Terara Shoalhaven Sand
C/- Ernest Panucci

Acid Sulfate Soils Assessment: Proposed Expansion of Sand Dredging Operations at Terara Sands, NSW

P1806743JR02V01
April 2019

Copyright Statement

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Head Office
Suite 201, 20 George Street
Hornsby, NSW 2077, Australia
ACN 070 240 890 ABN 85 070 240 890
Phone: +61-2-9476-9999
Fax: +61-2-9476-8767
Email: mail@martens.com.au
Web: www.martens.com.au

Document and Distribution Status

Author(s)	Reviewer(s)	Project Manager/ Director	Signature
Daniel O'Sullivan	Brett McLennan	Jeff Fulton	

Revision No.	Description	Status	Release Date	Document Location			
				File Copy	Ernest Panucci	-	-
1	Acid Sulfate Soil Assessment	Draft	30.01.19	1H, 1P, 1E	1P	-	-
1	Acid Sulfate Soil Assessment	Final	29.04.19	1H, 1P, 1E	1P	-	-

Distribution Types: F = Fax, H = Hard copy, P = PDF document, E = Other electronic format. Digits indicate number of document copies.

All enquiries regarding this project are to be directed to the Project Manager.

Contents

1 Introduction

1.1 Scope of Work

This report, prepared by Martens and Associates (MA), documents the findings of an acid sulphate soils (ASS) assessment to satisfy the Secretaries Environmental Assessment Requirements (SEARs 1234) outlined by the NSW Department of Planning & Environment (DPE) and accompany an Environmental Impact Statement (EIS) for a proposed expansion of sand extraction area in the vicinity of Pig Island in the lower Shoalhaven River, NSW (the site).

The objectives of the ASS assessment were:

- Undertake a preliminary ASS risk assessment.
- Undertake a field assessment with laboratory analysis for ASS.
- Determine if an ASS management plan is required, and where required provide preliminary management options.

1.2 Proposed Development

The proposal includes the extension of the existing dredging footprint around the western and north western portion of the Shoalhaven River mid-channel bar known as (Pig Island). The proposed dredging expansion will allow for the extraction of up to 100,000 tonnes of river sand per annum. Refer to Attachment A for the proposed dredging footprint.

1.3 Guidelines/Standards

This investigation was undertaken in general accordance with the following:

- Acid Sulfate Soil Management Advisory Committee (1998), *Acid Sulfate Soil Manual* (ASSMAC, 1998).
- Shoalhaven City Council (2012) *Shoalhaven Local Environmental Plan 2014*.

2 Site Description

2.1 Location and Setting

Site details are summarised in Table 1.

Table 1: General site information.

Item	Description / Detail
Site address	Pig Island, Nowra, NSW.
Legal identifier	Lot 1-4 DP 1184790
Approximate area	Pig Island: 1.16 km^2 (Six Maps, 2018) Sand extraction extension: 0.27 km^2 (JPS, 2018)
Local Government Area	Shoalhaven City Council (Council)
Current zoning	The property is currently zoned RU1 – Primary Production
Site description and proposed use	The existing sand extraction area is located within the Shoalhaven River at the western point of Pig Island. The proposal includes the extension of the existing dredging footprint to the east (along the northern edge of Pig Island) to allow extraction of sand via dredging a maximum of 100,000 tonnes of river sand in any year over a 30 year period.
Surrounding land uses	The northern bank of the Shoalhaven River is occupied by industrial properties including Shoalhaven Starches Pty Ltd, Argyle Meat and Venus Shell Systems with rural residential properties and agricultural land. The river bank to the south contains a mixture of residential properties, agricultural land and commercial properties including, Shoalhaven Caravan Village, Terara Shoalhaven Sand Pty Ltd and Terara Riverside Retreat.
Topography	The proposed dredging area is located on sand flats in the tidal portion of Shoalhaven River. The southeast portion of the proposed dredging area (closest to the western end of Pig Island) has an elevation of 0.19 mAHD, - 0.25 mAHD in the northern, - 1.11 mAHD in the eastern and - 2.7 mAHD in the western portion.
Expected geology	The *Wollongong 1:250,000 Geological Series Sheet S1 56.9 (1966)* describes site geology as alluvium, gravel, swamp deposits and sand dunes. The NSW Environment and Heritage eSPADE website identifies the site as having Shoalhaven soil landscapes consisting of alluvium – gravel, sand, silt and clay derived mainly from sandstone and shale overlying buried estuarine sediments.

3 Acid Sulfate Soils Assessment

3.1 Overview

The purpose of the assessment was to determine whether ASS will be disturbed during sand dredging operations and to assess whether an ASS management plan (ASSMP) is required for the proposed works. Refer to Attachment A for the proposed dredging footprint.

3.2 Desktop Review

3.2.1 ASS Risk Map Classification

The site is mapped as containing Class 2 and Class 3 land (Shoalhaven LEP, 2014). The site location and associated mapped ASS risk, is presented in Figure 1, Attachment C. Class 2 and Class 3 land require development consent where:

Class 2: Works occur below natural ground surface and/or works by which the water table is likely to be lowered.

Class 3: Works occur beyond 1 metre below the natural ground surface and/or works by which the water table is likely to be lowered beyond 1 m below the natural ground surface.

3.2.2 Geomorphic Setting

The likelihood of ASS occurrence at a site is a function of various geomorphic parameters, in particular those listed in Table 4 (ASSMAC, 1998). Each is an indicator that ASS are likely present onsite.

Table 4: Geomorphic features indicative of ASS.

Geomorphic Feature	Present on site?
Holocene sediments	Yes
Soil horizons less than 5 m AHD	Yes
Marine / estuarine sediments or tidal lakes	Yes
Coastal wetland; backwater swamps; waterlogged or scaled areas; interdune swales or coastal sand dunes	Yes
Dominant vegetation is mangroves, reeds, rushes and other swamp or marine tolerant species	No
Geologies containing sulfide bearing material / coal deposits or former marine shales/sediments	Yes
Deep older (Pleistocene) estuarine sediments	Yes

The geomorphic setting of the site indicates that ASS are likely to be present and intrusive investigation with laboratory testing of soils is required.

3.3 Field Investigations

Works were devised to identify the potential quality and extent of the sand resource within the proposed extraction area. A summary of field works undertaken on 18 September, 2018, for the land resource assessment is presented below. Further details are provided in Section 4.

- Inspection of the site via barge, to assess existing site conditions, river morphology and geology.
- Four Dynamic Cone Penetrometer (DCP) tests up to 5 metres below ground level (mbgl).
- Drilling of five vibracore boreholes (VC301, VC302A, VC302B, VC303, VC304A and VC304B) to termination depths between 1.6 m and 3.7 mbgl (-1.5 mAHD to -3.7 mAHD).
- Collection of soil samples for laboratory testing.

Vibracore locations are shown in Attachment B.

3.4 Sub-Surface Conditions

Intrusive investigations identified one general soil unit within the proposed extraction extension zone.

Unit 1: Sand, medium and coarse grained, with varying portions of fine grained sand, brown-grey to dark grey in colour.

