

Generic Acid Sulfate Soils Management Plan

Endeavour Energy use only

29/05/24



Contents

1.	Introduction	4
1.1	Definition	4
1.2	Importance of acid sulfate soil management	4
2.	Purpose	5
3.	Legislative requirements	5
4.	Work health and safety	5
5.	Identification and planning	5
5.1	Project planning and preliminary assessment	5
5.1.1	Determining if acid sulfate soil is present	6
5.1.2	Determining if acid sulfate soil disturbance can be avoided	7
5.1.3	Determining if acid sulfate soil disturbance can be avoided	7
6.	Acid sulfate soil management	9
6.1.	Prior to commencing work	9
6.1.1.	Inform workers	9
6.1.2.	Stage works	9
6.1.3.	Determine acid sulfate soil type	9
6.2.	Storage of acid sulfate soil	10
6.3.	Reinstatement of acid sulfate soils	10
6.3.1.	Potential acid sulfate soils	10
6.3.2.	Actual acid sulfate soils	10
6.4.	Treatment of acid sulfate soils	11
6.5.	Remedial action	11
6.6.	Disposal	11
6.6.1.	Potential acid sulfate soils	12
6.6.2.	Actual acid sulfate soils	12
6.7.	Transport	12
6.8.	Dewatering	12
7.	References	13
8.	Figures	13
9.	Tables	13



1. Introduction

This Acid Sulfate Soils Management Plan (ASSMP) focuses on environmental risks associated with acid sulfate soil and appropriate management of these risks. **This ASSMP is for use by Endeavour Energy employees only.** Accredited Service Providers (ASPs) should obtain advice regarding management of acid sulfate soils from suitably qualified environmental consultants.

1.1 Definition

Acid sulfate soils are a type of soil naturally found in both coastal (tidal) and inland or upland (freshwater) environments. Typically, these areas are less than 5 metres above sea level and include swamps, marshes, estuarine floodplains, and mangroves. These soils contain iron sulfides, which when exposed to oxygen generate sulfuric acid, and can also release toxic quantities of iron, aluminium, and heavy metals. Left undisturbed, these soils are considered harmless. However, when the surface of these soils is broken and the under layer is exposed to air, the soils can become toxic resulting in impacts on aquatic life and water quality.

Acid sulfate soils can be classified as either actual or potential. Actual acid sulfate soils are those that are exposed to the air and hence produce sulfuric acid. Potential acid sulfate soils are those that are waterlogged but have the potential to produce sulfuric acid if exposed to the air. Physical indicators of potential and actual acid sulfate soils are further discussed in section 6.1.3.



Figure 1- The presence of mangroves and grey soils is an indicator of acid sulfate soils

1.2 Importance of acid sulfate soil management

Acid sulfate soil can have environmental impacts including:

- Increases soil acidity.
- Strips nutrients from the soil.
- Dissolves heavy metals causing the soil to become toxic to plants and animals.
- Potential to contaminate groundwater.
- Potential to corrode infrastructure; and
- Acidic runoff can affect aquatic ecosystems and can kill aquatic life, including fish and crustaceans, and plants.

The implementation of appropriate management controls during the disturbance of acid sulfate soils is required to minimise environmental impacts. Contact the relevant Environmental Specialist in the project planning stages for advice on acid sulfate soil management.

2. Purpose

The purpose of this ASSMP is to provide guidance on the environmental management of acid sulfate soil for projects determined to have a **medium environmental risk**. A site specific ASSMP should be developed for larger projects or projects that are determined to have a high environmental risk (refer to Figure 4).

The guidance provided in this ASSMP is based on the *Acid Sulfate Soil Manual* published by the Acid Sulfate Soil Management Advisory Committee in 1998. It complements guidance provided in Endeavour Energy's Environmental Management Standard EMS 0001 – Environmental Impact Assessment and Environmental Management Plans and the Environmental Guidelines Handbook.

This ASSMP should be used during the planning stages of a project in preparation for construction and/or maintenance work and should be made available on site at the times of the works. The controls suggested in this ASSMP are in addition to requirements outlined in any associated environmental impact assessments (EIA), geotechnical investigations, permits and/or licenses.

3. Legislative requirements

Under the *Protection of the Environment Operations Act 1997 (NSW)*, it is an offence to cause or permit the pollution of waters or to unlawfully dispose of waste. Endeavour Energy is responsible for correctly identifying and managing acid sulfate soil to prevent pollution of waters and to lawfully dispose of acid sulfate soil.

