Ammos Resource Management Pty Ltd
C/ Tattersall Lander Pty Ltd

Acid Sulfate Soil Management Plan: Proposed Sand Quarry at 3631 Nelson Bay Road, Bobs Farm, NSW

martens consulting engineers

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

P1303897JR07V01
November 2020

Limitations Statement

The sole purpose of this report and the associated services performed by Martens & Associates Pty Ltd is to complete an Acid Sulfate Soil Management Plan in accordance with the scope of services set out in the contract/quotation between Martens & Associates Pty Ltd and Ammos Resource Management Pty Ltd C/ Tattersall Lander Pty Ltd (hereafter known as the Client). That scope of works and services were defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

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

Contents

Abbreviations

AASS	Actual acid sulfate soil
ABA	Acid base accounting
AHD	Australian height datum
ARI	Annual recurrence interval
ANC	Acid neutralising capacity
ASS	Acid sulfate soil
ASSMAC	Acid Sulfate Soil Management Advisory Committee
ASSMP	Acid sulfate soil management plan
BH	Borehole
HDPE	High density polyethylene
MA	Martens and Associates Pty Ltd
mAHD	Metres Australian height datum
Mbgl	Metres below ground level
MW	Monitoring well
NAS	Non-sulfuric acidic soil
NATA	National Association of Testing Authorities
PASS	Potential acid sulfate soil
RAP	Remediation action plan
SKCL	Potassium chloride extractable sulfur
SNAS	Net acid soluble sulfur
SPOCAS	Suspension peroxide oxidation combined acidity and sulfur
SPOS	Peroxide oxidised sulfur
TPA	Titratable peroxide acidity
TSA	Titratable sulfidic acidity

1 Introduction

This Acid Sulfate Soil Management Plan (ASSMP), prepared on behalf of Ammos Resource Management Pty Ltd C/ Tattersall Lander Pty Ltd, documents the environmental risks and appropriate management of acid sulfate soils (ASS) required for a proposed sand quarry at 3631 Nelson Bay Road, Bobs Farm (the site). Variations to this plan should only be undertaken with consultation from Martens and Associates (MA).

1.1 Objectives

The ASSMP has been developed to provide guidance on the environmental management of ASS for the project, as a result of site soil disturbance during extractive activities.

The objective of the ASSMP is to provide recommendations for appropriate management of ASS so that extractive activities are undertaken in a way that minimises or negates ASS risks.

1.2 Guidelines/Standards

This management plan was undertaken in general accordance with the principles of the following:

- Acid Sulfate Soil Management Advisory Committee (1998), Acid Sulfate Soil Manual. Referred to as ASSMAC (1998).
- Qld Natural Resources, Mines and Energy (2004) Acid Sulfate Soils Laboratory Methods Guidelines.
- Qld Department of Science, Information Technology, Innovation and the Arts (2014) Acid Sulfate Soils Technical Manual.
- Water Quality Australia (2018a) National Acid Sulfate Soils Guidance: Guidance for the dredging of acid sulphate soil sediments and associated dredge spoil management.
- Water Quality Australia (2018b) National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments.
- Water Quality Australia (2018c) National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual.

1.3 Proposed Development

For the purpose of this assessment, site extraction works are assumed to occur outside a 15 m buffer zone adjacent to the site boundaries with the exception of the southern and eastern quarry boundaries. Excavation in the southern portion at the site will start 15 m north of the electrical easement.

Based on information from Quarry Mining Systems (2013), VGT & Quarry Mining Systems (2013) and Tattersall Lander (2019), the proposed development is likely to include:

- Preliminary works: construction of access roads and an intersection with Nelson Bay Road; demolition of existing structures; construction of screening operations, loading ramp and storage shed; and construction of the main exit road onto the existing bitumen sealed road within Lot 10 DP 1071458.
- Clearing works: stockpiling of topsoil for future rehabilitation works.
- Stage 1 extraction: excavation of aeolian sands to 3 m Australian Height Datum (mAHD), using conventional excavation / extraction techniques, and stockpiling for later use for various purposes. Rehabilitation for stage 1 works will occur prior to the commencement of Stage 2 works.
- Stage 2 extraction: excavation of aeolian sands to 1 mAHD, using specialised excavation / extraction techniques, and stockpiling for later use for various purposes. Rehabilitation for stage 2 works will occur prior to the commencement of Stage 3 works.
- Stage 3 extraction: excavation of predominantly marine sand from 1 mAHD to -15 mAHD, by dredging techniques and stockpiling for later use for various purposes.

Sand extraction will involve processing to separate fines from the feed material via vibrating wet screen (Stages 1 – 3) with:

- Classifying tank (Stages 2 – 3 only); and / or
- Sand screen to sieve product (Stages 1 – 3).

Process waste water and fines shall be discharged to a settling pond.

2 Site Description

Site details are summarised in Table 1.

Table 1: General site information.

Item	Description / Detail
Site address	3631 Nelson Bay Road, Bobs Farm, NSW.
Legal Identifier	Lot 254 DP 753204
Surveyed Site Area	40.9 ha (Tattersall Lander, 2019)
Local Government Area	Port Stephens Council.
Site description	The southern portion of the site is currently used for agricultural purposes (primarily olive and fig plantations) with a small proportion of this area occupied by farm sheds and two dwellings. An electrical transmission line easement (poles and wires) cuts across the eastern and western boundary in the southern portion of the site. The remainder of the site is undeveloped native bushland apart from some vehicle access tracks.
Topography	The northern and western portion of the site is comprised of moderately to steeply undulating dune sequences with grades typically between 2 and 50 %. The southern and eastern portion of the site comprises predominantly flat and near level land. The site has a predominantly south easterly aspect, with some areas sloping to the north, west or southwest. Slopes are low (typically 0 – 5 %) in the eastern portion of the site and higher (typically 10 – 50 %) over the remainder of the site, where dune knolls are located. Site elevations range from approximately 35 mAHD at a knoll crest in the northwest of the site to approximately 2 mAHD at a depression in the north. The lower eastern portion of the site has typical elevations of between 2 and 8 mAHD.
Expected geology and soils	The Newcastle and Port Stephens 1:100,000 Geological Series Sheet 9232 indicates that the site is underlain by Quaternary Holocene sand (stable dunes). The area to the north of the site (beyond the northern boundary) is underlain by estuarine sands, silts and clays derived from deposition within Tilligerry Creek. The area to the south of the site (southern side of Nelson Bay Road) is underlain by Quaternary Holocene sands derived from older beach deposition and covered by low level windblown dunes. The NSW Environment and Heritage eSPADE (2019) website identifies the site as having soils of the: o Bobs Farm Landscape to the northern of the site, consisting of very poorly drained humic gleys. o Boyce Track Landscape at the central portion of the site, consisting of deep, very well drained weakly developed podzols. o Hawks Nest Landscape at the southern portion of the site, consisting of deep (>300 cm), well drained podzols on dunes with deep (>300 cm) minor acid peats / siliceous sands in swampy swales
Drainage	The majority of the site drains south east towards Nelson Bay Road and ultimately Stockton Beach. A small portion to the northwest drains northwards towards Tilligerry Creek.
Vegetation	Approximately 75% of the site consists of uncleared tall open forest dominated by the canopy species *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). The remaining low lying areas near Nelson Bay Road comprise olive and fig plantations.

