GEOTECH AND ACID SULFATE SOILS

Geotechnical Investigation

Arrawarra Beach Caravan Park

For

Astoria Group P/L

June 2016

de Groot & Benson Pty Ltd
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1 INTRODUCTION

This document reports on a geotechnical investigation undertaken at Arrawarra Beach Caravan Park. Arrawarra Beach is a small coastal community on the New South Wales mid north coast, some 30 km north of Coffs Harbour.

The geotechnical investigation was originally conducted by de Groot & Benson Pty Ltd in 2006, and this revision updates the investigation to 2016 circumstances.

The attached drawing 00074-G01 provides an overview of the park. Yarrawarra Creek forms the park's northern boundary while Arrawarra Creek forms the east and southern boundaries. The two creeks come together at the north-eastern corner of the park from where they cross the beach to the Pacific Ocean, just 250 metres to the north east.

The park's owners, the Astoria Group P/L, propose to undertake works to stabilise the creek banks from on-going erosion and to ensure the long term viability of the park. This investigation is to assist in formulating such works. It only present the findings of the geotechnical investigation and does not provide conclusions or recommendations as to appropriate works.

2 SITE DESCRIPTION

An overview of the park and surrounding area is shown on drawing 00074-G01. The park is contained within lot 12 of DP 835612 and lot 1 of DP 789002 and covers some 2.2 Ha. The park is bounded by Yarrawarra Creek to the north and Arrawarra Creek to east and south. The park is fairly level falling from RL 4.0 metres Australian Height Datum (m AHD) in the north to about RL 2.0 m AHD in the south.

The park has a managers residence, shop and office, two amenities buildings, a asphalt internal road system, approximately 14 permanent cabins, a dozen or so permanent caravans with additions and many tourist caravan sites.

The creek banks bounding much of the park are subject to substantial erosion caused by both the flow of the creeks and wave action from the ocean in large storm surge events. Work to stabilise some of the banks has been undertaken in the past. A low wall of rock filled wire baskets (Gabions) were placed along the eastern frontage with short returns along the northern and southern legs. These baskets have deteriorated. In places the wire has completely corrode through allowing some of the rocks to spill out.

The Yarrawarra Creek bank to the north is the highest at approximately 3 metres. Other than some toe protection offered by the gabions at the eastern end, the bank is only protected by vegetation. Significant scour, erosion and undercutting are present.

The Arrawarra Creek bank is lower, at between 1 and 2 metres in height. The gabions form the lower tier along the eastern boundary. Along the southern boundary the low bank is stabilised by mature melaleucas (paper barks) and some minor ineffectual timber structures.

Appendix A provides photos of the creek banks. The attached drawings 00074-G02 to 05 show detailed survey along the creek banks and through the park. They also show the M.H.W.M (mean high water mark) as surveyed in 1988, which predates the gabion installation. This line defines the property boundary in the current deposited plans (DP 789002 & DP 835612). Generally, the then surveyed M.H.W.M. is beyond the existing creek bank.

The Dorrigo – Coffs Harbour 1:250,000 Geological Series Sheet SH56 – 10 & 11 identifies the underlying strata as bordering Qs – "Beach and dune sand" and P-Cc – "Coramba Beds (Greywacke, slate, siliceous argillite) of the Coffs Harbour Block dating from the Carboniferous period".

3 FIELDWORK

The fieldwork comprised the excavation of five boreholes with standard penetrometer tests (SPT) and seven dynamic cone penetrometer (DCP) tests. The five boreholes were excavated by Aimil P/L on 7 November 2006 using a small 4wd drilling rig driving a 100mm spiral flight auger. The boreholes were sunk along the top of the creek bank to either 4.4 metres or 5.9 metres depth.

The seven DCP tests were carried out on 14 November 2006 along the base of the creek bank. They were driven to either 3 metres depth or greater than 20 blows per 100mm advance.

The location of the boreholes and DCPs are shown on the drawings.

4 LABORATORY TESTING

Samples were recovered from the SPT tests and delivered to the Coffs Harbour Environmental Laboratory for Acid Sulphate testing.

The testing results indicated that mild acid sulfate soils may be encountered on the site, and further details can be found in the Preliminary Acid Sulfate Soils Assessment (June 2016) conducted by de Groot & Benson Pty Ltd.

5 FINDINGS

The borehole logs are shown on drawings 00074-G06. The drawing also shows a profile of the creek bank plotted against chainage in metres and level to Australian Height Datum (AHD). The borehole logs and DCP results are plotted accurately to both chainage and level. The extent of the gabion wall is also shown. The base of the gabions was verified in places by probing.

The soil profile found in the boreholes was quite consistent along the creek bank. The general soil profile is predominantly alluvial sand above about RL 0.5 m AHD over residual clays. Specifically:

- Above about RL 0.5m AHD the sand is fine to medium sub-angular dune/beach sand. Some silt and clay were found above RL 2.7 m AHD in BH 1 and 2.

- The exposed creek bank along Yarrawarra Creek shows a fractured band of indurated sand (Coffee Rock), generally between RL 1.5 and 0.5 m AHD. The coffee rock appears to be only weakly cemented or is not continuos. While darkly stained sand was recovered in the boreholes any coffee rock struck offered minimal resistance to the auger and was not noticeable to the driller or engineer.

- The underlying clay is either residual or ancient alluvial in deposition. Apart from a thin zone of about 0.3 to 0.5 metres of soft super saturated clay immediately below the sand, the clays under were well consolidated, moist and stiff to very stiff in consistency.