4. Work health and safety

Acid sulfate soils can release hydrogen sulphide gas, which can be hazardous to humans at high concentrations or if exposed to for long periods of time. Contact with acid sulfate soils can also have health impacts. Exposure to acid sulfate soils and hydrogen sulphide gas can cause skin irritation, eye damage, headaches, irritation of gastrointestinal tract, serious respiratory and heart problems, insomnia, and prolonged exposure may lead to paralysis or meningitis.

Health and safety risks associated with acid sulfate soils should be determined on a case-by-case basis and will depend on the extent of disturbance. For example, trenching within acid sulfate soils may trigger requirements for air monitoring using a gas meter to determine safe exposure limits.

For further guidance on the health and safety aspects of acid sulfate soils contact the relevant Work Health and Safety (WHS) Business Partner.

5. Identification and planning

5.1 Project planning and preliminary assessment

The presence of acid sulfate soils should be determined in the project planning stage of works so effective design options, management actions and controls can be incorporated into the project.

The assessment process should consist of three steps:

1. Determine if acid sulfate soils are present,
2. Determine if the disturbance of acid sulfate soil can be avoided, and
3. If disturbance cannot be avoided, determine the appropriate management methods required to reduce the potential for environmental harm.

5.1.1 Determining if acid sulfate soil is present

A GIS is accessible to Endeavour Energy employees and contains environmental data such as the probability of acid sulfate soil occurring on the work site. It can be accessed at the following link:

<http://hwgi33vp/envirogis/framesetup.asp>.

Additionally, acid sulfate soil locations can be found on the NSW Office of Environment and Heritage website (<http://www.environment.nsw.gov.au/acidsulfatesoil/riskmaps.htm>) and can also be obtained from the relevant council website.

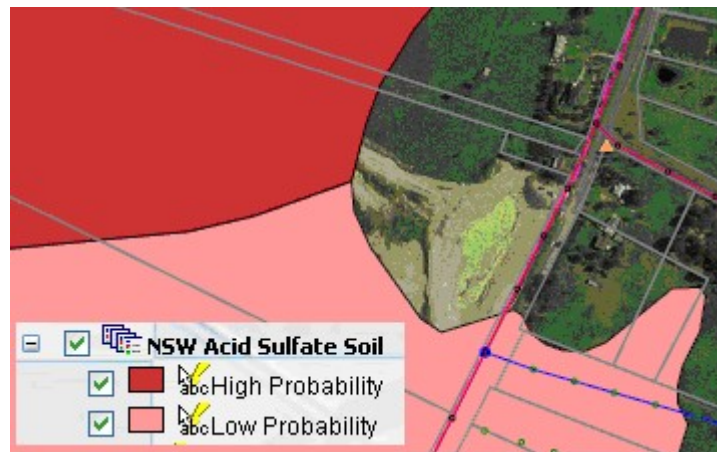


Figure 2- EnviroGIS

When a Summary Environment Report (SER) is being completed through the Endeavour Energy web-based program referred to as the SER Application, the SER Application will interact with the acid sulfate soil layer in the associated GIS (refer to EMS0001 for more information on the SER process).

The acid sulfate soil data in the GIS of the SER Application uses a classification system for the likelihood of acid sulfate soils being present in a particular area and at a certain depth. There are five classifications:

Class 1

Acid sulfate soils in a Class 1 area are likely to be found on and below the natural ground surface.

Class 2

Acid sulfate soils in a Class 2 area are likely to be found below the natural ground surface. Any works beneath the natural ground surface or works which are likely to lower the water table may encounter acid sulfate soils.

Class 3

Acid sulfate soils in a Class 3 area are likely to be found beyond 1 metre below the natural ground surface. Any works that extend beyond 1 metre below the natural ground surface or works which are likely to lower water table beyond 1 metre below the natural ground surface may encounter acid sulfate soils.

Class 4

Acid sulfate soils in a Class 4 area are likely to be found beyond 2 metres below the natural ground surface. Any works that extend beyond 2 metres below the natural ground surface or works which are likely to lower the water table beyond 2 metres below the natural ground surface may encounter acid sulfate soils.

Class 5

Acid sulfate soils are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres on adjacent class 1, 2, 3 or 4 lands. Works in a class 5 area that are likely to lower the water table below 1 metre AHD on adjacent class 1, 2, 3 or 4 land may encounter acid sulfate soils.



Figure 3- SER Application

Acid sulfate soil planning maps are indicative and on-site observations should also be used to identify acid sulfate soils (refer to Table 1.1 in Section 6.1.3 for physical indicators of acid sulfate soil).

