residential apartment buildings of brick wall and tiled roof construction. To the south and east of the site however, the properties contained generally single-storey residential houses of similar style and aged as those encountered within the subject site.

3.4 Subsurface Condition

The Geological map of the area (Penrith 1:100,000 Geological Series Sheet 9030) indicates the site to be located within the Nepean River Basin, which is affiliated with a large number of smaller creeks and associated flood plains. This site in particular is shown to be underlain by the Cranebrook Formation formed during the Quaternary period of the Cainozoic Era, consisting of Fluvial Gravels, Silts, Sands and / or Clays. This formation typically overlies the Bringelly Shale Formation of the Wianamatta Group. Based on the Geological map, the transition between the above formations is located about 200m south-east of the subject site.

Subsurface conditions encountered within the boreholes are detailed on the attached Engineering Logs presented in Appendix A. These logs confirm the presence of the above anticipated Cranebrook Formation and may be described in summary as follows:

TOPSOIL FILL:	SILT to a depth of about 0.3m in BH4 only, low plasticity,
	dark brown, dry to moist and poorly compacted, overlying,
FILL:	Silty Sandy GRAVELS containing crushed Concrete, Shale
	pieces and roadbase gravels to a depth of about 0.8m in BH4
	only, light grey, dry and moderately to well compacted
	or
TOPSOIL:	SILT to depths of between about 0.4m (BH1, BH2) and 0.7m
	(BH5), low plasticity, dark brown to brown, generally dry to
	moist and soft to firm, overlying,

S04114-A



FLUVIAL DEPOSITS: CLAY, Silty CLAY and Silty Sandy CLAY containing Ironstone fragments to depths of between about 6.5m (BH2) and 9.0m (BH1), medium to high plasticity, brown / dark brown grading to light grey, yellow-brown and red-brown, generally dry to moist and stiff to very stiff, overlying,

> Clayey SAND to depths of between about 7.3m (BH2) and 10.2m (BH1), fine to medium grained, brown to yellowbrown and light grey, moist and medium dense to dense, overlying,

> GRAVELS / Sandy GRAVELS to depths of between about 7.2m (BH4) and 10.4m (BH1), moist to wet, dense.

Bedrock was not encountered within the borehole excavations. The very dense Gravels encountered at the base of all boreholes induced refusal of the TC-bit.

Although groundwater was not encountered within the borehole investigations, the Gravels within BH1 and BH2 were encountered in a wet condition indicating that some ground water seepage flows are present.

4.0 DISCUSSIONS AND RECOMMENDATIONS

4.1 General

Based on the topography, our inspection of the site and the subsurface conditions encountered in our investigation and as discussed above, we believe filling within the site to have been limited to localised areas requiring level building / pavement platforms. Included in these fill areas is the raised and retained flowerbed located within the north-western corner of Lot 16A. BH4, which was excavated within this flowerbed, encountered topsoil fills consisted of low plasticity dark brown SILT to a depth of about 0.3m below ground surface level. This topsoil fill was found to be in a dry to moist condition and poorly compacted. Underlying these topsoil fills were Silty Sandy GRAVEL fills containing crushed Concrete, Shale pieces and roadbase to a depth of

about 0.8m below ground surface level. They and were light grey in colour, dry and moderately to well compacted. Other more minor and localised surface filling was identified within the site in the form of some building rubble within Lot 15A and compost heaps within Lot 14. We advise that all the topsoil fill and fill material is unsuitable as a foundation material. It must be excavated from within the development area and stockpiled for removal from site or re-use in landscaping (where applicable).

The remaining undeveloped areas were found to be covered by a layer of topsoil consisting of low plasticity dark brown to brown SILT to a depth of between about 0.4m (BH1, BH2) and 0.7m (BH5) below ground surface level. This topsoil was found to be in a dry to moist and soft to firm condition and is considered unsuitable for use as a founding stratum.

Fluvial deposits were encountered underlying the topsoils, topsoil fills and fills to depths of between about 7.2m (BH4) and 10.4m (BH1) below ground surface levels, comprising the following individual profiles:

- CLAY, Silty CLAY and Silty Sandy CLAY of medium to high plasticity was encountered to depths of between about 6.5m (BH2) and 9.0m (BH1) below ground surface levels containing varying amounts of Ironstone fragments throughout the profile. The brown / dark brown grading to light grey, yellow-brown and red-brown Clay was found to be generally in a dry to moist and stiff to very stiff condition. This soil will provide a suitable foundation but may be of limited bearing capacity when considering footings for a three to four storey building. For foundations within this soil profile, the design bearing capacity values in Table No.1 in Section 4.2 of this report may be adopted.
- Underlying these Clays was fine to medium grained Clayey SAND to depths of between about 7.3m (BH2) and 10.2m (BH1) below ground surface levels. This brown to yellow-brown and light grey material was found to be in a moist and medium dense to dense condition. This soil will provide a suitable foundation but may be of limited bearing capacity when considering footings for a three to four storey building. For foundations within this soil profile, the design bearing capacity

9

values in Table No.1 in Section 4.2 of this report may be adopted.

- GRAVELS / Sandy GRAVELS were encountered at the base of all borehole excavations. The depth to top of gravels, and analogously the thickness of the Clay and Sand profiles, increased from 7.2m (BH4) below ground surface levels within the western site regions to 10.4m (BH1) within the central to eastern regions. The dense and moist or wet Gravels induced refusal of the TC-bit and are therefore will provide the most suitable foundation for the proposed development. Design bearing capacity values are provided in Table No.1 in Section 4.2 of this report.