- The clays were light to dark grey of medium to high plasticity with increasing red and yellow mottling with depth.

- Underlying rock was not encountered in any borehole.

- The only significant departure from this profile was in BH5, which found clayey fill down to RL 0.0 m AHD over 0.5 m of alluvial sand over the clay starting from RL -0.5 m AHD. It is suspected that this corner of the park was filled and reclaimed when the gabion wall was installed.

- Mild acid sulfate soils may be encountered when performing excavations over the site.

In considering the profile shown on drawings 00074-G06 it must be noted that the DCP tests were carried out standing in the creek just below the creek bank while the boreholes were excavated a few metres in from the top of the bank.

In the creek itself, the underlying clay starts a little deeper than behind the banks, typically at 0.0 to 0.2 m AHD, probably reflecting past erosion and sedimentation along the creek.

The DCP results show the alluvial sand of the creek floor to be very loose. The surface 0.5 metres or so of the underlying clay is soft. Below which it quickly stiffens and becomes very stiff reaching DCP refusal (greater than 20 blows for 100 mm penetration) generally within 1.5 to 2.0 m depth (RL -0.5 to -1.0 m AHD).

Again the exception was at DCP7, opposite BH 5. Here reasonable resistance was offered until RL -0.2 m AHD from where the DCP sank to RL -1.0 m AHD with minimal effort. Below this

depth the consistency became stiff then gradually increased with depth until the 3.0 metre limit of the DCP was reached.

It is suspected that a deep hole has in the past eroded in the creek at this point and has since filled with loosely deposited alluvial material.

6 CONCLUSION

The existing creek banks show signs of scour and erosion, particularly that facing Yarrawarra Creek to the north. The previously installed gabion wall along the eastern bank is deteriorating. Gradual failure with loss of stones can be expected in the coming years if no preventative action is taken.

The surface soils throughout the park and to a shallower extent in the creek are predominately alluvial dune/beach sand. Below RL 0.0 to 0.5 m AHD the sand sits on residual or ancient alluvial clays. The first 0.3 m to 0.5 m of clay is soft, but the clay generally rapidly becomes stiff to very stiff. Underlying rock was not found and must be below RL -3.0 m AHD.

A band of weakly indurated sand (coffee rock) is evident along the Yarrawarra Creek bank from about RL 0.5 m to 1.5 m AHD. It is assisting in maintaining the bank's near vertical face but is being undercut and eroded. Its strength is very weak and/or it is discontinuous as its penetration was not detected in the boreholes other than by the colour of the sand.

DRAWINGS

PROPOSED WORKS BY COUNCIL WITHIN EXISTING 1m WIDE RIGHT OF FOOTPATH TO MAKE GOOD EXISTING FOOTPATH AT TOP OF BANK FOR PUBLIC ACCESS.

PROPOSED DRAINAGE WORKS WITHIN COUNCIL'S DRAINAGE EASEMENT ON ADJOINING LANDS TO BE UNDERTAKEN BY COUNCIL AT A FUTURE DATE.

REMOVE EXISTING LARGE SWAMP MAHOGANY, AND FIG TREE.

APPROX. EXTENT OF ROCK ARMOUR

EXISTING GABION SEA WALL TO BE REMOVED WHERE OUTSIDE BOUNDARY.

EXISTING GABION SEA WALL TO BE REMOVED WHERE OUTSIDE BOUNDARY.

BOUNDARY AS SURVEYED AS M.H.W.M. ON DP 835612 AND DP 789002, SURVEY 1988.

EXISTING GABION SEA WALL TO BE REMOVED WHERE OUTSIDE BOUNDARY. REPLACE WITH ROCK ARMOUR

YARRAWARRA CREEK

ARRAWARRA BEACH ROAD

ARRAWARRA BEACH

SHOP & OFFICE

COTTAGE

AMMENITIES

BBQ

A/C COTTAGE METAL ROOF No 44

A/C COTTAGE METAL ROOF No 42

A/C COTTAGE METAL ROOF No 40

WB COTTAGE METAL ROOF No 38

HARDIPLANK COTTAGE METAL ROOF 36

A/C COTTAGE METAL ROOF No 34

Ch 10.000 Ch 20.000 Ch 30.000 Ch 40.000 Ch 50.000 Ch 60.000 Ch 70.000 Ch 80.000 Ch 90.000 Ch 100.000 Ch 110.000 Ch 120.000 Ch 130.000 Ch 140.000 Ch 150.000 Ch 160.000 Ch 170.000 Ch 180.000 Ch 190.000 Ch 200.000 Ch 210.000 Ch 220.000 Ch 230.000 Ch 240.000 Ch 250.000 Ch 260.000 Ch 270.000 Ch 280.000 Ch 290.000 Ch 300.000 Ch 310.000 Ch 320.000 Ch 330.000 Ch 340.000 Ch 350.000 Ch 360.000 Ch 370.000 Ch 380.000 Ch 390.000 Ch 400.000 Ch 410.000 Ch 420.000 Ch 430.000 Ch 440.000 Ch 450.000

20 0 20 40 60 80 100

SCALE OF METRES 1:1000 @ A3

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GEO	05.06.16	2016 REVISION	TJP	RDG

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Checked xxx	Date xxx	No of Drawings

