Report on Desktop Geotechnical Assessment

Raffertys Resort

81022062-001.1

Prepared for
Iris Raffertys OperationsTrust

24 February 2022

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1 Introduction

This report presents the findings of a desktop geotechnical assessment undertaken by Cardno, Now Stantec (CnS) for the proposed development at Raffertys Resort, located at Cams Wharf, NSW.

CnS were supplied with a set of architectural Masterplans of the proposed development prepared by EJE Architecture (Rev D, Dated. 2/2/22, Preliminary Consultant Issue) [1]. Based on client briefing and drawing A5 of the architectural set, the major components of the development comprise construction of;

- Site A – Residential Apartment –two (2) four-storey residential flat buildings with shared basement carpark and associated pool/landscaping.
- Site B – Tavern – two-storey tavern and function centre.
- Site C – Hotel –seven-storey hotel with under croft car parking (2 levels).
- Site D – Residential Apartment –four-storey residential flat building with basement carpark.
- Site E – Multi-Unit Housing –eight attached two-storey villas and single garage (and associated car parking along Lorikeet Loop).

The site comprises the proposed development within Lot 30 and 31 in Deposited Plan 270043, which can be seen depicted in Drawing 1 of Appendix A. It should be noted that Site E – Multi-Unit Housing is proposed at Lot 14 in Deposited Plan 270043 to the south. Geotechnical comment on Site E based on desktop geotechnical assessment will be reported under separate cover. Another separate report for Site B will also be prepared and issued.

The report has been prepared to accompany a planning proposal for the development. The works were commissioned by Iris Raffertys OperationsTrust at the request of Mr Warwick Bowyer of Iris Capital.

1.1 Purpose and Objectives

The proposed development area and adjacent sites have been subject to a range of previous geotechnical and environmental assessments in the past by Cardno and others. The current assessment comprises review of available previous investigations (where relevant) and published data in conjunction with the provided draft layout plans and a site inspection. The scope of the assessment is to provide geotechnical comment on the following;

- Suitability of site for the proposed development Site's A, C and D with respect to the geological setting;
- Preliminary Acid Sulfate Soil Assessment; and
- Requirements for further investigation.

1.2 Document Review

The following report has been prepared based on a review of previous investigations and other documents including;

- Coffey Geosciences Pty Ltd (Coffey) – "Lakeside Sector – Wallarah Peninsula – Geotechnical Soils Investigation" (Ref. N07634/07-AB, Dated. 17/11/2003) [2];
- Douglas Partners Pty Ltd (DP) – *"Report on Geotechnical Investigation – Wallarah Water and Sewer Project Wallarah*" (Ref. 39017, Dated. November 2004) [3];
- Geotech Solutions Pty Ltd (GS) – *"Preliminary Acid Sulphate Soil Assessment – Proposed Subdivision – Raffertys Resort – Cams Wharf"* (ref. GS577-002/0, Dated. 12/02/2010) [4];
- GS – "*Contamination Testing – Proposed Subdivision – Raffertys Resort, Cams Wharf*" (ref. GS577-003/0, Dated. 22/02/2010) [5];
- GS – "Site Classification Report – Raffertys Resort – Stage 1 Cams Wharf: (ref. GS577-004/0, Dated October 2011) [6];
- Published Geological and Acid Sulfate Soils maps; and
- Online Aerial Imagery.

Intrusive investigation data relevant to the current site has been extracted from the above reports to assist in providing comment on subsurface conditions. Approximate test bore and test pit data can be seen overlayed on aerial imagery in Drawing 2 of Appendix A with relevant engineering logs attached in Appendix B. Comments made in the reports and relevant laboratory testing data have been considered (where appropriate) to assist in the preparation of this report and its recommendations.

It should be noted that subsurface conditions may have changed since the investigations as a result of development and associated earthworks at the site.

2 Site Description

The proposed development site is defined as irregular shaped parcels of land situated at existing Rafferty's Resort, Cams Wharf, NSW. The proposed development (Site A to D) is situated with Lot 30 and 31 of DP 270043 and is generally bounded by:

- Lake Macquarie water front and boat shed facilities to the west;
- Existing residential development and internal road network to the north, east and south; and
- A small east-west trending gulley line traversing between proposed Site D and E to the south.

Lorikeet Loop internal road traverses between the lots.

Proposed Site E is situated in Lot 14 of DP 270043 to the south.

Topography at the site is generally categorised by west-facing foot slopes associated with undulating, steep terrain to the further east of the site. A subtle, broad east-west trending spur traverse west through the centre of the site in the envelope of the existing function centre resulting in southwest slopes in the site's southern portion and north-west in the northern portion. An east-west trending gulley line was noted through the southern portion of the site and had evidently been formalised (rock-lined) during previous developments.

The site has been subject to earthworks as a result of the original development resulting in cut and filling to create level building platforms. A few areas of cut and fill have been retained using retaining wall solutions, with others battered at grades in the order of 2H:1V. Natural slopes were estimated to fall at approximately 3-6◦ and fall towards the Lake Macquarie water edge. Surface run-off expected to follow these trends via formalised stormwater or the gulley line to the south.

A range of existing facilities and structures are present at the site including a facility building (Site B envelope), pool facility (Site A envelope) , carpark and existing commercial structures (Site E envelope).

The proposed development and existing layout at the site are depicted below in Figure 2-1 and Figure 2-2. Additional site observations are discussed in Section 5 of this report on the basis of a site walkover.

Figure 2-1 Proposed Development Layout – EJE Architecture Drawing A5 (North up Page) [1]

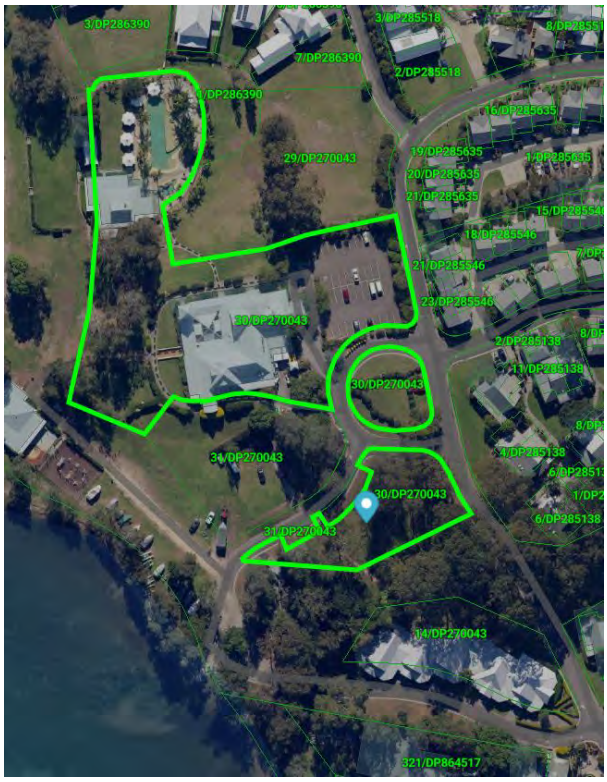

Figure 2-2 Mecone Mosiaic Aerial Imagery of Lot boundaries and Site in existing condition (North up Page) [7]

3 Published Data

3.1 Geological Mapping

Review of the Seamless Geology on NSW Government online web mapping application “Minview” [8] indicates that the proposed development Site’s A to E are predominantly underlain by the Catherine Hill Bay Formation (**Pnmc**) of the Moon Island Beach Subgroup. This formation is known to comprise Quartz-lithic pebble polymictic conglomerate, quartz-lithic sandstone, shale, carbonaceous shale, coal, tuff and soils derived from the weathering of these rocks.

The northernmost residential apartment building, proposed Site A is mapped as being underlain by Alluvial fan deposits (**Q_avf**) known to comprise fluvially-deposited quartz-lithic sand, silt, gravel and clay.

Estuarine fluvial delta front (**QH_ed**) (and sub-aqueous variant **QH_edw**) associated with Lake Macquarie and its banks are situated west of the site as close as approximately 25 m.

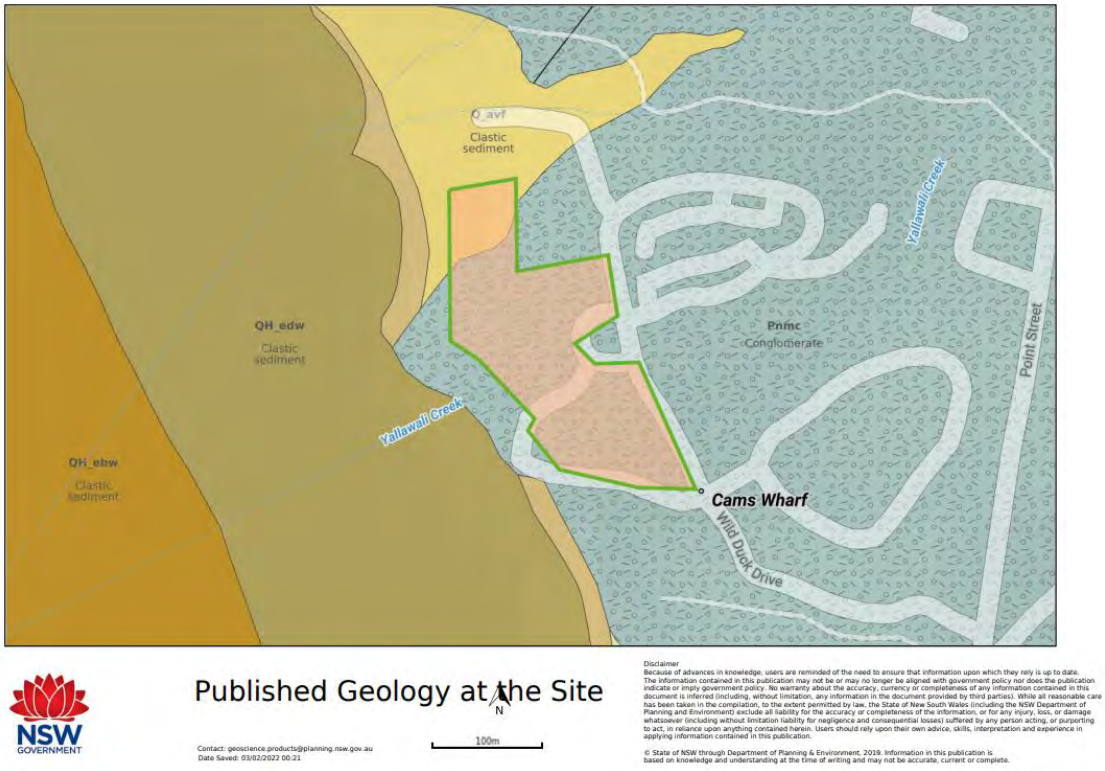

Figure 3-1 Approximate Published Geological Conditions at the Site – Seamless Geology - Minview [8]

3.2 Mine Subsidence

A review of New South Wales (NSW) Government Online Planning Portal (ePlanning Spatial Viewer) [9] indicates that the site is situated within the Swansea North Entrance Mine Subsidence District. A review of the Underground Coal Mining layer within the Planning Portal indicates that the site is clear of any mapped historical underground coal mining.