Rock was not encountered within our borehole excavations nor were rock outcrops identified within the subject site or it's immediate surrounds.

The groundwater table was not encountered within any of the borehole excavations. However, other investigations undertaken by Brink & Associates in previous years within the surrounding area have identified groundwater tables at depths of up to about 7.5m below ground surface levels, which are similar to the subject property's ground surface levels. We therefore anticipate the dry conditions experienced in Penrith over the last year may have caused a reduction in the groundwater table and induced the dry conditions encountered within the boreholes.

In addition, we anticipate the upper regions of the encountered fluvial deposits to be relatively impermeable to surface water ingress and subsurface seepage flows owing to their high Silt and Clay content (visually assessed as greater than 70% in volume). Seepage flows are therefore considered limited to the more sandy profile near the base of the soil and the gravelly profiles, which are considered more permeable owing to a lower Silt and Clay content. The encountered wet gravels within the BH1 and BH2 excavations support the inferred seepage conditions. On inspection of the boreholes approximately 3 hours subsequent to their completion, no build up of water was identified. This substantiates the fact that the wet conditions are the result of current slow seepage flows rather than saturated groundwater levels.



Based on the encountered conditions and the design levels, we anticipate that the seepage flows will not adversely affect the proposed development. However, we do anticipate that the seepage flows through or groundwater levels within the sandy and gravelly profiles are likely to increase during and after more substantial rainfall periods. These flows / water table may be constrained vertically by the impermeable Clays overhead, thereby generating a confined / charged aquifer within the sandy and gravelly profiles. These conditions are considered to have an adverse effect on the installation of deep footing systems.

4.2 Footings

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From our observations, our borehole investigation results and the anticipated 6.0m deep excavation of the land for the basement car park, it is evident that the Gravels (estimated bearing capacity of 500kPa), which were encountered from depths of between 1.2m and 4.2m beneath the estimated building footprints, will provide a suitable foundation for deep footings. At this level the gravels will provide a foundation, which will experience only minor settlement and ground movements. We consider that piers founding due to the Gravels will provide the most suitable footing system for the proposed building due to the depth of this stratum. This will involve removal of the overlying fluvial soils to a design level of approximately 6.0m below ground surface levels and construction of concrete piers to the depth of the Gravels. The piers are to be additionally socketed into the Gravels. The socket depth and pier dimensions depend on the load requirements and are to be based on the design bearing capacity values provided below in Table No.1. The high cost of such footings is however to be considered and weighed up against alternative footings such as pad footings. Should foundation on different materials be considered, design bearing capacity values are provided below in Table No.1.

The footings should be designed and constructed in accordance with the recommendations and advice contained in AS/NZS 2870-1996 "Residential Slabs and Footings". In addition, the development must be carried out in accordance with sound engineering principles and the following recommendations and advice:

• For the purpose of the footing design for the proposed development, the site is

classified as **CLASS H** (high ground movement) in accordance with AS/NZS 2870-1996 "Residential Slabs and Footings". We anticipate that the material has the potential to shrink and swell in the range of 40mm to 70mm due to wetting and drying processes.

- All footings of the proposed building must found on natural ground of similar bearing capacity to prevent differential movement resulting from varying foundation materials. We therefore recommend all footings to found entirely within the gravels located from depths of between about 7.2m (BH4) and 10.2m (BH1) below ground surface levels. Alternatively all footings are to found either entirely on the in-situ fluvial Clay or entirely on the fluvial Sands.
- All footings must be designed in accordance with the maximum bearing capacity values in Table 1.

T_{-1} , I_{-1} , N_{-1}	Def De Constant Vil
	Design Rearing Canacity Values
	Design Dearing Capacity values

Soil Type	End Bearing (kPa)*	Shaft Adhesion (kPa)*
Topsoil, Topsoil Fill, Fill	0	0
Fluvial Silty Clay / Clay	200	20
(<~6.5 in west or ~9.0m in east)		
Fluvial Clayey Sand	250	25
(<~7.5m in west or ~10.5m in east)		
Gravels	500	50
(> 7.2m in west or 10.5m in east)		

- * End Bearing Capacity and Shaft Adhesion values are to be verified by a Senior Geotechnical Engineer at the time of excavation.
- All footing excavations must be suitably cleaned free of loose debris and wet soil before construction.
- The foundation material is to be inspected by a Senior Geotechnical Engineer at the time of footing excavation in order to ensure that all footings found on suitable ground with the anticipated foundation conditions.

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4.3 Earthworks

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Earthworks for the preparation of building pads will necessitate excavation to depths of approximately 6m for the basement car park. These earthworks must be performed as follows:

- 1. Excavate and remove all building rubble, compost and existing vegetation from within the development area and stockpile for removal from site or re-use for landscaping (compost only).
- 2. Excavate the existing topsoils / topsoil fills from within the footprint of the footings and stockpile these for either re-use for landscaping or removal from site.
- Excavate the existing fill from the development footprint and stockpile these for either re-use within the development as 'controlled fill' as detailed below or removal from site.
- 4. Excavate the subsurface fluvial soils in the building areas to the design level of the building pads. Stockpile these materials for re-use within the development or removal from site. These soils are suitable for re-use within the development as 'controlled fill' as detailed below.
- 5. Proof roll the exposed surfaces of the building pads. A heavy (10 tonne) vibratory roller is required. This is required to assess the ability of the prepared surfaces to act both as a foundation platform for pad footings and also as a subgrade in the location of the basement carpark level.