3 Acid Sulfate Soil Assessment Summary

Previous geotechnical and ASS related reports prepared for the proposed quarry development include:

- Preliminary Geotechnical and Acid Sulfate Soils Assessment: Proposed Sand Quarry – Bobs Farm, NSW. P1303897JR02V02 (MA01, 2015).
- Supplementary Acid Sulfate Soil Assessment: Proposed Sand Quarry – 3631 Nelson Bay Road, Bobs Farm, NSW, Ref No. P1303897JR06V01 (MA02, 2020).

Key findings of the previous ASS assessments are summarised below:

1. Site soil profile consisted of 4 soil layers: topsoil, aeolian sand, clayey sand / sandy clay and marine sand. Topsoil and aeolian sand layers were identified as neither PASS nor AASS. Clayey soil (clayey sand / sandy clay) and marine sand layers were identified as PASS.
2. No actual acid sulfate soils (AASS) were detected.
3. Laboratory analysis triggered the ASSMAC (1998) action criteria in the clayey soil and marine sand layers. The action criteria values exceeded:
    - The sulfur trail trigger level for sPOS in 25 samples (out of 50 samples tested from these layers).
    - The acid trail trigger level for TPA and net acidity in 23 samples (out of 50 samples tested from these layers).
4. An ASSMP was recommended to be prepared to address risks associated with ASS works as the site constitutes a very high treatment category as per Table 4.5 in ASSMAC (1998). Due to the variability of the site, the ASSMP should be developed with respect to the soil layers. The ASSMP should have consideration of final extraction plans for the proposed sand quarry development.
5. Any material encountered during sand mine development that varies from these reports would require assessment by MA to determine requirements for additional investigation and/or management options.

4 Acid Sulfate Soil Management Plan

4.1 Acid Sulfate Soil Definition

4.1.1 Acid Sulfate Soils

ASS are natural soils of Holocene or Pleistocene age, generally found in coastal (tidal) and inland (freshwater) environments. In general, they are found in areas less than 5 meters above sea level in swamps, marshes and floodplains. These soils contain iron sulfides, which when exposed to air, oxidise to generate sulfuric acid.

ASS are classified as either actual ASS (AASS) or potential ASS (PASS). AASS are those that have been exposed to air, have oxidised and produced sulfuric acid. PASS are in an anaerobic (low oxygen) environment, usually waterlogged soils that have the potential to produce sulfuric acid if exposed to air.

The impacts of ASS can in some instances cause severe short and long term economic and environmental impacts to the surrounding environment. These impacts could include:

- Increased soil acidity.
- Decreased nutrients in soil.
- Mobilisation of heavy metals, making water and soil toxic.
- Potential contamination of groundwater.
- Potential corrosion of infrastructure.
- Acidic runoff that can affect aquatic ecosystems and can kill aquatic life.

4.1.2 Non-Sulfuric Acidity

Non-sulfuric acidic soil (NAS) is common in residual soils through leaching of the soil profile. It is also common in areas where organic acids occur, which can overlap with environments that are ASS impacted.

These acids are not ASS and are not considered a risk due to their generally weak nature and low mobility. No guidelines for NAS are available and site management of spoil should be undertaken in line with erosion and sediment control guidelines, within the site's construction environment management plan.

Soils are identified in this ASSMP as being NAS by the following criteria:

- Low soluble sulfur (SKCl <0.03%).
- No reportable oxidisable sulfur (SCr or S_{POS}).
- No visual or reported jarosite or similar acid producing iron/aluminium hydrosulfate minerals (SRAS or SNAS).

4.2 Receptors

Possible ecological, human and built environment receptors include:

- Site vegetation.
- Site visitors and workers.
- Surrounding flora and fauna.
- Groundwater.
- Downstream vegetation and aquatic biota (Tilligerry Creek).

4.3 Training and Awareness

All project personnel, subcontractors and consultants are to receive training in their personal environmental obligations during quarry inductions and toolbox talks. All project personnel are to undergo a general project induction prior to commencing work with the contractor. This includes an ASS component to reinforce the importance of management and the measures that will be implemented to address ASS issues.

4.4 Potential Mitigation Strategies

Potential mitigation strategies have been reviewed and assessed for site relevancy based on the nature of material to be extracted and the extraction and processing proposed. Strategies are summarised and assessed for relevancy to the project in Table 2.

Table 2: Mitigation strategies and whether they can be applied to the site.