Lenses of silty sand and sandy silt with clay and organic matter, typically wood fragments, were encountered up to 0.5 m thick, with vibracore termination often occurring on or within these lenses. Encountered lenses are likely to be shallow (< 0.5 m), but may extend laterally across the site. The thin lenses may be due to fine sediment and / or organic matter becoming trapped and subsequently buried in ripple hollows or crossbeded sequences after sediment settlement following periods of high river conditions (i.e. flooding).

Encountered conditions are described in more detail on the borehole logs in Attachment D.

3.5 Soil Sampling and Laboratory Analysis

3.5.1 Laboratory Analysis

As stated by the ASSMAC (1998) guidelines, ASS may be indicated by field pH < 4 in soils.

As field pH was not analysed, the pH_{KCl} was used for the assessment, which can overestimate pH levels.

None of the tested samples showed signs of being actual acid sulfate soils (i.e. pH_{KCl} <4).

3.5.2 Action Criteria

A total of 24 samples from the vibracores were submitted to Envirolab Pty Ltd (a Nata accredited laboratory) for ASS analysis using the chromium suite, to determine presence of actual or potential acid sulfate soils (AASS or PASS).

As the site is estimated to disturb more than 1000 tonnes of soil, ASSMAC (1998) indicates that a detailed ASSMP is required if one of the following criteria is exceeded:

- Sulfur trail (% S) is > 0.03%; or
- Acid trail (H+/tonne) is >18 mol H^+/tonne

3.6 Discussion

The following summarises the laboratory analytical results:

- The possible presence of AASS was not detected.
- Chromium suite test results using acid-base accounting was calculated using the net acidity = actual acidity (as TAA) + retained acidity (as Scr) – net neutralising capacity (as Anc).
- All samples returned existing acidity (TAA) below the laboratory reporting limit.
- Six samples returned Scr results above the action criteria ranging from 0.04 to 0.52 % w/w.

As the action criteria values were exceeded for % S, the dredging works in the proposed extension area are to continue to be undertaken under the existing ASSMP to address risks associated with PASS and potential acid generation during site works.

The works will fall under a very high treatment category as per Table 4.5 in ASSMAC (1998). Provided the existing ASSMP continues to be implemented, acidic soil conditions should not restrict the proposed dredged sand works.

4 References

Acid Sulfate Soil Management Advisory Committee (1998), *Acid Sulfate Soil Manual* (ASSMAC, 1998).

Johnson Procter Surveyors, Survey, 2018.

NSW Department of Environment & Heritage (eSPADE, NSW soil and land information), www.environment.nsw.gov.au.

NSW Department of Primary Industries Water (DPIW) real time groundwater bore database.

NSW EPA (2014), *Waste Classification Guidelines, Parts 1&4*.

Rose G. (1966) *Wollongong 1:250 000 Geological Sheet SI/56-09, 2nd edition*, Geological Survey of New South Wales, Sydney.

Secretary's Environmental Assessment Requirements (SEARs) - Terara Shoalhaven Sand (SEAR 1234), dated 29 July 2018.

Shoalhaven City Council (2012) *Shoalhaven Local Environmental Plan 2014*.

5 Attachment A – Proposed Dredging Area

JOHNSON PROCTER SURVEYORS PTY LIMITED

ABN 99 030 462 878

Land, Engineering & Subdivision Development Surveying Consultants

2 KEFT AVENUE NOWRA, PO BOX 2031 BOMADERRY NSW 2541

PHONE: (02) 4423 3566 MOBILE: 0408 487 201

FAX: (02) 4423 1641 E-MAIL: jps@jpsurveyors.com.au

PLAN OF SEA GRASS LOCATION AND LEVEL SPOT HEIGHTS WITHIN THE SHOALHAVEN RIVER FOR SHOALHAVEN SAND PTY. LTD.

DATE : 16 OCTOBER, 2018

DATUM : SEE NOTES

LEVEL ORIGIN : SEE NOTES

REDUCTION RATIO : 1 : 2000 (A1) 1 : 4000 (A3)

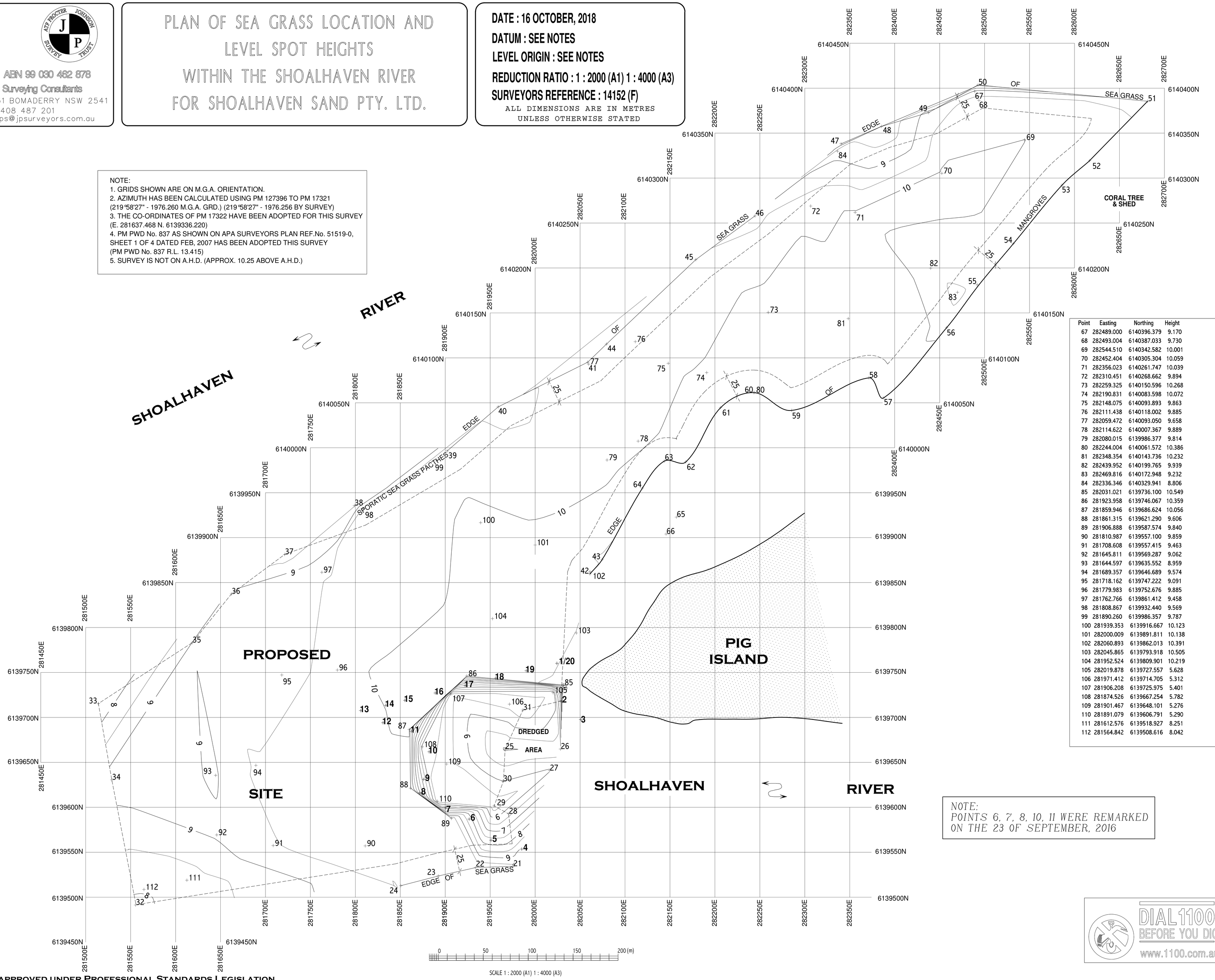
SURVEYORS REFERENCE : 14152 (F)