4.4 Excavations and Retaining Walls

We understand that the construction of the basement will require excavation of up to about 6.0m to reach the bulk excavation level. Based on the results of our investigation, this excavation will intersect some topsoil fill, fill and topsoil but predominantly fluvial Silty Clay and Clay. These materials may be readily excavated using a conventional excavator.

Based on design levels and landslip possibilities within the fluvial deposits, some form of temporary retaining structure will be required. In the location of the basement level car park, these would be up to approximately 6.0m high. Sheet piled walls could be installed,

which could either be braced by soil nailing or extended to deeper depths to act as cantilevered supports. Alternatively, contiguous reinforced concrete piles could be installed as temporary support with the possibility of incorporating these into the permanent support design. Soldier pile retaining walls may be used to temporarily support shallow soil exposures, particularly where adjacent supported areas will be subjected to minor live loads only. All retaining structures must be appropriately engineered. An angle of shearing resistance of 26° and a K₀ value of 0.56 are to be adopted for the Silty Clays and Clays while a shearing resistance of 30° and a K₀ value of 0.50 are to be adopted for the Clayey Sands. Although we anticipate the excavation not to be affected by ground water, we do consider subsurface drainage will be required at the base of and behind all retaining walls, particularly if part of the permanent structure in order to reduce water pressures within the retained materials.

An alternative to constructing retaining walls is to batter / grade the excavation faces of the soil to a maximum temporary stable slope of 1V:1H (45°). The formation of battered slopes would however increase excavation extents. Due to the close vicinity of the surrounding buildings there may not be sufficient room to provide permanent batters adjacent to the site's boundaries particularly the north and east boundaries. A combination of batters and retaining structures may also be possible.

All exposed land surfaces must be paved or vegetated immediately after completion of construction in order to limit risks associated with soil erosion. Storm water flows, surface run off and collected subsurface seepage flows must be piped and discharged into Council's system or to an appropriate and Council approved discharge point down slope of the property. These flows must be prevented from entering the building site and in particular the founding stratum.

S04114-A



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Please do not hesitate to contact the undersigned if you have any queries.

For and on behalf of

Brink & Associates

 $\underline{\sim}$ \bigcirc Ralph Erni B.Sc. Eng (Civil)

Senior Geotechnical Engineer

Reviewed by · CAL

R.C. Blinman, BE Civil (Hons) MIEAust CPEng NPER Manager Engineering Services



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BRINK & Associates

Geotechnical, Geological, Environmental Consultants

Job No:	S04114-A
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Sheet	1 of 3

ENGINEERING BOREHOLE LOG

Cli	ent:				Ker	nmick Group Pty. Ltd.			Test	Locat	ion:Ref Dwg	J No. S04114	-1
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		.			Per	nrith			Surfa	ice Le	vel:Existing	Date: 25/5/0	4
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BRINK & Associates

Geotechnical, Geological, Environmental Consultants

Job No:	S04114-A
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Sheet	2 of 3

ENGINEERING BOREHOLE LOG

Cli	ent:					Ke	nmick Group Pty. Ltd.			Test	Locat	ion:Ref Dwg No. S04114	-1
Pro	oject	:	Proposed Residential Development					nent	Test Method: Truck Mounted Drill Rig				
Pro	oject	ect Location: Cnr. Derby & Castlereagh Streets					ets	Coordinates: - Logged by: RE					
		· ,				Pe	<u>nrith</u>			Surfa	<u>ice Le</u>	vel:Existing Date: 25/5/0	4
Groundwater	Samples/	Field Tests	Depth (m)	Graphic Log	Unified Classification		Descr	iption		Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
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Brink Holdings Pty Ltd ABN 75050212710 trading as

BRINK & Associates

Geotechnical, Geological, Environmental Consultants

Job No:	S04114-A
Hole No:	BH1
Sheet	3 of 3

ENGINEERING BOREHOLE LOG

	ient:					Ker	nmick Group Pty. Ltd.			Test	Locat	ion:Ref Dwg No. S04114	-1
Pr	ojec	:t:	Proposed Residential Development					ent	Test Method: Truck Mounted Drill Rig				
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					·	Per	nrith			Surfa	ice Le	vel:Existing Date: 25/5/0	4
Groundwater	Samples/	Field Tests	Depth (m)	Graphic Log	Unified Classification		Descri	ption		Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
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	$\left \right $		10.5	<u>av 3</u>			BH1 terminated (TC bit R	at 10.4 efusa	4m depth I)				10.5
		1 ator	<u></u>	tes:				··	<u> </u>	l	I	l	<u>ا</u> ــــــــــــــــــــــــــــــــــــ
	nsiste N	tenc Ver	y So	tes. ft		<u>Den</u> VL	<u>isity Index</u> Very Loose	<u>Sam</u> r B	<u>bles</u> Bulk Sample		<u>Moist</u> D D	ure Iry	
S F St	: [:	Sofi Firn Stiff	t 7 :			L MD D	Loose Medium Dense Dense	D U50	Disturbed Sample Undisturbed Samp (50mm diam.)	ole	M M W V Wp P	loist Vet Ilastic Limit	
VS H	t `	Ver Har	y Sti d	ff		VD	Very Dense	N	S.P.T. Value		WL	iquid Limit	



