Tallawarra Lands Concept Plan Approval Modification

APPENDIX

GEOTECHNICAL REPORT



Geotechnical Considerations

Tallawarra Concept Approval Modification

8201714202

Prepared for Bridgehill (Tallawarra) Pty Ltd

7 August 2017







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Table of Contents

1	Introduction			
2	Agen	cy Enviro	onmental Assessment Requirements Review	2
3	Previ	3		
	3.1	Dougla	as Partners (2006-2007)	3
	3.2	Coffey	(2010)	3
	3.3	Central	l Precinct:	3
		3.3.1	Acid Sulfate Soils	3
		3.3.2	Site Observations	3
		3.3.3	Laboratory Test Results	4
		3.3.4	Groundwater	4
		3.3.5	Conclusion	4
	3.4	Northe	rn Precinct:	4
		3.4.1	Acid Sulfate Soils	4
		3.4.2	Site Observations	4
		3.4.3	Laboratory Test Results	5
		3.4.4	Groundwater	5
		3.4.5	Conclusion	5
4	Exist	ing Envir	onment: Geology & Soils	6
5	Modi	fication A	Area:	7
	5.1	Central	I Precinct	7
	5.2	Northe	rn Precinct	7
6	Conc	lusion ar	nd Recommendations	9

Appendices

Appendix A	Testpit locations
Appendix B	Testpit Logs

Tables

Table 2-1	Secretary's Environmental Assessment Requirements	2
Table 5-1	Site Investigations for the Central Precinct	7
Table 5-2	Site Investigations for Northern Precinct	8

Figures

Figure 4-1	Geological Map – Approximate site locations	6



1 Introduction

A review of the geotechnical constraints associated with the Tallawarra Lands 75W modification has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the proposed modification to the Tallawarra Concept Plan (MP 09_0131 MOD 1).

A Geotechnical, Contamination and Ground Water Investigation Report for the Tallawarra Lands, Yallah, NSW was prepared by Coffey Environments and Coffey Geotechnics dated 22 December 2010. This report addressed the Northern, Central and Lakeside (Southern) precincts.

Previous studies were summarised in the Coffey reports; however, these reports were not available. A geotechnical investigation report was prepared by Douglas Partners in 2006-2007 and a number of environmental investigations were conducted by different parties. The investigations undertaken in this current study consisted of a review of the Coffey investigations and subsequent intrusive investigations.

This assessment concerns the modification areas and land surrounding the modification area where deemed necessary.



2 Agency Environmental Assessment Requirements Review

A review of the SEARs and the associated response is provided in the Table below.

Table 2-1 Secretary's Environmental Assessment Requirements

Secretary's Environmental Assessment Requirements	Precinct	Comments
	Central	There is a risk of erosion and disturbance of the soils during earthworks. Additional investigation / laboratory tests of erodibility of the soils is required for further stages of development.
Impacts of potential earthworks however detailed assessment would be undertaken as part of future detailed DA		This area poses moderate risks, however, these can be managed by appropriate engineering design, to be determined by further intrusive investigation and assessment. It is anticipated that expanding area poses limited slope instability risk for residential development following appropriate engineering design
	Northern	There is a risk of erosion and disturbance of the soils during earthworks. Additional investigation / laboratory tests of erodibility of the soils is required for further stages of development.
		The expanded areas of the Northern Precinct are not expected to have major constraints.



3 Previous Studies

The previous studies are briefly summarised below:

3.1 Douglas Partners (2006-2007)

A copy of the geotechnical investigation Report of Douglas Partners was not provided. A summary of the report was available and it is understood that the Douglas Partners Report consisted of Ash Pond Areas 1 to 3 which are outside of the modification areas.

3.2 Coffey (2010)

The objective of this report was to collect and collocate information on contamination. Geotechnical, groundwater and acid sulfate soil (ASS) concerns. With this purpose, a site walk over to identify areas of environmental and chemical concern and geotechnical constraints were undertaken. The following site investigations were conducted:

- > Geotechnical investigation consisted of 86 test pits, 7 boreholes, 9 groundwater monitoring wells and 24 piezocones. Depth of investigation changed between 0.5m to 24m.
- > 24 Cone penetration tests and pore pressure dissipation tests were carried out.
- > Shrink swell test, particle size distribution including hydrometer and Atterberg Limits test with linear shrinkage test were conducted on selected samples.

The Central Precinct was divided into two parts, the site adjacent to the proposed expansion was Zone 2(D). The proposed modification site was located in Zone 4(B) (D).

The Northern Precinct was located in Zone 1(B) and was adjacent to Zone 4 (B) (D).

Where B denoted undulating slopes and D steep slopes.

Summaries of the zones in question are presented below.

3.3 Central Precinct:

3.3.1 Acid Sulfate Soils

According to ASS Mapping presented in the report, this zone was in No Known occurrence zone.