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED

NOTE:
1. GRIDS SHOWN ARE ON M.G.A. ORIENTATION.
2. AZIMUTH HAS BEEN CALCULATED USING PM 127396 TO PM 17321 (219°58'27" - 1976.260 M.G.A. GRD.) (219°58'27" - 1976.256 BY SURVEY)
3. THE CO-ORDINATES OF PM 17322 HAVE BEEN ADOPTED FOR THIS SURVEY (E. 281637.468 N. 6139336.220)
4. PM PWD No. 837 AS SHOWN ON APA SURVEYORS PLAN REF.No. 51519-0, SHEET 1 OF 4 DATED FEB, 2007 HAS BEEN ADOPTED THIS SURVEY (PM PWD No. 837 R.L. 13.415)
5. SURVEY IS NOT ON A.H.D. (APPROX. 10.25 ABOVE A.H.D.)

Point	Easting	Northing	Height
1	282024.232	6139760.149	10.436
2	282028.679	6139718.220	10.420
3	282050.704	6139697.679	10.300
4	281985.081	6139553.548	9.253
5	281950.932	6139563.353	9.936
6	281926.621	6139586.862	9.645
7	281900.124	6139599.419	9.793
8	281871.624	6139615.912	9.757
9	281875.961	6139631.082	9.739
10	281882.122	6139661.720	9.778
11	281862.220	6139684.682	9.825
12	281830.737	6139694.118	9.763
13	281805.905	6139707.552	9.668
14	281833.850	6139713.504	9.714
15	281855.056	6139719.037	9.803
16	281888.847	6139727.207	9.863
17	281922.171	6139735.289	9.975
18	281956.128	6139743.681	10.263
19	281990.130	6139751.874	10.398
20	282024.230	6139760.162	10.485
21	281975.380	6139534.420	9.649
22	281933.694	6139532.928	9.935
23	281892.274	6139523.607	9.849
24	281850.608	6139512.844	9.543
25	281966.541	6139664.598	7.050
26	282028.205	6139664.808	6.835
27	282015.982	6139640.792	5.940
28	281970.436	6139592.728	3.559
29	281954.336	6139601.546	5.178
30	281964.260	6139628.895	5.992
31	281986.361	6139708.250	5.165
32	281555.505	6139491.319	7.880
33	281514.090	6139715.389	7.578
34	281529.085	6139630.549	9.293
35	281618.564	6139783.138	9.011
36	281662.160	6139837.370	9.140
37	281721.409	6139881.341	8.235
38	281798.906	6139935.613	8.483
39	281902.058	6139996.365	9.772
40	281958.930	6140045.475	9.373
41	282058.472	6140095.149	9.831
42	282060.881	6139859.681	10.476
43	282074.487	6139875.617	10.548
44	282079.375	6140115.411	9.732
45	282178.735	6140209.236	9.542
46	282244.595	6140257.968	9.383
47	282340.335	6140338.144	7.738
48	282385.202	6140357.495	7.998
49	282437.587	6140372.854	9.201
50	282492.711	6140403.626	7.846
51	282681.318	6140385.449	9.362
52	282616.767	6140319.392	9.865
53	282585.990	6140292.132	9.901
54	282531.897	6140227.082	9.953
55	282491.653	6140181.318	9.881
56	282457.736	6140133.691	9.952
57	282387.248	6140055.357	10.209
58	282371.303	6140077.799	10.132
59	282285.370	6140041.585	10.263
60	282243.016	6140061.386	10.397
61	282206.279	6140044.625	10.324
62	282167.569	6139984.290	10.267
63	282143.630	6139985.216	10.296
64	282119.215	6139955.098	10.369
65	282157.118	6139922.802	11.215
66	282145.673	6139903.966	11.074

Point	Easting	Northing	Height
67	282489.000	6140396.379	9.170
68	282493.004	6140387.033	9.730
69	282544.510	6140342.582	10.001
70	282452.404	6140305.304	10.059
71	282356.023	6140261.747	10.039
72	282310.451	6140268.662	9.894
73	282259.325	6140150.596	10.268
74	282190.831	6140083.598	10.072
75	282148.075	6140093.893	9.863
76	282111.438	6140118.002	9.885
77	282059.472	6140093.050	9.658
78	282114.622	6140007.367	9.889
79	282080.015	6139986.377	9.814
80	282244.004	6140061.572	10.386
81	282348.354	6140143.736	10.232
82	282439.952	6140199.765	9.939
83	282469.816	6140172.948	9.232
84	282336.346	6140329.941	8.806
85	282031.021	6139736.100	10.549
86	281923.958	6139746.067	10.359
87	281859.946	6139686.624	10.056
88	281861.315	6139621.290	9.606
89	281906.888	6139587.574	9.840
90	281810.987	6139557.100	9.859
91	281708.608	6139557.415	9.463
92	281645.811	6139569.287	9.062
93	281644.597	6139635.552	8.959
94	281689.357	6139646.689	9.574
95	281718.162	6139747.222	9.091
96	281779.983	6139752.676	9.885
97	281762.766	6139861.412	9.458
98	281808.867	6139932.440	9.569
99	281890.260	6139986.357	9.787
100	281939.353	6139916.667	10.123
101	282000.009	6139891.811	10.138
102	282060.893	6139862.013	10.391
103	282045.865	6139793.918	10.505
104	281952.524	6139809.901	10.219
105	282019.878	6139727.557	5.628
106	281971.412	6139714.705	5.312
107	281906.208	6139725.975	5.401
108	281874.526	6139667.254	5.782
109	281901.467	6139648.101	5.276
110	281891.079	6139606.791	5.290
111	281612.576	6139518.927	8.251
112	281564.842	6139508.616	8.042



NOTE:
POINTS 6, 7, 8, 10, 11 WERE REMARKED ON THE 23 OF SEPTEMBER, 2016

DIAL 1100 BEFORE YOU DIG www.1100.com.au

COVER OF EXCELLENCE

6 Attachment B – Vibracore Locations

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
C	**MINOR AMENDMENT**	**30/04/2019**	**RK**	**DOS**	**DOS**	**BM**
B	MINOR AMENDMENT	7/11/18	EM		DOS	BM
A	INITIAL RELEASE	15/10/2018	LZ			

