SHOALHAVEN STARCHES
ENVIRONMENTAL MANAGEMENT PLAN

TITLE:	**Acid Sulfate Soil Management Plan**
PURPOSE:	To implement measures to reduce the potential environmental impacts associated with the disturbance of Acid Sulfate Soils during works associated with Shoalhaven Starches Development Consent 06_0228.
SCOPE:	Shoalhaven Starches Development Consent 06_0228, including the requirements of Schedule 3, Condition 21 of the Consent.
ACTION ON NON-CONFORMANCE:	Notify Environmental Coordinator Notify Project Manager Notify Project Site Supervisor
REFERENCES:	Shoalhaven Starches Development Consent (Consolidated) 06_0228 Phase 1 Contamination Assessment, Acid Sulfate Soils Investigation, and Riverbank Stability Assessment, Proposed Flour Mill B, 10 October 2016, (Services Pty Ltd (Coffey 2016) Manildra Group Pty Ltd, Acid Sulfate Soils Management Plan, Proposed Starch Dryer Area, 24 December 2015, by Coffey Environments Pty Ltd (Coffey 2015) Coffey Geotechnics Pty Ltd (2014). Geotechnical Investigation and Preliminary Environmental Assessment, Proposed New Silos, Bomaderry, NSW. Report reference GEOTWOLL03658AA-AA, Dated 6 August 2014 (Coffey 2014) Dear SE, Moore NG, Dobos SK, Watling KM and Ahern CR (2002) Queensland Acid Sulfate Soil Technical Manual - Soil management Guidelines Version 3.8 (Dear et al 2002) Phase 1 Contamination and Acid Sulfate Soil Assessment Boiler House Modifications, Bolong Road, Bomaderry, May 2017 (Coffey 2017) Shoalhaven Starches Environmental Assessment Proposed Modification to Project Approval 06_0228, New Specialty Product Processing Facility, New Gluten Dryer, and Other Associated Works, June 2018, by Cowman Stoddart Pty Ltd.

Contents

1. Introduction

This Acid Sulfate Soil Management Plan (ASSMP) has been developed to satisfy the requirements of Schedule 3, Condition 21, of Shoalhaven Starches Expansion Development Consent 06_0228, approved by the NSW Department of Planning & Environment.

Condition 21 of the approval states:

> *The Applicant shall prepare an Acid Sulfate Soil Management Plan for the development, as modified. The plan must be prepared in accordance with the Acid Sulfate Soils Manual (Acid Sulfate Soils Management Advisory Committee, 1998), and be submitted to the Secretary prior to the commencement of construction. The plan must include specific measures to manage Acid Sulfate Soils during construction of the grain intake pit and piling works described in MOD 16.*
>
> *If a modification does not require an update of the plan listed above, the Applicant shall provide written justification to the satisfaction of the Secretary.*

The objective of the ASSMP is to reduce the potential environmental impacts associated with the disturbance of acid sulfate soils within the site.

This ASSMP has been prepared based on previous ASSMPs and studies prepared by Coffey Environments Pty Ltd including:

- Shoalhaven Starches, Acid Sulfate Soils Management Plan, Proposed Starch Dryer Area, 24 December 2015
- Phase 1 Contamination Assessment, Acid Sulfate Soils Investigation, and Rive Riverbank Stability Assessment, Proposed Flour Mill B, 10 October 2016, Coffey Services Pty Ltd (Coffey 2016) and;
- Phase 1 Contamination and Acid Sulfate Soil Assessment Boiler House Modifications, Bolong Road, Bomaderry, May 2017 (Coffey 2017)

The ASSMP is prepared in general accordance with the Acid Sulfate Soils Assessment Guidelines (Ahern et al, 1998a) and the Acid Sulfate Soils Management Guidelines (Ahern et al, 1998b) in the Acid Sulfate Soil Manual, published by the Acid Sulfate Soils Management Advisory Committee (ASSMAC).

2. Project Description

The latest project modification approval (MOD 16) is summarised in Shoalhaven Starches Environmental Assessment, Proposed Modification to Project Approval 06_0228, New Specialty Product Processing Facility, New Gluten Dryer, and Other Associated Works, June 2018, by Cowman Stoddart Pty Ltd.

The modification (MOD 16) proposes additional infrastructure to increase flour, starch and gluten production and increase on-site energy generation. The modification involves several items of additional plant including a third flour mill, a new gluten dryer, conversion of two gluten dryers to starch dryers, a specialty products building, a new boiler and a coal-fired cogeneration plant.