3.3 Acid Sulfate Soils

A review of NSW Government only planning portal “ePlanning Spatial Viewer” [9] indicated that the site is mapped as being within a Class 5 (ASS) area. ASS are typically not found within Class 5 areas and are classified as Class 5 as they are located within 500 metres on adjacent class 1,2,3 or 4 land. The adjacent Lake Macquarie water body is mapped as being in a Class 1 area where ASS soils are likely to be found on and below the natural ground surface.

3.3.1 Soil Landscape Maps

A review of soil landscape maps at the site was made using the online information system from Office of Environment and Heritage, Electronic Soil Profiling Maps (eSPADE) V2.1 [10]. The review found the site to be underlain by a range of landscapes summarised in Table 3-1 below.

Table 3-1 Soil Landscape Properties

Unit	Locality	Landscape	Soils and Limitations
Wyong- Wy	Predominant landscape across the site	Broad poorly drained deltaic floodplains and alluvial flats of Quaternary sediments. Slopes on the Central Coast Lowlands are <3%; local relief <10 m. Meander scrolls, oxbows, and swamps are common. Extensively cleared open-forest.	Deep (>2m) Yellow Podzxolic Soils, Brown Podzolic Soils, Soloths with some Humus Podzols around lake edges. Limitations include flooding, seasonal waterlogging, foundation hazard, strongly acidic, poorly drained, impermeable soils of very low fertility with saline subsoils. Localised areas may have permanent waterlogging, stream bank erosion and acid sulphate potential.
Doyalson - do	North-east portion of the site and upslope to the east	Gently undulation rises on Munmorah Conglomerate with Slope gradients <10% and local relief <30 m. Broad crests and ridges and long gently inclined slopes.	Sandstone/Conglomerate Parent - Moderately Deep (0.5-1.5 m) yellow Earths, Yellow Podzolic and Soloths. Siltstone/Claystone Parent – Moderately deep yellow Podzolic Soils, Soloths and some Red Podzolic Soils. Drainage lines – Moderately deep to deep (1.0 to >1.5 m) Yellow Leached Earths, Grey Earths, Soloths and Gleyed Podzolic Soils. Limitations include high erosion hazard, hard setting, stoniness, strongly acidic soils of low fertility and localised foundation hazard, high run-on, seasonal waterlogging.

Notes to table:
Derived from The Office of Environment and Heritage, Electronic Soil Profiling Maps (eSPADE) V2.1 [10].

3.4 Aerial Imagery

A range of historical aerial imagery was undertaken for the site from former projects and accessed online from NSW Government's Search and Discovery Historical Imagery Portal [11] and Metromap. Imagery from the following dates were reviewed: 1954, 1965, 1971,1976,1980,1983, 1990 1994, 1996, 2001, 2007, 2010, 2015, 2019 and current.

Key features regarding former works include;

- Between 1954 and 1984 aerials indicated the site was predominantly undeveloped with what appears to be a few small cottage style structures near the water frontage and south of proposed Site E.
- The 1990 aerial indicated road pavement construction for Lorikeet Loop and Wild Duck Drive had been undertaken.
- In the 1994 aerial, what appears to be an access track and fill pad associated with a boat shed had been constructed at the water frontage as well as a jeti.
- The 1996 aerial depicted earthworks were being undertaken to construct the fill embankment associated with the existing function centre structure.
- The 2001 aerial indicated construction of the existing function centre, car park and pool facility had been undertaken.
- The 2007 aerial imagery indicated construction of a structure in the envelope of Site C with the 2010 aerial indicating the structure had been demolished. The 2007 aerial also indicated the construction of commercial structures within the Site E envelope.
- Construction of residential structures north of proposed Site A commenced in 2015 finishing in 2019.

4 Document Review

4.1 Documents

4.1.1 Coffey, 2003 [2]

In 2003, Coffey undertook a geotechnical investigation for the wider Cams Wharf and Murrays Beach area with the aim of characterising geotechnical conditions at the site likely to impact on future development. Coffey summarised the site into five different geological units based on the investigation, each with unique features and constraints. The area of Raffertys Resort was not given a unit category; however, adjacent land was designated 'D1 – footslopes, broad, open slopes' and 'D2 – Valley Floor units'. Coffey concluded that development in Unit D2 *"is feasible with appropriate geotechnical management and design".*

Coffey noted that soils in these units based on their investigation are characterised by colluvial and residual over conglomerate in Unit D1 and variable, mostly clayey alluvium/colluvium with sandy lenses and some shallow residual soils in Unit D2. Characteristics of the units included minor ASS potential for D2 areas, minor scour and gulley erosion where not vegetated, low infiltration and boggy ground/ponding expected in lower areas (D2).

Acid Sulfate testing north of the Raffertys Resort at similar reduced levels was undertaken. Based on site observations, screening and detailed testing, Coffey concluded that the soils are not actual or potential ASS. Coffey also recommended further testing to be undertaken once the areas requiring excavation within Unit D2 are defined.

The report also contains data of previous geotechnical investigation undertaken by Coffey in 1997 with a few bores in proximity to the site (BH2-BH5). The boreholes generally indicated Sandy CLAY / Gravelly SAND / Sandy GRAVEL filling materials of depths ranging from 0.6 to 1.2 m bgl which were typically underlain by stiff to very stiff sandy and sandy gravelly CLAYs with variable minor component. Moisture was generally above plastic limit. Alluvial SAND was also encountered in BH5 to 1.1 m bgl underlying the filling. Conglomerate rock was encountered in two bores (BH5 and BH2) with auger refusal encountered at depths of 1.2 and 7.7 m bgl respectively. Groundwater was encountered during drilling at depts ranging from 0.6 to 2.5 m bgl.

4.1.2 Douglas Partner's, 2004 [3]

In 2004, DP undertook a geotechnical investigation for proposed water and sewer infrastructure across the Wallarah Peninsula area (Spanning Caves Beach, Cams Wharf and Swansea). The investigation was undertaken to assess subsurface conditions and provide engineering comment including depth to rock and groundwater, trench support, occurrence of Acid Sulfate Soils (ASS), excavation conditions etc.

Part of the proposed infrastructure comprised a lead in gravity sewer traversing to Rafferty's resort from the north. DP also augmented previous data including boreholes undertaken by Coffey Geosciences Pty Ltd (Coffey) (1997), discussed above in Section 4.1.1.

Intrusive investigation (boreholes) undertaken by DP in proximity to Raffertys Resort generally indicated conditions comprising of SILT and clayey / Gravelly SILT surficial topsoil and fill materials (≤0.7 m bgl) overlying typically firm to very stiff Gravelly / Sandy CLAY and CLAY materials with variable minor components. Clay materials were generally above plastic limit. A layer of loose, wet clayey sand was also encountered at depth (2.4 to 2.7 m). Conglomerate rock was encountered in bores 31 and 32 with auger refusal encountered at a depth of 2.8 m bgl. Seepage was encountered in bore 33 at 2.1 m bgl.

Acid Sulfate Soil (ASS) Screening tests were undertaken on samples obtained from locations of alluvial soils in proximity to the Lake Macquarie water edge. Few of the tests were taken in proximity to Raffertys Resort (BH33 and BH31). DP concluded that the results of the screenings indicate that actual acid sulfate soils are not present at the locations and depths sampled.

DP concluded that as a precautionary measure, it is recommended that a monitoring procedure is drafted, including contingency measures to treat soil (if necessary) during construction.

4.1.3 Geotech Solutions, Preliminary Acid Sulfate Soil Assessment – GS577-002.0, 2010 [4]

In 2010 Geotech Solutions Pty Ltd (GS) undertook a preliminary Acid Sulfate Soil (ASS) Assessment at Raffertys Resort, Cams Wharf for subdivision of an existing lot into unit developments. Three (3) test bores were drilled to a depth of 3.1 to 3.2 m bgl using a 300 mm spiral flight auger attached to a 5t excavator.

The test bores revealed subsurface conditions to generally comprise Gravelly Sandy Clayey SILT topsoil materials overly predominantly very stiff to hard Clays with variable Sand, silt and gravel content. TB01 also

had medium dense gravelly SAND material encountered under the clay materials from a depth of 1.8 m. Groundwater was encountered in all test bores at a depth of 2.5 to 3.0 m bgl.

Based on a range of screening and detailed (SPOCAS) ASS lab tests, it was concluded that the materials tested, while slightly acidic, were below tolerable levels as detailed in ASSMAC and would not be classified as potential or actual acid sulphate soils.

4.1.4 Geotech Solutions, Contamination Testing - GS577-003.0, 2010 [5]

In conjunction with the above Preliminary ASS Assessment, GS undertook preliminary contamination testing at the site. An additional four (4) test bores to the preliminary ASS assessment were drilled across the site for the purpose of the contamination assessment. The test bores (TB004-TB007) were advanced to depths ranging from 0.3 to 1.2 m bgl.

Test bores revealed conditions typically comprising of silty and clayey topsoils overlying hard sandy gravelly CLAYs to depths of 0.8 to 1.0 m bgl overlying Sandy CLAYs. TB007 comprised CLAY fill to 0.3 m bgl (termination depth). No groundwater was encountered in these additional test bores.

Selected samples of the encountered materials were analysed for a range of contaminants with results compared to NEMP 1999 guidelines. All tested samples were either below the laboratory limit of reporting or below compared thresholds.

4.1.5 Geotech Solutions, Site Classification – Raffertys Resort - Stage 1, 2011 – GS577-004.0, 2011 [6]

In 2011, GS undertook site classification of stage 1 of the Raffertys Resort subdivision comprising six allotments and construction of 140 m of road. Test pitting was undertaken within the allotments to a target depth of 1.5 m to 1.7 m bgl with collection of U50 tubes or laboratory testing.

Natural subsurface conditions typically comprised of Silty topsoil (≈0.15 m) overlying a mixture of stiff to very stiff Gravelly Sandy / Sandy CLAYs and medium dense Gravelly SANDs. One test bore comprised Sandy CLAY and gravelly SAND controlled fill material associated with the subdivision earthworks to a depth of 1.5 m bgl. No groundwater was encountered in the test bores; however, observation during subdivision development identified groundwater at variable levels, generally less than 2 m depth. Sitly SAND material was also encountered in TP103 to 0.5 m bgl.

Shrink swell results indicated that the clayey soils at the site encounter in the test pits ranged from slightly to moderately reactive with ISS values of 0.4 to 1.8 %.

4.2 Summary of Subsurface Conditions and laboratory Testing

The Subsurface conditions encountered in the previous intrusive investigations are summarised in Table 4-1 below.