Strategy	Details	Application to Site
Avoidance	Avoid areas containing ASS	Not possible – as identified PASS (clayey sand / sandy clay and marine sand) is present within a significant portion of the site's identified sand resources, it is not possible that works during stage 2 and 3 extraction can avoid PASS material.
Minimisation	Modification of site design to minimise disturbance	Not possible – as above.
Hydraulic separation via classifying tank and / or sand screen systems	-	Yes – hydraulic separation will occur during the sand processing proposed on the site. This will occur in the classifying tank and / or sand screen systems detailed in the project EIS. During these processes the PASS material (associated with the waste fines from sand processing) shall be separated from the sand (product for sale). The fines shall then be managed either through neutralisation or through strategic reburial.
Neutralisation	Treatment and neutralisation	Yes – treatment by neutralisation is an option for management of PASS material (i.e. fines extracted from stage 2 and 3) which cannot be immediately reburied below water in the dredge lake. Water from the washing / dredge process may also require neutralisation prior to discharge from the settling pond to the dredge lake.
Strategic reburial	Burial in settling ponds (temporary) and / or dredge lake	Yes – once stage 3 excavation (dredging below groundwater level) commences PASS material may be reburied in the dredge lake. Prior to the formation of the dredge lake any PASS material may be temporarily stored in the site settling ponds.
Leachate from treatment	Collection and treatment of leachate from treatment areas prior to discharge	Yes – leachate control will be required for fines that are treated on the bunded treatment pad following removal from the settling pond. Similarly, water in the settling pond may require treatment prior to discharge to dredge lake.
Groundwater and surface water monitoring	Ongoing monitoring of groundwater trends	Yes – monitoring groundwater and surface water will provide indications of potential risks from the oxidation of ASS. Where a trigger value is exceeded, investigation into management options will be required.

4.5 Approach

The approach for managing PASS in each layer of excavated soils is summarised in Table 3 and identified in Figure 2, Attachment A. The approach has been separated into identified soil layers as noted in the ASS report (MA, 2020).

Table 3: Management approach.

Soil layers	Dry Mining Procedure	Wet Mining Procedure
Topsoil – no management required	Topsoil has negligible liming requirements from laboratory testing and **does not require treatment** as it has natural acid neutralising capacity.	**Not applicable** as all topsoil is above expected water table.
Aeolian Sand – no management required	No ASS identified. **Does not require treatment.**	**Not applicable** as aeolian sand is expected to be above the water table.
Clayey Soil (clayey sand / sandy clay)	**Not expected** as clayey sand / sandy clay are expected to be nearer to below water table. If clayey soils are encountered above the water table, the clayey soils may either be processed through sand wash plant with generated fines managed for PASS or material may be pushed into dredge lake and managed in wet mining plan.	Soils to be dredged and potential acid generating fines are to be separated from sand via vibrating wet screen and classifying tank processes. **Fines treated** as outlined in Section 4.8.
Marine Sand	**Not expected** as marine sand is expected to be below water table. If marine sand is above the water table, the sand will be processed through the sand wash plant or pushed into dredge lake and managed in wet mining plan.	Marine sand will be dredged and potential acid generating fines are to be extracted via vibrating wet screen and classifying tank processes. **Fines treated** as outlined in Section 4.8.

Topsoil and aeolian sand will not require treatment as topsoil has acid neutralising capacity and aeolian sand is not PASS. The PASS management plan for acid generating fines in clayey sand / sandy clay and marine sands below the groundwater table is explained in detail in Section 4.8.

4.6 PASS Treatment Plan

A PASS treatment plan is required for the potential acid generating fines within the clayey sand / sandy clay and marine sands layers which will be separated by the sand washing process.

Based on information provided by the client, it is understood that the potential acid generating fines separated from extracted clayey and marine sand material will either be immediately deposited into the dredge lake (i.e. strategically reburied) or be directed to a settling pond. Fines will then be either retained in the pond or be settled then removed from the pond and treated to allow reuse above the water table. Strategic reburial will not require any treatment of fines. Treatment of fines removed from the pond for site landscaping or stockpiling shall be undertaken Table 4.

All liming works for fines are to be undertaken using agricultural lime (calcium carbonate). The rate of lime application is expected to vary greatly based on the laboratory results to date. Lime purity will impact on liming rates (i.e. 90% purity will require liming at 110% of the liming rate). Where the purity of the lime has not been certified, it must be analysed prior to use.

Table 4: Treatment of PASS fines material.

Stage	Management and Mitigation Measures
1 – Establish treatment area	The site settling pond is to be lined with compacted clay, geosyntheic clay liner (GCL) or HDPE liner. An impermeable treatment pad for untreated PASS stockpiling and treatment is to be constructed near the settling pond. Pad(s) is to be formed with drainage controls and bunded to prevent water flow both into and out of the area, and to retain any generated leachate.
2 – Testing of fines	Before treating fines in settling pond, fines will be sent for laboratory analysis to determine required liming rates.
3 – Treatment of fines	Separated potential acid generating fines extracted from the settling pond are to be treated on the pad area on a batch by batch scenario. Fines are to be mixed with agricultural lime at liming rates as determined by laboratory testing to neutralise impact of PASS. Stockpiling of untreated soil shall be managed so as to not exceed time frames in Table 5.
4 – Treatment validation	The treated fines shall be sampled and tested for validation (as noted in Section 4.9) to confirm adequacy of treatment. If fines are to be reused on site, testing is to be undertaken at a rate of 1 sample per 500 m^3. Disposal of water from the settling pond is to be carried out only following treatment and validation to confirm discharge criteria as outlined in Table 6.
5 - Retreatment	Where treated fines do not meet adopted validation criteria (Section 4.8), repeat retreatment and validation is required until validation is successful.
6 - Placement	Once fines are treated and validated, material may be dry stockpiled for future use, be placed in the dredge lake, or may be reused on site as fill or landscaping material. Offsite removal of treated fines may only occur following classification in accordance with EPA Waste Classification Guidelines (2014).

Table 5: Recommended maximum periods for stockpiling untreated PASS.

Type of Material	Duration of Stockpiling [1]	
Texture Range	Approx. Clay Content (%)	Short Term
Coarse texture Sands to loamy sands	≤5	18 hours
Medium texture Sandy loams to light clays	5 – 40	70 hours

Note:

[1]. Stockpiling time frames are based on Table 11-1 of Qld DSITIA (2014).

4.7 Leachate Control

Leachate may discharge from PASS material during stockpiling and treatment. Management of the leachate is required to ensure risk of discharge of acidified leachate to the environment is minimised.

Leachate collected from treatment areas is to be directed to a second pond (leachate collection pond) for leachate treatment only**.** Leachate collection ponds are to be assigned to accommodate storm water runoff generated by a 1 year ARI, 72 hour duration storm event and are to only receive runoff from the treatment area. The pond is to be lined with compacted clay, GCL or a HDPE liner.