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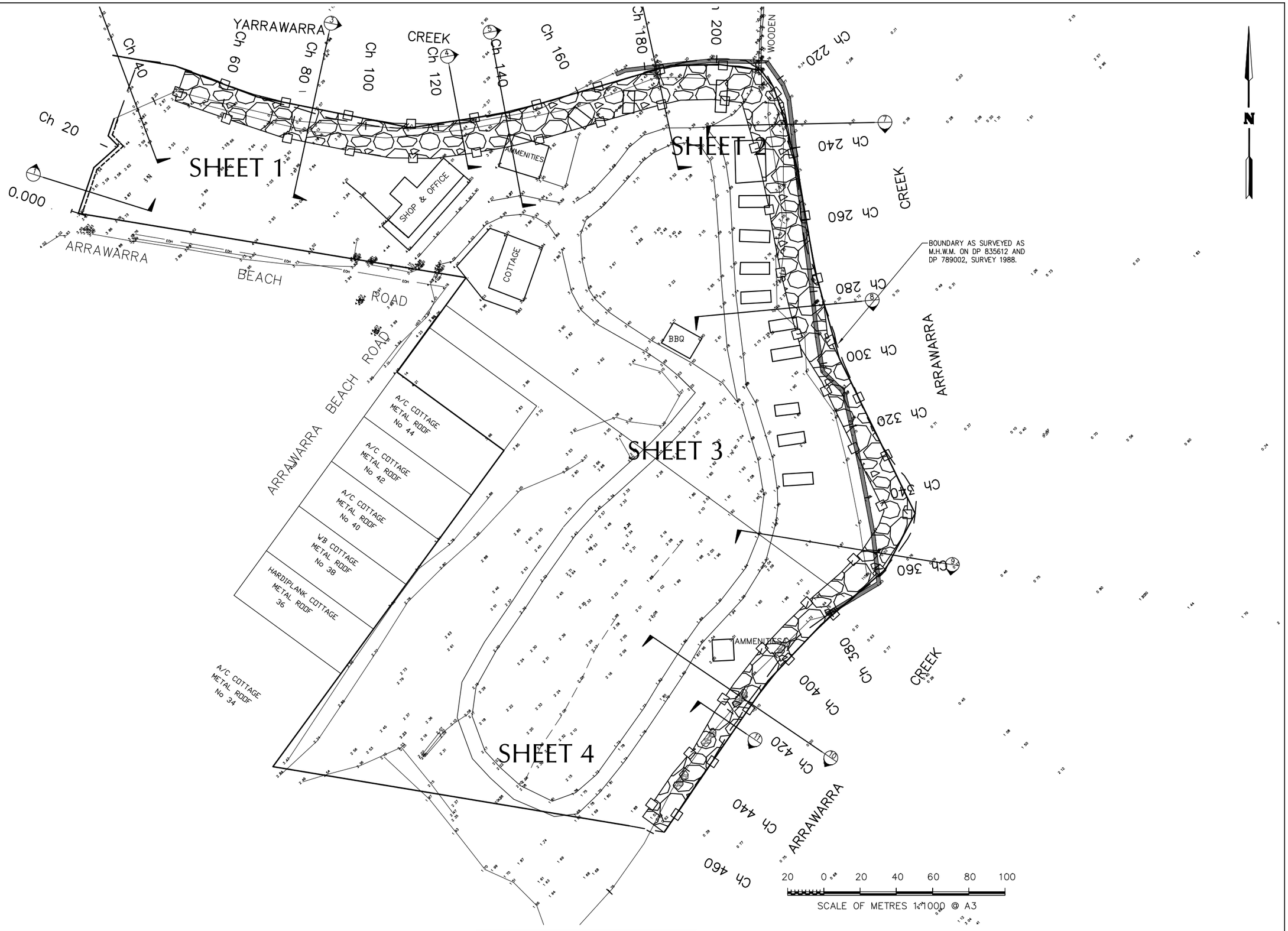
PROPOSED SEA WALL
ARRAWARRA BEACH CARAVAN PARK
ARRAWARRA

FOR *ASTORIA DEVELOPMENTS P/L*

SITE PLAN

Drawing No. 00074–G01
Amendment No. GEO
Council No.



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PROPOSED SEA WALL
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ARRAWARRA

FOR *ASTORIA DEVELOPMENTS P/L*

PLAN OVERVIEW

Drawing No. 00074–G02
Amendment No. GEO
Council No.

BANK PLOTTED FROM
SURVEYOR KEN BLAIRS
1988 FIELD DATA

BOUNDARY AS SURVEYED AS M.H.W.M. ON DP 835612 AND DP 789002, SURVEY 1988.

YARRAWARRA CREEK

ARRAWARRA BEACH

SHOP & OFFICE

COTTAGE

AMENITIES

CABIN RELOCATED

APPROX. EXTENT OF REVETMENT

Ch 10.000
Ch 20.000
Ch 30.000
Ch 40.000
Ch 50.000
Ch 60.000
Ch 70.000
Ch 80.000
Ch 90.000
Ch 100.000
Ch 110.000
Ch 120.000
Ch 130.000
Ch 140.000
Ch 150.000
Ch 160.000
Ch 170.000

0 5 10 15 20Metres
SCALE 1:400 AT A3

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PROPOSED SEA WALL
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ARRAWARRA

FOR *ASTORIA DEVELOPMENTS P/L*

PLAN 1 OF 4

Drawing No. 00074–G03
Amendment No. GEO
Council No.