Table 4-1 Summary of Subsurface Conditions of Previous Investigations

ID	Date	FILL	TOPSOIL	ALLUVIUM/ COLLUVIUM[2]	RESIDUAL	WRK	Refusal	Groundwater
-	-	m bgl Bottom of layer				m bgl	m	m bgl
TP101[3]	22/09/11	1.5	-	1.7	-	NE	NE	NE
TP102[3]	22/09/11	-	0.15	1.5	-	NE	NE	NE
TP103[3]	22/09/11	-	0.15	1.5	-	NE	NE	NE
TP104[3]	22/09/11	-	0.15	1.5	-	NE	NE	NE
TP105[3]	22/09/11	-	0.15	1.5	-	NE	NE	NE
TB001[4]	22/01/10	-	0.3	3.1	-	NE	NE	2.4
TB002[4]	22/01/10	-	0.25	3.1	-	NE	NE	2.9
TB003[4]	22/01/10	-	0.35	3.2	-	NE	NE	3.0
TB004[4]	22/01/10	-	0.05	1.1	-	NE	NE	NE
TB005[4]	22/01/10	-	0.07	1.1	-	NE	NE	NE
TB006[4]	22/01/10	-	0.25	1.2	-	NE	NE	NE
TB007[4]	22/01/10	0.3	-	-	-	-	NE	-
31[5]	29/08/04	-	0.5	2.8	-	2.8	2.8	NE
32[5]	29/08/04	-	0.25	2.4	-	2.4	2.8	NE
33[5]	29/08/04	0.7	-	3.0	-	NE	NE	2.1
34[5]	29/08/04	0.5[1]	-	-	-	NE	NE	NE
BH2[6]	17/12/96	1.2	-	-	5.8	5.8	7.7	2.5
BH3[6]	10/01/97	0.6	-	3.0	-	NE	NE	0.6
BH4[6]	10/01/97	1.3	-	3.0	-	NE	NE	1.3
BH5[6]	10/01/97	0.6	-	1.1	-	1.1	1.2	NE

Notes to Table:
NE: Not Encountered
WRK: Weathered Rock
(1) Hand Auger refusal on filling
(2) Where no origin description, materials have been assumed to be alluvium/colluvium.
(3) Test pits undertaken during previous GS site classification [6].
(4) Test bores undertaken during previous GS contamination Assessment [5].
(5) Boreholes undertaken during previous DP investigation [3].
(6) Boreholes referenced in previous Coffey 2003 [2] and DP 2004 [3] investigation reports.

Acid Sulfate Soil testing undertaken at locations in proximity to the proposed development are summarised below in Table 4-2 below.

Table 4-2 below summarises the Acid Sulfate Soil Testing undertaken in previous investigations in proximity to the proposed Rafterys Resort Development.

Table 4-2 Summary of Previous Acid Sulfate Soil Testing

Location	Depth (m)	Date Sampled	Filling (F) / Natural (N)	Material Description	pH_F	pH_{FOX}	pH_F - pH_{FOX}	Reac-tion Rate	TAA		TPA		TSA		ANC_E			S_{POS}		Net Acidity		Liming Rate	
									TAA	s-TAA	TPA	s-TPA	TSA	s-TSA	ANC_E	a-ANC_E	s-ANC_E	S_{POS}	a-S_{POS}	a-Net Acidity	a-Net Acidity (-ANCE)	Liming Rate	Liming Rate (-ANCE)
					pH units	pH units	pH units		moles H+/t	%w/w S	moles H+/t	%w/w S	moles H+/t	%w/w S	% CaCO3	moles H+/t	%w/w S	%w/w	moles H+/t	moles H+/t	moles H+/t	kg CaCO3/t	kg CaCO3/t
Douglas Partners Pty Ltd (2004)																							
31	0.45	29/08/04	N	Silty CLAY	6	4.9	*1.1*	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	2.5	29/08/04	N	CLAY	5.5	4.9	0.6	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	0.3	29/08/04	Possible F	Clayey SILT	6	5.6	0.4	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	0.6	29/08/04	Possible F	Clayey SILT	6.2	5.1	*1.1*	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	0.8	29/08/04	N	CLAY with sand	5.5	5.1	0.4	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	1.2	29/08/04	N	CLAY with sand	6	5.2	0.8	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	1.5	29/08/04	N	CLAY with sand	5.8	5.4	0.4	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	2.3	29/08/04	N	Sandy CLAY	5.9	5.5	0.4	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	2.5	29/08/04	N	Clayey SAND	5.8	5	0.8	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Geotech Solutions Pty Ltd (2010)																							
TB001	0.5 - 0.6	22/01/10	N	Sandy Gravelly CLAY	6.3	2.6	*3.7*	Moderate	<2	<0.02	<2	<0.02	<2	<0.02	0.5	100	0.16	<0.02	<10	<10	<10	<1	<10
TB001	2.0 - 2.1	22/01/10	N	Clayey SAND / Sandy CLAY	6.4	3.1	*3.3*	Slight	<2	<0.02	<2	<0.02	<2	<0.02	0.88	175	0.28	<0.02	<10	<10	<10	<1	<10
TB002	0.5 - 0.6	22/01/10	N	Gravelly CLAY	6.3	2.4	*3.9*	Slight	<2	<0.02	<2	<0.02	<2	<0.02	-	-	-	<0.02	<10	<10	<10	<1	<10
TB002	1.5 - 1.6	22/01/10	N	Sandy CLAY	6	3.2	*2.8*	Slight	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TB003	0.0 - 0.1	22/01/10	N	Clayey SILT	6	2.7	*3.3*	Moderate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TB003	1.5 -1.6	22/01/10	N	Silty CLAY	6.4	4	*2.4*	Slight	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guideline Value				**Envirolab PQL**	-	-	-	-	5	0.01	5	0.01	5.00	0.01	0.05	5	0.05	0.005	5	10	10	0.75	0.75
ASSMAC (1998) Potential Acid Sulfate Soil Indicator Value					4 - 5.5 [1]	< 3 [3]	1 [4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASSMAC (1998) Actual Acid Sulfate Soil Indicator Value					≤ 4 [2]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASSMAC (1998) Action Criteria - Course Soils (1 - 1000 tonnes) [5]					-	-	-	-	-	-	18	-	18	-	-	-	-	0.03	-	18	18	-	-
ASSMAC (1998) Action Criteria - Medium Soils (1 - 1000 tonnes) [6]					-	-	-	-	-	-	36	-	36	-	-	-	-	0.06	-	36	36	-	-
ASSMAC (1998) Action Criteria - Fine Soils (1 - 1000 tonnes) [7]					-	-	-	-	-	-	62	-	62	-	-	-	-	0.10	-	62	62	-	-
ASSMAC (1998) Action Criteria - Course Soils (>1000 tonnes) [5]					-	-	-	-	-	-	18	-	18	-	-	-	-	0.03	-	18	18	-	-
ASSMAC (1998) Action Criteria - Medium Soils (>1000 tonnes) [6]					-	-	-	-	-	-	18	-	18	-	-	-	-	0.03	-	18	18	-	-
ASSMAC (1998) Action Criteria - Fine Soils (>1000 tonnes) [7]					-	-	-	-	-	-	18	-	18	-	-	-	-	0.03	-	18	18	-	-

Notes to Table:

1 - pH values >4 and <5.5 are acid and may be the result of some previous or limited oxidation of sulfides, but is not confirmatory of actual acid sulfate soils

2 - pH readings of pH≤4, indicates that actual acid sulfate soils are present with the sulfides having been oxidized in the past, resulting in acid soils (and soil pore water)

3 - The lower the final pH_{FOX} value is, the better the indication of a positive result.
» If the pH_{FOX} < 3 and there was a strong reaction to the peroxide, there is a high level of certainty of a potential acid sulfate soils. The more the pH_{FOX} drops below 3, the more positive the presence of sulfides.
» A pH_{FOX} 3-4 is less positive and laboratory analyses are needed to confirm if sulfides are present.
» For pH_{FOX} 4-5 the test is neither positive nor negative. Sulfides may be present either in small quantities and be poorly reactive under quick test field conditions.
» For pH_{FOX} >5 and little or no drop in pH from the field value, little net acid generating ability is indicated.

4 - If the pH_{FOX} value is at least one unit below field pH_F, it may indicate potential acid sulfate soils. The greater the difference between the two measurements, the more indicative the value is of a potential acid sulfate soils.

5 - Course soils comprise sands to loamy sands - Approximate clay content (% < 0.002mm) ≤ 5%

6 - Medium soils comprise sandy loams to light clays - Approximate clay content (% < 0.002mm) between 5 and 40%

7 - Fine soils comprise medium to heavy clays and silty clays - Approximate clay content (% < 0.002mm) ≥ 40%

Contaminant Exceedance Indicators:

Bold	Indicates the laboratory result is within the specified range of the ASSMAC (1998) Actual Acid Sulfate Soil Indicator Values
Italics	Indicates the laboratory result either exceeds or is within the specified range of the ASSMAC (1998) Potential Acid Sulfate Soil Indicator Values
	Indicates exceedance of the ASSMAC (1998) Action Criteria triggering the need to prepare a ASS Management Plan
	Indicates the requirement for localised lime treatment of the material, that is, when the laboratory results for SCr (%w/w) > 0.03 and the SCr (mole H=/t) > 18

5 Site Inspection

A site inspection was undertaken by experienced geotechnical consultants from CnS to confirm existing site features and relevance to the development. The following was noted at the time of inspection;

- A range of existing structures within the proposed development area evidently constructed at different timelines. No obvious visual indications of defects in the buildings were noted.
- A range of earthworks had been undertaken at the site associated with previous development to construct level building pads and facilitate construction of road pavements. Observations indicated that existing pavements were performing adequately.
- Vegetation generally comprised of maintained lawns with stands of mature trees.

Proposed Site A – Apartment Buildings

- An existing single storey structure and pool facility is situated within portions of the proposed Site A envelopes.
- Fill batters associated with the existing function centre to the south-east were noted to encroach the proposed envelope of the southernmost apartment building (Site A).
- Semi-mature to mature trees were also noted within or close proximity to the envelopes of the Site A apartment buildings.

Proposed Site B – Tavern and Function Centre

- An existing structure was noted within the proposed Tavern and Function Centre envelope.
- A fill embankment in the order of 2 m high was noted in the envelope, evidently constructed to provide a level building platform for the existing structure given the natural west facing slopes. Consequently, it is likely the eastern portion of the structure is founded in cut to on-grade with minor filling anticipated.
- Batter slopes associated with the embankment were noted to slope generally west towards Lake Macquarie (Figure 5-1) at approximately 2H:1V.

Proposed Site C – Hotel

- The area of Site C high-rise comprised of maintained grass with mature trees and a footpath in the northern portion.
- Landforms generally indicated the area to be formed in minor cutting to filling with the western portion generally level and eastern portion on west facing slopes. Minor filling associated with a demolished former structure and road construction may be present.

Proposed Site D – Apartment Building

- Apartment Building Site D is likely to be on natural soils with potential minor filling based on surrounding topography associated with road construction.
- A significant amount of semi-mature to mature trees were noted in the proposed building envelope that would require removal.

Proposed Site E – Multi-Unit Housing

- A rock lined water course traversing west between proposed Site D and Site E. Observations indicated that this was formerly a natural gulley line, formalised for aesthetic and ecological conservation purposes.
- Existing single storey commercial structures were noted within the envelope of the proposed multi-unit housing.
- Surrounding topography indicated that the existing structures on Site E Multi-unit housing apartments were formed via cut to fill operations to form level building platforms with existing filling in the order of 1.0 m anticipated for the westernmost unit.

Figure 5-1 Photo of Fill Embankment and Batter Slopes (Facing North to North-East)

Figure 5-2 Photo of Fill Batters and area of Proposed Site A – Apartment Buildings (Facing North)

Figure 5-3 Photo of Site C area (Facing East).

Figure 5-4 Photo of trees within envelope of proposed Site D (Facing East).

6 Geotechnical Comments and Recommendations

The following recommendations have been made based on available existing data and a limited site inspection. Additional investigation should be undertaken at design phase.