3.3.2 <u>Site Observations</u>

Zone 2(D)

- > Sandstone outcrops were identified at several locations.
- > Disturbed and eroded soils were noted on the western and eastern sides of the zone.
- > Steep slopes were detected on the eastern side of the zone.
- > Unauthorised placement was observed at the central part of the site.
- > A pond of water was observed at the centre of the site.

Zone 4(B)(D)

- > Several dams were located.
- > Two water tanks were located in the central region, cuts and fills were observed associated with the tanks.
- > In the eastern portion an area of excavation/erosion was noted.
- > Overhead power lines extended through the zone.



3.3.3 Laboratory Test Results

Test results concerning the modification area are presented below:

Test Pit No:	Sample Depth	Geological unit	Moisture Content (%)	Shrink Swell Index (Iss, %)
CTP 36	0.00-010	Sandy Clay	32.9	5.9
CTP 33	0.8-1.0	Clay	30.4	6.6

3.3.4 <u>Groundwater</u>

It was noted that no groundwater level was observed within the depth of investigation in Zone 1 (B).

3.3.5 <u>Conclusion</u>

In conclusion, rock depths were determined to be at 1.0m - 3.0m depth. An area of fill was identified in the north western portion of the site with an inferred depth of 1.0m - 2.0m. The site was identified as:

Zone 2 (D) and Zone 4 (B) (D):

- "Upper steep slopes of hillside areas generally with slopes greater than about 10°, either colluvial and/or residual soils present in the areas. Soil cover generally less than 2m in most areas with some deeper areas near gullies overlying Budgong Sandstone."
- "Moderate Risk (with some high risk) of landslide in these areas. Further detailed geotechnical assessment works would be necessary to further refine areas suitable for development. Some of this land may be excluded from future development."

3.4 Northern Precinct:

3.4.1 Acid Sulfate Soils

According to ASS Mapping presented in the report, this zone was in a No Known Occurrence zone.

3.4.2 <u>Site Observations</u>

Zone 1(B)

- > Undulating slopes with 3 to 15° degrees of slope angles were observed.
- > Sandstone outcrops were observed at several locations.
- > Base of the valley was boggy with minor ponding.
- > Several dams were located on the site.
- > Areas of fill were noted.

Zone 4(B)(D)

- > Several dams were located.
- > Two water tanks were located at the central region, cuts and fills were observed associated with the tanks.
- > In the eastern portion an area of excavation/erosion was noted.
- > Overhead power lines extended through the zone.

3.4.3 Laboratory Test Results

Test Pit No:	Sample Depth	Geological unit	Passing 2.36mm Sieve %	Passing 75mm Sieve %	Plasticity Index	Liquid Limit	Llinear Shrinkage (%)
CTP 70	0.00-010	Sandy Clay	100	45	18	42	12
CTP 69	0.8-1.0	Sandy Clay	97	50	20	43	11

Test results concerning the modification area are presented below:

3.4.4 Groundwater

It was noted that no groundwater level was observed within the depth of investigation in Zone 2(D).

3.4.5 <u>Conclusion</u>

In conclusion, rock depths were determined to be at 1.0m - 2.0m depth. An area of fill was identified in the north eastern portion of the site with an inferred depth of 1.0m - 2.0m. The site was identified as:

Zone 1 (B):

- "Lower undulating footslopes of hillside areas, generally with slopes less than or equal to about 10°, either colluvial and/or residual soils present in the areas. Soil cover generally less than 2m in most areas with some deeper areas near gullies overlying Budgong Sandstone."
- "Generally no significant geotechnical constraints to urban development within these areas. Further geotechnical assessment works required during planning and detailed design stages for future development"

Zone 4 (B) (D):

- "Upper steep slopes of hillside areas generally with slopes greater than about 10°, either colluvial and/or residual soils present in the areas. Soil cover generally less than 2m in most areas with some deeper areas near gullies overlying Budgong Sandstone."
- "Moderate Risk (with some high risk) of landslide in these areas. Further detailed geotechnical assessment works would be necessary to further refine areas suitable for development. Some of this land may be excluded from future development."



4 Existing Environment: Geology & Soils

Reference to the Wollongong Area Coastal Quaternary Geology Map 2016 (1:100,000) indicates the site is located within Shoalhaven group (Psh) with minor localised areas of Gerringong Volcanics.

Shoalhaven Group consists of, polymictic pebble paraconglomerate, fine-grained muddy lithic sandstone. Sandy micaceous siltstone, minor shale, sporadic minor carbonate and evaporite,: Sandstone sporadically bioturbated, abundant fossil shell fragments, dropstones.

Gerringong Volcanics consist of; Latite, trachytic tuff with pebbly bands, sandstone, minor siltstone and conglomerate.

In the figure below, the approximate locations of the sites and underlying geology is presented.