5.1.2 Determining if acid sulfate soil disturbance can be avoided

If acid sulfate soils are likely to be present, then an alternative design and/or route options to avoid disturbing acid sulfate soils should be investigated. If disturbance is unavoidable the following should be considered:

- soil disturbance should be minimised and occur as shallow as possible.
- the use of heavy machinery in acid sulfate soil areas should be minimised.
- disturbance of the water table should be avoided; and/or
- the addition of clean fill to build up the surface ground level in areas requiring excavation so that works do not intersect the acid sulfate soil layer.

5.1.3 Determining if acid sulfate soil disturbance can be avoided

The appropriate management method is determined using a risk assessment approach as shown in Figure 4. Once a risk level is determined the corresponding management method should be followed.

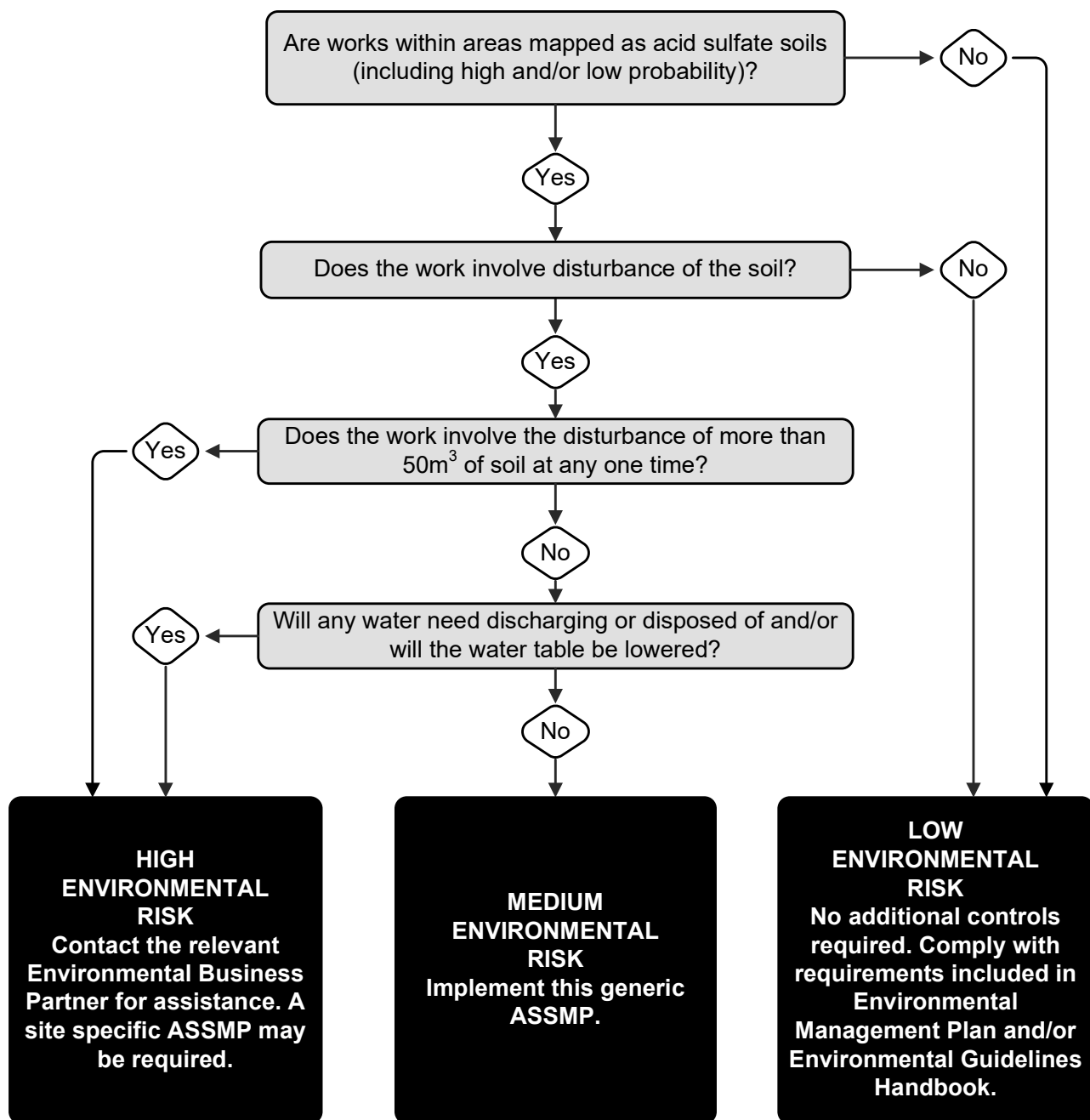


Figure 4- Determining the appropriate management method for acid sulfate soils

Notes:

- 50m³ of soil is equivalent to approximately 150m of trenching, or the excavation required for 12-16 wooden poles
- Environmental Business Partners are now referred to as Environmental Specialists

6. Acid sulfate soil management

The management methods in this ASSMP are for **small projects** which are allocated a **medium environmental risk** associated with acid sulfate soils as shown in Figure 4. A site specific ASSMP is required for projects determined to have a high environmental risk. Contact the relevant Environmental Specialist for assistance with projects determined to have a high environmental risk.