A review of sections [1] and discussions with the client have indicated that the proposed development scheme for the overall area has been deliberately designed to utilise the existing site profiles (where possible) to minimise excavations, Acid Sulfate Soil (ASS) disturbance, groundwater considerations and spoil management where possible. Part of this scheme has allowed the use of under croft car parking as opposed to basements for the larger structures (Sites A, C and D) with aim to reduce groundwater and potential ASS disturbance. Other structures have been designed on-grade (where possible).

A review of the sections in the masterplan architectural plans [1] indicate that the under croft parking will be constructed partially in and partially out of ground due to existing topography. Preliminary indications of excavation depths based on the provided sections include;

- Site A –Varying from minor (<0.5 m) in the west to up to approximately 4.5 m deep in the east to accommodate basement construction and a driveway ramp. The deeper excavations are evidently within the area impacted by the existing fill embankment;
- Site C - Varying from ground level to up to approximately 3.5 m deep to accommodate basement level 2 construction; and
- Site D – Varying from (<0.5 m) ground level to up to approximately 3.0 m deep to accommodate basement construction.

6.1 Preliminary Acid Sulfate Soils Assessment

Previous data in the proposed Rafferty's redevelopment area has been reviewed in order to make preliminary comment on the presence of Acid Sulfate Soils (ASS) at the site. Laboratory testing was undertaken in previous Douglas Partner's [3] and Geotech Solutions [4] assessments with laboratory results summarised in Table 4-2.

As previously stated, review of published mapping b indicates the site is in a Class 5 area where ASS is not typically found with the exception of Lake Macquarie water body to the west mapped as likely encountering ASS (Class 1). It should be noted, that ASS can be found isolating in gulley lines.

As summarised in Table 4-2, preliminary field screening testing was undertaken on samples north of the proposed development on a range of soils to a depth of 2.5 m bgl. The samples were taken in proximity to a natural watercourse discharging to Lake Macquarie.

The results of the field screening returned differences in pH and pH_{FOX} predominantly of less than 1 when exposed to peroxide, for the 2004 DP testing except for two samples with a difference of 1.1 units. All the Geotech Solutions 2010 samples returned a difference in pH and pH_{FOX} of 2.4 to 3.9 units. Additional testing using the SPOCAS method on Geotech Solution Samples returned Total Actual (TAA), Potential (TPA) and Sulfuric (TSA) Acidity below reporting limits.

The action criteria indicating the requirements for an Acid Sulfate Soil Management Plan (ASSMP) is detailed in the ASSMAC [12] which suggests values of the percentage of oxidisable sulfur for soil types broadly categorised as fine texture, medium texture and coarse texture. The subsurface profile in proximity to the proposed development area are considered both coarse texture "sands to loamy sands" and fine texture "medium to heavy clays and silty clays".

The action criteria is also based on the extent of the proposed ASS soil disturbance, with various trigger values for where 1-1000 tonnes or where greater than 1000 tonnes is disturbed. Based on the proposed development works, soil volumes of 1000 tonnes are anticipated to be disturbed.

The relevant action criteria where greater than 1000 tonnes of fine, medium or coarse soils is disturbed from Table 4.4 of ASSM [12] is:

- Sulfur trail of 0.03% or 18 mole H+/tonne; and
- Acid trail of 18 mole H+/tonne.

With reference to the published ASS mapping and the preliminary results discussed above, it is suggested that the tested soils are slightly acidic but not considered potential or actual acid sulfate soils given the results are below the tolerable levels detailed in the ASSMAC.

Given the proposed developments are within similar nearby terrain and similar distances to the Lake Macquarie water edge, it is likely that no specific treatment will be required for ASS based on previous results. It is recommended that further ASS investigation is undertaken in the proposed disturbance envelopes and to soil disturbance depths during detailed design phase to confirm the presence of any ASS and requirements for any treatment.

As also recommended by DP, a monitoring procedure should be developed containing information on monitoring the presence if ASS during construction and contingency measures for treating soil in encountered. Any treatment is likely to comprise neutralisation by addition and blending of agricultural lime during excavations on site within the specific construction areas. Validation testing following preliminary excavation and dosing would then usually be required to confirm application rates. Following suitable treatment, the material would be suitable for reuse on site as fill.

6.2 Groundwater

Based on the previous investigations, groundwater was encountered at depths ranging from 0.6 to 3.0 m bgl at the time of the previous investigations. Groundwater levels are likely to fluctuate with variations in climatic and site conditions, particularly given the sites proximity to Lake Macquarie and its tidal variations.

During construction of a unit subdivision closely to the north of the site, Geotechnical staff from Geotech Solutions noted groundwater at variable levels, generally less than 2 m depth of ground level.

Based on the available information and the site's proximity to Lake Macquarie, it should be anticipated that groundwater will be encountered below natural ground level particularly where excavations exceed 1.0 m and in proximity to any gulley lines such as the gulley between Site's D and E.

It is expected that groundwater will be encountered during development, particularly during the construction of the under croft sections of Site A, C and D where deepest cuts are proposed. As such, waterproofing and drainage solutions will be required subject to further assessment of groundwater levels at the site. Techniques that could be employed during construction where groundwater is encountered would comprise sump and pump techniques. Groundwater considerations should be made during engineer design of any retaining structures, particularly those associated with deeper cuts of the under croft.

6.3 Foundation Conditions

Based on existing data at the site and review of the architectural sections, foundation conditions for the proposed Site A, C and D are expected to predominantly comprise either stiff / medium-dense (or better) natural soils or weathered rock encountered at depth. The presence of existing filling at the site as a result of previous development would not be suitable as a foundation material, nor would any firm or loose natural soil materials, topsoil, loose alluvium or any deleterious materials. Where existing filling is at foundation level, this would required to be removed and replaced with suitable controlled filling or founded below these materials.

Geotechnical investigation during design phase of individual elements/structures should be undertaken to confirm subsurface conditions and provide geotechnical parameters for foundation design.

6.4 Geotechnical Constraints and Additional Assessment

The preliminary assessment has considered several geotechnical elements at the site including the presence of groundwater, Acid Sulfate Soils (ASS) and foundation conditions. Based on review of the available data, site visit observations and published data review, it is considered that the site is suitable for the proposed development. There are a range of geotechnical considerations for design of the development that will further assessment as part of detailed design and include;

- Assessment of current groundwater level;
- Assessment of existing filling in proposed building and pavement;
- Vegetation removal and impact of roots;
- Acid Sulfate Soils (ASS);
- Foundation conditions of the individual elements and provision of geotechnical design parameters;
- Parameters for Retaining Wall structures;
- Recommendations for Earthworks and Filling; and
- Consideration of the presence of underground utilities.

It would also be prudent to undertake a hazardous materials assessment pre-demolition of existing structures.

It should be noted that geotechnical considerations will also be dependent on the proposed design levels and elements of the structure during design phase. As such, site specific geotechnical investigation will be required during the detailed engineering design of each element/structure.

It is recommended that further geotechnical assessment could comprise investigation for depth to rock, ground water, foundation conditions including parameters, Acid Sulfate Soil (ASS) confirmatory testing and any other aspects deemed appropriate by the engaged Geotech for the proposed elements/structures.

7 Conclusion

CnS have undertaken a desktop geotechnical assessment for a proposed development scheme at Rafferty's Resort, Cam's Wharf NSW to accompany a planning proposal. The desktop assessment comprised review of previous geotechnical investigations at and in proximity to the site, a site inspection and review of published data. The preliminary assessment has considered several geotechnical elements at the site including the presence of groundwater, Acid Sulfate Soils (ASS) and foundation conditions with preliminary recommendations in the respective sections above.

A review of sections and discussions with the client have indicated that the proposed development scheme for the overall area has been deliberately designed to utilise the existing site profiles (where possible) to minimise excavations, Acid Sulfate Soil (ASS) disturbance, groundwater considerations and spoil management where possible. Part of this scheme has allowed the use of under croft car parking as opposed to basements for the larger structures (Sites A, C and D) with the aim to reduce groundwater and potential ASS disturbance and mitigate other measures. Other structures have been designed on-grade (where possible).

Based on the review of previous geotechnical investigations, site observations and published data review, it is considered that the site is suitable for the proposed development. There are however a range of geotechnical considerations for design of the development including groundwater, existing filling extent, vegetation removal, ASS impacts, foundations conditions and retaining walls. It is expected that many of these considerations can be suitably managed through industry standard design and construction techniques subject to additional geotechnical investigation during detailed engineering design of each individual structure/site.

The additional investigations should comprise investigation for depth to rock, ground water, foundation conditions including parameters and reactivity, retaining structures, Acid Sulfate Soil (ASS) confirmatory testing and any other aspects deemed appropriate by the engaged Geotechnical consultant for each proposed structure/site. It would also be prudent to undertake a hazardous materials assessment pre-demolition of existing structures.

8 Limitations

Cardno have performed investigation and consulting services for this project in general accordance with current professional and industry standards. The extent of testing was limited to discrete test locations and variations in ground conditions can occur between test locations that cannot be inferred or predicted.

A geotechnical consultant or qualified engineer shall provide inspections during construction to confirm assumed conditions in this assessment. If subsurface conditions encountered during construction differ from those given in this report, further advice shall be sought without delay.

Cardno, or any other reputable consultant, cannot provide unqualified warranties nor does it assume any liability for the site conditions not observed or accessible during the investigations. Site conditions may also change subsequent to the investigations and assessment due to ongoing use.

This report and associated documentation was undertaken for the specific purpose described in the report and shall not be relied on for other purposes. This report was prepared solely for the use by Iris Raffertys OperationsTrust and any reliance assumed by other parties on this report shall be at such parties own risk.

9 References

[1] EJE Archtiecture, Rafferts Resort Masterplan -Revision D (Dated 2/2/22, Drawings A01 to A32), February 2022 .

[2] Coffey Geosciences Pty Ltd, Lakeside Sector - WallarahPeninsula - Geotechnical Soils Investigation - Re. N07634/07-AB, 17 November 2003.

[3] Douglas Partners Pty Ltd, Report on Geotechnical Investigation - Wallarah Water and Sewer Project Wallarah - Project 39017, November 2004.

[4] Geotech Solutions Pty Ltd, Preliminary Acid Sulphate Soil Assessment - Proposed Subdivision - Raffertys Resort - Cams Wharf - GS577-002/0, 12 February 2010.

[5] Geotech Solutions Pty Ltd , Contamination Testing - Proposed Subdivision, Raffertys Resort, Cams Wharf - GS577-003/0, 22/02/2010.

[6] Geotech Solutions Pty Ltd, Site Classification Report - Raffertys Resort - Stage 1 - Cams Wharf - CGS577-004/0, October 2011.

[7] Mecone Mosaic, “Mecone Mosaic,” NSW Cadastre as of 2021-11-24 and imagery from Spatial Services NSW Dept of Finance, Services and Innovation, [Online]. Available: https://www.mecone.com.au/mosaic/. [Accessed 2022 Feb 7].

[8] NSW Government, “Minview,” 2021. [Online]. Available: https://minview.geoscience.nsw.gov.au/#/?lon=151.6148&lat=-33.12101&z=19&bm=bm1&l=ge611:n:100,ge610:n:100,ge69:n:100,ge68:n:100,ge67:n:100,ge66:n:100,ge65:n:100,ge64:n:100,ge63:n:100,ge62:n:100,ge61:n:100,ge612:y:100,hi1:n:25,wa1:y:100,ut1:y:50,ad0:y:100. [Accessed 7 December 2021].