SCALE
0 20 40 60 80 100 120 140 160 180 200 METRES
A1 (A3) 1:2,000 (1:4,000)

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	SN

CLIENT
TERARA SHOALHAVEN SAND

PROJECT NAME/PLANSET TITLE
EXPANSION OF SAND EXTRACTION
CONTAMINATION ASSESSMENT
125 TERARA ROAD, TERARA NSW 2541

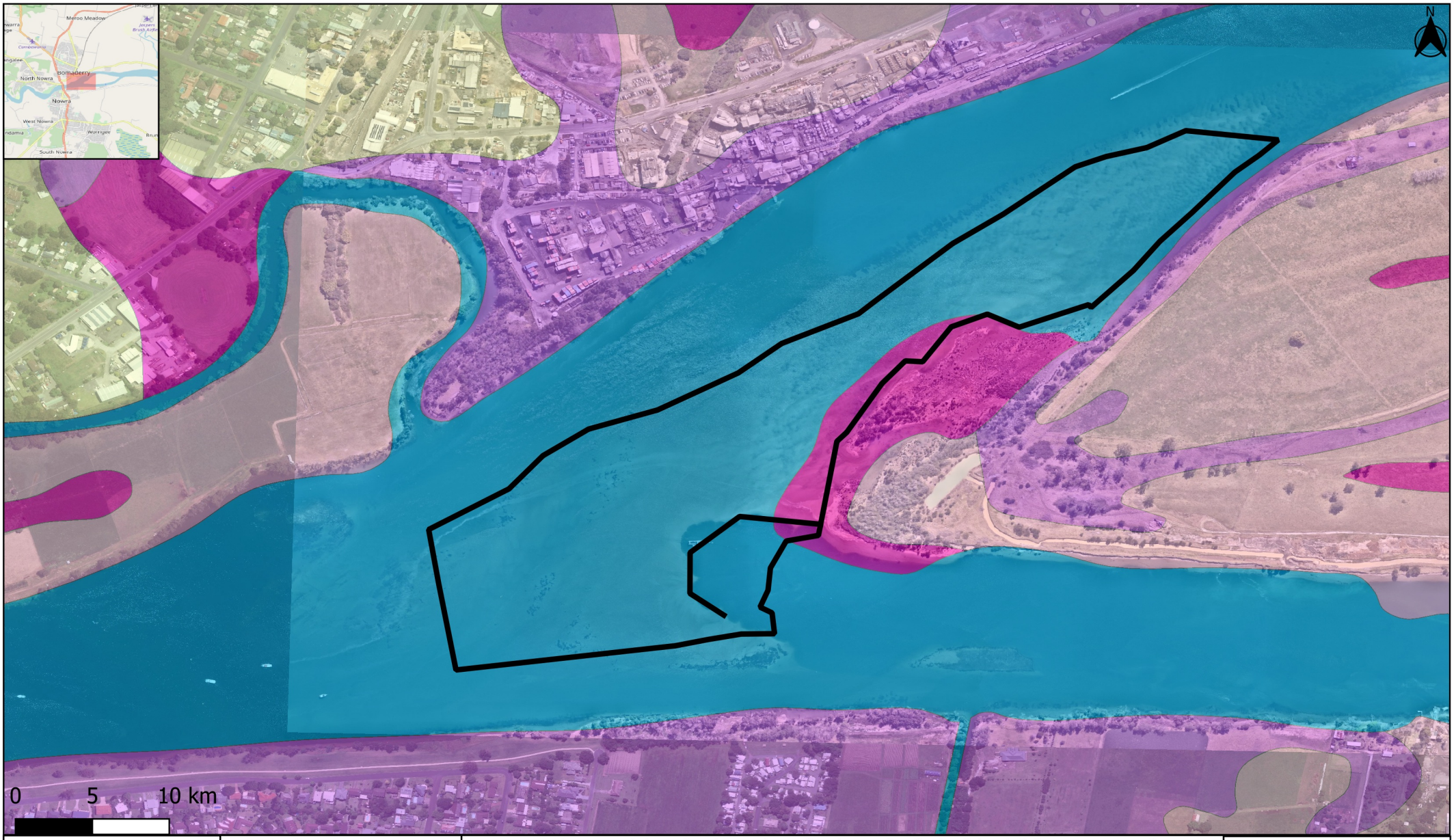
martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE
EXTENT OF SAND DREDGING OPERATIONS

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1806743	PS01	R03	PS01-AZ00	C

PRINTED: 15.10.2019 - USER: RKOLANDOZHA
A1 / A3 LANDSCAPE (A1LC_v02.0.01)
DRAWING ID: P1806743-PS01-R03-AZ00

7 Attachment C – Shoalhaven LEP, 2014, ASS Risk Map



Project:	P1806743
Drawn / Approved:	BM / DM
Date:	20.12.2018
Scale:	1:5071
Martens & Associates Pty Ltd ABN 85 070 240 890	

Environment | Water | Wastewater | Geotechnical | Civil | Managment

SHOALHAVEN ASS RISK MAP

EXPANSION OF SAND EXTRACTION

125 TERARA ROAD, TERARA NSW 2541

Drawing:
Figure 1
P1806743DR01V01

martens

Legend

ASS Risk Mapping

- NA
- Class 1
- Class 2 & 2a
- Class 2b
- Class 3
- Class 4
- Class 5
- Proposed Footprint

8 Attachment D – Borehole Logs

CLIENT	Terara Shoalhaven Sand Pty Ltd	COMMENCED	18/09/2018	COMPLETED	18/09/2018	**REF VC301**
PROJECT	Land Resource and Contamination Assessment	LOGGED	AM	CHECKED	BM	Sheet 1 OF 1
SITE	Shoalhaven River (Pig Island), NSW	GEOLOGY		VEGETATION	N/A	PROJECT NO. P1806743
EQUIPMENT	Vibrocore	EASTING		RL SURFACE	-0.3 m	DATUM AHD
EXCAVATION DIMENSIONS	Ø80 mm x 3.10 m depth	NORTHING		ASPECT	West	SLOPE <2%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
VC	L	Drilled Over Water	0.5	-0.30	6743/VC301/0.0-0.5/S/1 D 0.00 m 6743/VC301/0.1-0.4/S/1 D 0.10 m 6743/VC301/0.2-1.0/S/1 D 0.20 m			SP	SAND, medium grained; brown-grey; trace wood.			ALLUVIUM
			1.0									
			1.5		6743/VC301/1.3-1.5/S/1 D 1.30 m					W		
				1.80								
	M		2.0	-2.10	6743/VC301/1.8-2.0/S/1 D 1.80 m 6743/VC301/1.9-2.2/S/1 D 1.90 m				Medium to coarse grained; grey; trace clay and wood fragments.			
			2.5	*2.70*								
	H		3.0	-3.00	6743/VC301/2.7-3.0/S/1 D 2.70 m 6743/VC301/2.7-3.1/S/1 D 2.70 m			SM	Silty SAND; medium to coarse grained; dark grey; with clay and wood.			2.70: to 3.1m; Partial core recovery.
				3.10								
			3.5						Hole Terminated at 3.10 m			3.10: Terminated due to high penetration resistance from wood fragments.
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - TEST