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Job No:	S04114-A
Hole No:	BH2
Sheet	1 of 3

ENGINEERING BOREHOLE LOG

	Clie	ent:	_			Ker	mick Group Pty. Ltd	i.		Te	st I	_ocati	ion:Ref Dw	J No. S04114	-1
	Pro	ject:				Pro	posed Residential D	evelopm	ent	Te	st I	Metho	d:Truck Mo	ounted Drill Ri	ig
	Pro	oject Lo	ocati	ion:		Cnr	. Derby & Castlerea	gh Stree	ts	Co	orc	linate	S: -	Logged by: F	RE
						Per	rith			Su	rfa	ce Le	vel:Existing	Date: 25/5/04	4
	Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		Des	cription		Moisture	Condition	Consistency/ Rel. Density	Additiona	I Comments	Jepth (m)
	Ň			ЙL	ML		SILT, low p	lasticity,	brown		5	S	TOPSOIL		
	l L						· ·					F			
)			0.5	$ \mathbf{n} $	CL		Silty CLAY, medium	to low p	lasticity, brown	D/	M	St/	FLUVIAL		0.5
			<u> </u>	I.			with red-brown, cont	taining m	any Ironstone			VSt			
			<u> </u>	ויו			gr	avels							
				Kil											
			10												1.0
				ッ											
				11											
				Y											
				~											
			1.5	リリ			gra	ding to							1.5
					СН		CLAY, high plasticit	ty, yellow	-brown & light						<u> </u>
							grey from at	out ton	rdepth						
			2.0												20
			2.0												
Y															
1															
			2.5												2.5
			<u> </u>												\vdash
1															┝╌┥
			3.0												3.0
				\land	l										
					[
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1			3,5												3.5
ł				-1			Continued of	on Sheet	2 of 3	+					┝──┦
		lanator	u⊥i v No	tes:					_ •. •		1		<u></u>		└──┤
	Con	sistend	<u>y</u>	_ ,		Den	sit <u>y Index</u>	Samp	bles			<u>Moisti</u>	ure		
	vs	Ver	y So	ft		VL.	Very Loose	в	Bulk Sample			DD	ry		
	S	Sof	ť			L	Loose	D	Disturbed Samp	ple		M M	oist		
	F	Firr	n			MD	Medium Dense	U50	Undisturbed Sa	ample		W W	/et		
	St	Stif	t or	4			Dense Vens Dense	N 7	(50mm diam.)			wp Pl with t	iastic Limit		
	vət H	ver Har	y Sü ml	11		v۵	very Dense	IN	S.F.I. value			441 L.	գատ բյուն		



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Job No:	S04114-A
Hole No:	BH2
Sheet	2 of 3

ENGINEERING BOREHOLE LOG

	Clie	ent:				Ker	mick Group Pty. Ltd.	Test	Locat	ion:Ref Dwg No. S04114	4-1
	Pro	oject:				Pro	posed Residential Development	Test	Metho	od:Truck Mounted Drill F	Rig
	Pro	oject Lo	ocati	ion:		Cn	. Derby & Castlereagh Streets	Coor	dinate	es: - Logged by:	RE
			-			Per	nrith	Surfa	ice Le	vel:Existing Date: 25/5/0)4
	Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		Description	Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
							Continued from Sheet 1 of 3				
	- N				СН	С	LAY, high plasticity, yellow-brown & light grey	D/M	St/ VSt	FLUVIAL	
)	Ŀ		4.0								4.0
							some red-brown from about 4.2m depth, containing Ironstone gravels				
			4.5								4.5
			5.0								5.0
				л Л	CL		Silty CLAY, medium plasticity, yellow-brown				
			5.5	1							5.5
)		5P1 7,11,14 N=25					becoming				
			6.0	J. J.		-	Silty Sandy CLAY from about 5.8m depth				6.0
			6.5	1)	SP		Clayey SAND, fine to medium grained,		MD/		6.5
							yellow-brown		D		
			7.0								7.0
				[Continued on Sheet 3 of 3		[[
	Exp	lanator	y No	tes:		D .	site Index		M-* •		
	Cor	nsistenc	Σ Σ			Uen Vi	<u>Samples</u>			ure	
	vS e	Ver	y 50 +	भा		VL I	Very Loose B Bulk Sample			uy loiet	
	3 E	501	ι n			⊢ MD	Medium Dense US0 Undisturbed Same	hle	W W	loist let	
	St	Stif	ri f			D	Dense (50mm diam.)	510	Wn P	lastic Limit	
	VSt	Ver	v Sti	ff		VD	Very Dense N S.P.T. Value		WE	iquid Limit	
	н	Hai	y Su d								

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Version: 1, Version Date: 15/02/2018



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Job No:	S04114-A
Hole No:	BH2
Sheet	3 of 3