9 Legend Qavf Qhap Qav Qhap ap Opat Qhạc 2pat/ 71 Qhemdw JAH Qay PO LAKELANDS Da BOOMBERRY MNT Qavf Qav VAR POINT has Qheb Qhap lher Qhaa Jav

Figure 4-1 Geological Map – Approximate site locations

5 Modification Area:

A site walkover and site investigation was conducted for the modification areas. Site observations and a site investigation summary are provided in the sections below.

5.1 Central Precinct

During site walkover, steep slopes were observed on site. Although no dams were located within the expanded areas, several dams were located on site suggesting high ground water levels. It was observed that the site was adjacent to existing structures (i.e. Telecommunication towers).

Site investigation consisted of six (6) hand augured test pits. Test pits CHA 101. CHA 102, CHA 103, CHA 104, CHA 105 and CHA 106 were excavated using hand excavation tools – shovel. Encountered subsurface stratum and rock levels are presented in the table below.

Test Pit No:	Soil Type	Soil Layer thickness (m)	Rock Type	Rock Depth (mbg)
CHA101	Sandy Silt Clayey Sandy Silt	0.4m 0.5m	Sandstone	0.9m
CHA102	Sandy Silt Silty Clay	0.4m 0.6m	Sandstone	1.0m
CHA103	Sandy Silt Silty Sand	0.6m 0.2m	Sandstone	0.8m
CHA104	Sandy Silt EW Sandstone	0.2m 0.2m	Sandstone	0.4m
CHA105	Sandy Silt EW Sandstone	0.3m 0.2m	Sandstone	0.5m
CHA106	Sandy Silt EW Sandstone	0.4m 0.4m	Sandstone	0.8m

 Table 5-1
 Site Investigations for the Central Precinct

The depth of sandstone levels are consistent with the subsoil investigation Coffey has conducted. The geology is consistent with Wollongong Area Coastal Quaternary Geology Map.

5.2 Northern Precinct

During site walkover, undulating slopes were observed on site. Several dams were located in northern precinct. Additional site investigation consisted ten (10) hand augured or excavated test pits. Test pits CTP 100, CTP101, CTP102, CTP103, CTP 104 and CTP 106 are excavated with a 5 tonne excavator and the remaining of the test pits, CHA100, CHA105, CHA107 and CHA108 were excavated using hand augers. DCP test was undertaken on following test pits: CHA100, CTP100, CTP101, CTP102, CTP103 and CTP104. Test pit logs are attached. Encountered subsurface stratum and rock levels are presented in the table below.



Table 5-2 Si	te investigations for Northern I			
Test Pit No:	Soil Type	Soil Layer thickness (m)	Rock Type	Rock Depth (mbg)
CHA100	Topsoil – Silty Clay	0.3m	Sandstone	0.9m
CHATOU	Silty Sand	0.6m	Sandstone	0.911
CHA107	Sandy Silt	0.4m	_	_
CHAIO	Silty Clay	0.4m	-	-
CHA108	Sandy Silt	0.4m		
CHATOS	Silty Clay	0.3m	-	-
	Topsoil – Silty Clay	0.4m		
CTP100	Sandy Silty Clay	0.4m	Sandstone	1.0m
	Gravelly Clay (EW Sandstone)	0.2m		
	Topsoil – Silty Clay	0.2m		
CTP101	Sandy Silty Clay	0.6m	Sandstone	1.1m
	Gravelly Clay (EW Sandstone)	0.3m		
	Topsoil – Silty Clay	0.2m		
CTP102	Sandy Silty Clay	0.3m	Sandstone	0.9m
011 102	Clay	0.2m	Ganasione	0.911
	Gravelly Clay (EW Sandstone)	0.2m		
	Topsoil - Silty Clay	0.4m		
CTP103	Sandy Silty Clay	0.4m	Sandstone	0.9m
	Silty Sand	0.1m		
	Topsoil - Silty Clay	0.7m		
CTP104	Sandy Clay (EW Sandstone)	0.25m	Sandstone	1.1m
	Sandstone (EW to DW))	0.15m		
CTP105	Sandy Silt -Silty Clay	1.8m	Sandstone	2.0m
	EW Sandstone	0.2m		2.011
	Sandy Gravelly Silt	0.4		
CTP106	Silty Clay	0.2	Sandstone	1.0m
	EW Sandstone	0.4		

Table 5-2 Site Investigations for Northern Precinct

The depth of sandstone levels is consistent with the subsoil investigation Coffey has conducted. The geology is consistent with Wollongong Area Coastal Quaternary Geology Map.