CLIENT	Terara Shoalhaven Sand Pty Ltd		COMMENCED	18/09/2018	COMPLETED	18/09/2018	**REF VC302A**
PROJECT	Land Resource and Contamination Assessment		LOGGED	AM	CHECKED	BM	Sheet 1 OF 1
SITE	Shoalhaven River (Pig Island), NSW		GEOLOGY		VEGETATION	N/A	PROJECT NO. P1806743
EQUIPMENT		Vibrocore	EASTING		RL SURFACE	0.1 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø80 mm x 1.60 m depth	NORTHING		ASPECT	West	SLOPE <2%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
VC	L-M	Drilled Over Water	0.5	0.10	6743/VC302A/0.0-0.4/S/1 D 0.00 m 6743/VC302A/0.0-0.5/S/1 D 0.00 m			SP	SAND; medium grained; brown-grey.			ALLUVIUM
					6743/VC302A/0.6-0.9/S/1 D 0.60 m					W		
			1.0	*0.90* -0.80	6743/VC302A/0.9-1.2/S/1 D 0.90 m				Grey.			
					6743/VC302A/1.1-1.6/S/1 D 1.10 m 6743/VC302A/1.2-1.6/S/1 D 1.20 m							
	H		1.5	*1.60*					Hole Terminated at 1.60 m			1.60: Terminated due to high penetration resistance from wood fragments.
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - TEST

CLIENT	Terara Shoalhaven Sand Pty Ltd	COMMENCED	18/09/2018	COMPLETED	18/09/2018	**REF VC302B**
PROJECT	Land Resource and Contamination Assessment	LOGGED	AM	CHECKED	BM	Sheet 1 OF 1
SITE	Shoalhaven River (Pig Island), NSW	GEOLOGY		VEGETATION	N/A	PROJECT NO. P1806743
EQUIPMENT	Vibrocore	EASTING		RL SURFACE	0.1 m	DATUM AHD
EXCAVATION DIMENSIONS	Ø80 mm x 3.40 m depth	NORTHING		ASPECT	West	SLOPE <2%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
VC		Drilled Over Water	0.5	0.10	6743/VC302B/0.0-0.3/S/1 D 0.00 m			SP	SAND; medium grained; brown-grey.			ALLUVIUM
	L-M		1.0		6743/VC302B/0.6-0.9/S/1 D 0.60 m							
			1.5		6743/VC302B/1.2-1.6/S/1 D 1.20 m							
				1.60 -1.50	6743/VC302B/1.6-2.0/S/1 D 1.60 m				From 1.6-1.8m: wood.	W		
	M		2.0		6743/VC302B/2.0-2.4/S/1 D 2.00 m							
			2.5									
	H		3.0		6743/VC302B/2.8-3.0/S/1 D 2.80 m 6743/VC302B/2.8-3.4/S/1 D 2.80 m							
				3.40								
			3.5						Hole Terminated at 3.40 m			3.40: Terminated due to high penetration resistance.
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - TEST

CLIENT	Terara Shoalhaven Sand Pty Ltd	COMMENCED	18/09/2018	COMPLETED	18/09/2018	**REF VC303**
PROJECT	Land Resource and Contamination Assessment	LOGGED	AM	CHECKED	BM	Sheet 1 OF 1
SITE	Shoalhaven River (Pig Island), NSW	GEOLOGY		VEGETATION	N/A	PROJECT NO. P1806743
EQUIPMENT	Vibrocore	EASTING		RL SURFACE	-0.7 m	DATUM AHD
EXCAVATION DIMENSIONS	Ø80 mm x 3.00 m depth	NORTHING		ASPECT	West	SLOPE <2%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
VC		Drilled Over Water	0	-0.70	6743/VC303/0.0-0.5/S/1 D 0.00 m 6743/VC303/0.0-0.5/S/2 D 0.00 m			SP	SAND; fine to medium grained; brown-grey.			ALLUVIUM
				0.50								
			0.5	-1.20	6743/VC303/0.5-0.8/S/1 D 0.50 m 6743/VC303/0.5-0.8/S/2 D 0.50 m			ML	Clayey SILT; low plasticity; dark grey.			
				0.80								
				-1.50				SP	SAND; medium to coarse grained; brown-grey.			
	L		1.0		6743/VC303/0.9-1.3/S/1 D 0.90 m 6743/VC303/0.9-1.3/S/2 D 0.90 m							
			1.5		6743/VC303/1.5-2.1/S/1 D 1.50 m					W		
				2.00								
			2.0	-2.70					Trace subangular, fine grained, lithic gravel.			
	M-H		2.5									
	H				6743/VC303/2.7-3.0/S/1 D 2.70 m 6743/VC303/2.7-3.0/S/2 D 2.70 m							
				3.00								
			3.0						Hole Terminated at 3.00 m			3.00: Terminated due to high penetration resistance.
			3.5									
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - TEST

CLIENT	Terara Shoalhaven Sand Pty Ltd		COMMENCED	18/09/2018	COMPLETED	18/09/2018	**REF VC304A**
PROJECT	Land Resource and Contamination Assessment		LOGGED	AM	CHECKED	BM	Sheet 1 OF 1
SITE	Shoalhaven River (Pig Island), NSW		GEOLOGY		VEGETATION	N/A	PROJECT NO. P1806743
EQUIPMENT		Vibrocore	EASTING		RL SURFACE	-0.2 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø80 mm x 3.40 m depth	NORTHING		ASPECT	West	SLOPE <2%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
VC		Drilled Over Water	0	-0.20	6743/VC304A/0.0-0.2/S/1 D 0.00 m 6743/VC304A/0.0-0.2/S/2 D 0.00 m			SP	SAND; fine to medium grained; brown-grey; trace silt.			ALLUVIUM
				0.20								
				-0.40				SP	SAND; fine to medium grained, brown-grey.			
	L		0.5		6743/VC304A/0.4-0.6/S/1 D 0.40 m 6743/VC304A/0.4-0.6/S/2 D 0.40 m							
				0.90								
				-1.10					Trace wood.			
			1.0		6743/VC304A/1.0-1.2/S/1 D 1.00 m							
	L-M		1.5							W		
					6743/VC304A/1.8-2.0/S/1 D 1.80 m							
			2.0		6743/VC304A/2.1-2.5/S/1 D 2.10 m							
	M		2.5		6743/VC304A/2.5-2.7/S/1 D 2.50 m							
				2.90								
				-3.10				ML	Sandy SILT; low plasticity; dark grey; with wood.			
	H		3.0		6743/VC304A/3.0-3.2/S/1 D 3.00 m							
					6743/VC304A/3.2-3.4/S/1 D 3.20 m							
				3.40								
			3.5						Hole Terminated at 3.40 m			3.40: Terminated due to high penetration resistance from wood fragments.
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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Engineering Log - TEST