Disposal of water from the leachate collection pond is to be carried out only following treatment and testing to confirm leachate is greater than pH 5.7 (median of site baseline data). pH buffering is to be undertaken using sodium hydroxide solution (or other acid neutralising methods).

4.8 Fines Treatment Validation Testing

The effectiveness of fines' treatment is to be validated to confirm fines no longer possess acid generation potential in excess of neutralization capacity.

Validation sampling should be undertaken batch by batch during removal. 1 validation sample per 500 m^3 should be collected for each batch, with a minimum of 3 validation samples collected for every batch regardless of volume removed. Validation samples are to be sent for laboratory analysis for pH_{FOX}, and values below pH_{FOX} of 5.0 will indicate validation failure.

If validation of treated fines fail, additional neutralisation is needed until results are above validation trigger value (pH_{FOX} of 5.0).

5 Environmental Monitoring

Groundwater monitoring shall be undertaken to demonstrate that quarrying works have no significant impact on groundwater levels or quality. Nine monitoring wells (MW1 to MW5, MW101 to MW104) have been previously installed and used to monitor baseline groundwater conditions. These conditions have been documented in MA03 (2020).

Where existing wells are required to be decommissioned due to proposed development works, they should be replaced as near as possible to the existing wells and outside future quarrying areas.

Based on client's advice, surface water is not a receiving environment as the dredge lake cannot overflow: the dredge lake discharges to groundwater. Therefore, the adopted baseline monitoring conditions for the dredge lake are the same as that of groundwater.

Field monitoring (for groundwater in every constructed well and 3 evenly spaced locations around the perimeter of the dredge lake) during quarrying works shall be undertaken once every 3 months for pH and dissolved aluminium.

Trigger value for pH (4.4) has been calculated in MA03 (2020) from previous monitoring events at the site by taking the median value and subtracting (pH) two standard deviations. Trigger value for dissolved aluminium (0.8 mg/L) has been set based on guideline values. These trigger values will be assessed against water sampled from the groundwater monitoring wells, dredge lake and for leachate pond prior to discharge.

Fluctuations in parameters are normal due to seasonal variation. Trigger values of site baseline data (developed prior to quarrying) may be adjusted and revised by the environmental consultant as data sets are further developed. Advice from the environmental consultant is to be sought if the monitored parameters exceed the following trigger values.

- pH levels below 4.4.
- Dissolved aluminium above 0.8 µg/L.

The environmental consultant must assess the cause of exceedance(s) likely cause of the variation and any potential environmental harm, recommend remediation measures for such harm and recommend alternative management strategies which will allow the works to proceed without environmental risk.

6 Record Keeping and Reporting

Monthly reporting of ASS management and water monitoring is to be undertaken by the environmental consultant to the site quarry manager. Compliance tracking reports shall be prepared by the environmental consultant annually, demonstrating that the requirements of this ASSMP have been achieved.

Complete records of all treatment and any further testing undertaken shall be maintained by the site quarry manager. Records should include as a minimum:

- Amount of fines removed from settling pond for treatment.
- Register of all agricultural lime and sodium hydroxide delivered to site and location of use, including rate of application.
- Laboratory test results detailing validation for treated fines and leachate.
- Location of reuse or disposal dockets.
- Laboratory test results for leachate prior to discharge into dredge lake.
- Laboratory test results for environmental monitoring as required by this ASSMP.

Records should be made available to regulators if requested.

If disposal of ASS is required, the environmental consultant is to classify the material in accordance with the NSW EPA Waste Classification Guideline (EPA, 2014). Disposal shall be to a waste facility licenced by the EPA to receive that type of waste.

7 Roles and Responsibilities

This section outlines the roles that are responsible to manage, document and report on ASS issues for the project:

- The site quarry manager is responsible for ensuring that all requirements of the ASSMP are met during the project.
- The engaged environmental consultant is responsible for:
    1. Record keeping and reporting (Section 6).
    2. Validation sampling of treated fines (Section 4.8) and water sampling for environmental monitoring (Section 5).
    3. Reviewing and updating the ASSMP as further assessment, excavation methodology and staging become available.
    4. Conducting site specific investigation in the event of exceedance(s) of trigger value(s) and provide recommendations / remediation strategies if necessary.
- All other site personnel are responsible for implementing the strategies and procedures prescribed in the ASSMP, as applicable to their work activities.

Any non conformance to the ASSMP must be addressed as soon as is practical. The personnel responsible for the non conformance must be notified immediately for purposes of issuing rectification instructions.

8 Contingency Plan

A contingency plan is to be followed in the event of situations where management practices do no achieve desired outcomes or when surrounding environments have been impacted by quarry activities.

8.1 Treated Fines

If treated fines exceed validation trigger values as outlined in Section 4.8, retreatment of fines be undertaken until fines pass validation (step 5 of Table 4).

8.2 Leachate

If treated leachate exceeds validation trigger value, retreatment will be undertaken as outlined in Section 4.7.

8.3 Environmental Monitoring

When water monitoring (groundwater and surface water from dredge lake) indicates exceedance(s) in trigger values as outlined in Section 5, the following contingency plan must be implemented:

- Notify the site quarry manager.
- Quarry manager to report site conditions to relevant authorities if necessary, and engage the environmental consultant to conduct site specific investigation.
- The environmental consultant to conduct additional testing at and around the vicinity of exceedance(s). If more exceedance(s) are to be found, the consultant is to determine the cause and extent of exceedance(s), and conduct further testing if required.
- If exceedance(s) are due to quarrying activities, the environmental consultant shall provide recommendations and site specific remedial action(s).
- Quarry manager to implement the recommendations of the environmental consultant subject to appropriate consent and / or approvals as required from the relevant authorities (as necessary).

When the specified remedial actions fail, or if monitoring results identify failure of the management strategy to meet the specified criteria, the quarrying works will cease and all attempts be made to contain the affected soils or water to minimise the possible impact of exceedance(s)

to non-impacted areas. A restoration action plan may need to be implemented.