6 Conclusion and Recommendations

The following conclusions and recommendations are made:

- Data obtained from the Coffey geotechnical report is consistent with the findings from the additional test pits and hand augered boreholes drilled by Cardno. According to the data obtained at these locations shallow Sandstone is expected to be encountered. Extremely weathered sandstone depth is anticipated to be around 1.0 – 3.0m depths.
- > The geotechnical profile is consistent with Wollongong Area Coastal Quaternary Geology Map 2016 (1:100,000).
- > During the site walkover of the Central Precinct some potential/previous slope instability was observed. Further intrusive investigation is recommended to confirm the extent of any instability. The central precinct (expanding area) poses moderate risks, however, these can be managed by appropriate engineering design, to be determined by further intrusive investigation and assessment. It is anticipated that expanding area poses limited slope instability risk for residential development following appropriate engineering design. There is the potential that discrete areas may require remediation prior to dwelling construction, again, to be areas determined by further intrusive investigation.
- > The expanded areas of the Northern Precinct are not expected to have major geotechnical constraints. The existing data provides sufficient geotechnical information at this stage to understand the geotechnical constraints. Consequently, the proposed expansion does not present further geotechnical constraint.
- > There is a risk of erosion and disturbance of the soils during Earthworks. Additional investigation and associated laboratory tests of soil erodibility is required for further stages of development. These investigations should be undertaken prior to construction.
- > Areas of boggy ground suggest the existence of localised high groundwater levels, dewatering and ground improvement may be necessary for these areas. Additionally, these areas can have soft soil layers. Further assessment of soil compressibility / swell characteristics should be undertaken prior to construction.

Tallawarra Concept Approval Modification

APPENDIX APPENDIX TESTPIT LOCATIONS







Site Plan

TALLAWARRA LANDS

Legend

¢	Approximate Hand Auger Location
₽	Approximate Test Pit Location
	Proposed Lot Layout
	Watercourses (LPI)
	Cadastre (DFSI-SS, 2017)

1:10,000 Scale at A3

		Metres		
0	100	200	300	400



Map Produced by Cardno NSW/ACT Pty Ltd (WOL) Date: 2017-07-18 | Project: 8201714202 Coordinate System: GDA 1994 MGA Zone 56 Map: 8201714202-GS-001-SitePlan.mxd 01 Aerial imagery supplied by nearmap (October, 2016) Tallawarra Concept Approval Modification

APPENDIX B TESTPIT LOGS









TALLAWARRA LANDS GINT LOGS.GPJ 26/07/2017 09:46 10.0.000

TESTHOLE

ENVIRO

CARDNO

50 To

SEOTECH GLB



TALLAWARRA LANDS GINT LOGS.GPJ 26/07/2017 09:46 10.0.000

TESTHOLE

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	0.10m PID = 0.1PPM, r = 0A 0.20m	0.0-		•	0.20m	Sandy SILT: low plasticity, brown, sandstone gravel and cobbles < 80	fine grained sand, with 0 mm diameter	some	м		rootlets present	-
	0.30m PID = 0.1PPM, r = 0A			· · · · · · · · · · · · · · · · · · ·		SANDSTONE: coarse, brown, extr	remely weathered		D			
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		-		•	0.30m SANDSTONE: coarse	, orange-brov	vn, extremely weathered					
	0.40m								xw			
1	PID = 0.0PPM, r = 0A								~**			
1	0.50m	0.5 —			0.50m Test hole CHA105 ten	minated at 0.	50 m					
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	0.10m PID = 0.2PPM, r = 0A 0.20m	0.0 - -		•		Sandy SILT: low plasticity, brown, f some gravel and boulders up to 60	ine to medium grained s mm diameter	and, with	м		rootlets and earthworms	s present to 200 mm
	0.60m PID = 0.1PPM, r = 0A 0.70m	- 0.5 — -			0.40m	SANDSTONE: coarse, orange-brow	wn, extremely weathered	I	D	-		
		- - 1.0 —		•	0.80m	Test hole CHA106 terminated at 0.						
		- - 1.5 —										
D M W	M - Moist D - Disturbed Sample W - Wet ES - Environmental sample OMC - Optimum MC PL - Plastic Limit ▶ - Water seepage/inflow SPT - Standard Penetration Test				Undisturbed Sample Disturbed Sample Environmental sample Bulk Disturbed Sample Standard Penetration Test	CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	RELATIVE D VL - Very L L - Loose MD - Mediu D - Dense VD - Very D	.oose m Dense	, EI VI L M H VI		ROCK WEATHERING RS - Residual soil XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock	
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	0.10m PID = 0.3PPM, r = 0A 0.30m	0.0			Sandy SILT: low plasticity, drak bro	own .		D		rootlets present	
	0.50m PID = 0.2PPM, r = 0A 0.70m	- 0.5			0.40m Silty CLAY: medium to high plastic	ity, orange-brown, with tr	ace sand	D/M			
		- - 1.0 - - -			0.80m Test hole CHA107 terminated at 0 EOH at 0.8 m - target depth	80 m					
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PL ► ₽	- Wet C - Optim - Plasti - Wate - Wate	c Limit r seepaç r level	ge/inflow		ES - Environmental sample B - Bulk Disturbed Sample SPT - Standard Penetration Test HP - Hand/Pocket Penetrometer	F - Firm St - Stiff VSt - Very Stiff H - Hard	MD - Mediu D - Dense VD - Very D	m Dense Dense	L M H V	- Low - Medium - High	DW - Distinctly weathered DW - Slightly weathered SW - Slightly weathered FR - Fresh rock
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LOC	ATION :	Northern	n Precino	ct (see drawing for precise loo	cation)				
۲	<u>م x</u> 0		z				~_7		
GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	LOG	MATE Soil Type, plastici Rock T Seconda	RIAL DESCRIPTION ty or particle characteristic, colo ype, grain size, colour y and minor components	n. Moisture /	WEATHERING CONSISTENCY / REL DENSITY / REL DENSITY /	& OI	STRUCTURE her Observations
	PID = 0.4PPM, r = 0A 0.20m			Sandy SILT: low plasticity,	dark brown	C)	rootlets present	
				0.40m Silty CLAY: medium plastic)		
	0.50m PID = 0.2PPM, r = 0A	0.5-				C	5		
	0.70m			0.70m Test hole CHA108 termina	ted at 0.70 m				
				EOH at 0.7 m - target dep	h				
		1.0							
		-							
		1.5 —							
		2.0							
D M W	MOISTURE & GROUNDWATER SAMPLES if D - Dry U - Un M - Moist D - Dis M - Optimum MC ES - En DMC - Plastic Limit B - Bu PL - Plastic Limit SPT - Sta			D - Disturbed Sample ES - Environmental sample		RELATIVE DENSI VL - Very Loose L - Loose MD - Medium De D - Dense VD - Very Dense	ense e	ROCK STRENGTH EL Extremely low VL Very low L Low M Medium H High VH Very high EH Extremely high	ROCK WEATHERING RS - Residual soil XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock
detai		ory Notes reviations criptions.	for	CA	RDNO (NSW/A				ı