An overall site plan showing the existing Shoalhaven Starches facility and the proposed MOD 16 development (in red) is shown in Appendix A.

2.1. Proposed development

The proposed MOD 16 development will comprise various plant & equipment as described below and depicted in Appendix A:

- Specialty Products Building & Product Dryer Building (Gluten Dryer #8)
- Boiler #8, Generator Set & Lime Silos
- Indoor Electrical Substation
- Grain Intake Pit & Bucket Elevator
- Extension to Existing Main Substation
- Sifter Room
- Flour Mill C & Flour Mill Mechanical Ventilation System
- Starch Dryer No.5 baghouse

- Conversion of Existing Gluten Dryers No.1. & No.2 to Starch Dryers
- Carpark Relocation

There will be no earthworks associated with the Sifter Room, Conversion of Existing Gluten Dryers (1 & 2) to Starch Dryers, Flour Mill C and Flour Mill Mechanical Ventilation System (all above ground works) and therefore acid sulfate soils are not applicable for these developments.

Piling foundations for the various MOD 16 projects will be completed by either Auger Piling (CFA) method utilising a slow speed screw auger to drill holes which are backfilled with concrete or the Screw Piling method utilising long steel tubes, with a screw head on one end, that are wound into the ground much like a screw into wood. Soil cuttings from the piles may be reused within other parts of the Manildra site, subject to acid sulfate soil testing.

The carpark construction will involve minor excavations works restricted to less than 0.5 metre in depth and therefore the presence of acid sulfate soils is unlikely.

Measures for active dewatering of the grain intake pit and piling works is further discussed in section 3.5.

2.2. Summary of geoenvironmental site setting

Based on previous investigations soils beneath depths of 3 metres in the central and western Main Manildra Factory areas, are likely to be acid sulfate soils. At shallower depths, there is a low risk that acid sulfate soils are present, however this may be influenced by the presence of fill within the site. Should dark grey, high plasticity estuarine clays be encountered in the current site at depths shallower than 3m, these soils should be considered potential acid sulfate soils unless otherwise tested.

Should the proposed development involve excavation of soils from depths greater than 3m at the site, and/or dewatering that could result in a drop in the water table, this could also impact acid sulfate soils, then an acid sulfate management plan (ASSMP) should be developed and actioned.

An ASSMP will present the approach and methodology of acid sulfate soil management at the site during the construction phase of the project which is to be followed by Manildra and/or their subcontractors.

The ASSMP has been prepared in accordance with the relevant sections of the 1998 ASS Manual prepared by ASSMAC. The detail of the ASSMP can be refined based on the likely volumes to be extracted. For small volumes a simple work plan may be sufficient. If possible, avoidance of disturbing the ASS is preferred.

2.3. Acid sulfate soils

2.3.1. Background

Coastal acid sulfate soils (ASS) are commonly found in low lying coastal floodplains, estuaries, rivers and creeks. They are naturally occurring sediments rich in iron sulphides that form sulphuric acid when exposed to oxygen. Acid sulfate soils include potential acid sulfate soils (PASS) and actual acid sulfate soils (AASS).

PASS are soils which contain iron sulphides or sulphidic material. In their undisturbed state, PASS may exhibit a pH of 4 or greater, and may be slightly alkaline. When exposed to air, the sulphides in PASS oxidise and can release significant quantities of acid. Following oxidation, the pH of these soils may fall considerably below pH 3.5.

AASS are highly acidic soils resulting from the oxidation of iron sulphides or sulphidic material present in the soil profile. AASS are formed through the disturbance of PASS, which may be a result of either natural disturbances (e.g. regional fall in groundwater levels which exposes PASS to oxygen) or human disturbances (e.g. excavating PASS). AASS are typically characterised by pale yellow mottles, coating of soils with jarosite and pH of 4 or less.