CLIENT	Terara Shoalhaven Sand Pty Ltd		COMMENCED	18/09/2018	COMPLETED	18/09/2018	**REF VC304B**
PROJECT	Land Resource and Contamination Assessment		LOGGED	AM	CHECKED	BM	Sheet 1 OF 1
SITE	Shoalhaven River (Pig Island), NSW		GEOLOGY		VEGETATION	N/A	PROJECT NO. P1806743
EQUIPMENT		Vibrocore	EASTING		RL SURFACE	-0.2 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø80 mm x 3.70 m depth	NORTHING		ASPECT	West	SLOPE <2%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
VC		Drilled Over Water	0	-0.20	6743/VC304B/0.0-0.3/S/1 D 0.00 m			SP	SAND, fine to medium grained; brown-grey.			ALLUVIUM
				0.50								
			0.5	-0.70					Trace wood.			
	L-M				6743/VC304B/0.7-1.0/S/1 D 0.70 m							
			1.0		6743/VC304B/1.0-1.5/S/1 D 1.00 m							
			1.5		6743/VC304B/1.5-1.7/S/1 D 1.50 m							
			2.0							W		
	M				6743/VC304B/2.2-2.5/S/1 D 2.20 m							
			2.5									
			3.0									
				3.20								
				-3.40	6743/VC304B/3..2-3.4/S/1 D 3.20 m		×	SM	Silty SAND; fine to medium grained; brown-grey.			3.20: to 3.7m: Partial core loss.
	H				6743/VC304B/3.2-3.7/S/1 D 3.20 m		×					
			3.5		6743/VC304B/3.4-3.7/S/1 D 3.40 m		×					
				3.70			×					
									Hole Terminated at 3.70 m			3.70: Terminated due to high penetration resistance.
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

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mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - TEST

9 Attachment E – Laboratory Test Results

ASS Laboratory Test Results Interpretation

Method based on Acid Sulfate Soil Manual (ASSMAC, 1998)
Method ST-50 V05 Revised 30.04.2018

Suite 201, 20 George Street, Hornsby, NSW 2077 Ph: (02) 9476 9999 Fax: (02) 9476 8767 mail@martens.com.au, www.martens.com.au

PROJECT DETAILS

Client	Terara Shoalhaven Sand C/- Ernest Panucci	**Page No.**	1 of 1
Project	Acid Sulfate Assessment	**Date**	20.12.2018
Sampling Site	Pig Island, Terara NSW	**Job Number**	P1806743JR03V01
Sample History	18.09.2018	**Sampled By**	DOS

ASSUMED PARAMETERS

SAMPLE DETAILS / TEST RESULTS

Sample ID	Sample Depth (m)	Material Type [1]	Scr %	TAA[3] (mol H+/t)	ANC	S_{NAS}[5] (%w/w S)	Net acidity
6743/VC301/0.0-0.5	0.0-0.5	C	0.012	<5	3	<0.005	0.007
6743/VC301/1.3-1.5	1.3-1.5	C	0.012	<5	10	<0.005	0.0160
6743/VC301/1.9-2.2	1.9-2.2	C	0.013	<5	48	<0.005	0.0760
6743/VC301/2.7-3.1	2.7-3.1	C	0.030	<5	160	<0.005	0.2500
6743/VC302A/0.0-0.4	0.0-0.4	C	0.011	<5	5	<0.005	0.0080
6743/VC302A/0.6-0.9	0.6-0.9	C	0.015	<5	5	<0.005	0.0080
6743/VC302A/1.2-1.6	1.2-1.6	C	0.013	<5	25	<0.005	0.0400
6743/VC302B/0.6-0.9	0.6-0.9	C	0.013	<5	<3	<0.005	0.0050
6743/VC302B/1.2-1.6	1.2-1.6	C	0.010	<5	7	<0.005	0.0110
6743/VC302B/2.0-2.4	2.0-2.4	C	0.010	<5	10	<0.005	0.0160
6743/VC302B/2.8-3.0	2.8-3.0	C	0.011	<5	9	<0.005	0.0140
6743/VC303/0.0-0.5	0.0-0.5	C	0.017	<5	8	<0.005	0.0140
6743/VC303/0.9-1.3	0.9-1.3	C	0.015	<5	8	<0.005	0.0130
6743/VC303/2.7-3.0/2	2.7-3.0/2	C	0.010	<5	5	<0.005	0.0080
6743/VC304A/0.0-0.2	0.0-0.2	C	0.016	<5	19	<0.005	<0.005
6743/VC304A/0.4-0.6	0.4-0.6	C	0.012	<5	<3	<0.005	<0.005
6743/VC304A/1.0-1.2	1.0-1.2	C	0.013	<5	3	<0.005	0.0050
6743/VC304A/1.8-2.0	1.8-2.0	C	0.012	<5	<3	<0.005	<0.005
6743/VC304A/2.5-2.7	2.5-2.7	C	0.014	<5	46	<0.005	0.0740
6743/VC304A/3.0-3.2	3.0-3.2	C	0.054	<5	320	<0.005	0.5200
6743/VC304B/0.7-1.0	0.7-1.0	C	0.019	<5	19	<0.005	0.0300
6743/VC304B/1.5-1.7	1.5-1.7	C	0.010	<5	<3	<0.005	<0.005
6743/VC304B/2.2-2.5	2.2-2.5	C	0.011	<5	<3	<0.005	<0.005
6743/VC304B/3.2-3.4	3.2-3.4	C	0.019	<5	4	<0.005	<0.005
6743/VC302B/0.0-0.3	0.0-0.3	C	0.010	<5	110	<0.005	0.1800
6743/VC303/0.5-0.8	0.5-0.8	C	0.030	<5	<3	<0.005	<0.005
6743/VC304B/3.4-3.7	3.4-3.7	C	0.012	<5	<3	<0.005	<0.005
Assessment Criteria: (For exposed soil >1000t, use coarse textured criteria)		(F)ine textured; > 40 % clay	0.100	62	62	0.100	
		(M)edium textured; 5-40 % clay	0.060	36	36	0.060	
		(C)oarse textured; < 5 % clay	0.030	18	18	0.030	

Notes:

1. Material type based on field texture assessment or laboratory report.
2. Pre-oxidation soluble sulfur.
3. Total Actual Acidity. Highlighted values exceed ASSMAC (1998) action criteria.
4. Chroimium Reducible Sulfure. Highlighted values exceed ASSMAC (1998) action criteria.
5. Percentage net acid soluble sulfur. Highlighted values exceed ASSMAC (1998) action criteria.
6. From laboratory test results (refer to laboratory test certificates).