EXISTING GABION SEAWALL TO BE REMOVED

BOUNDARY AS SURVEYED AS M.H.W.M. ON DP 835612 AND DP 789002, SURVEY 1988.

RELOCATE CABINS

EXISTING GABION SEA WALL TO BE REMOVED WHERE OUTSIDE BOUNDARY

Ch 130.000 Ch 140.000 Ch 150.000 Ch 160.000 Ch 170.000 Ch 180.000 Ch 190.000 Ch 200.000 Ch 210.000 Ch 220.000 Ch 230.000 Ch 240.000 Ch 250.000 Ch 260.000 Ch 270.000 Ch 280.000

BRIDGE

AMMENITIES

COTTAGE

CREEK

N

0 5 10 15 20Metres
SCALE 1:400 AT A3

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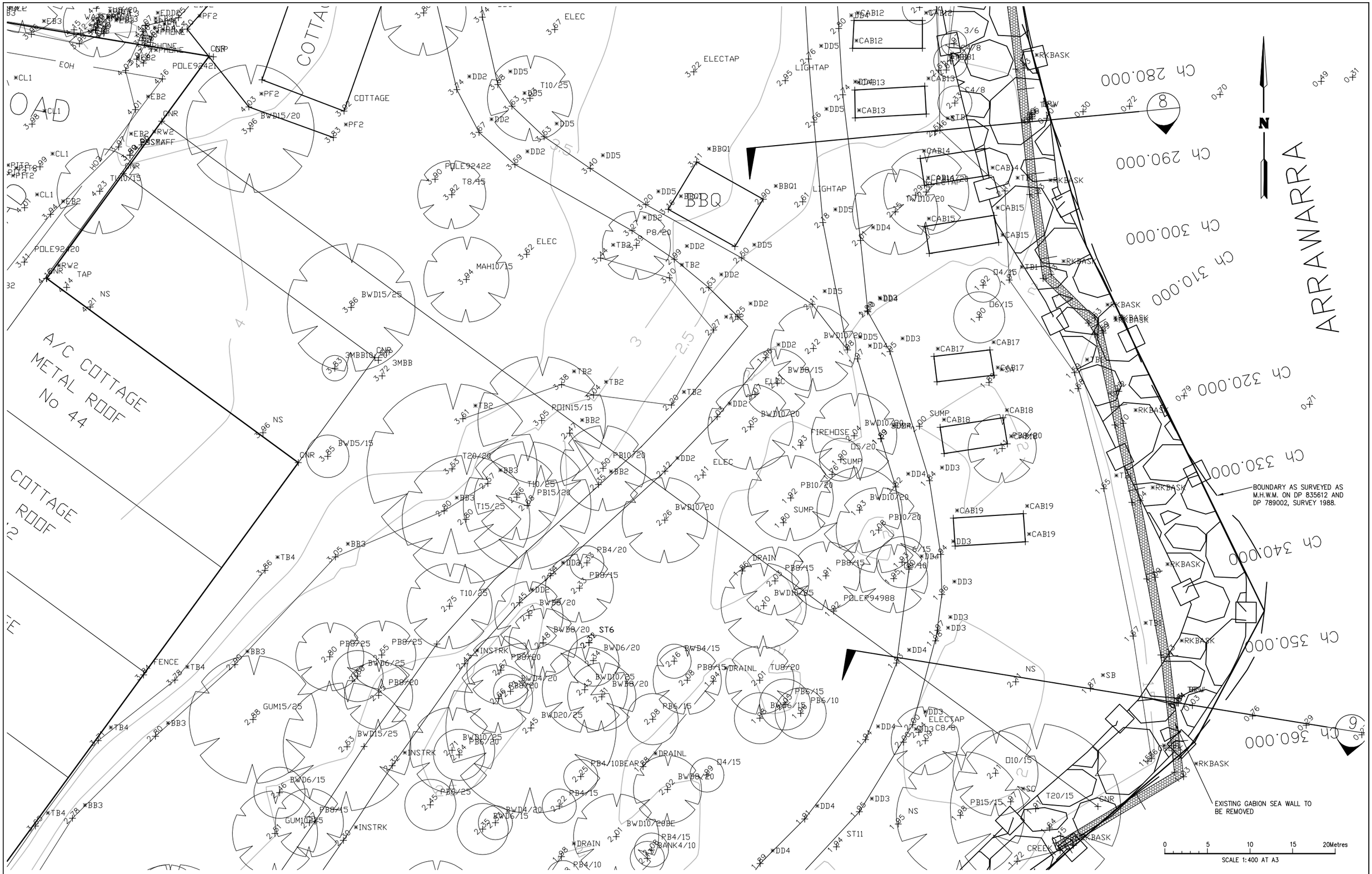
PROPOSED SEA WALL
ARRAWARRA BEACH CARAVAN PARK
ARRAWARRA

FOR *ASTORIA DEVELOPMENTS P/L*

PLAN 2 OF 4

Drawing No. 00074–G04
Amendment No. GEO
Council No.