[9] NSW Government - Departmment of Customer Service, “ePlanning Spatial Viewer,” 2020. [Online]. Available: https://www.planningportal.nsw.gov.au/spatialviewer/#/find-a-property/address. [Accessed 3 Febraury 2022].

[10] NSW Office of Environment and Heritage, “eSPADE V2.1,” NSW Office of Environment and Heritage, 2022. [Online]. Available: https://www.environment.nsw.gov.au/eSpade2WebApp#. [Accessed 3 Febraury 2022].

[11] NSW Government, “NSW Government Historical Imagery Search and Discovery,” NSW Government - Spatial Collaboration Portal, 2020. [Online]. Available: https://portal.spatial.nsw.gov.au/portal/apps/webappviewer/index.html?id=f7c215b873864d44bccddda8075238cb.

[12] ASSMAC, “Acid Sulfate Soil Manual, New South Wales,” Acid Sulfate Soil Management Advisory Committee, August 1998.

Raffertys Resort

APPENDIX A

SITE DRAWINGS

Cardno

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Stantec

NOTES:

Image underlay adapted from Metromaps aerial imagery and supplied masterplan prepared by EJE Archtiecture (Drawing. A05, Dated 2/2/22, Rev. D) .

LEGEND:

XX	Approximate bore locations and numbers from previous DP assessment (2004).
TB00X	Approximate bore locations and numbers from previous GS contam/ASS assessment (2010).
X	Approximate bore locations and numbers from previous Coffey assessment (1997).
TP10X	Approximate bore locations and numbers from previous GS Final Site Class (2011).

0 25 50m

SCALE 1:1250 @A3

NORTH

30 31 32 33 34 5 2 3 4

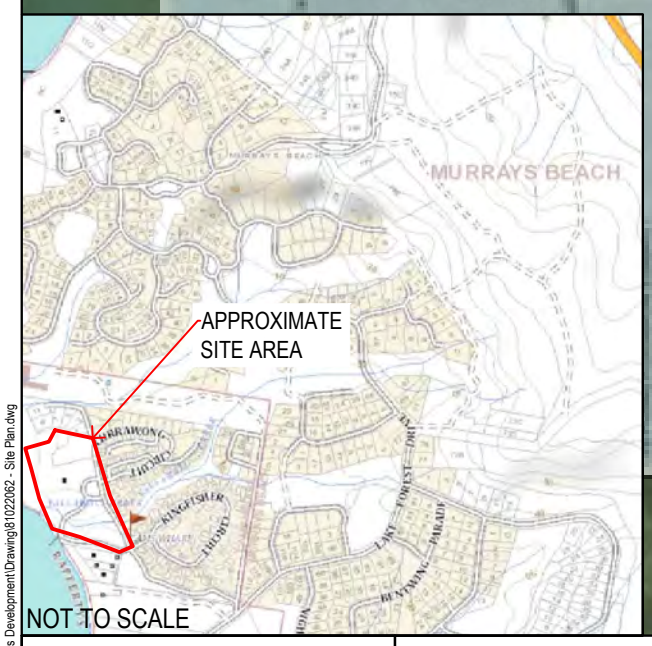
TB001 TB002 TB003 TB004 TB005 TB006 TB007

TP101 TP102 TP103 TP104 TP105

site A site B site C site D site E

EJE

RAFFERTYS RESORT



Cardno
Shaping the Future
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Unit 1, 10 Denney Street
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Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.cardno.com.au

Drawn JG	Date 4/2/22
Checked	Date
Designed	Date
Verified	Date
Approved	

Client: Iris Rafferts OperationsTrust

Project: Desktop Geotechnical Assessment
Raffertys resort Redevelopment
Cams Wharf NSW

Title: Site Plan

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
81022062-001	1:1250	A3

Drawing Number: Drawing 1

Revision: A

DATE PLOTTED: 16 February 2022 11:19 AM BY: JESSE GRACZYK

XREFs:
CAD File: N:\Projects\810\FY22\062_Raffertys Development\Drawing\81022062 - Site Plan.dwg

DATE PLOTTED: 16 February 2022 11:26 AM BY: JESSE GRACZYK

NOTES:

Image underlay adapted from Metromaps aerial imagery.

LEGEND:

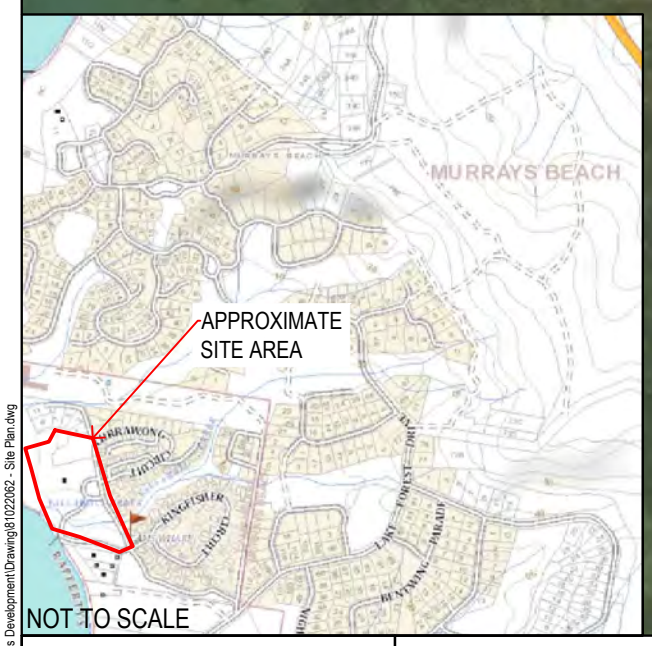
XX	Approximate bore locations and numbers from previous DP assessment (2004).
TB00X	Approximate bore locations and numbers from previous GS contam/ASS assessment (2010).
X	Approximate bore locations and numbers from previous Coffey assessment (1997).
TP10X	Approximate bore locations and numbers from previous GS Final Site Class (2011).

0 25 50m

SCALE 1:1250 @A3

NORTH

30
31
TB001
TB002
TB003
33
32
TB004
TP102
TP101
TP103
TB005
TP104
TP105
TB006
34
TB007
5
4
3
2



NOT TO SCALE

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Drawn JG	Date 4/2/22
Checked	Date
Designed	Date
Verified	Date
Approved	

Client: Iris Rafferts OperationsTrust

Project: Desktop Geotechnical Assessment
Raffertys resort Redevelopment
Cams Wharf NSW

Title: Site Plan

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
81022062-001	1:1250	A3

Drawing Number: Drawing 2

Revision: A

XREFs:
CAD File: N:\Projects\810\FY22\062_Raffertys Development\Drawing\81022062 - Site Plan.dwg

Raffertys Resort

APPENDIX B

PREVIOUS LOGS

Cardno

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Stantec

TEST BORE REPORT

BORE No: 30

CLIENT: Hunter Water Australia | **PROJECT No:** 39017 | **DATE:** 29 Aug 04

PROJECT: Water & Sewer Pipeline | **SURFACE LEVEL:** -- | **SHEET** 1 OF 1

LOCATION: Wallarah | **DIP OF HOLE:** 90° | **AZIMUTH:** --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results & Comments	Core Rec. %
	TOPSOIL - Dark grey clayey silt with abundant organics to 01.m, moist				
0.2	GRAVELLY CLAY - (Firm to stiff), light grey clayey gravel, generally comprising fine to coarse sized subrounded gravel, wet, (M>>Wp)	A	0.3		
	from 0.5m, (stiff), moist, (M>Wp)	A	0.8		
1					
1.2	CONGLOMERATE - (Extremely low strength), extremely weathered, light brown conglomerate with some clay	A	1.3		
1.45	TEST BORE DISCONTINUED AT 1.45m due to refusal on conglomerate bedrock				
2					

RIG: Backhoe **DRILLER:** Kingston Plant Hire **LOGGED:** Harris **CASING:**

TYPE OF BORING: 300mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials:
Date: 26/11/04

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

CLIENT: Hunter Water Australia
PROJECT: Water & Sewer Pipeline
LOCATION: Wallarah

PROJECT No: 39017
SURFACE LEVEL: --
DIP OF HOLE: 90°

BORE No: 31
DATE: 29 Aug 04
SHEET 1 OF 1
AZIMUTH: --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results & Comments	Core Rec. %
	TOPSOIL - Dark grey silt with some clay, trace rootlets, humid	A,pp	0.2	300 kPa	
0.5	CLAY - (Stiff), light grey-brown clay with some silt and trace fine sized gravel and charcoal (slope wash), M>Wp	A	0.45		
		A	0.8		
1	from 1m, (firm to stiff), graavelly clay generally comprising fine to medium sized subangular gravel, M>Wp, damp	pp	1.2	150-200 kPa	
		A	1.5		
2		A	2.0		
	from 2.3m, (firm), with some silty sand	A	2.5		
2.75	SILTY SAND - Pebbly sandstone, light brown				
2.8	TEST BORE DISCONTINUED AT 2.8m due to refusal on pebbly sandstone bedrock				

RIG: Backhoe **DRILLER:** Kingston Plant Hire **LOGGED:** Harris **CASING:**

TYPE OF BORING: 300mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials: MW
Date: 26/11/04

Douglas Partners
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TEST BORE REPORT

CLIENT: Hunter Water Australia
PROJECT: Water & Sewer Pipeline
LOCATION: Wallaràh

PROJECT No: 39017
SURFACE LEVEL: --
DIP OF HOLE: 90°

BORE No: 32
DATE: 29 Aug 04
SHEET 1 OF 1
AZIMUTH: --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results & Comments	Core Rec. %
	TOPSOIL - Dark grey-brown silt with trace to some organics, moist				
0.25	CLAYEY SILT - (Loose), light grey clayey silt, wet to saturated	A	0.3		
0.6	GRAVELLY CLAY - (Stiff), light brown gravelly clay, generally comprising fine to coarse sized subrounded gravel, M>Wp	A,pp	0.8	250 kPa	
1					
	from 1.5m (stiff to very stiff), dark brown mottled red, M<Wp	A	1.5		
	from 1.7m, light grey-white mottled red	A	1.7		
2					
2.4	PEBBLY SANDSTONE / CONGLOMERATE - Brown pebbly sandstone / conglomerate	A	2.5		
2.8	TEST BORE DISCONTINUED AT 2.8m due to refusal on pebbly sandstone / conglomerate bedrock				

RIG: Backhoe **DRILLER:** Kingston Plant Hire **LOGGED:** Harris **CASING:**

TYPE OF BORING: 300mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U_x	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials: PHJ
Date: 26/11/04

Douglas Partners
Geotechnics · Environment · Groundwater

TEST BORE REPORT

CLIENT: Hunter Water Australia
PROJECT: Water & Sewer Pipeline
LOCATION: Wallarah