10 Attachment F – Laboratory Test Certificates

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

CERTIFICATE OF ANALYSIS 201261

Client Details

Client	Martens & Associates Pty Ltd
Attention	Andrew Mesthos, S Noor
Address	Suite 201, 20 George St, Hornsby, NSW, 2077

Sample Details

Your Reference	**P1806743 - Terara, NSW**
Number of Samples	27 Soil
Date samples received	20/09/2018
Date completed instructions received	20/09/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	27/09/2018
Date of Issue	27/09/2018

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Jacinta Hurst, Laboratory Manager

Chromium Suite						
Our Reference		201261-1	201261-2	201261-3	201261-4	201261-5
Your Reference	UNITS	6743/VC301/0.0-0.5	6743/VC301/1.3-1.5	6743/VC301/1.9-2.2	6743/VC301/2.7-3.1	6743/VC302A/0.0-0.4
Date Sampled		18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
Date analysed	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
pH $_{kcl}$	pH units	6.3	5.8	5.9	6.4	6.0
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+ /t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.005	0.02	0.08	0.25	0.008
a-Chromium Reducible Sulfur	moles H^+ /t	3	10	48	160	5
S_{HCl}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
S_{KCl}	%w/w S	0.012	0.012	0.013	0.030	0.011
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_{BT}	% $CaCO_3$	<0.05	<0.05	<0.05	<0.05	<0.05
s-ANC_{BT}	%w/w S	<0.05	<0.05	<0.05	<0.05	<0.05
s-Net Acidity	%w/w S	0.0070	0.016	0.076	0.25	0.0080
a-Net Acidity	moles H^+ /t	<5	10	48	160	<5
Liming rate	kg $CaCO_3$ /t	<0.75	0.76	3.6	12	<0.75
a-Net Acidity without ANCE	moles H^+ /t	<5	10	48	160	<5
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	0.76	3.6	12	<0.75
s-Net Acidity without ANCE	%w/w S	0.0070	0.016	0.076	0.25	0.0080

Chromium Suite						
Our Reference		201261-6	201261-7	201261-8	201261-9	201261-10
Your Reference	UNITS	6743/VC302A/0.6-0.9	6743/VC302A/1.2-1.6	6743/VC302B/0.6-0.9	6743/VC302B/1.2-1.6	6743/VC302B/2.0-2.4
Date Sampled		18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
Date analysed	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
pH $_{kcl}$	pH units	6.2	6.1	6.0	6.1	6.3
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+ /t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.008	0.04	<0.005	0.01	0.02
a-Chromium Reducible Sulfur	moles H^+ /t	5	25	<3	7	10
S_{HCl}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
S_{KCl}	%w/w S	0.015	0.013	0.013	0.010	0.010
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_{BT}	% $CaCO_3$	<0.05	<0.05	<0.05	<0.05	<0.05
s-ANC_{BT}	%w/w S	<0.05	<0.05	<0.05	<0.05	<0.05
s-Net Acidity	%w/w S	0.0080	0.040	<0.005	0.011	0.016
a-Net Acidity	moles H^+ /t	<5	25	<5	6.9	9.7
Liming rate	kg $CaCO_3$ /t	<0.75	1.9	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+ /t	<5	25	<5	6.9	9.7
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	1.9	<0.75	<0.75	<0.75
s-Net Acidity without ANCE	%w/w S	0.0080	0.040	<0.005	0.011	0.016

Chromium Suite						
Our Reference		201261-11	201261-12	201261-13	201261-14	201261-15
Your Reference	UNITS	6743/VC302B/2.8-3.0	6743/VC303/0.0-0.5	6743/VC303/0.9-1.3	6743/VC303/2.7-3.0/2	6743/VC304A/0.0-0.2
Date Sampled		18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
Date analysed	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
pH $_{kcl}$	pH units	6.1	6.4	6.2	6.1	7.0
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+ /t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.01	0.01	0.01	0.008	0.03
a-Chromium Reducible Sulfur	moles H^+ /t	9	8	8	5	19
S_{HCl}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
S_{KCl}	%w/w S	0.011	0.017	0.015	0.010	0.016
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_{BT}	% $CaCO_3$	<0.05	<0.05	<0.05	<0.05	0.68
s-ANC_{BT}	%w/w S	<0.05	<0.05	<0.05	<0.05	0.22
s-Net Acidity	%w/w S	0.014	0.014	0.013	0.0080	<0.005
a-Net Acidity	moles H^+ /t	8.9	8.5	8.1	<5	<5
Liming rate	kg $CaCO_3$ /t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+ /t	8.9	8.5	8.1	<5	19
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	<0.75	<0.75	<0.75	1.4
s-Net Acidity without ANCE	%w/w S	0.014	0.014	0.013	0.0080	0.030

Chromium Suite						
Our Reference		201261-16	201261-17	201261-18	201261-19	201261-20
Your Reference	UNITS	6743/VC304A/0.4-0.6	6743/VC304A/1.0-1.2	6743/VC304A/1.8-2.0	6743/VC304A/2.5-2.7	6743/VC304A/3.0-3.2
Date Sampled		18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
Date analysed	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
pH $_{kcl}$	pH units	6.4	6.3	6.4	6.3	5.8
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+ /t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	<0.005	0.005	<0.005	0.07	0.52
a-Chromium Reducible Sulfur	moles H^+ /t	<3	3	<3	46	320
S_{HCl}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
S_{KCl}	%w/w S	0.012	0.013	0.012	0.014	0.054
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_{BT}	% $CaCO_3$	<0.05	<0.05	<0.05	<0.05	<0.05
s-ANC_{BT}	%w/w S	<0.05	<0.05	<0.05	<0.05	<0.05
s-Net Acidity	%w/w S	<0.005	0.0050	<0.005	0.074	0.52
a-Net Acidity	moles H^+ /t	<5	<5	<5	46	320
Liming rate	kg $CaCO_3$ /t	<0.75	<0.75	<0.75	3.5	24
a-Net Acidity without ANCE	moles H^+ /t	<5	<5	<5	46	320
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	<0.75	<0.75	3.5	24
s-Net Acidity without ANCE	%w/w S	<0.005	0.0050	<0.005	0.074	0.52

Chromium Suite						
Our Reference		201261-21	201261-22	201261-23	201261-24	201261-25
Your Reference	UNITS	6743/VC304B/0.7-1.0	6743/VC304B/1.5-1.7	6743/VC304B/2.2-2.5	6743/VC304B/3.2-3.4	6743/VC302B/0.0-0.3
Date Sampled		18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
Date analysed	-	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018
pH $_{kcl}$	pH units	6.1	6.4	6.4	6.7	6.2
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+ /t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.03	<0.005	<0.005	0.006	0.18
a-Chromium Reducible Sulfur	moles H^+ /t	19	<3	<3	4	110
S_{HCl}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
S_{KCl}	%w/w S	0.019	0.010	0.011	0.019	0.010
S_{NAS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_{BT}	% $CaCO_3$	<0.05	<0.05	<0.05	0.58	<0.05
s-ANC_{BT}	%w/w S	<0.05	<0.05	<0.05	0.19	<0.05
s-Net Acidity	%w/w S	0.030	<0.005	<0.005	<0.005	0.18
a-Net Acidity	moles H^+ /t	19	<5	<5	<5	110
Liming rate	kg $CaCO_3$ /t	1.4	<0.75	<0.75	<0.75	8.2
a-Net Acidity without ANCE	moles H^+ /t	19	<5	<5	<5	110
Liming rate without ANCE	kg $CaCO_3$ /t	1.4	<0.75	<0.75	<0.75	8.2
s-Net Acidity without ANCE	%w/w S	0.030	<0.005	<0.005	0.0060	0.18