2.3.2. Summary of previous assessment findings

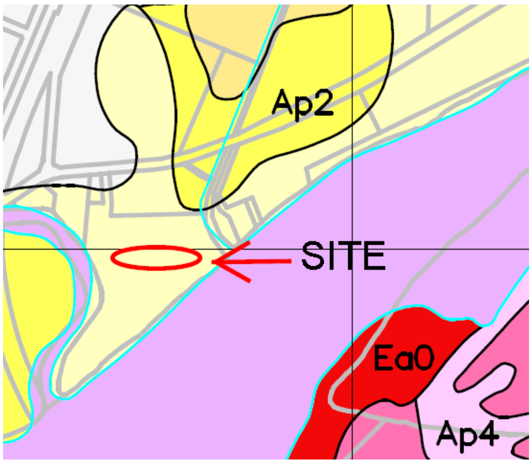
Coffey assessed the potential for acid sulfate soils at the site in an environmental investigation (Coffey, 2015). A summary of relevant information is included below.

- The site is located in an area of “low probability” of occurrence of acid sulfate soil material within the soil profile, according to the Acid Sulfate Soil Risk map (DLWC, 1997). The site location is shown overlying an extract of this map as shown in Figure 1 below. If present, acid sulfate soil materials would be expected to occur at depths between 1m and 3m below the ground surface. Acid sulfate soil materials (if present) are said to be widespread or sporadic within the soil profile and may be buried by alluvium or wind-blown sediment.
- A former borehole located near Abernethy’s drain (CBH501) encountered soils logged as alluvial soil between 2.8m and 5.4m below existing ground surface. The alluvial soils were described as grey clayey sand. Soils of similar description have been found to be acid sulfate soil in other parts of the Shoalhaven Starches plant. Other soils (upper fill layers) and deeper residual soil and rock are not likely to be acid sulfate soil based on their appearance and geological origin.
- Laboratory ASS testing was carried out one soil sample (CBH503/0.85-0.95), collected within shallow fill soils at a depth of 0.9m below the existing ground surface. The results of testing suggested there could be some acid sulfate potential based on the net acidity, but is not severe.
- Based on previous investigations (Coffey 2014 and Coffey 2016), soils beneath depths of 3m in this general area are considered to be acid sulfate soils. At shallower depths, there is a low likelihood that acid sulfate soils are present, however this may be influenced by the presence of fill within the site. Should dark grey, high plasticity estuarine clays be encountered in the current site at depths shallower than 3m, these soils should be considered potential acid sulfate soils unless otherwise tested.

2.3.3. Acid sulfate soils risk

Based on previous assessments carried out by Coffey for Manildra along the flanks of the river, acid sulfate soils are likely to be present in estuarine material and intermittent in alluvial soils. There is a risk of potential acid sulfate soils within alluvial soils excavated for foundation piles. It is considered that potential acid sulfate soils will be limited to those soils which fit the description of alluvial soils, as distinct from deeper residual soils and weathered sandstone.

Figure 1 Acid Sulfate Soil Risk Map at Shoalhaven Starches Site, ASS Risk Map (DLWC, 1997)



Map Class Description	Depth to Acid Sulfate Soil Materials	
HIGH PROBABILITY High probability of occurrence of acid sulfate soil materials within the soil profile. The environment of deposition has been suitable for the formation of acid sulfate soil materials. Acid sulfate soil materials are widespread or sporadic and may be buried by alluvium or windblown sediments.	Below water level	Bottom sediments.
		At or near the ground surface.
		Within 1 metre of the ground surface.
		Between 1 and 3 metres below the ground surface.
		Greater than 3 metres below the ground surface.*
LOW PROBABILITY Low probability of occurrence of acid sulfate soil materials within the soil profile. The environment of deposition has generally not been suitable for the formation of acid sulfate soil materials. Soil materials are often Pleistocene in age. Acid sulfate soil materials, if present, are sporadic and may be buried by alluvium or windblown sediments.	Below water level	Bottom sediments.
		At or near the ground surface.
		Within 1 metre of the ground surface.
		Between 1 and 3 metres below the ground surface.
		Greater than 3 metres below the ground surface.*
NO KNOWN OCCURRENCE Acid sulfate soils are not known or expected to occur in these environments.		No known occurrences of acid sulfate soil materials.

3. Management plan and procedures for acid sulfate soils identification

The following general management procedures are considered applicable for pile excavations. The monitoring and management of acid sulfate soils (ASS) will be the responsibility of Manildra and their contractor who undertakes the work. The management procedures are:

1. Appoint an appropriately qualified person to manage the acid sulfate soil issues during the earthwork activities (refer to section 3.1);

2. Undertake monitoring and laboratory testing of excavated materials (mainly based on visual assessment) to assess the potential presence of acid sulfate soils during excavation activities and assess liming rates if necessary (refer to section 3.2);

3. Segregate and stockpile materials excavated from the site appropriately. Materials suspected as being acid sulfate soils will be stockpiled separately to materials assessed as non-acid sulfate soils. (refer to section 3.3);

4. Manage the excavated materials assessed to potentially be acid sulfate soils through either offsite disposal or on-site treatment (refer to section 3.4).