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PROPOSED SEA WALL
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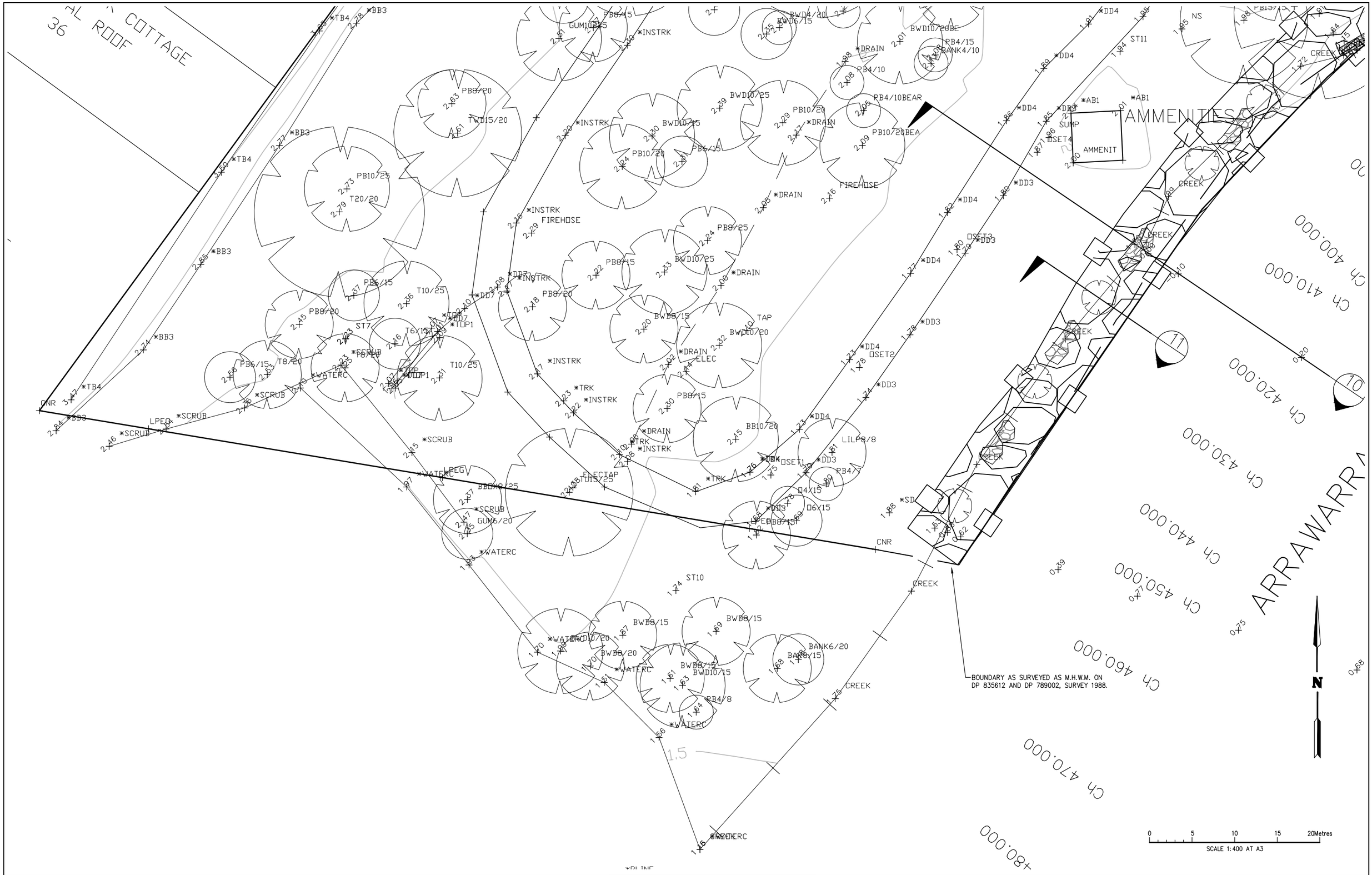
ARRAWARRA

FOR *ASTORIA DEVELOPMENTS P/L*

PLAN 3 OF 4

Drawing No. 00074–G05
Amendment No. GEO
Council No.



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PROPOSED SEA WALL
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FOR *ASTORIA DEVELOPMENTS P/L*

PLAN 4 OF 4

Drawing No. 00074–G06
Amendment No. GEO
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CHAINAGE (m)

LEVEL (mAHD)

4.00 3.00 2.00 1.00 0.00 −1.00 −2.00 −3.00

CH 20 CH 40 CH 60 CH 80 CH 100 CH 120 CH 140 CH 160 CH 180 CH 200 CH 220 CH 240 CH 260 CH 280 CH 300 CH 320 CH 340 CH 360 CH 380 CH 400 CH 420 CH 440 CH 460 CH 480 CH 500

BH1

SANDY TOPSOIL

SC CLAYEY SAND, Dark Brown–black, Med dense, Moist.

CI SANDY CLAY, Med plasticity, Brown, Moist, Firm.

SP SAND, Fine to med grained, Sub angular (Dune/beach sand), Light brown, Medium Dense, Moist.

SPT 5 6 6 N=12

Mauve coloured below 2.0m (weak coffee rock)

Saturated below 2.5m.

SPT 2 5 6 N=11

CI/CH SILTY CLAY, Medium to high plasticity, Grey with some brown mottle, Moist, Stiff.

Becoming CH CLAY, High plasticity, Grey with some brown mottle, Moist, Very Stiff.

SPT 4 8 13 N=21

Increasing red mottling and a trace of iron stone gravel below 5.0m.

End @ 5.9m

BH2

SANDY TOPSOIL

SM SILTY SAND, Fine to medium grained, Sub angular, Light grey–brown, Dry,Medium dense.