Chromium Suite			
Our Reference		201261-26	201261-27
Your Reference	UNITS	6743/VC303/0.5-0.8	6743/VC304B/3.4-3.7
Date Sampled		18/09/2018	18/09/2018
Type of sample		Soil	Soil
Date prepared	-	26/09/2018	26/09/2018
Date analysed	-	26/09/2018	26/09/2018
pH $_{kcl}$	pH units	6.7	6.3
s-TAA pH 6.5	%w/w S	<0.01	<0.01
TAA pH 6.5	moles H^+ /t	<5	<5
Chromium Reducible Sulfur	%w/w	<0.005	<0.005
a-Chromium Reducible Sulfur	moles H^+ /t	<3	<3
S_{HCl}	%w/w S	<0.005	<0.005
S_{KCl}	%w/w S	0.030	0.012
S_{NAS}	%w/w S	<0.005	<0.005
ANC_{BT}	% $CaCO_3$	0.66	<0.05
s-ANC_{BT}	%w/w S	0.21	<0.05
s-Net Acidity	%w/w S	<0.005	<0.005
a-Net Acidity	moles H^+ /t	<5	<5
Liming rate	kg $CaCO_3$ /t	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+ /t	<5	<5
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	<0.75
s-Net Acidity without ANCE	%w/w S	<0.005	<0.005

Method ID	Methodology Summary
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: Chromium Suite						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			26/09/2018	1	26/09/2018	26/09/2018		26/09/2018	[NT]
Date analysed	-			26/09/2018	1	26/09/2018	26/09/2018		26/09/2018	[NT]
pH $_{kcl}$	pH units		Inorg-068	[NT]	1	6.3	6.3	0	98	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	<0.01	1	<0.01	<0.01	0	[NT]	[NT]
TAA pH 6.5	moles H^+ /t	5	Inorg-068	<5	1	<5	<5	0	95	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	<0.005	1	0.005	0.007	33	[NT]	[NT]
a-Chromium Reducible Sulfur	moles H^+ /t	3	Inorg-068	<3	1	3	4	29	93	[NT]
S_{HCl}	%w/w S	0.005	Inorg-068	<0.005	1	<0.005	<0.005	0	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-068	<0.005	1	0.012	0.010	18	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-068	<0.005	1	<0.005	<0.005	0	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	0.05	Inorg-068	<0.05	1	<0.05	<0.05	0	[NT]	[NT]
s-ANC_{BT}	%w/w S	0.05	Inorg-068	<0.05	1	<0.05	<0.05	0	[NT]	[NT]
s-Net Acidity	%w/w S	0.005	Inorg-068	<0.005	1	0.0070	0.0090	25	[NT]	[NT]
a-Net Acidity	moles H^+ /t	5	Inorg-068	<5	1	<5	5.7	13	[NT]	[NT]
Liming rate	kg $CaCO_3$ /t	0.75	Inorg-068	<0.75	1	<0.75	<0.75	0	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+ /t	5	Inorg-068	<5	1	<5	5.7	13	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$ /t	0.75	Inorg-068	<0.75	1	<0.75	<0.75	0	[NT]	[NT]
s-Net Acidity without ANCE	%w/w S	0.005	Inorg-068	<0.005	1	0.0070	0.0090	25	[NT]	[NT]

QUALITY CONTROL: Chromium Suite						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	11	26/09/2018	26/09/2018		26/09/2018	[NT]
Date analysed	-			[NT]	11	26/09/2018	26/09/2018		26/09/2018	[NT]
pH $_{kcl}$	pH units		Inorg-068	[NT]	11	6.1	6.3	3	98	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
TAA pH 6.5	moles H^+ /t	5	Inorg-068	[NT]	11	<5	<5	0	96	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	[NT]	11	0.01	0.01	0	[NT]	[NT]
a-Chromium Reducible Sulfur	moles H^+ /t	3	Inorg-068	[NT]	11	9	7	25	93	[NT]
S_{HCl}	%w/w S	0.005	Inorg-068	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-068	[NT]	11	0.011	0.013	17	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-068	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	0.05	Inorg-068	[NT]	11	<0.05	<0.05	0	[NT]	[NT]
s-ANC_{BT}	%w/w S	0.05	Inorg-068	[NT]	11	<0.05	<0.05	0	[NT]	[NT]
s-Net Acidity	%w/w S	0.005	Inorg-068	[NT]	11	0.014	0.012	15	[NT]	[NT]
a-Net Acidity	moles H^+ /t	5	Inorg-068	[NT]	11	8.9	7.3	20	[NT]	[NT]
Liming rate	kg $CaCO_3$ /t	0.75	Inorg-068	[NT]	11	<0.75	<0.75	0	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+ /t	5	Inorg-068	[NT]	11	8.9	7.3	20	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$ /t	0.75	Inorg-068	[NT]	11	<0.75	<0.75	0	[NT]	[NT]
s-Net Acidity without ANCE	%w/w S	0.005	Inorg-068	[NT]	11	0.014	0.012	15	[NT]	[NT]

QUALITY CONTROL: Chromium Suite						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	26/09/2018	26/09/2018		[NT]	[NT]
Date analysed	-			[NT]	21	26/09/2018	26/09/2018		[NT]	[NT]
pH $_{kcl}$	pH units		Inorg-068	[NT]	21	6.1	6.3	3	[NT]	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	[NT]	21	<0.01	<0.01	0	[NT]	[NT]
TAA pH 6.5	moles H^+ /t	5	Inorg-068	[NT]	21	<5	<5	0	[NT]	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	[NT]	21	0.03	0.03	0	[NT]	[NT]
a-Chromium Reducible Sulfur	moles H^+ /t	3	Inorg-068	[NT]	21	19	17	11	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-068	[NT]	21	<0.005	<0.005	0	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-068	[NT]	21	0.019	0.021	10	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-068	[NT]	21	<0.005	<0.005	0	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	0.05	Inorg-068	[NT]	21	<0.05	<0.05	0	[NT]	[NT]
s-ANC_{BT}	%w/w S	0.05	Inorg-068	[NT]	21	<0.05	<0.05	0	[NT]	[NT]
s-Net Acidity	%w/w S	0.005	Inorg-068	[NT]	21	0.030	0.028	7	[NT]	[NT]
a-Net Acidity	moles H^+ /t	5	Inorg-068	[NT]	21	19	17	11	[NT]	[NT]
Liming rate	kg $CaCO_3$ /t	0.75	Inorg-068	[NT]	21	1.4	1.3	7	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+ /t	5	Inorg-068	[NT]	21	19	17	11	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$ /t	0.75	Inorg-068	[NT]	21	1.4	1.3	7	[NT]	[NT]
s-Net Acidity without ANCE	%w/w S	0.005	Inorg-068	[NT]	21	0.030	0.028	7	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

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

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

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

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.