If the assessment demonstrates the need for the modification of any part of the ASSMP, the site quarry manager is to be notified of all proposed changes prior to the recommencement of the activity causing the non compliance.

9 References

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Water Quality Australia (2018b) *National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments.*

Water Quality Australia (2018c) *National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual.*

10 Attachment A – Figures

0 90 180 270 360 450 m

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Viewport B

Notes:
- Aerial from Nearmap (2020).
- Monitoring wells surveyed by Tattersall Lander.
- Borehole locations are approximate.
- Cadastre from site survey (Tattersall Lander, 2013) and NSW DFSI (2019).

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Map Title / Figure:

Acid Sulfate Soil Testing Plan

Map 01	Map
3631, 3679 & 3721 Nelson Bay Rd, Bobs Farm, NSW	Site
Proposed Sand Mine	Project
Acid Sulfate Soils Management Plan	Sub-Project
Ammos Resource Management P/L	Client
22/09/2020	Date

Project No: P1303897 Map Set: MS04-R01 EPSG: 28356

LEGEND

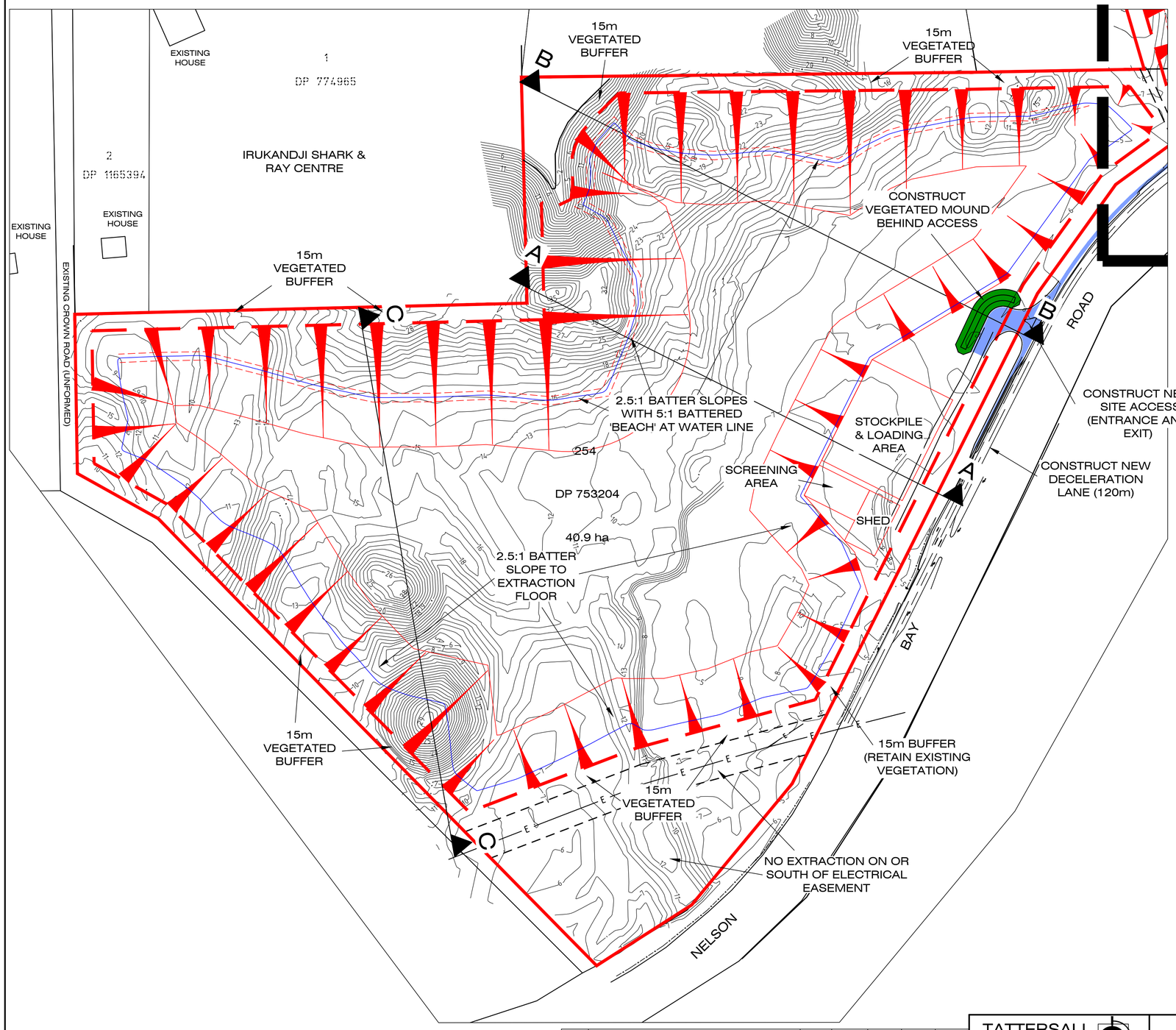
DENOTES PROPOSED SITE BOUNDARY

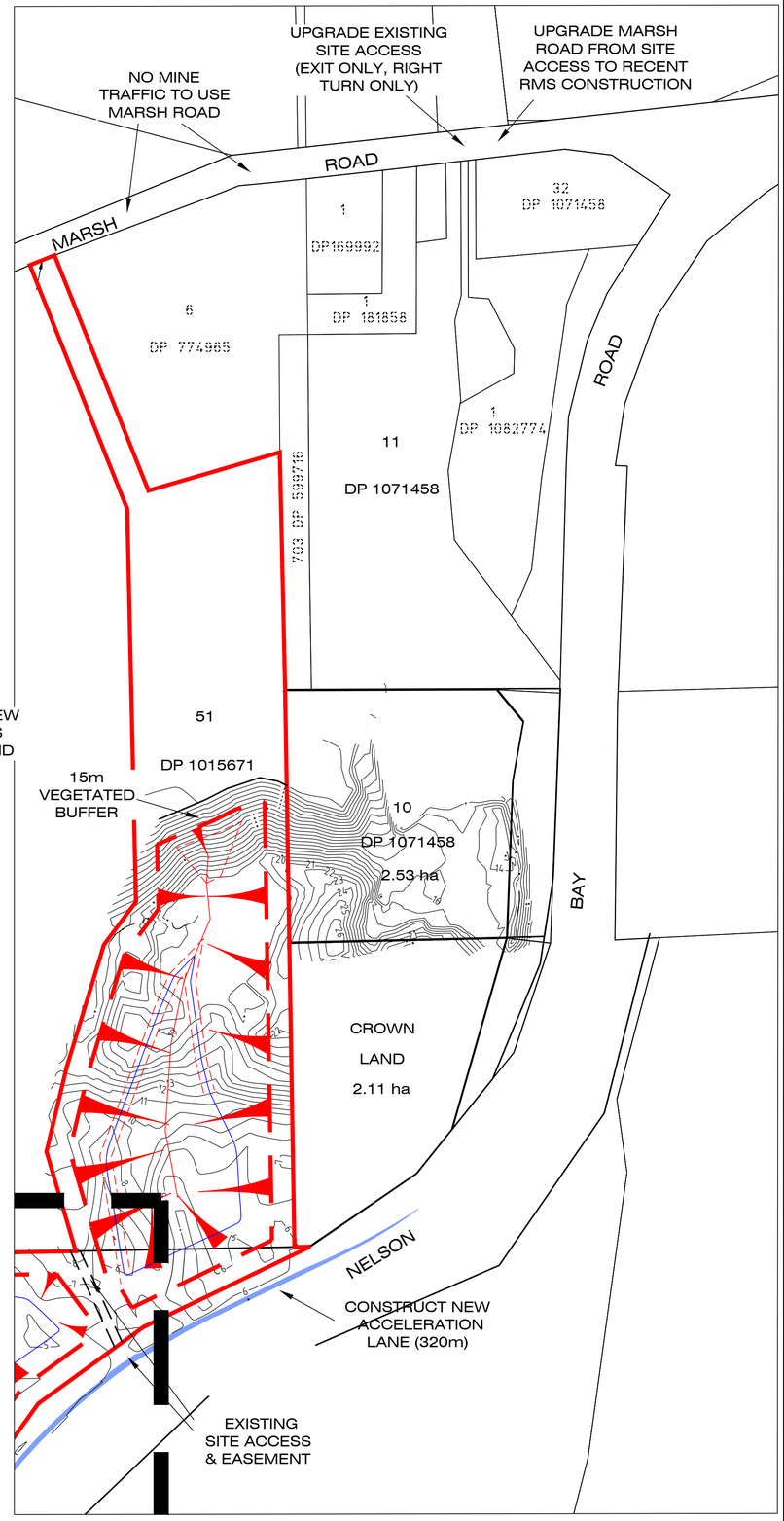
DENOTES PROPOSED EXTRACTION AREA - 36.07Ha
MAXIMUM EXCAVATION LEVEL -15.0m AHD

INDICATIVE VEHICLE HAUL ROUTE

EXISTING CONTOURS
1m INTERVALS

DENOTES INDICATIVE FINAL WATER BODY - 24.27Ha
ASSUMED 1.8m AHD





0 20 40m
(1: 2000for A1 Size Plot)

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
E	Site Extents and Entrance Revised	DS	DS			
D	Reduced Footprint - Additional Buffers Added	AV	AV			
C	Footprint Withdrawn from Electrical Easement	AV	AV			
B	Batter Slopes Modified	AV	AV			

* Denote the original signature and date when revision was issued.

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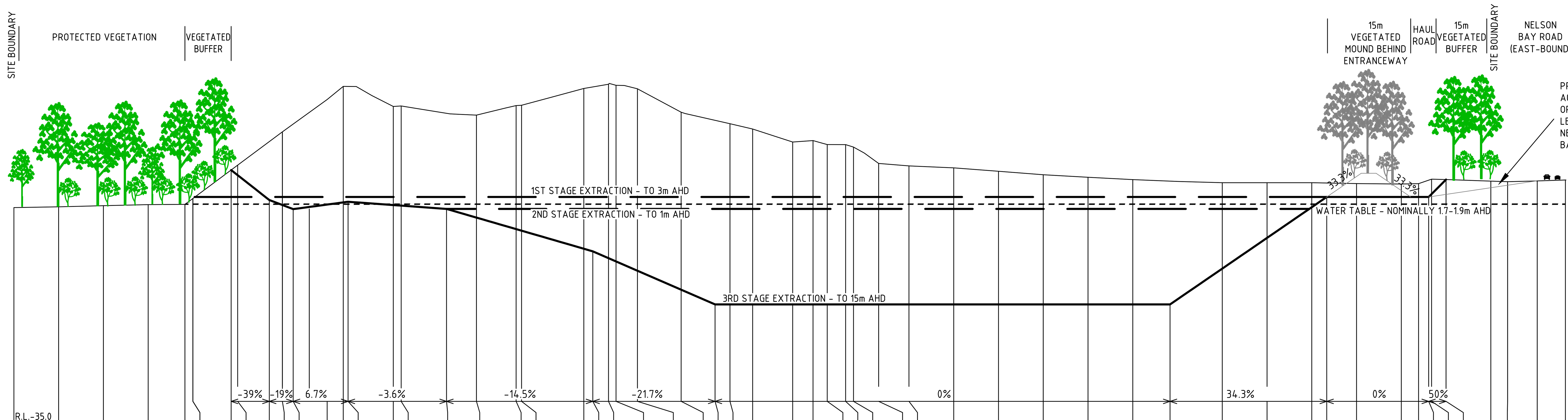
ENGINEERING, SURVEYING & PLANNING
2 Bourke St. P.O.Box 580
RAYMOND TERRACE 2324
Fax (02) 49871733 Phone (02) 49871500