Becomming SP SAND, Fine to med grained, Sub angular (Dune/beach sand), Light brown–white, Medium Dense, Moist.

Dark brown below 2.0m (weak coffee rock)

SPT 5 4.5 N=7

CI SILTY CLAY, Medium to high plasticity, Grey, Saturated, Firm.

2.5

Becoming Moist to wet and Stiff

Becoming CH CLAY, High plasticity, Grey with some red & yellow mottle, Moist, Very Stiff.

End @ 4.4m

DCP1

1 1 2 3 4 7 8 9 14 16 >20

DCP2

1 2 2 2 2 2 4 8 10 10 11 14 >20

APPROXIMATE

BH3

SANDY TOPSOIL

SP SAND, Fine to med grained, Sub angular (Dune/beach sand), Light grey–white, Loose to medium dense, Dry.

Dark Brown Bands (Coffee rock) below 1.0m

SPT 1.5 3.5 N=8

CI SILTY CLAY, Medium to high plasticity, Light grey, Saturated, Soft.

5

Becoming Moist and Stiff below 3.5m.

With increasing red & yellow mottling below 4.0m.

End @ 4.4m

DCP3

1 1.5 2 2 3 7 12 13 20

DCP4

1 2 3 1 1 3 3 3 5 8 10 16 22

TOP

APPROXIMATE EXTENT OF ROCK FILLED BASKETS

APPROXIMATE BOTTOM OF

BH4

SANDY TOPSOIL FILL

SP SAND FILL, Fine to med grained, Sub angular (Dune/beach sand), Light grey–white, Loose, Dry.

Saturated below 2.5m.

CI/CH SILTY CLAY, Medium to high plasticity, Grey, Wet, Soft.

SPT 2 5 8 N=13

Stiff & moist below 1.5m.

Some yellow–brown gravel & staining

SPT 3 6 6 N=12

Becoming very stiff

Increasing red mottling below 4.0m.

Dark Grey below 5.0m.

End @ 5.9m

DCP5

1 2 5 2 4 5 10 17 20

DCP6

3 3 3 5 7 12 15 18 >20

BH5

SANDY TOPSOIL FILL

CI SANDY GRAVELLY CLAY FILL, Low to Medium plasticity, Mix of grey & brown, Some debris (tyres, concrete rubble), Moist, Soft to firm.

SP SAND, Fine to med grained, Sub angular (Dune/beach sand), Light grey–white, Medium dense, Saturated.

CI/CH SILTY CLAY, Medium to high plasticity, Grey, Saturated, Soft.

Becoming moist & Stiff

SPT 3 4 5 N=9

Dark grey below 4.0m

End @ 4.4m

DCP7

2 1 – – – – – – – – – – 4 5 5 6 7 7 7 8 8 9

BANK

BANK

979 757 458 185

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PROPOSED SEA WALL
ARRAWARRA BEACH CARAVAN PARK
ARRAWARRA

FOR *ASTORIA DEVELOPMENTS P/L*

BOREHOLE LOGS

Drawing No. 00074–G09
Amendment No. GEO
Council No.

APPENDIX A - PHOTOS

Photo 1 – Yarrawarra Creek bank, Ch 40 to 80 m

Photo 2 – Yarrawarra Creek Bank, Ch 80 – 140 m

Photo 3 – Bank at Ch 80 m.

Photo 4 – Base of large trees at Ch 125 m, note under cutting.

Photo 5 – Ch 155 Note coffee rock at base.

Photo 6 – Ch 170, Note start of gabion baskets at toe of bank.

Photo 7 – Ch 190 to 210 m.

Photo 8 – Ch 185, Note scour and erosion to bank behind the gabion toe.

Photo 9 – Arrawarra Creek, Ch 220 on.

Photo 10 – Arrawarra Creek looking downstream from Ch 350 m to 220 m.

Photo 11 – Ch 370 m.

Photo 12 – Ch 420.

ANNEXURE C - PRELIMINARY ACID SULFATE SOILS ASSESSMENT

Ref: 00074

1 June 2016

de Groot & Benson Pty Ltd

Consulting Engineers & Planners

The General Manager
Coffs Harbour City Council
Locked Bag 155
COFFS HARBOUR NSW 2450

Dear Sir,

PRELIMINARY ACID SULFATE SOILS ASSESSMENT
Proposed Subdivision - Arrawarra Beach Caravan Park (DA 0667/16DA)
46 Arrawawarra Beach Rd, Arrawarra

Introduction

de Groot & Benson Pty Ltd has conducted a preliminary acid sulfate soils assessment for the proposed residential subdivision of the above mentioned site.

The aim of the study was to assess the presence of actual or potential acid sulfate soils (ASS) within the area which could be affected by the proposed works, in order to determine if an action plan was necessary for managing acid sulfate soils.

Existing Site

The proposed development site consists of two parcels of land, namely, Lot 1 DP 1209371 and Lot 2 DP 1209371, which are situated on the south-west corner of the junction of Arrawarra Gully and Arrawarra Creek.

The development site is approximately 2.59 ha in total and is currently occupied by facilities and infrastructure associated with the operation of the caravan park.

The topography of the site is generally characterised by the gentle spur which forms the south bank of Arrawarra Gully, and the west bank of Arrawarra Creek, on which it is situated. Consequently, the northern portion of the site falls north, and the southern portion of the site falls east.

The site has gentle slopes, and varies in elevation from approximately RL 0.25m to around RL 4.00m.