LIENT : Bri ROJECT :	•		Lan	ds	ENVIRC	NMENTAL	TEST PI	TLC)G	HOLE NO :	CTP105 EF : 8201714202
OCATION :	Talla	warr	a lan	ds						SHEET : 1 OF	
					avator		THOD : Mad		cavatio		
ATE EXCA\ OCATION :					e drawing for precise location)	LO	GGED BY :	IVID		CHECKE	D BY : JMG
LEVELS SAMPLES & FIELD TESTS	0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	GRAPHIC	LOG	SYMBOL	MATERIAL D Soil Type, plasticity or par Rock Type, gra Secondary and m	ticle characteristic, colo ain size, colour	ur	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	& Ot	STRUCTURE her Observations
	0.0				Sandy Gravelly SILT: low plasticity gravel	, dark brown with some s	sandstone			rootlets present	
0.10m PID =											
0.2PPM, r = 0A								D			
0.20m		 									
				0.30							
		Ż		0.30	Silty CLAY: medium plasticity, orar sandstone gravel (<30 mm)	ge-brown, with trace sar	nd and		-		
		V									
0.50m PID =	0.5 —	ľ						D/M			
0.2PPM, r = 0A		II.									
0.60m											
				0.70	n						
					Silty CLAY: medium to high plastic sandstone gravel (<30 mm)	ity, orange-brown, with tr	ace sand and				
		K									
4.00											
1.00m PID = 0.2PPM,	1.0	K									
r = 0A 1.10m											
		K						D/M			
		V									
	1.5										
		K									
	.	ĮĮ.		1.80			1 0 1				
					SANDSTONE: fine to medium grai sandstone, with trace mottled gree		ery weathered				
1.90m PID =								D/M			
0.1PPM, r = 0A 2.00m				2.00	n						
12.0011	2.0	•		12.001	Test hole CTP105 terminated at 2.	00 m					
	GROU	NDW		SA	MPEES & AFAELD TESTSepth	CONSISTENCY	RELATIVE D	ENSITY		OCK STRENGTH	ROCK WEATHERING
OISTURE & GROUNDWATER - Dry - Moist					- Undisturbed Sample	VS - Very Soft	VL - Very L	oose	E	L - Extremely low	RS - Residual soil
V - Wet DMC - Optim	1 - Moist V - Wet DMC - Optimum MC				Disturbed Sample Environmental sample Bulk Disturbed Sample	S - Soft F - Firm St - Stiff	L - Loose MD - Mediu D - Dense	m Dense			XW - Extremely weather DW - Distinctly weathered
PL - Plasti - Water	c Limit r seepa		flow	B SP HP	Bulk Disturbed Sample Standard Penetration Test Hand/Pocket Penetrometer	St - Stiff VSt - Very Stiff H - Hard	D - Dense VD - Very [H	- High H - Very high	SW - Slightly weathered FR - Fresh rock
		tee f	or		·					H - Extremely high	
ee Explanato etails of abbr basis of des	eviatio	ons	וע		CARDI	NO (NSW/A	CT) PT	Y LTI	D		