PROJECT No: 39017
SURFACE LEVEL: --
DIP OF HOLE: 90°

BORE No: 33
DATE: 29 Aug 04
SHEET 1 OF 1
AZIMUTH: --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results & Comments	Core Rec. %
	CLAYEY SILT - (Possible fill), dark grey clayey silt, (wet to saturated), M>>Wp				
	from 0.3m, silty clay	A,pp	0.3	150-250 kPa	
		A	0.6		
0.7	CLAY - (Stiff), light brown-grey clay with trace to some silt and with trace fine sized subrounded gravel, M>Wp	A	0.8		
1					
	from 1.2m with trace to some fine to medium grained sand	A	1.2		
		A	1.5		
2					
2.1	SANDY CLAY - Firm to stiff, light grey sandy clay, M>Wp	A	2.3		
2.4	CLAYEY SAND - (Loose), light brown clayey sand, saturated	A	2.5		
2.7	GRAVELLY CLAY - (Firm to stiff), grey gravelly clay, generally comprising fine sized subangular gravel, M>Wp				
3 3.0	TEST BORE DISCONTINUED AT 3.0m due to collapsing conditions at 2.1m				

RIG: Backhoe **DRILLER:** Kingston Plant Hire **LOGGED:** Harris **CASING:**

TYPE OF BORING: 300mm diameter solid flight auger

WATER OBSERVATIONS: Seepage at 2.1m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U,	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials: PWW
Date: 24/11/04

Douglas Partners
Geotechnics • Environment • Groundwater

TEST BORE REPORT

BORE No: 34

CLIENT: Hunter Water Australia | **PROJECT No:** 39017 | **DATE:** 29 Aug 04

PROJECT: Water & Sewer Pipeline | **SURFACE LEVEL:** -- | **SHEET** 1 OF 1

LOCATION: Wallarah | **DIP OF HOLE:** 90° | **AZIMUTH:** --

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Test Results & Comments	Core Rec. %
	FILLING - Dark grey gravelly silt, generally comprising fine to medium subrounded and subangular gravel		0.1		
		A	0.3		
0.5	TEST BORE DISCONTINUED AT 0.5m due to hand auger refusal on filling				
1					
2					

RIG: Backhoe **DRILLER:** Kingston Plant Hire **LOGGED:** Harris **CASING:**

TYPE OF BORING: 300mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	PL	Point load strength Is(50) MPa
B	Bulk sample	S	Standard penetration test
C	Core drilling	U_x	Tube sample (x mm dia.)
pp	Pocket penetrometer (kPa)	V	Shear vane (kPa)

CHECKED
Initials:
Date: 26/11/04

Douglas Partners
Geotechnics · Environment · Groundwater

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: BH 2
sheet 1 of 2

client:	PATTERSON BRITTON & PARTNERS PTY LTD	office job no:	N5656/2
principal:		hole commenced:	17-12-96
project:	NORDS WHARF TO SWANSEA SEWER MAIN	hole completed:	17-12-96
borehole location:	CAMS WHARF NO 1 PUMP STATION RMS Cr Dr	logged by:	JEL
		checked by:	[signature]
drill model and mounting:	Gemco 457 Trailer	slope: -90 DEG	R.L. Surface: 2.3 m
hole diameter:	100mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa	structure and additional observations
ADT		Nil						CL	FILL: Sandy CLAY, medium plasticity, dark grey-brown, sand fine to coarse grained, with some gravel	<Wp	St		FILL
					2								
				2, 5, 5 N*=10									
						1							
					1			CH	SANDY GRAVELLY CLAY: high plasticity, grey orange brown, sand fine to coarse grained, gravel fine to medium grained	>Wp	VSt		RESIDUAL
				5, 8, 6 N*=14									Gravelly Clay band 200mm thick
								CH	SANDY CLAY: high plasticity, grey, sand fine to coarse grained	>Wp	VSt		
						2							Static water level not established
					0								
			▽					CH	SANDY GRAVELLY CLAY: high plasticity, grey, sand fine to coarse grained, some iron stained areas with some siltstone rock fragments				
				7, 10, 14 N*=24		3							
					-1								
						4							

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

SUPPORT
Nil no support
M mud
C casing

PENETRATION 1 2 3 4
little resistance ranging to refusal
no resistance

WATER
X not measured
O none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample 50mm
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey Partners International Pty. Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

Borehole no: BH 2
Sheet 2 of 2

client:	PATTERSON BRITTON & PARTNERS PTY LTD	office job no:	N5666/2
principal:		hole commenced:	17-12-96
project:	NORDS WHARF TO SWANSEA SEWER MAIN	hole completed:	17-12-96
borehole location:	CAMS WHARF NO. 1 PUMP STATION - PA5 - Ch. 0m	logged by:	JEL
		checked by:	
drill model and mounting:	Gemco HS7 Trailer	slope: -90 DEG	R.L. Surface: 2.3 m
hole diameter:	100mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
ADT								CH	SANDY GRAVELLY CLAY: high plasticity, grey, sand fine to coarse grained, some iron stained areas, with some siltstone rock fragments.		VSt		
					-2								
				7, 7, 8 Nx=15					Sand and gravel content increasing.			X	
						5							
					-3								
									CONGLOMERATE: fine to coarse grained, grey-brown.		H		EW ROCK
				Nx=R0		6							SPT hammer refusal on rock
					-4								
									Penetration becoming very difficult, fresher rock.				
						7							
					-5								
				Nx=R0									SPT hammer refusal on rock
						8			Borehole BH 2 Terminated at 7.70 m Refusal met on rock				

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

SUPPORT
Nil no support
C casing
M mud

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
X not measured
O none observed
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nx SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

GB7 2/90

COFBORE VERSION 03 19 / 2/97 13 31 58 HO1

Coffey Partners International Pty Ltd
ACN 003 602 019

engineering log - borehole

COFFEY

borehole no: BH 3
sheet: 1 of 1

office job no: GS656/2

client:	PATTERSON BRITTON & PARTNERS PTY LTD	hole commenced:	10-01-97
principal:		hole completed:	10-01-97
project:	NORDS WHARF TO SWANSEA SEWER MAIN	logged by:	JEL
borehole location:	RMS - Ch 115m 10m LEFT	checked by:	
drill model and mounting:	Bobcat Mounted Rig	slope: -90 DEG	R.L. Surface: 0.9 m
hole diameter:	100mm	bearing:	datum: AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
AOT		NIL	▽		0		SP	TOPSOIL FILL: Gravelly SAND, fine to coarse grained, orange-brown,	M			TOPSOIL FILL
							GP	FILL: Sandy GRAVEL, fine to coarse grained, grey-brown,				
					1		CH	SANDY CLAY: high plasticity, grey, sand fine to coarse grained, with some gravel.	M >Wp			ALLUVIUM
								Grading into Sandy Gravelly CLAY grey-orange-brown.				
					2		CH	SILTY SANDY CLAY: high plasticity, light grey, sand fine to coarse grained, with some fine grained, gravel.				
					3			Borehole BH 3 Terminated at 3.00 m				

METHOD
AS auger screwing
AD auger drilling
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
bolt shown by suffix
B blank bit
V V bit
T TC bit
e.g. AOT

SUPPORT
Nil no support M mud
C casing
PENETRATION
1 2 3 4
little resistance
ranging to
very slow progress
WATER
✱ not measured ○ none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test:
N* SPT = sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey Partners International Pty Ltd
ACN 003 592 019

engineering log - borehole

COFFEY

borehole no: BH 4
sheet: 1 of 1

client:	PATTERSON BRITTON & PARTNERS PTY LTD	office job no:	N5656/2
principal:		hole commenced:	10-01-97
project:	NORDS WHARF TO SWANSEA SEWER MAIN	hole completed:	10-01-97
borehole location:	RMS - Ch 130m 10m LEFT	logged by:	JE
		checked by:	
drill model and mounting:	Bobcat Mounted Rig	slope:	-90 DEG
hole diameter:	100mm	bearing:	
R.L. Surface:	1.6 m	datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
ADT		NIL	▽		1.6		SP	TOPSOIL FILL: Gravelly SAND, fine to coarse grained, dark grey-brown,	M			TOPSOIL FILL
					1		GP-SP	FILL: Sandy GRAVEL/Gravelly SAND, fine to coarse grained, grey-brown,				FILL
					0		CH	SANDY CLAY, high plasticity, grey-orange-brown, sand fine to coarse grained, with some fine grained, rounded gravel	M >Wp	VSt		ALLUVIUM
					-1							
					-2			Borehole BH 4 Terminated at 3.00 m				
					-3							

METHOD
AS auger screwing
AD auger drilling
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
ADT shown by suffix
B blank bit
V V bit
T TC bit
e.g ADT

SUPPORT
Nil no support M mud
C casing
PENETRATION
1 2 3 4
little resistance
ranging to
very slow progress
WATER
* not measured 0 none observed
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nx SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

COFBORE VERSION 83 ADT RDI 13.33.12 19/2/97

Coffey Partners International Pty Ltd
ACN 003 692 019

engineering log - borehole

COFFEY

borehole no: BH 5
sheet: 1 of 1

client:	PATTERSON BRITTON & PARTNERS PTY LTD	office job no:	15656/2
principal:		hole commenced:	10-01-97
project:	WORDS WHARF TO SWANSEA SEWER MAIN	hole completed:	10-01-97
borehole location:	RH5 - Ch. 200m	logged by:	JEL
		checked by:	
drill model and mounting:	Bobcat Mounted Rig	slope:	-90 DEG
hole diameter:	100mm	bearing:	
		R.L. Surface:	2.2 m
		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
AOT		Nil	D		2		SP	TOPSOIL FILL: Gravelly SAND, fine to coarse grained, dark grey.	M			TOPSOIL FILL
							SP	SAND: fine to coarse grained, light brown, with some shells.				ALLUVIUM
					1							
AOT					1			CONGLOMERATE: fine to coarse grained, light orange-brown.		H		EN ROCK
								Borehole BH 5 Terminated at 1.20 m				
								Refusal met on rock				
					2							
					0							
					3							
					-1							
					4							

METHOD
- AS auger screwing
- AD auger drilling
- RR roller/tricone
- W washbore
- CT cable tool
- HA hand auger
- DT diatube
- bit shown by suffix
  - B blank bit
  - V V bit
  - T TC bit
  - e.g. AOT

SUPPORT
- Nil no support
- M mud
- C casing

PENETRATION
1 2 3 4
- little resistance
- ranging to
- very slow progress

WATER
- * not measured
- 0 none observed
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- N standard penetration test:
- Nx SPT + sample recovered
- Nc SPT with solid cone
- VS vane shear
- PM pressuremeter
- DP dynamic penetrometer
- WS water sample
- PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - borehole

COFFEY

Borehole no	BH 6
sheet	1 of 1

client:	PATTERSON BRITTON & PARTNERS PTY LTD	office job no:	N5656/2
principal:		hole commenced:	10-01-97
project:	NORDS WHARF TO SWANSEA SEWER MAIN	hole completed:	10-01-97
borehole location:	RW5 - Ch. 385m	logged by:	JEL
		checked by:	[signature]

drill model and mounting:	Bobcat Mounted Rig	slope:	-90 DEG	R.L. Surface:	1.3 m
hole diameter:	100mm	bearing:		datum:	AHD

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
ADT		Nil			1		SP	FILL: Gravelly SAND, fine to coarse grained, dark grey.	M			FILL
			▽		0	1	CH	SANDY GRAVELLY CLAY: high plasticity, grey-orange-brown, sand fine to coarse grained, gravel fine grained.	M >Wp	VSt		ALLUVIUM
					-1	2	CI	SANDY CLAY: medium plasticity, grey, sand fine to coarse grained. With some gravel, grading into Sandy Gravelly CLAY		St		
					-2	3		Borehole BH 6 Terminated at 3.00 m				
						4						