ENGINEERING BOREHOLE LOG

Cli	ent:					Ke	nmick Group Pty. Ltd	1.		Test	Locat	ion:Ref Dwg No. S041	14-1
Pro	oject	:				Pro	posed Residential D	evelopm	ent	Test	Metho	d:Truck Mounted Drill	Rig
Pro	oject	Lo	cati	on:		Cn	r. Derby & Castlerea	gh Stree	ts	Coor	dinate	es: - Logged by	/: RE
					··· ···	Pe	nrith			Surfa	ice Le	vel:Existing Date: 25/5	5/04
Groundwater	Samples/	Field Tests	Depth (m)	Graphic Log	Unified Classification		Des	cription		Moisture Condition	Consistency/ Rel. Density	Additional Comments	č Depth (m)
<u> </u>					00	┞—	Continued tro	om Snee	et 2 of 3	NA/D	MOV		
		┝		· · ,	SP		Clayey SAND, fine	e to mea	ium grained,				
		ŀ		, A		}	Grave	e Ouart	7		<u>-</u>		
 		-	75	60		┣—	BH2 terminate	ed at 7 4	<u>n denth</u>		<u> </u>		75
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103 e	۱ د	very Soft	- 30	IL		vL l		n n	Disturbed Sample		MM	~y loist	
E	с Б	-irm				MD	Medium Dense	1150	Undisturbed Same	hle	W W	Vet	
St	, S	Stiff				D	Dense	000	(50mm diam.)		Wo P	lastic Limit	
VSI	: \	/en	/ Stil	ff		VD	Very Dense	N	S.P.T. Value		WL	iquid Limit	
Н	. , F	у - аго	1					••					
	nent (Set I	D 8	0520	00								

Version: 1, Version Date: 15/02/2018



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Geotechnical, Geological, Environmental Consultants

Job No:	S04114-A
Hole No:	BH3
Sheet	1 of 3

ENGINEERING BOREHOLE LOG

Clie	nt:		.		Ker	nmick Group Pty. Ltd.		·	Test	Locat	ion:Ref Dwg	No. S04114-	1
Pro	ject:				Pro	posed Residential Dev	elopm	ent	Test	Metho	od:Truck Mo	ounted Drill Rig	g
Pro	ject L	ocati	ion:		Cn	r. Derby & Castlereagh	Stree	ts	Coor	dinate	S: -	Logged by: F	RE
 					Per	nrith		<u>.</u>	Surfa	ice Le	vel:Existing	Date: 25/5/04	1
Sroundwater	samples/ ield Tests	Jepth (m)	Sraphic Log	Jnified Classification		Descri	otion		Aoisture Condition	Consistency/ Rel. Density	Additiona	I Comments)epth (m)
M	<u> </u>		114	ML		SILT. low plas	sticity.	brown		S	TOPSOIL		
			15							F			
			1817										
		0.5											0.5
			K	CL		Silty CLAY, medium to	low p	lasticity, brown	D/M	St/	FLUVIAL		
			IT		to	red-brown, containing	many	Ironstone gravels		VSt			
		1.0											1.0
Í													
		-	[]/										
ļĮ				CH		CLAY, high plasticity	, yello	w-brown with					
		1.5				light grey from ab	out 1.	3m depth					1.5
		2.0								ļ			2.0
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		2.5		:									2.5
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		3.5											3.5
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Expl	anato	ry No	tes:							•	 	······································	-1
Con	<u>sisten</u>	су			Der	<u>isity Index</u>	<u>Sam</u>	oles		<u>Moist</u>	ure		
VS	Ve	ry Sc	oft		VL	Very Loose	B	Bulk Sample		DD	iry		
S	So	ft			L	Loose	D	Disturbed Sample) nle	MM	loist		
F e₄	Fir	m #			MD	Medium Dense	U50	Undisturbed Sam	pie	Win P	Vet Vactic Limit		
SL VSt	ວແ \/e	n tv St	iff		Vn	Very Dense	N	S.P.T. Value		WIL	iauid Limit		
н	Ha	rd											



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Job No:	S04114-A
Hole No:	BH3
Sheet	2 of 3

ENGINEERING BOREHOLE LOG

Cli	ent:					Ke	nmick Group Pty. Ltd.			Test	Locati	on:Ref Dwg	No. S04114	-1
Pro	ojec	t:				Pro	posed Residential Dev	elopn	ient	Test	Metho	d:Truck Mou	nted Drill Ri	<u>g</u>
Pro	ojec	t Lo	ocati	on:		Cn	r. Derby & Castlereagh	Stree	ts	Coor	<u>dinate</u>	<u>s: - L</u>	ogged by: F	<u>RE</u>
_	r				_	Pe	nrith			Surfa		Vel:Existing L	Date: 25/5/04	4
Groundwater	Samples/	Field Tests	Depth (m)	Graphic Log	Unified Classification		Descri	otion		Moisture Condition	Consistency/ Rel. Density	Additional	Comments	Depth (m)
							Continued from	Shee	et 1 of 3					
					СН		CLAY, high plasticity light g	, yello rey	w-brown with	M/D	VSt/ St	FLUVIAL		
			4.0											4.0
													i	
			4.5											4.5
	SF 5,7	РТ 7,9				,	with some red-brown fro	om at	oout 4.6m depth					
	N=	16												
			5.0											5.0
			_											
			5.5											5.5
ļ							becon	ning						
)				.IJ.	CL	Ľ	Silty Sandy CLAY, med	lium t	o low plasticity,					
			6.0			Πį	gnt grey & yellow-browr	i with	some red-brown					6.0
				J.										
			6.5											6.5
		ļ		Ľ										
			[
			7.0											7.0
							Continued on	Sheet	3 of 3			······································		
Exp	lana	atory	/ No	tes:		<u> </u>		0	-1		14.1.1			
	nsist	enc Ver	Y V So	ft		<u>Den</u> Vi	Verv Loose	<u>Sam</u> B	Bulk Sample			ure rv		
s	:	Sof	y 30 t	"		L	Loose	D	Disturbed Sample		MM	• , oist		
F		Firn	1			MD	Medium Dense	U50	Undisturbed Samp	ble	w w	/et		
St	-	Stiff				D	Dense		(50mm diam.)		Wp P	lastic Limit		
VSI	t '	Ver	y Sti: ⊿	ff		VD	Very Dense	Ν	S.P.T. Value		WI LI	quid Limit		
IH		Har	đ						<u> </u>					