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Acid Sulfate Soils

Acid sulfate soils (ASS) are soils which contain significant concentrations of pyrite which, when exposed to oxygen in the presence of sufficient moisture, oxidize and generate sulfuric acids. Unoxidised pyritic soils are referred to as potential acid sulphate soils (PASS). When the soils are exposed the oxidation of pyrite occurs and sulfuric acids are generated, the soils are said to be actual ASS (AASS).

Pyritic soils typically form in waterlogged, saline sediments rich in iron and sulfate. The usual environment for the formation of acid sulphate soils are tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rivers and creeks, i.e. as alluvial soils.

Pyritic soils of concern on low lying coastal lands have mostly formed in the Holocene period, (i.e. approximately 10,000 years ago to the present day) predominantly in the 7,000 years since the last rise in sea level. Generally it is held that pyritic soils which formed prior to the Holocene period have already oxidized and leached during geological periods of low sea level, thus previously exposing pyritic coastal sediments to oxygen.

Disturbance of acid sulfate soils can generate substantial sulfuric acid, which can lower soil and water pH to levels below pH 4. Fish kills in coastal rivers are highly visible examples of the consequences of acid sulphate generation. In addition, high salinity soils can adversely impact vegetation growth and can produce aggressive soil conditions detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life.

Acid Sulfate Soil Risk

According to Coffs Harbour City Council mapping, the majority of the site is listed as being Class 5 ASS. However a low lying portion land in the north-eastern corner of the property is recorded as Class 1 ASS, as can be seen in the figure below.

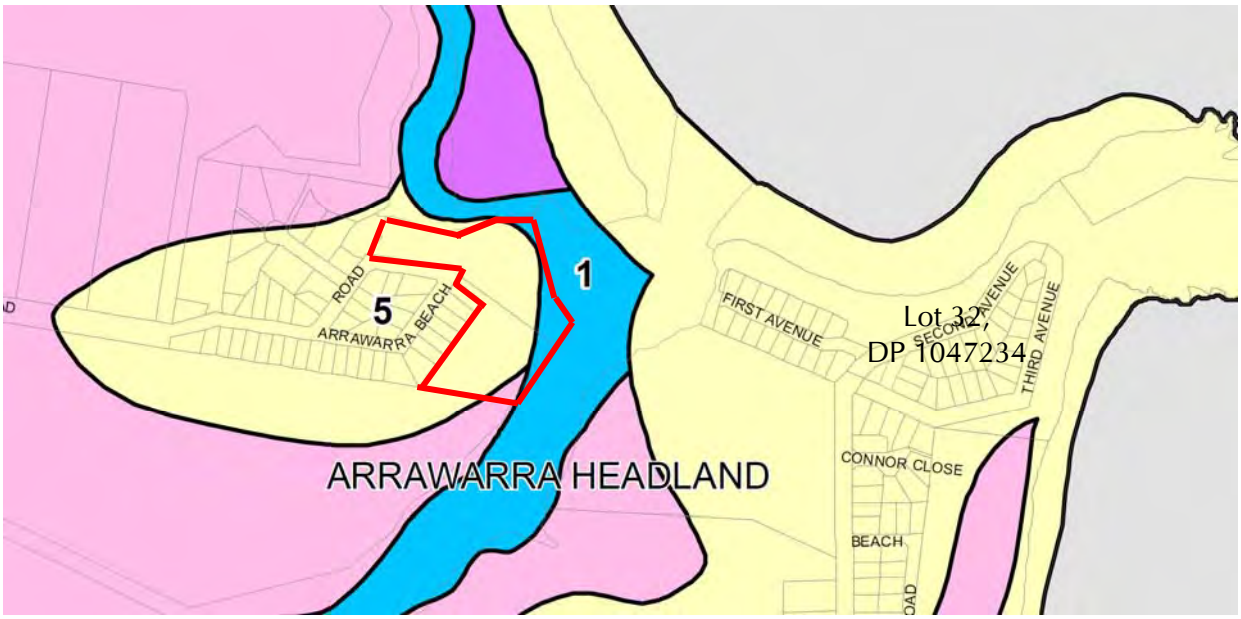

Figure 1: Extract from Coffs Harbour LEP Mapping

For Acid Sulfate Soils Class 1, Coffs Harbour Local Environment Plan 2013 requires consideration of acid sulphate soil management where development would involve any ground works.

The proposed civil construction works within the Class 1 area of the site include;

- A sea wall ~~(not part of this development application).~~

The proposed development civil works are shown on drawings 00074 - DA01 to 00079-DA09.

Site Investigation

The fieldwork comprised the excavation of five boreholes with standard penetrometer tests (SPT) and seven dynamic cone penetrometer tests. The boreholes where conducted by Aimil Pty Ltd on the 7th of November, 2006, using a small 4wd drilling rig, driving a 100mm spiral flight auger. The boreholes were sunk along the top of the creek bank to eith 4.4m or5.2m depth.

The location of the boreholes are shown in the report for the Geotechnical Investigation for the site (November, 2006), by de Groot & Benson Pty Ltd.

The general soil profiles encountered consisted of sands, intermittently interrupted by some clays and silts of varying mottles.

Soil Testing Results

The soil samples taken during the fieldwork was sent to Coffs Harbour Laboratory for equivalent TPA and TAA testing.
The sample was tested for pH, total actual acid, total potential acid, sulphur trail. These values were then compared to the criteria given in the *'Acid Sulfate Soil Manual (1998)'* by the NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC).