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

SUPPORT
Nil no support
M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
X not measured
O none observed
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
N* SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TESTBORE LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Preliminary Acid Sulphate Assessment
LOCATION : Rafferty's Resort

PIT NO : TB 001
FILE / JOB NO : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : Kobelco 5t Excavator | METHOD : 300mm spiral flighted auger
DATE EXCAVATED : 22/01/10 | LOGGED BY : GM/ZO | CHECKED BY :
POSITION : For location of test bores see Drawing 1

DRILLING | MATERIAL

DEPTH (m)	SAMPLES & FIELD TESTS	SUPPORT	GROUND WATER LEVELS	PENETRATION (VE E F H)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETRO-METER kPa (100 200 300 400)	STRUCTURE & Other Observations
0.0	D 0.10m						TOPSOIL, Sandy Gravelly Clayey SILT, stiff to hard, slightly moist, brown, fine to medium sub rounded to round gravel, fine grained sand, contains rootlets	D to M	St to VSt		Well grassed @ Surface DCP @ Surface 5, 13, 32, 18/100mm, 7/50mm, 15, 15, 15, 18, 18, 30, 25/100mm, 4/50mm, 10, 10, 7, 5, 8, 7, 14, 14, 9, 8, 8, 6
							0.30m				
							Sandy Clayey Gravelly SILT, hard, slightly moist, grey brown, fine to coarse sub rounded to round gravel, fine grained sand	D to M	H		
	0.50m						0.52m				
0.5	D-E021 0.60m						Sandy Gravelly Silty CLAY, hard, slightly moist to moist, brown, fine sub rounded gravel, medium plasticity				
	1.00m										
1.0	D 1.10m							M	H		
	1.50m										
1.5	D 1.60m						1.50m				
							Gravelly Sandy CLAY, very stiff, moist to very moist, brown, fine sub rounded gravel	M to W	VSt		
	2.00m						1.80m				
2.0	D-E022 2.10m						Gravelly SAND with Clay, very moist to wet, grey brown, fine sub rounded gravel				
			Water inflow @ 2.4m					W	MD to D		
2.5	2.50m D 2.60m										
	3.00m										
3.0	D 3.10m						3.10m				
3.5							Testbore TB 001 Terminated at 3.10 m Target depth				

PHOTOGRAPHS NOTES ☐ YES ☒ NO

METHOD
N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U50 - Undisturbed Sample 50 mm diameter
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTBORE LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Preliminary Acid Sulphate Assessment
LOCATION : Rafferty's Resort

PIT NO : TB 002
FILE / JOB NO : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : Kobelco 5t Excavator | METHOD : 300mm spiral flighted auger
DATE EXCAVATED : 22/01/10 | LOGGED BY : GM/ZO | CHECKED BY :
POSITION : For location of test bores see Drawing 1

DRILLING | MATERIAL

DEPTH (m)	SAMPLES & FIELD TESTS	GROUND WATER LEVELS	SUPPORT	PENETRATION (VE, E, F, H)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETROMETER kPa (100, 200, 300, 400)	STRUCTURE & Other Observations
0.0	0.10m D-E020 D-QA01 0.20m						TOPSOIL, Sandy Clayey SILT with trace Gravel, stiff to very stiff, dry to slightly moist, brown, fine sub round to rounded gravel, fine grained sand, contains rootlets	D to M	St to VSt		Well grassed @ Surface DCP @ Surface 6, 3/100mm, R
							0.25m Sandy Gravelly Silty CLAY, dry to slightly moist, grey brown, fine to coarse sub round to rounded gravel, fine grained sand				
0.5	0.50m D-E023 0.60m							D to M			
							0.70m Silty Gravelly CLAY, hard, slightly moist, brown, fine to medium sub rounded gravel, medium plasticity				DCP @ 0.75m 17, 15, 10/100mm, 15/50mm, 13/30mm, R
1.0	1.00m D 1.10m							M	H		
							1.20m Sandy CLAY with Gravel, very stiff to hard, moist, grey mottled orange brown, fine to medium sub rounded gravel				
1.5	1.50m D-E024 1.60m	Drilled Over Water									
											DCP @ 1.8m 16, 10, 16, 16, R
2.0	2.00m D 2.10m							M to W	VSt to H		
2.5	2.50m D 2.60m										
		▶ Water inflow @ 2.9m					2.90m Gravelly CLAY, moist to wet, grey, fine to medium sub rounded gravel, medium plasticity	W			
3.0	3.00m D 3.10m						3.10m Testbore TB 002 Terminated at 3.10 m Target depth				
3.5											

PHOTOGRAPHS NOTES ☐ YES ☒ NO

METHOD
N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U50 - Undisturbed Sample 50 mm diameter
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTBORE LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Preliminary Acid Sulphate Assessment
LOCATION : Rafferty's Resort

PIT NO : TB 003
FILE / JOB NO : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : Kobelco 5t Excavator | METHOD : 300mm spiral flighted auger
DATE EXCAVATED : 22/01/10 | LOGGED BY : GM/ZO | CHECKED BY :
POSITION : For location of test bores see Drawing 1

DRILLING | MATERIAL

DEPTH (m)	SAMPLES & FIELD TESTS	GROUND WATER LEVELS	SUPPORT	PENETRATION (VE, E, F, H)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETROMETER kPa (100, 200, 300, 400)	STRUCTURE & Other Observations
0.0	D-E025 0.10m						TOPSOIL, Sandy Clayey SILT with trace Gravel, stiff to hard, slightly moist, brown, fine to medium sub rounded to round gravel, fine grained sand, contains rootlets	D to M	St to VSt		Well grassed @ Surface DCP @ Surface 4, 16, 14, 19/100mm, 15/50mm, 10/20mm, R
							0.35m				
0.5	0.50m D 0.60m						Silty CLAY with Sand and Gravel, hard, dry to slightly moist, brown, fine sub rounded gravel, fine grained sand, medium plasticity Dry layer @ 0.6 - 2.4m		H		
1.0	1.00m D 1.10m										
1.5	1.50m D-E026 1.60m	Drilled Over Water						M	H		DCP @ 1.2m 30, 32
2.0	2.00m D 2.10m										
2.5	2.60m D 2.70m						Sandy Gravelly CLAY, moist to wet, grey mottled brown, fine to coarse sub rounded to round gravel, fine to medium grained sand	M to W			
3.0		Water inflow @ 3.0m									
							3.20m				
3.5							Testbore TB 003 Terminated at 3.20 m Target depth				

PHOTOGRAPHS NOTES ☐ YES ☒ NO

METHOD
N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U50 - Undisturbed Sample 50 mm diameter
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remoulded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

File: GS 577 TB 003 Page 1 OF 1

TESTBORE LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Preliminary Acid Sulphate Assessment
LOCATION : Rafferty's Resort

PIT NO : TB 004
FILE / JOB NO : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : Kobelco 5t Excavator | METHOD : 300mm spiral flighted auger
DATE EXCAVATED : 22/01/10 | LOGGED BY : GM/ZO | CHECKED BY :
POSITION : For location of test bores see Drawing 1

DRILLING					MATERIAL						
VE / E / F / H PENETRATION	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETRO-METER kPa	STRUCTURE & Other Observations
			ES-E01	0.0			0.05m TOPSOIL, Sandy Clayey SILT with Gravel, hard, slightly moist, brown, fine to medium sub rounded to round gravel, fine grained sand, contains minor rootlets	D to M	H		Well grassed @ Surface DCP @ Surface 15/100mm, 15/50mm, R
			0.10m				Sandy Gravelly Silty CLAY, hard, dry to slightly moist, brown mottled orange brown, fine to coarse sub rounded gravel, fine to medium grained sand, medium plasticity		H		
			0.50m ES-E02 0.60m	0.5			Increase in Sand and Gravel content @ 0.5m	D to M	H		DCP @ 0.5m 22, R
			1.00m ES-E03 1.10m	1.0			0.80m Sandy CLAY, slightly moist to moist, grey mottled orange brown, fine grained sand 1.10m Testbore TB 004 Terminated at 1.10 m Target depth	M			
				1.5							
				2.0							
				2.5							
				3.0							
				3.5							

PHOTOGRAPHS NOTES ☐ YES ☒ NO

METHOD
N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U50 - Undisturbed Sample 50 mm diameter
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTBORE LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Preliminary Acid Sulphate Assessment
LOCATION : Rafferty's Resort

PIT NO : TB 005
FILE / JOB NO : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : Kobelco 5t Excavator | METHOD : 300mm spiral flighted auger
DATE EXCAVATED : 22/01/10 | LOGGED BY : GM/ZO | CHECKED BY :
POSITION : For location of test bores see Drawing 1

DRILLING					MATERIAL						
VE / E / F / H PENETRATION	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETRO-METER kPa	STRUCTURE & Other Observations
			0.10m ES-E04 0.20m	0.0			0.07m TOPSOIL, Sandy Clayey SILT with Gravel, hard, dry, brown, fine to medium sub rounded to round gravel, fine grained sand, contains minor rootlets	D to M	VSt	100 200 300 400	Well grassed @ Surface DCP @ Surface 6, 15, 24, 22/100mm, 15/50mm, R
			0.50m ES-E05 & E05DP 0.60m	0.5			Sandy Silty Gravelly CLAY, hard, slightly moist, brown, fine to medium sub rounded gravel, medium plasticity	M	H		
			1.00m ES-E06 1.10m	1.0			0.95m Sandy CLAY with Gravel, slightly moist, mottled orange and grey, fine to medium sub rounded gravel, fine to medium grained sand 1.10m	M			
				1.5			Testbore TB 005 Terminated at 1.10 m Target depth				
				2.0							
				2.5							
				3.0							
				3.5							

PHOTOGRAPHS NOTES ☐ YES ☒ NO

METHOD
N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U50 - Undisturbed Sample 50 mm diameter
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remoulded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTBORE LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Preliminary Acid Sulphate Assessment
LOCATION : Rafferty's Resort

PIT NO : TB 006
FILE / JOB NO : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : Kobelco 5t Excavator | METHOD : 300mm spiral flighted auger
DATE EXCAVATED : 22/01/10 | LOGGED BY : GM/ZO | CHECKED BY :
POSITION : For location of test bores see Drawing 1

DRILLING					MATERIAL							
VE / E / F / H PENETRATION	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETRO-METER kPa 100 200 300 400	STRUCTURE & Other Observations
			0.10m ES-E07 0.20m	0.0			TOPSOIL, Sandy Sandy Gravelly CLAY, very stiff to hard, dry to slightly moist, brown, fine to coarse sub rounded to round gravel, fine grained sand, contains rootlets	D to M	VSt to H		Well grassed @ Surface DCP @ Surface 9, 14, 20, 18, 14, 15, 16, 20, 30, 35
							0.25m Sandy Silty Gravelly CLAY, hard, slightly moist, brown to orange brown, fine to medium sub rounded gravel				
			0.50m ES-E08 0.60m	0.5				M	H		
			1.00m ES-E09 1.10m	1.0			1.00m Sandy CLAY with Gravel, hard, slightly moist, orange brown speckled brown/white/grey, fine sub rounded gravel	M	H		
							1.20m Testbore TB 006 Terminated at 1.20 m Target depth				
				1.5							
				2.0							
				2.5							
				3.0							
				3.5							