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Version: 1, Version Date: 15/02/2018



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Job No:	S04114-A
Hole No:	BH3
Sheet	3 of 3

ENGINEERING BOREHOLE LOG

Cli	ent					Ke	nmick Group Pty. Ltd.			Test	Locati	ion:Ref Dwg No. S04114	4-1
Pro	ojec	:t:				Pro	pposed Residential Dev	elopn	nent	Test	Metho	od:Truck Mounted Drill F	Rig
Pro	ojec	t Lo	cati	ion:		Cn	r. Derby & Castlereagh	Stree	ts	Coor	dinate	es: - Logged by:	RE
					-	Pe	nrith			Surfa	ace Le	vel:Existing Date: 25/5/0)4
Groundwater	Samples/	Field Tests	Depth (m)	Graphic Log	Unified Classification		Descri	ption		Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
	<u> </u>					L	Continued from	h Shee	et 2 of 3				
N I L					CL	1	Silty Sandy CLAY, mea ght grey & yellow-brown	dium f n with	o low plasticity, some red-brown	D/M	St/ VSt	FLUVIAL	
)			7.5							ł			7.5
			8.0	=\=\=	-								8.0
			8.5										85
				1-		-							
					CL and		Sandy CLAY/Clayey yellow-brown, fine gra	SANE iined (), light brown/ Sand, medium		VSt and		
			9.0	<u>·</u>	SP		plasticit	y Clay	,		D		9.0
	-												
			9.5										9.5
					SW		Clayey SA	ND, g	rey	M	D		
							0101						
			10.0				BH3 terminated (Refusal on	at 9.9 I Grav	els)				10.0
			10.5										10.5
Exp	lana	atory	/ No	tes:									
Cor	<u>isist</u>	enc	Y	_		<u>Den</u>	sity Index	<u>Sam</u>	oles		<u>Moist</u>	ure	
VS		Ver	y So	ft		VL	Very Loose	В	Bulk Sample		D D	ry	
5		Sofi					LOOSE	D	Unsturbed Sample		M M	oist	
		rum Stiff	1			עואו ת	Mealum Dense Dense	050	(50mm diam.)	Ne	Wn P	rei lastic Limit	}
VSF		Ven	v Sti	ff		vn	Very Dense	N	S.P.T. Value		WH I	iauid Limit	
Н	•	Har	d	••									



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Job No:	S04114-A
Hole No:	BH4
Sheet	1 of 2

ENGINEERING BOREHOLE LOG

Cli	ent:				Ke	nmick Group Pty. I	.td.		Test	Locat	ion:Ref Dwg	No. S04114	-1	
Pro	oject:				Pro	posed Residentia	Develop	nent	Test	Test Method: Truck Mounted Drill Rig				
Pro	oject Lo	ocati	on:		Cnr. Derby & Castlereagh Streets					Coordinates: - Logged by: RE				
					Pe	nrith			Surfa	ace Le	vel:Existing	Date: 1/6/04		
iroundwater	amples/ ield Tests	epth (m)	sraphic Log	Inified classification		ſ	locariation		foisture condition	consistency/ tel. Density	Additiono	1 Commonte	epth (m)	
	SE				┞──-		escription	ork brown		<u> 0 ¤</u>				
			\diamond	IVIL		SILT, IOW PI	asticity, u			-	I DE SOIL I	nacted)	<u> </u> i	
L.	ł	\vdash	\Diamond		ł				1			ipucied)	┝┈──	
			\bigotimes	ĞΡ	t-s	Silty Sandy GRAVE	LS, with c	rushed Concrete.	-t		FILL			
}	r -	0.5	\otimes			shale pieces a	nd roadba	se, light grey			(moderatel	y to weil	0.5	
)	ļ		X						}		compacted	ĺ)		
1			X		Į						1			
			X		L					- -	 			
				ML	S	ILT, low plasticity,	brown, co	ntaining Ironstone	D/M	F	FLUVIAL			
		1.0					gravels			{	(possibly fil	I)	1.0	
1	SPT									1	ļ		\vdash	
	N=19				<u></u>	Silty CLAY mediu	m plasticit	v vellow-brown/]	Fisi/				
		15		ŰL		brown with some	e red-brov	vn. containing		VSt			15	
		<u> </u> -	X			Irons	tone grav	els			ļ			
			\mathcal{Y}			g	rading to.			{	1			
			<u>الا</u>		ļ									
				СН	[CI	LAY, medium to hi	gh plastici	ty, red-brown with		}		i		
		2.0			}	some light grey	/grey and	yellow-brown					2.0	
1									Ì				$\left - \right $	
1		25											25	
									1					
	SPT								Į					
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		2		<u> </u>	.	y Silty CLAV mediu	rauny w. molasticit	 v. light grev and					2.	
		3.5		00	'	vellow-brown	with some	e red-brown	ļ				3.5	
H	<u> </u>	$\left - \right $	4		— —	Continue	d on Shee	t 2 of 2	+		 			
Exp	lanator	y No	tes:								• • • · · · · · · · · · · · · · · · · ·		L	
Cor	nsistenc	<u>Y</u>			Der	<u>nsity Index</u>	<u>Sam</u>	ples		<u>Moist</u>	ure		Ì	
vs	Ver	y So	ft		VL	Very Loose	В	Bulk Sample		DD	ry			
S	Sof	t			L	Loose	D	Disturbed Sampl	e	MM	oist			
F	Firr	n			MD	Medium Dense	U50	Undisturbed Sam	ple	W W	/et			
St	Stif	1 	#		U VD	Uense Voru Donas	¥1	(50mm diam.)		WP P	astic Limit		Ì	
H H	i ver Hai	y उग d	11		٩IJ	very Dense	N	S.F.I. Value		**I L)	iquiu Limit			