Based on previous piling excavations on site, we note that active dewatering is unlikely required for pile excavations. Special management procedures for dewatering and surface water monitoring are discussed in sections 3.5 and 3.6.

3.1. Training and Responsibilities

Manildra will appoint an appropriately trained person who is responsible for managing the acid sulfate soil issues at the site during the earthwork activities. This person should be familiar with:

- Details of this ASSMP;
- Council and other relevant statutory requirements;
- Recognition of acid sulfate soils;
- Acid sulfate soil testing and treatment procedures; and
- Onsite management of acid sulfate soils, including implementing management procedures. The classification of ASS during excavation should be carried out by personnel trained in the identification of acid sulfate soils and be based on visual classification. Field peroxide testing and also be carried out to supplement observations. If required, a suitably qualified Environmental Consultant could be engaged to assist or train the earthworks contractor in the identification of acid sulfate soils and sampling and analysis.

3.2. Monitoring of excavated materials

Due to the nature of the piling works it may be difficult to make clear observations of the material for visual classification. We have therefore provided two options for monitoring ASS:

Option 1 This option simply sets a conservative depth for which all soil cuttings are regarded as ASS.

This option avoids the need for detailed monitoring and is more practical given the soil extraction is via augers compared with say a large open excavation. Although the volume of soil potentially requiring management as ASS will be greater.

Option 2 This requires more intense visual assessment and field screening to differentiate ASS from non-ASS.

The following procedures are recommended for monitoring ASS:

Option 1

- Conservatively assume that all soils **in the upper 6m** could be ASS. Temporary stockpiling of such materials should be carried out as per Section 3.3.2. The upper 6m has been based beyond the deepest alluvial soils previously encountered.
- All other deeper soils which have been assessed to have a low risk of acid sulfate soils will be stockpiled in accordance with normal good earthworks practice to reduce water ponding, and to control surface erosion and sediment transport outside the stockpiled areas.

Option 2

The following should be carried out by staff experienced in identifying and testing acid sulfate soils in the field:

- Pile excavations will be observed and logged by staff experienced in identifying and testing acid sulfate soils in the field;
- Excavated materials will be visually assessed and field tested as per Sections 3.2.1 and 3.2.2;
- Based on the field classification tests, materials suspected as being ASS will be stockpiled separately to materials assessed as probably non-ASS. Temporary stockpiling of such materials should be carried out as per Section 3.3.2;
- Materials assessed as having a low risk of acid sulfate soils will be stockpiled in accordance with normal good earthworks practice as discussed in Option 1. Depending on site constraints, other equivalent procedures may be adopted by the Contractor or as work progresses where a clearer indication of the location and depth of potential ASS becomes apparent.

3.2.1. Visual classification (for Option 2 only)

The preliminary visual checking of potential ASS will be based on material type, colour and consistency. Soils which have potential ASS are described as the following:

- Alluvial soils have been described as grey, very loose, clayey sands and were previously encountered between depths of 2.8m bgs and 5.4m bgs at a location near to Abernethy's Creek. There is potential for alluvial soils to be encountered at other parts of the site at different depths.
- Dark grey and black, very soft to soft, occasionally firm clays and sandy and dark grey to grey clayey sands and sands are highly characteristic of ASS and if encountered should be regarded as ASS unless shown otherwise. We note these soils were not encountered during previous investigations.
- Any soils showing jarosite staining (yellow straw coloured stains/streaks typically along roots), but would be very difficult to observe during piling.

If suspected acid sulfate soils are classified based on the visual check, the peroxide screening test should be carried out more frequently.

We note that deeper residual soils, typically comprising red, orange and brown, firm to stiff clays are generally not ASS and if identified during excavation need not be managed as ASS. It may be practical to segregate soil cuttings into two separate piles; above and below the base of alluvial soils subject to visual classification. Soils above this depth may be managed and treated as potential ASS (refer to section 3.3) and soils beneath this depth may be managed as non-ASS.