PLAN OF PROPOSED SAND MINE
LOT 254 DP 753204, LOT 51 DP 1015671, LOTS 10 & 11 DP 1071458
NELSON BAY ROAD
BOBS FARM

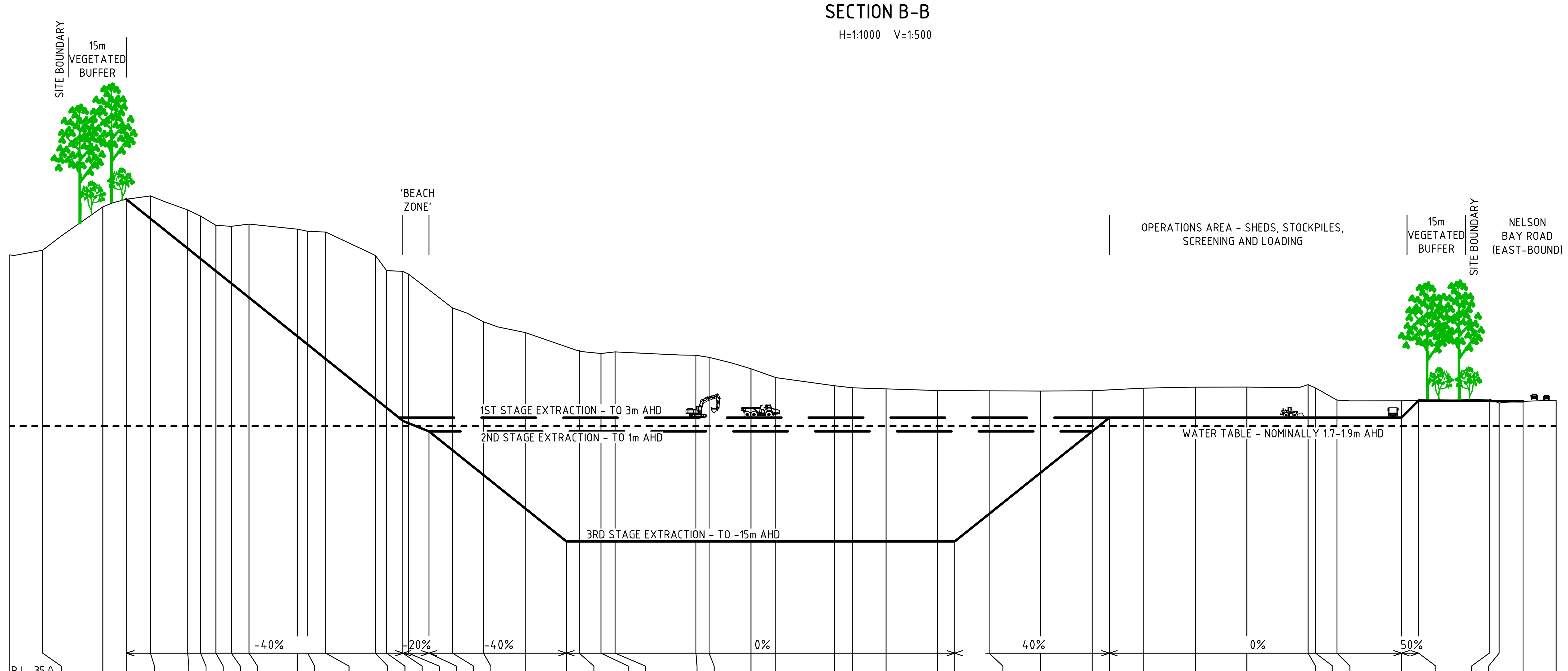
COUNCIL: PORT STEPHENS	REFERENCE: 21400060
PARISH: TOMAREE	SHEET SIZE: A1
SCALE: 1:2000 on A1	SHEET No.: 1 of 3
DATE : Plotted 16:59 11/07/19	
CLIENT: PATRA HOLDINGS PTY LTD	JOB No.: 212434
COMPUTER FILE : S:\Clients\2012\212434\Dwg\Layout Plan.dwg	



CHAINAGE	DESIGN LEVEL	EXISTING LEVEL
0		1.221
15		1.353
30		1.536
45		1.718
57.339		1.76
60		2.75
72.815	7.513	
75	6.655	8.332
85.6	2.493	
90	1.653	13.914
93.6	0.965	
105	1.73	19.328
110.387	2.092	21.527
112	2.2	
127.157	1.649	18.165
129.812	1.552	18.255
145	1	
155.028	-0.454	16.715
168.324	-2.382	18.313
170.152	-2.647	18.366
191.022	-5.673	21.184
194.029	-6.109	
199.305	-7.254	21.893
201.82	-7.8	21.708
208.994	-9.357	21.126
223.64	-12.535	17.205
235	-15	
240	-15	15.281
247.602	-15	14.387
261.022	-15	12.21
267.843	-15	12.448
272.609	-15	11.784
278.753	-15	11.776
281.405	-15	11.36
289.822	-15	8.622
300	-15	8.208
315	-15	7.876
330	-15	7.313
345	-15	6.726
360	-15	6.3
375	-15	5.906
387.5	-15	
405	-9	5.394
420	-3.857	5.396
435	1.286	5.393
440	3	
450	3	5.24
465	3	5.168
470.787	3	5.234
474.166	3	
475.153	3.494	5.986
480	5.917	5.917
495		5.662
500.64		5.559
510.55		5.685
520		

SECTION B-B

H=1:1000 V=1:500



CHAINAGE	DESIGN LEVEL	EXISTING LEVEL
0		26.661
9.603		27.34
27.108		33.643
33.927	34.749	34.749
40.944	31.94	35.235
51.805	27.593	33.193
55.524	26.105	32.302
60	24.313	30.964
64.46	22.528	30.814
69.622	20.462	31.143
83.733	14.814	30.401
86.704	13.625	30.095
91.955	11.524	29.982
106.422	5.733	26.572
109.674	4.432	24.37
114.5	2.5	24.269
116.006	2.199	23.879
122	1	
128.837	-1.735	18.95
137.855	-5.342	16.942
150	-10.2	15.378
162	-15	
165.724	-15	12.779
172.059	-15	12.324
176.158	-15	12.56
199.686	-15	12.073
203.519	-15	11.764
215.711	-15	10.108
222.93	-15	8.822
240	-15	7.636
245.185	-15	7.336
255	-15	7.178
270	-15	6.942
275	-15	
285	-11	6.892
300	-5	6.863
315	1	6.906
320	3	
330	3	7.291
345	3	7.441
360	3	7.449
377.82	3	7.793
380.011	3	7.31
386.235	3	5.55
405	3	5.449
410	5.5	
430.547		5.693
433.412		5.104
440.364		5.372
450		