TALLAWARRA LANDS GINT LOGS.GPJ 26/07/2017 09:46 10.0.000

TESTHOLE

ENVIRO

CARDNO

ğ

SEOTECH GLB

	NT : Br JECT :	-		ands			TESTPIT	LOG				PRC	JEC	D:CHA100 T REF:8201714202
						rn and Central Precinct	МГ			(ation/	Chove		ET : 1	1 OF 1
	IPMENT E EXCA\				ger			THOD: Har GGED BY:		vation/s	Snove		CHE	CKED BY : MB
LOCA	ATION :	North	nern Pre	ecinct	(see d	rawing for precise location)								
GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		MATERIAL Di Soil Type, plasticity or par Rock Type, gra Secondary and m	ticle characteristic, colo ain size, colour	ır	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	(BLOW COUNT)	100 HAND 200 PENETRO-		STRUCTURE & Other Observations
		0.0 —			1	TOPSOIL, Silty CLAY, medium to h subangular to angular sandstone g	nigh plastic, dark brown, ravel	trace			4			TOPSOIL
		-			(0.30m	Same as above, with angular to su <110mm)	bangular sandstone grav	vel and cobble			4			
Not Observed		-				Silty SAND, fine to coarse grained, angular to subangular sand, mediu	brown, black and orang m dense to dense	e-red patches,			6			EW SANDSTONE
Not O		0.5 —		SM					MC < PL	St	5 13 20/RB			-
		-			0.90m									
		-				Testpit CHA100 terminated at 0.90	m							
		1.0 — - -	-			Refusal on SANDSTONE								
		-												
		-	-											
		-	-											
		2.0 —												
D M W	M - Moist D - Disturbed Sample W - Wet ES - Environmental sample OMC - Optimum MC B - Bulk Disturbed Sample PL - Plastic Limit SPT - Standard Penetration				Undisturbed Sample Disturbed Sample Environmental sample Bulk Disturbed Sample	CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	RELATIVE D VL - Very I L - Loose MD - Mediu D - Dense VD - Very I	Loose e ım Dense e	E V L N H V	1 - 1	Extrem √ery lo ∟ow Mediun High √ery hi	ely lov w n gh	XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock	
detail	Explanato ls of abbr sis of des	eviatio	ons	I		CARDI	NO (NSW/A	CT) PT	Y LTI) D		-		4202 CHA100 Page 1 OF

	NT : Bri JECT :	-		nds	Т	ESTPIT	LOG):CTP100 「REF :8201714202
					Northern and Central Precinct SK55SRX 5.5t	ME	THOD : Mad	chino Ev	covotic	n 600			OF 1
							GGED BY :		cavalic	000			CKED BY : MB
LOCA	ATION :	North	ern Pre	ecinct	(see drawing for precise location)								
GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRI Soil Type, plasticity or particle ch Rock Type, grain size Secondary and minor co	aracteristic, colo , colour	ır	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	(BLOW COUNT)	100 HAND 200 PENETRO-	400 (kPa)	STRUCTURE & Other Observations
		0.0-			TOPSOIL, Silty CLAY, moderate to high p subangular to angular sandstone gravel	lasticity, dark bro	wn, trace			6			TOPSOIL with root fibres and earthworms
		-			0.40m					6			HP In-situ = 330 - 370 kPa
Not Observed		- 0.5 —			Sandy Silty CLAY, moderate to high plast grey, fine to coarse grained sand, subang sandstone gravel					14		 X	RESIDUAL HP In-situ = 350 - 370 kPa
-		-		CL- CH				MC > PL	St to H	34/RB			
		-			0.80m Gravelly CLAY, Low plasticity, pale grey,t gravel, hard	rown mottled blac	k sandstone			-	X 	 	HP In-situ = 250 kPa EW SANDSTONE
		-		CL	1.00m			MC < PL	н				
		1.0-			Testpit CTP100 terminated at 1.00 m Refusal on SANDSTONE							 }> > 	HP In-situ > 600 kPa
		-	-										
		-	-										
		1.5 —	-										
		-	-										
		-	-										
		2.0-											
_	_	2.0	_	-		_	_	_	_	_	_	_	
D M W OMC	M - Moist W - Wet OMC - Optimum MC PL - Plastic Limit ► - Water seepage/inflow D - Disturbed Sample ES - Environmental sam B - Bulk Disturbed Sample SPT - Standard Penetratio				U - Undisturbed Sample VS D - Disturbed Sample S ES - Environmental sample F B - Buik Disturbed Sample St SPT - Standard Penetration Test VS	NSISTENCY - Very Soft - Soft - Firm - Stiff t - Very Stiff - Hard	RELATIVE D VL - Very I L - Loose MD - Mediu D - Dense VD - Very I	Loose e um Dense e	E V L M H V		xtreme 'ery low ow ledium ligh 'ery hig	ly low '	XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock
details	Explanato s of abbr sis of des	eviatio	ns		CARDNO	(NSW/A	CT) PT	Y LTI))				I