3.2.2. Field test classification using peroxide (for Option 2 only)

We note that field testing at this property may not yield results suitable to differentiate ASS from other soils. It is considered that visual classification will provide the better field indicator. However the methodology for field screening is described below should it be considered necessary.

A field screening test using hydrogen peroxide should be performed on soils visually suspected of being ASS. The screening test should be carried out based on the field pH and peroxide test, generally as described in the QLD Department of Natural Resources, Mines and Energy (2004) Acid Sulfate Soils – Laboratory Methods Guidelines. Initially the pH of the soil is tested in a 1:5 solution of distilled water and then also tested following reaction with 30% H_2O_2.

Soils that record a pH below 3, following oxidation with H2O2, will be managed as acid sulfate soils. Soils that record a pH between 3 and 4, following oxidation, will be treated as highly suspicious and will be confirmed by laboratory analysis using the Scr method.

Selected soils samples (at a minimum rate of 5% of field screenings) should be sent for laboratory analysis using the S_{cr} method to confirm the peroxide screening test results and assess the required liming rate.

3.3. Management and treatment of excavated soil

Where actual/potential ASS are identified following the procedures outlined in Section 3.2, excavated soils will be either placed in a temporary stockpile for testing or transported directly to a specially prepared treatment pad for liming.

3.3.1. Laboratory testing

Laboratory testing should be carried out for representative soil samples collected from the stockpile to assess the liming rate. Depending on the option selected, the volume of ASS could range from about $50m^3$ to $150m^3$. A minimum of three samples should be collected for characterising stockpiles, but no less than 1 sample per $25m^3$. The soil samples should be tested for acid sulfate soils based on the S_{cr} method. Based on the laboratory results a liming rate will be calculated as per below:

kg $CaCO_3$/tonne (by dry weight) = %S x 30.59 x 1.02 x FOS

Note: 30.59 converts to H_2SO_4; 1.02 converts to $CaCO_3$ %S = net acidity (where net acidity could be inaccurately influenced by coarse material buffering that is crushed in the laboratory, then acid neutralising potential (ANC), may need to be omitted from net acidity calculation)
FOS = Factor of safety (1.5 recommended)

3.3.2. Temporary stockpiling

The following management plan should be followed for temporary stockpiling of excavated ASS:

- Soils will be stockpiled away from stormwater drains or creeks (such as such as Abernethy's Drain) and if possible placed in a topographically high area to avoid inundation following heavy rain. The soil stockpiles will be bunded, and placed on an existing paved surface (or strong impermeable plastic sheeting), and provision made for collection of surface runoff and appropriate sediment, erosion and dust controls;

- The stockpiles will be kept moist to help slow the oxidation process;

- A supply of fine grained agricultural lime (with a neutralisation factor of at least 97%) will be kept on site during construction work. The amount of lime to be kept on site will be sufficient to provide emergency liming of existing stockpiles on site (see Section 5.4).

- The stockpiles will also be routinely observed for obvious signs of oxidation, such as jarosite staining;

Where stockpiling exceeds two days, the excavated soils will be bunded and covered with plastic to help slow the oxidation process.

3.3.3. Treatment pad & liming methodology

Where extended periods of stockpiling occur (i.e. greater than 18 hours) and testing indicates the presence of potential or actual ASS, the soils will undergo treatment at a designated treatment pad and lime applied. Normal stormwater and sediment controls should be in place. Extended periods of stockpiling will require leachate collection and monitoring. Where monitoring of the leachate indicates low pH, the addition of a neutralising agent will be required prior to discharge to stormwater. Discharge to stormwater would also be subject to other criteria such as the presence of contaminants and suspended solids and relevant Council approval.

The type and amount of lime to be applied will be such that a neutralising value (NV) of 100 can be achieved. NV relates to the purity of the lime and an NV of 100 is required to ensure that the lime is effective in neutralising the potential acid. Fine powdered agricultural lime ($CaCO_3$) generally has an NV of 90% to 100% whilst other manufactured forms of lime can have an NV as low as 80%. Where NV is below 100, the factor of safety, hence the amount of lime, will have to be adjusted accordingly.

The design of the treatment pad should be in general accordance with Figure 4, page 24, of Dear et al (2002). The following procedures (or other equivalent) should be undertaken for the treatment pad and liming:

- The designated treatment pad (if different from the temporary stockpiling area) should be located away from a permanent waterway or creek and if possible placed in a topographically high area to avoid inundation following heavy rain. The designated treatment pad may be on an existing paved surface or should have a compacted surface (preferably clay). The pad area shall be bunded to a minimum height of 0.5m with non-ASS or treated ASS provision made to collect runoff water. Alternatively, plastic covered hay bales could be used to form the bund.