The *Acid Sulfate Soil Manual* provides criteria based on the sulfur trail and acid trail of the soil, which determine whether or not a Acid Sulfate Soils Management Plan is required. The action criteria values differ according to soil type and magnitude of earthworks within the acid sulfate soil zone.

The laboratory test results and the ASSMAC action criteria values are shown in the table below. Note that the action criteria values presented in the table have been taken for sandy soils and earthworks disturbing more than 1000 tonnes of soil.

Action Criteria	**ASSMAC 1998**	BH 1 RL 1.4 - 1.85	BH 1 RL 3.0 - 3.3	BH 2 RL 2.9 - 3.45	BH 3 RL 3.5 - 4.0	BH 2 RL 1.4 - 1.85
TPA	18	9.7	32.4	11.9	26.5	17.8
TSA	18	9.7	18.3	6.5	23.3	17.8
% Spos	0.03	<0.01	<0.01	0.02	0.02	<0.01

Table 1: Comparison of Test Results to Action Criteria

The results indicate that, generally, actionable conditions are met hence an acid sulfate soil management plan is to be developed, as is described below.

As can be seen in the table presented, boreholes BH 1 and BH 3 exceed the limits for TPA an TSA set out by the ASSMAC Guidelines, and therefore trigger the need for further investigations and action.

As part of the laboratory analysis, the amount of lime required to neutralise any ASS was calculated and is shown in Annexure A. The maximum liming requirement calculated by Coffs Harbour Laboratory was 2.5 kg / tonne, which includes a factor of safety of 1.5.

This is a relatively small amount, which reflects a very mild acid sulfate soil condition.

Acid Sulfate Soil Management Plan

The Acid Sulfate Soil Assessment has determined that there are likely to be mild acid sulfate soils at depths which will be disturbed in development of this site.
For this reason it is necessary that an Acid Sulfate Soil Management Plan (ASSMP) be prepared for the proposed development.

As part of the ASSMP, disturbed acid sulfate soil should be treated to neutralise the effects of oxidisation. ASS treatment would include the addition of lime at rates proposed by Coffs Harbour Laboratory. Soil and water testing should be undertaken for the duration of the civil construction period to ensure the development would not have detrimental effects on the surrounding environment.

Such monitoring should be carried out by an independent testing authority, to be engaged by the contractor.

Conclusion & Recommendations

de Groot & Benson Pty Ltd conducted field survey and desktop survey to determine the likelihood of Acid Sulfate Soils being disturbed by the development of Arrawarra Beach Caravan Park (DA 0667/16DA) at No. 46 Arrawawarra Beach Rd, Arrawarra, NSW.

The investigations found that mild amounts of acid sulfate soils are likely to be encountered and as such, an Acid Sulfate Soil Management Plan for the proposed development is required to be compiled as part of the detailed design process for a residential subdivision.

Should you have any further queries, please contact Rob de Groot on 02 6652 1700, or mobile 04 1883 1700 or by email at rob@dgb.com.au.

Yours faithfully

R J de Groot

Annexure A - Soil Testing Results from Coffs Harbour Laboratory

RECEIVED
27 NOV 2006
BY:

COFFS HARBOUR LABORATORY
Environmental Analysis

CLIENT: DEGROOT AND BENSON
Attn: MR GRAHAM KNIGHT
P.O. BOX 1908
COFFS HARBOUR NSW 2450

BATCH NUMBER: 4216
No of SAMPLES: 5
DATE COLLECTED: 07.11.06
DATE RECEIVED: 07.11.06
TIME RECEIVED: 14:30 PM

ANALYTICAL REPORT

SAMPLE – SOIL

TEST	BH1 1.4 – 1.85 4216/1	BH1 3.0 – 3.3 4216/2	BH2 2.9 – 3.45 4216/3	BH3 3.5 – 4.0 4216/4	BH4 1.4 – 1.85 4216/5
SPOCAS					
pH in KCl	5.4	4.2	4.7	5.0	6.8
pH in H_2O_2	6.4	5.9	5.4	7.0	7.3
Acidity Trail					
TPA pH 6.5 mol H^+/t	9.7	32.4	11.9	26.5	17.8
TAA pH 6.5 mol H^+/t	<1	14.1	5.4	3.2	<1
TSA molH^+/t	9.7	18.3	6.5	23.3	17.8
Sulphur Trail					
% S_P	0.01	0.04	0.03	0.05	0.04
% S_{KCl}	0.01	0.04	0.01	0.03	0.04
% S_{POS}	<0.01	<0.01	0.02	0.02	<0.01
Derived Values					
% S_{TPA}*	0.02	0.05	0.02	0.04	0.03
Lime Requirement (kg/tonne)**	<1	2.5	<1	2.0	1.4

*TPA equivalent S%, where 1% sulphide produces 623.7 mole H^+/tonne soil.
**Includes a safety factor of 1.5.

Please refer to the "Acid Sulfate Soil Manual" by the New South Wales Acid Sulfate Management Advisory Committee, May 2004 .
Samples collected by client and analysed as received.

Analysis performed according to the Suspension Peroxide Oxidation – Combined Acidity & Sulfate (SPOCAS) Method. [ASS Method 23]

All pages of this report have been checked and approved for release.

B J Wadleigh
Laboratory Manager
CHCC Environmental Laboratory

22.11.06
Date

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