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Geotechnical, Geological, Environmental Consultants

Job No:	S04114-A
Hole No:	BH4
Sheet	2 of 2

ENGINEERING BOREHOLE LOG

С	lie	nt:				Ke	nmick Group Pty. Ltd.		·····	Test	Locat	ion:Ref Dwg No. S0411	4-1
P	roj	ect:				Pro	posed Residential Dev	/elopn	nent	Test	Metho	od:Truck Mounted Drill F	Rig
P	roj	ect Lo	ocat	ion:	_	Cn	r. Derby & Castlereagh	Stree	ts	Coor	dinate	es: - Logged by:	RE
						Pe	nrith			Surfa	ice Le	vel:Existing Date: 1/6/04	4
Broundwater		samples/ Field Tests	Jepth (m)	Sraphic Log	Jnified Classification		Descri	intion		Aoisture Condition	Consistency/ Sel. Density	Additional Comments	tepth (m)
٣	+	<u>0) IL</u>	┝╩╴	Р		╎──	Continued from	n Shee				Additional Comments	- 0-
				7	Ċ	<u> </u>	Silty CLAY medium pla	asticity	/ light grey and	D/M	St/	FLUVIAI	
	1						vellow-brown with	some	red-brown		VSt		
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		SPT		$\boldsymbol{\lambda}$				ig to					
	1	8,9,11		2		5	Silty Sandy CLAY, low r	plastic	tv. vellow-brown				
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Į	ļ				GP	Sa	andy GRAVELS, quartz	, coar	se grained Sands	M			
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			7.0	0.4		/	BU/ termineted		m dopth				7.0
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E	l nl	anator				L					I	<u> </u>	
	ne ne	listenr	ייי ז ע	. 		Der	sity Index	Sam	oles		Moist	re	ļ
	<u>, 10</u>	Ver	≆ vS∩	ft		VL	Verv Loose	<u></u>	Bulk Samole		D D	<u></u> ry	
s	•	Sof	, t	••		L	Loose	D	Disturbed Sample		MM	oist	
F		Firm	n			MD	Medium Dense	U50	Undisturbed Sam	ole	w w	et	Ì
St		Stif	F			D	Dense		(50mm diam.)		Wp Pl	lastic Limit	
vs	it	Ver	y Sti	ff		VD	Very Dense	Ν	S.P.T. Value		Wİ Li	quid Limit	
н		Har	d										

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Job No:	S04114-A
Hole No:	BH5
Sheet	1 of 3

ENGINEERING BOREHOLE LOG

Cl	ien	t:				Ke	nmick Group Pty. Ltd.			Test	Locat	ion:Ref Dwg	No. S04114	-1
Pr	oje	<u>ct:</u>				Pro	posed Residential Dev	velopm	nent	Test	Metho	od:Truck Mo	unted Drill Ri	g
Pr	oje	ct Lo	cati	on:		Cn	r. Derby & Castlereagh	n Stree	ts	Coor	dinate	SI -	Logged by: H	<u>RE</u>
<u> </u>	-					Pel	nrita			Suna			Date: 1/6/04	
broundwater	amples/	ield Tests	epth (m)	sraphic Log	Jnified Classificatior		Descri	intion		foisture condition	consistency/ tel. Density	Additional	Commonte	lepth (m)
	10					S	II T low plasticity dark	hrow	n containing root	<u>20</u> M	<u>o r</u>	TOPSOIL	Comments	
			0.5				fibres, Ironst	one gr	avels		to F			0.5
			1.0		CL	Si	Ity CLAY, low to mediu to brown, containing	im plas g Irons	sticity, dark brown tone gravels	•	St	FLUVIAL		1.0
			1.5		СН	CL	gradii AY, medium to high p. yellow-brown a	ng to lasticit and lig	 y, red-brown with ht grey	D/M	St/ VSt			1.5
			2.0				gradir	ng to						2.0
)			2.5		CL	ę	Silty CLAY, medium pla and yellow-brown wi	asticity ith son	v, light grey/grey ne red-brown					2.5
\$	S 7,1 N	9,12 9,12		れた										
	 		3.0	У										3.0
			3.5											3.5
 	-		-+				Continued on	Sheet	2 of 3					
Exp Co	olar nsis	ator stenc	t y Not ⊻	les:	1	Den	nsity Index	Sam	oles	L	Moist	ure		
vs		Ver	y Soʻ	ft		VL	Very Loose	в	Bulk Sample		DD	ry		
s		Sof	t			L	Loose	D	Disturbed Sample		MM	oist		
F		Firn	n •			MD	Medium Dense	U50	Undisturbed Sam	ple	WW	/et		
St		Stif	f			D	Dense Vers Deces		(50mm diam.)		Wp P	lastic Limit		
иs Н	Ľ	Ver Har	y Stil d			VD	very Dense	N	S.P.I. value		WI LI	iquid Limit		