- Spreading of the soil in thin (<200mm) layers on impervious pads within the boundary of the site works. A guard layer of neutralising agents should be provided at the base of the pad prior to the addition of ASS.

- Addition of lime by hand or light weight truck followed by mixing, using light weight rotovators (or other lightweight earthmoving machinery). The amount of lime to be added shall be assessed from the results of the laboratory Scr testing, with a factor of safety of 1.5 applied to account for incomplete mixing.

- Moisture conditioning may be required as this methodology has proved generally ineffective with fine grained soils drier than the plastic limit. The use of heavy equipment may be more effective in mixing lime with these soils depending on the nature of the stockpiled material and the bearing capacity of the underlying pavement or topsoil.

3.3.4. Lime register

In order to demonstrate that appropriate quantities of lime have been used, a lime register shall be maintained by the Contractor. The register shall list all lime delivered to the site, verified by delivery dockets, and where the lime has been used. The lime usage shall quantify areas limed and soil volumes treated, liming rates and quantities of lime used. The amount of lime to be kept on-site for emergencies will be assessed by Manildra and/or their subcontractor.

Observations of the limed material will be made by an experienced consultant who will also assess the lime register.

Monitoring of pH will be carried out at least weekly prior to re-use of the material. Readings of pH at or above background, in conjunction with the lime register and observations of mixing, can be used as verifiable performance indicators.

3.3.5. Emergency Liming of Soil

Where emergency liming is required and additional laboratory testing results are not readily available, the liming of acid sulfate soils may be carried out at a rate of about 10kg lime per tonne of soils **(i.e.1% dry weight).** The emergency liming rate is a temporary measure to lower the immediate risk to the surrounding environment and may not be sufficient for complete neutralisation.

3.4. Offsite disposal or reuse of acid sulfate soils

3.4.1. Offsite disposal

The successfully treated soils may be disposed of to an appropriately licensed landfill following waste classification. The waste classification and disposal should be undertaken in accordance with relevant standards and requirements, including the NSW EPA (2014) Waste Classification Guidelines: Part 4: Acid Sulfate Soils.

Post-treatment acid sulfate soils should be chemically assessed in accordance with Step 5 of the NSW DECC (2014) Waste Classification Guidelines, Part 1, Classifying Waste. Based on the classification the treated ASS should then be disposed offsite to a licensed landfill.

3.4.2. Reuse of treated soils

Manildra have identified potential areas to reuse the soil on another nearby property owned by them (the Environmental Farm). The movement of waste in NSW is regulated through The Protection of the Environment Operations (Waste) Regulation 2014 (the Waste Regulation).

As the soils are potential ASS, there are no current approved resource recovery exemptions allowing re-use of the soils at other properties. The NSW EPA would need to be contacted to discuss if there opportunity to explore a specific exemption to allow the material to be re-used at another site. If so a specific exemption would need to be obtained.

3.5. Dewatering during construction

A minimal amount of water is expected to be generated from pile excavations using the proposed piling method (i.e. Screw/Continuous Flight Augering). Active dewatering of the pile excavations is therefore unlikely. Small amounts of water (if any) that arises from the excavated soils and excavations should be managed as normal construction water in accordance with Council requirements and be documented in the Manildra's Construction Safety & Environmental Management Plan (CSEMP).

If active dewatering is required for piling works or the Grain Intake Pit excavation, the water must be transferred to the site's waste water treatment plant. Consult with the Project Manager on the location of the appropriate factory drain to transfer the construction water to.

No water is to be released to the stormwater system unless it has been tested and approval gained by the Environmental Coordinator.

3.6. Surface water monitoring

Stormwater runoff from the construction site should be appropriately managed to protect the nearest surface water body (Shoalhaven River). We consider that no additional monitoring of surface water is required from an acid sulfate soils perspective. This again should be in accordance with Council requirements. The site procedure for this is documented in Manildra's CSEMP, which forms part of the Construction Contract documents for the project.

Prepared By: J. Studdert	Authorised By: J. Studdert
Date: 24-2-2020	Date: 24-2-2020

Appendix A – Overall Site Plan Including Proposed MOD 16 Infrastructure