PHOTOGRAPHS NOTES ☐ YES ☒ NO

METHOD
N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U50 - Undisturbed Sample 50 mm diameter
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTBORE LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Preliminary Acid Sulphate Assessment
LOCATION : Rafferty's Resort

PIT NO : TB 007
FILE / JOB NO : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : Kobelco 5t Excavator | METHOD : 300mm spiral flighted auger
DATE EXCAVATED : 22/01/10 | LOGGED BY : GM/ZO | CHECKED BY :
POSITION : For location of test bores see Drawing 1

DRILLING					MATERIAL						
PENETRATION (VE, E, F, H)	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	HAND PENETRO-METER kPa (100, 200, 300, 400)	STRUCTURE & Other Observations
			ES-E10 0.05m	0.0			0.05m FILL, Sandy Silty Gravelly CLAY, dry to slightly moist, brown	D to M			Well grassed @ Surface DCP @ Surface 10, 8, 14, 14
			0.20m ES-E11 & E11DP 0.30m				FILL, CLAY with Gravel, dry to slightly moist, brown 0.30m	D to M			
							Testbore TB 007 Terminated at 0.30 m Target depth				
				0.5							
				1.0							
				1.5							
				2.0							
				2.5							
				3.0							
				3.5							

PHOTOGRAPHS NOTES ☐ YES ☒ NO

METHOD
N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U50 - Undisturbed Sample 50 mm diameter
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTPIT LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Site Classification
LOCATION : Rafferty's Resort

HOLE NO : TP 101
PROJECT REF : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : 5t Excavator | METHOD : 400 mm bucket

DATE EXCAVATED : 22/09/11 | LOGGED BY : GM | CHECKED BY :

LOCATION : See Drawing for location

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, colour, plasticity or particle characteristic Rock Type, colour, grain size Secondary and minor components	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	DCP (BLOW COUNT)	HAND PENETRO-METER (kPa)	STRUCTURE & Other Observations
Not Observed		0.0			FILL -TOPSOIL,Sandy Clayey SILT, dark brown/ black, fine grained sand, with trace of fine to medium grained subrounded to rounded gravel,	D	St	4		
					0.15m FILL- Sandy CLAY, medium plasticity, brown, fine to medium grained sand, trace of fine to medium grained rounded to subrounded gravel			1		
								5		
	0.50m U50	0.5				M to W	F to St	2		
								1		
								4		
	1.00m	1.0			1.00m FILL- Gravelly Sand , fine to coarse, grey, moist (Bottom ASH)			11		
						M	St to VSt	10		
		1.5			1.50m Gravelly Sandy CLAY, medium plasticity, grey mottled brown, fine to medium subrounded to rounded gravel, fine to medium grained sand	M	St to VSt			
					1.70m Testpit TP 101 terminated at 1.70 m					
		2.0								

HAND PENETROMETER (kPa) scale: 100, 200, 300, 400

WATER / MOISTURE
- D - Dry
- M - Moist
- W - Wet
- OMC - Optimum MC
- PL - Plastic Limit
- ▶— Water inflow

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 DENSITY
- VL - Very Loose
- L - Loose
- MD - Medium Dense
- D - Dense
- VD - Very Dense

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTPIT LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Site Classification
LOCATION : Rafferty's Resort

HOLE NO : TP 102
PROJECT REF : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : 5t Excavator | METHOD : 400 mm bucket

DATE EXCAVATED : 22/09/11 | LOGGED BY : GM | CHECKED BY :

LOCATION : See Drawing for location

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, colour, plasticity or particle characteristic Rock Type, colour, grain size Secondary and minor components	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	DYNAMIC PENETROMETER	HAND PENETRO-METER (kPa)	STRUCTURE & Other Observations
Not Observed		0.0			TOPSOIL, Sandy Clayey SILT, dark brown/ black, fine grained sand, trace of fine to medium subrounded to rounded gravel	D	F	2		
		0.15m			Gravelly Sandy CLAY, medium plasticity, grey mottled brown, fine to medium grained sand, trace of fine to medium subrounded to rounded gravel	M to W	St to VSt	4 10		
		0.50m			Gravelly SAND, fine to medium grained sand, grey, fine to medium subrounded to rounded gravel	M	VSt to H	10 15		
		0.70m			Sandy CLAY, medium plasticity, grey mottled brown, fine to medium grained sand, with fine to medium subrounded to rounded gravel	M	St to VSt	22 6 7 8		
	1.00m U50	0.5								
	1.50m	1.0								
		1.5			Testpit TP 102 terminated at 1.50 m					
		2.0								

WATER / MOISTURE
D - Dry
M - Moist
W - Wet
OMC - Optimum MC
PL - Plastic Limit
▶— Water inflow

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 DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTPIT LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Site Classification
LOCATION : Rafferty's Resort

HOLE NO : TP 103
PROJECT REF : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : 5t Excavator | METHOD : 400 mm bucket

DATE EXCAVATED : 22/09/11 | LOGGED BY : GM | CHECKED BY :

LOCATION : See Drawing for location

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, colour, plasticity or particle characteristic Rock Type, colour, grain size Secondary and minor components	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	DCP (BLOW COUNT)	HAND PENETRO-METER (kPa)	STRUCTURE & Other Observations
Not Observed		0.0			TOPSOIL, Sandy Clayey SILT, dark brown/ black, fine grained sand, trace of fine to medium grained subrounded to rounded gravel	M	St	7		
		0.15m			Silty SAND, fine to medium grained sand, grey, with fine to medium grained subrounded to rounded gravel	M	VSt	12 6		
	0.50m U50	0.5			Gravelly Sandy CLAY, medium plasticity, mottled grey brown, fine to medium grained sand, with fine to medium grained subrounded to rounded gravel	M to D	St to VSt	5 6 6		
	1.00m U50	1.0			Gravelly SAND, fine to medium grained sand, mottled grey/ brown, with fine to medium subrounded to rounded gravel	M	St to VSt	9 7		
	1.50m	1.5			Testpit TP 103 terminated at 1.50 m					
		2.0								

WATER / MOISTURE
D - Dry
M - Moist
W - Wet
OMC - Optimum MC
PL - Plastic Limit
▶— Water inflow

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 DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTPIT LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Site Classification
LOCATION : Rafferty's Resort

HOLE NO : TP 104
PROJECT REF : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : 5t Excavator | METHOD : 400 mm bucket

DATE EXCAVATED : 22/09/11 | LOGGED BY : GM | CHECKED BY :

LOCATION : See Drawing for location

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, colour, plasticity or particle characteristic Rock Type, colour, grain size Secondary and minor components	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	DCP (BLOW COUNT)	HAND PENETRO-METER (kPa)	STRUCTURE & Other Observations
Not Observed		0.0			TOPSOIL, Sandy Clayey SILT, dark brown/ black, fine grained sand, trace of fine to medium grained subrounded to rouded gravel	D	St	4		
		0.15m			Garvelly SAND, fine to medium grained sand, dark brown, fine to medium subrounded to rounded gravel	D	St to VSt	6 5		
		0.5						5		
		0.50m			Gravelly Sandy CLAY, medium plasticity, mottled grey brown, fine to medium grained sand, fine to medium graioned subrounded to rounded gravel	M	VSt	10 6 12 9		
		1.0								
		1.5			Testpit TP 104 terminated at 1.50 m					
		1.50m								
		2.0								

HAND PENETROMETER (kPa): 100, 200, 300, 400

WATER / MOISTURE
- D - Dry
- M - Moist
- W - Wet
- OMC - Optimum MC
- PL - Plastic Limit
- ▶— Water inflow

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 DENSITY
- VL - Very Loose
- L - Loose
- MD - Medium Dense
- D - Dense
- VD - Very Dense

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

TESTPIT LOG

CLIENT : Stevens Holdings Pty. Ltd.
PROJECT : Site Classification
LOCATION : Rafferty's Resort

HOLE NO : TP 105
PROJECT REF : GS 577
SHEET : 1 OF 1

EQUIPMENT TYPE : 5t Excavator | METHOD : 400 mm bucket

DATE EXCAVATED : 22/09/11 | LOGGED BY : GM | CHECKED BY :

LOCATION : See Drawing for location

GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, colour, plasticity or particle characteristic Rock Type, colour, grain size Secondary and minor components	MOISTURE / WEATHERING	CONSISTENCY / REL DENSITY / ROCK STRENGTH	DCP (BLOW COUNT)	HAND PENETRO-METER (kPa)	STRUCTURE & Other Observations
Not Observed		0.0			TOPSOIL, Sandy Clayey SILT, dark brown/ black, fine grained sand, fine to medium grained subrounded to rounded gravel	D	F	3	100 200 300 400	
		0.15m			Gravelly SAND, fine to medium graied sand, dark brown, fine to medium grained subrounded to rounded gravel	D	St to VSt	3 16		
		0.5						17		
		0.50m			Gravelly Sandy CLAY, medium plasticity, mottled grey brown, fine to medium grained sand, fine to medium graned subrounded to rounded gravel	D	VSt to VH	12 10 8 7		
		1.0								
		1.5			Testpit TP 105 terminated at 1.50 m					
		1.50m								
		2.0								

WATER / MOISTURE
- D - Dry
- M - Moist
- W - Wet
- OMC - Optimum MC
- PL - Plastic Limit
- ▶— Water inflow

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 DENSITY
- VL - Very Loose
- L - Loose
- MD - Medium Dense
- D - Dense
- VD - Very Dense

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

GEOTECH SOLUTIONS PTY LTD

Geotech Solutions Pty Ltd
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Perth Sand Penetrometer Report

Client:	**Stevens Holdings Pty Ltd**	Report Number:	**Report GS577-1**
Address:	**PO Box 3171 ERINA NSW 2250**		
Job Number:	**GS 577**	Date Tested:	**22.09.2011**
Project:	**Stage 1 Raffertys Resort**	Report Date:	**25.10.2011**
Location	**Cams Wharf**	Test Method:	**AS1289 6.3.2**

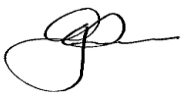
Test ID:	DCP1	DCP2	DCP3	DCP4						
Test Number:										
Retest of:										
Location	See Dtawing GS577-004-1									
Depth (m):										
0.00 - 0.15	**2**	**1**	**12**	**11**						
0.15 - 0.30	**2**	**3**	**8**	**10**						
0.30 - 0.45	**2**	**6**	**8**	**6**						
0.45 - 0.60	**6**	**5**	**10**	**4**						
0.60 - 0.75	**4**	**7**	**16**	**4**						
0.75 - 0.90	**4**	**9**	**7**	**3**						
0.90 - 1.05	**5**	**6**	**6**	**5**						
1.05 - 1.20	**6**	**5**	**7**	**7**						
1.20 - 1.35										
1.35 - 1.50										
1.50 - 1.65										
1.65 - 1.80										
1.80 - 1.95										
1.95 - 2.10										
2.10 - 2.25										
2.25 - 2.40										
2.40 - 2.55										
2.55 - 2.70										
2.70 - 2.85										
2.85 - 3.00										

Laboratory Location: Beresfield **NATA Accreditation Number:** 15689

NATA WORLD RECOGNISED ACCREDITATION

This document is issued in accordance with NATA's accreditation requirements. The results of the tests, calibrations, and /or measurements included in this document are traceable to Australian/National standards.

Approved Signatory



I.G.Piper

Form Number

RP51 - 2