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Job No:	S04114-A
Hole No:	BH5
Sheet	2 of 3

ENGINEERING BOREHOLE LOG

Cli	ent:				Ke	nmick Group Pty.	Ltd.			Test	Locati	on:Ref Dwg	No. S04114	-1
Pro	oject:				Pro	posed Residentia	l Devel	opm	ent	Test	Metho	d:Truck Mo	unted Drill Ri	g
Pro	oject Lo	ocati	on:		Cn	r. Derby & Castler	eagh S	tree	IS	Coor	dinate	s:	Logged by: F	RE
		,			Per	nrith				Surfa	ice Le	vel:Existing	Date: 1/6/04	
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		<u>[</u>	Descripti	00		Moisture Condition	Consistency/ Rel. Density	Additional	Comments	Depth (m)
.	<u> </u>						I from S	snee		0.04	-			
		4.0		ΟL			in piasi	цску	, iignit greyvgrey		VSt			4.0
		4.5	キオチキー											4.5
	SPT 7,8,9 N=17	5.5	1111444	СН	С	د LAY, medium to h yellow-brown	igh plas with sc	to sticit	y, light grey and red-brown	M				5.5
		6.5 7.0		CL	/ -s	ilty Sandy CLAY, with light g Continue	low pla irey and d on St	stici 1 rec neet	ty, yellow-brown I-brown 3 of 3					7.0
Exp	lanator	y No	tes:		Dee	sity Index	c				Mainte	IFO		}
Cor	isisteno	<u>y</u> er	fł		Uen Vi		<u>5</u>	amp 2	nies Bulk Somelo			116 116		
1V5 e	ver	ყ ა0 1	ΓL		VL. I	Very LOOSE	5 7	י א	Duik Jahipie Disturbad Samela		MM	•y nist		Ì
E	SU	r n			ь МП	Medium Dense	L. I	, 150	Undisturbed Sample	ole	W W	et		
C+	F III Stif	f			שיייי ח	Dense	L L		(50mm diam)		Wn P	lastic Limit		ļ
Ve	- Vor	v Cti	ff		vn	Veny Dense	,	N.	SPT Valua		WIL	auid Limit		
	. ven Hau	y Gu M	11		٩U	Tory Delibe	ĥ	4	Off TE Ading		77, LI	quia mint		



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Job No: S04114-A Hole No: BH5 Sheet 3 of 3

ENGINEERING BOREHOLE LOG

Clie	nt:				Ke	nmick Group Pty. Ltd.			Test	Locat	ion:Ref Dwg No. S0411	4-1
Pro	ject:				Pro	posed Residential Dev	elopn	nent	Test	Metho	od:Truck Mounted Drill F	₹ig
Pro	ject Lo	ocat	ion:		Сn	r. Derby & Castlereagh	Stree	ts	Coord	dinate	es: - Logged by:	RE
					Pei	nrith			Surfa	ce Le	vel:Existing Date: 1/6/04	4
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		Descri	otion	at 2 of 2	Moisture Condition	Consistency/ Rel. Density	Additional Comments	Donth (m)
						Conunued Iron		plasticity		<u>C+/</u>		+
		┣	hu l		l	Silly Sanuy CLA		plasticity,	ועו		FLUVIAL)
11		┣	I			yenow-prown with light	grey	and rea-proven]	VOL		\vdash
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	I			sw	1	Clayey SAND, fine grain	ned, y	ellow-brown to		MD/		
						light g	rey) }	D		
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		10,0	ie.			Sandy GR	AVE	S	{		,	10
-†	{					BH5 terminated a	t 10.0	m depth.			<u> </u>	Ť
}	{			ļ		(TC-bit Refusa	l in G	ravels)				
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				[
	[10.5		Í								10.
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				l								
Expla	anator	y No	tes:									
Cons	sistenc	¥			<u>Den</u>	sity Index	<u>Sam</u>	oles		<u>Moist</u>	<u>ure</u>	
VS	Ver	y So	ft		VL	Very Loose	в	Bulk Sample		D D	ry	
S	Sof	t			L	Loose	D	Disturbed Sample	_	M M	oist	
Ē	Fim	n r			MD	Medium Dense	U50	Undisturbed Samp	ble	W W	et	
5t	Stif	1	**		D V-	Dense		(50mm diam.)		Wp Pl	lastic Limit	
VSt	Ver	y Sti	11		VD	Very Dense	N	S.P.T. Value		wl Li	quid Limit	
n Imen	Har Thomas T	d 1. 80*	2900									

Version: 1, Version Date: 15/02/2018