	NT : Br	-				TESTPIT	LOG					O : CTP101
	JECT: ATION:				Northern and Central Precinct						PROJEC SHEET :	CT REF : 8201714202 1 OF 1
					SK55SRX 5.5t		THOD : Mad		cavatio	on 600		
	E EXCA\ ATION:				(see drawing for precise location)	LO	GGED BY :	DA			CHE	ECKED BY : MB
									1			
GROUND WATER LEVELS	SAMPLES & FIELD TESTS	0.0 DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	Soil Type, plasticity or pa Rock Type, gr	DESCRIPTION rticle characteristic, color ain size, colour ninor components	ur	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	BLOW COUNT)	100 HAND 200 PENETRO- 300 METER 400 (kPa)	
		- 0.0			TOPSOIL, Silty CLAY, moderate to subangular to angular sandstone (o high plasticity, dark bro gravel	wn, trace			5		TOPSOIL with root fibres and earthworms
erved				CL-	Sandy Silty CLAY, moderate to hig grey, fine to coarse grained sand, sandstone gravel	gh plasticity, orange-brow subangular to angular, w	n mottled pale ith some	MC > PL	St to H	11 17 >30		RESIDUAL
Not Observed		-		СН	0.80m					6/RB		
		- 1.0		CL	Gravelly CLAY, Low plasticity, pak gravel, hard		sk sandstone	MC < PL	н			EW SANDSTONE
		-			Testpit CTP101 terminated at 1.10) m						
		1.5										
MOISTURE & GROUNDWATER D - Dry M - Moist W - Wet OMC - Optimum MC PL - Plastic Limit → Water seepage/inflow ¥ - Water level				R	SAMPLES & FIELD TESTS U - Undisturbed Sample D - Disturbed Sample ES - Environmental sample B - Bulk Disturbed Sample SPT - Standard Penetration Test HP - Hand/Pocket Penetrometer	CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	RELATIVE D VL - Very I L - Loose MD - Mediu D - Denso VD - Very I	Loose e um Dense e	E V L M H V	L - E - L - L - M - H	Extremely lo Far low .ow Medium High /ery high Extremely hi	w RS - Residual soil XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock
letail	Explanate ls of abbi sis of des	eviatio	ns		CARD	NO (NSW/A	CT) PT	Y LTI	D			14202 CTP101 Page 1 O

	NT : Bri JECT :	-		nds			TESTPI	LOG):CTP102 「REF :8201714202
						ern and Central Precinct SRX 5.5t	Δ	1ETHOD : Ma	chine Ex	vcavatio	on 60(OF 1
	EXCA				01100			OGGED BY :		loavaile	000			CKED BY : MB
.0CA	ATION :	North	ern Pre	cinct	(see	drawing for precise location)								
GROUND WAIER LEVELS	SAMPLES & FIELD TESTS	O DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		MATERIAL DE Soil Type, plasticity or part Rock Type, gra Secondary and m	ticle characteristic, co in size, colour	lour	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	BLOW COUNT)	100 HAND 200 PENETRO-		STRUCTURE & Other Observations
		- 0.0				TOPSOIL, Silty CLAY, moderate to subangular to angular sandstone g	high plasticity, dark b ravel	rown, trace			6			TOPSOIL with root fibres and earthworms
Not Observed		-		CL- CH	0.20m	Sandy Silty CLAY, moderate to hig grey, fine to coarse grained sand, s sandstone gravel	h plasticity, orange-br subangular to angular,	own mottled pale with some	MC > PL	St	5			RESIDUAL
SZ		0.5		сн	0.50m	CLAY: high plasticity, pale grey, mo medium grained sandstone gravel	ottled orange - brown,	with fine to	w	St	26 20/RB			root fibres and decomposing wood matter observed
		-		CL	0.90m	Gravelly CLAY, low plasticity, pale g gravel, hard		ack sandstone	MC < PL	St to H				EW SANDSTONE
		1.0				Testpit CTP102 terminated at 0.90 Refusal on SANDSTONE								
		-												
		- 1.5 —												
		-												
		-												
D M W	STURE & - Dry - Moist - Wet - Optim - Plasti	um MC		R	U D ES B	PLES & FIELD TESTS - Undisturbed Sample - Disturbed Sample - Environmental sample - Bulk Disturbed Sample - Standard Penetration Test	CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff	RELATIVE D VL - Very L - Loos MD - Medi D - Dens VD - Very	Loose e um Dense e	, L , N H	iL - E iL - V - L 1 - F	Medium High	ely low v	ROCK WEATHERING RS - Residual soil XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock
letail	- Water - Water Explanato s of abbr sis of des	eviatio	tes for			- Hand/Pocket Penetrometer	NO (NSW/	-		E		/ery hig Extreme		