SECTION A-A

H=1:1000 V=1:500

INDICATIVE VOLUMES

STAGE 1	~~2,755,000m³~~
STAGE 2	~~485,000m³~~
STAGE 3	~~2,810,000m³~~

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
E	Site Extents and Entrance Revised	DS	DS			
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C	Footprint Withdrawn from Electrical Easement	AV	AV			
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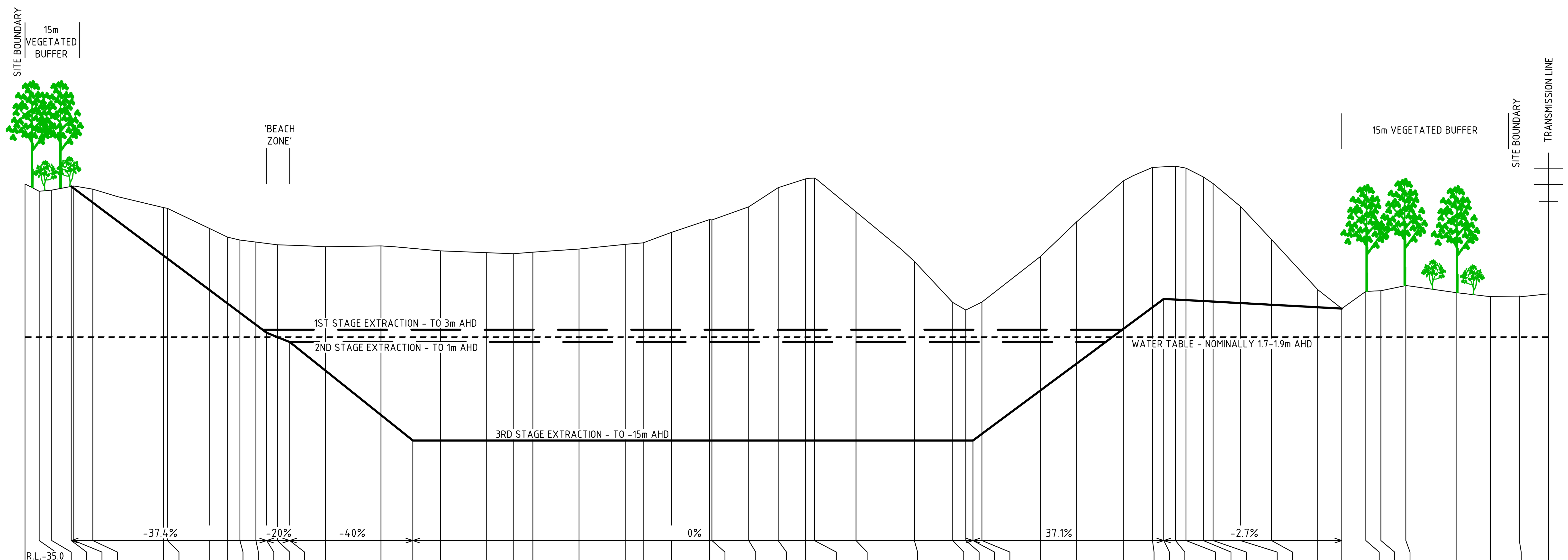
INDICATIVE CROSS SECTIONS
PROPOSE SAND MINE
NELSON BAY ROAD
BOBS FARM

CLIENT: PATRA HOLDINGS PTY LTD
JOB No.: 212434
COMPUTER FILE : S:\Clients\2012\212434\Dwg\Layout Plan.dwg

COUNCIL: PORT STEPHENS	REFERENCE: 21400061
PARISH: TOMAREE	SHEET SIZE: A1
SCALE: 1:2000 on A1	SHEET No.: 2 of 3
DATE :	Plotted 17:08 11/07/19



CHAINAGE	DESIGN LEVEL	EXISTING LEVEL
0	-	26.676
4.583	-	25.489
8.662	-	25.668
15	26.27	26.27
15.849	25.952	26.35
22.017	23.643	25.824
45	15.04	22.83
46.245	14.574	22.714
60	9.425	19.421
65.82	7.247	18.028
69.82	5.749	17.557
75	3.81	17.231
78.5	2.5	-
81.986	1.803	16.791
86	1	-
97.619	-3.648	16.471
115.641	-10.856	16.61
126	-15	-
135	-15	15.803
150	-15	15.508
158.614	-15	15.342
165	-15	15.592
180	-15	16.101
195	-15	16.868
200.843	-15	17.105
210	-15	18.803
222.415	-15	20.889
223.18	-15	20.824
235.143	-15	22.958
244.7	-15	26.072
253.616	-15	27.497
256.472	-15	27.629
270	-15	22.141
288.958	-15	14.087
301.434	-15	7.427
305.665	-15	6.191
308	-15	-
310.912	-13.92	7.487
330	-6.839	14.931
341.705	-2.497	20.539
356.843	3.119	27.167
366.332	6.639	29.365
370	8	-
373.81	7.897	29.553
377.208	7.805	29.247
382.822	7.652	27.82
386.006	7.566	26.734
394.894	7.325	23.038
405	7.051	17.65
420	6.645	9.504
427.84	6.432	6.432
435.655	-	9.221
440.551	-	9.324
448.646	-	10.16
465	-	9.023
476.13	-	8.363
485.515	-	8.334
495	-	8.82

SECTION C-C

H=1:1000 V=1:500

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
E	Site Extents and Entrance Revised	DS	DS			
D	Reduced Footprint - Additional Buffers Added	AV	AV			
C	Footprint Withdrawn from Electrical Easement	AV	AV			
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INDICATIVE CROSS SECTIONS
PROPOSE SAND MINE
NELSON BAY ROAD
BOBS FARM

COUNCIL PORT STEPHENS	**REFERENCE** 21400062		
PARISH TOMAREE	**SHEET SIZE**	A1	
SCALE 1:2000 on A1	**SHEET No.** 3 of 3		
DATE :	Plotted 17:09 11/07/19		

CLIENT: PATRA HOLDINGS PTY LTD **JOB No.:** 212434 **COMPUTER FILE :** S:\Clients\2012\212434\Dwg\Layout Plan.dwg