PRO	NT : Bri JECT : ATION ·	Tallaw	/arra La		Northern and Central Precinct	TESTPIT	LOG				PRO	DJEC	D : CTP103 T REF : 8201714202 1 OF 1
EQUI DATE	IPMENT E EXCAV	TYPE /ATEC	: Kobe): 17/5	elco /17	SK55SRX 5.5t (see drawing for precise location)		THOD: Mad GGED BY:		cavatio	on 600)mm	tooth	
					(;;;;;;;;;;;;;;;				т				1
GROUND WATER LEVELS	SAMPLES & FIELD TESTS	O DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL D Soil Type, plasticity or par Rock Type, gra Secondary and n	ticle characteristic, color ain size, colour	ur	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGT	BLOW COUNT)		300 METER 400 (kPa)	STRUCTURE & Other Observations
		0.0			TOPSOIL, Silty CLAY, moderate to subangular to angular sandstone of	high plasticity, dark brov ravel	wn, trace			7			TOPSOIL with root fibres and earthworms
Not Observed		- - 0.5 —		CL- CH	0.40m Sandy Silty CLAY, moderate to hig grey, fine to coarse grained sand, sandstone gravel	h plasticity, orange-brow ubangular to angular, w	n mottled pale ith some	MC > PL	VSt	8 9 9 26 28/RB			RESIDUAL
		-		SM	0.80m Silty SAND, fine to coarse grained subangular to angular sand 0.90m Testpit CTP103 terminated at 0.90	-	e-red patches,		D to VD	-			EW SANDSTONE
		1.0 —			Refusal on SANDSTONE								
		-											
		-											
		1.5 —											
		-											
		-											
		2.0-											
D M W OMC	D - Dry U - U M - Moist D - D W - Wet ES - E OMC - Optimum MC PL - Plastic Limit → Water seepage/inflow SPT - S				D - Disturbed Sample ES - Environmental sample B - Bulk Disturbed Sample SPT - Standard Penetration Test	CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	RELATIVE D VL - Very I L - Loose MD - Mediu D - Dense VD - Very I	Loose e um Dense e	E V L M H V		Extrem /ery lo .ow /lediur High /ery hi	iely lov w n gh	XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock
detail	Explanato Is of abbr sis of des	eviatio	ns		CARDI	NO (NSW/A	CT) PT	Y LTI	D				

CLIE	NT : Br	idgehil	I			TESTPIT	LOG				HOLE	NO :	: CTP104
-											REF : 8201714202 DF 1		
EQUIPMENT TYPE : Kobelco SK55SRX 5.5t METHOD : Machine Excavation 600mm toothed													
DATE EXCAVATED : 17/5/17 LOGGED BY : DA CHECKED BY : MB LOCATION : Northern Precinct (see drawing for precise location) CHECKED BY : MB													KED BY : MB
200/		North											
GROUND WATER LEVELS	SAMPLES & FIELD TESTS	O DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL D Soil Type, plasticity or par Rock Type, gra Secondary and r	ESCRIPTION ticle characteristic, colour ain size, colour ninor components		MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	BLOW COUNT)	100 HAND 200 PENETRO- 300 METER 400 (kPa)		STRUCTURE & Other Observations
Not Observed					TOPSOIL, Silty CLAY, moderate to subangular to angular sandstone o	high plasticity, dark bro	wn, trace			6 6 5 10 26			OPSOIL with root fibres and earthworms
Not C		1.0 -		CL- CH	0.70m Sandy CLAY: medium to high plas clay, fine to medium grained angul cobble (<180mm) Rock structure observed frequently 0.95m SANDSTONE, extremely to distinc brown, mottled black and orange-b	ar sand, with sandstone	gravel and	M > PL	VSt to H	20/RB 			EW SANDSTONE EW to DW SANDSTONE
MOI D M W OMM PL Y See B detail & bas		- - - 1.5 - - - -			1.10m Testpit CTP104 terminated at 1.10 Refusal on SANDSTONE	m							-
MOI: D M W OMC PL FL	STURE & - Dry - Moist - Wet C - Optim - Plasti - Wate - Wate	ium MC c Limit r seepa			SAMPLES & FIELD TESTS U - Undisturbed Sample D - Disturbed Sample ES - Environmental sample B - Bulk Disturbed Sample SPT - Standard Penetration Test HP - Hand/Pocket Penetrometer	CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	VL - Very Loose E L - Loose VI MD - Medium Dense L D - Dense H VD - Very Dense VI						ROCK WEATHERING RS - Residual soil XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock
See I detail & bas	Explanato ls of abbr sis of des	eviatio	ns		CARDI	NO (NSW/A	CT) PT	/ LTI	D	 ''		74.4	202 CTP104 Page 1 OF