6.1. Prior to commencing work

6.1.1. Inform workers

Prior to commencing work, the relevant workers should be informed of additional on-site management required to minimise environmental risk from acid sulfate soils. Suitable areas should be designated for stockpiling and/or waste bins provided for storing acid sulfate soils.

6.1.2. Stage works

The project should be scheduled to minimise the time acid sulfate soil material is exposed to air. This involves scheduling the works so acid sulfate soil can be reburied as quickly as possible (that is within the same working day) and to minimise the exposure time of soils in open excavations. This is particularly important for sandy sediments as they tend to oxidise and leach rapidly (a few hours) as compared to clay (a few days).

Quantities should be kept to manageable proportions in suitably lined and covered waste bins or as suitably sized stockpiles (refer to Section 6.2).

6.1.3. Determine acid sulfate soil type

As discussed in Section 1.1, acid sulfate soils can be classified as either potential or actual acid sulfate soils. Table 1.1 summarises physical indicators of potential and actual acid sulfate soils.

Table 1.1- Indicators of potential and actual acid sulfate soils	
Potential acid sulfate soil indicators:	
● Presence of mangroves, reeds, rushes, salt marsh or swamp vegetation etc ● Sulfureous (rotten egg gas) smell after rain, following a dry spell or when the soils are disturbed ● Marine or estuarine sediments ● Soils can be described as unripe muds/sediments (soft, buttery, blue grey or dark greenish grey) which can include sands and gravels ● Milky blue/green water ● Shell fragments in the soil ● Waterlogged, scalded or backswamp areas ● Land below 5m AHD elevation	
Actual acid sulfate soil indicators:	
● Any jarosite (a pale-yellow mineral deposit) or iron oxide (rusty) colouring ● Extensive iron stains on any drain surfaces, or iron-stained drain water and ochre deposits ● Corrosion of concrete and/or steel structures ● Surface or ground water on or draining from the site with a pH < 5.5, or of an unusually clear or milky green ● Sulfureous (rotten egg gas) smell when soils are disturbed	

6.2. Storage of acid sulfate soil

If acid sulfate soils are required to be stored on site, different soil layers should be stored separately, in particular separating non-acid sulfate soil from acid sulfate soil layers. Each layer should be managed according to the potential to produce acid. Stockpile the highest risk soil (considered most likely to produce acid) closest to the trench/ excavation.

When storing acid sulfate soil:

- store in a covered bin lined with heavy duty plastic in preference to stockpiling.
- if bins are not available or practical, stockpile on an impervious material, away from stormwater and drainage lines, and cover with a heavy-duty plastic. Weigh down the cover edges using sandbags or equivalent.
- stockpiles should be bunded (if possible) to prevent run-off of acidic water.
- sediment control and diversion banks (if required) should be installed around the stockpiles.
- spoil in bins/ stockpiles should remain moist and contained at all times.
- minimise the surface area exposed to air. Disturbance and exposure to air may render soils acidic. As such covers should be air and watertight where possible; and
- consider weather conditions especially rainfall, heat, and wind.



Figure 5- Covered acid sulfate soil stockpile

6.3. Reinstatement of acid sulfate soils

6.3.1. Potential acid sulfate soils

It is recommended that potential acid sulfate soils be re-instated on site, where practical, provided it is:

- Re-instated within 24 hours of being excavated.
- The soils have been correctly stored (in accordance with Section 6.2), and
- Soils are re-instated at the same depth as excavated.

If there are any doubts that acid may have been produced during exposure, the soil should be treated with a neutralising agent as a precaution prior to reinstatement (refer to Section 6.4).

Refer to Section 6.6 for disposal requirements if re-instatement is not practical and the soil needs to be disposed off-site.

6.3.2. Actual acid sulfate soils

Actual acid sulfate soils are acid producing and they should be treated with a neutralising agent before re-

instatement or during long periods of storage (refer to Section 6.4). Refer to Section 6.6 for disposal requirements if re-instatement or treatment is not practical and the soil needs to be disposed off-site.

6.4. Treatment of acid sulfate soils

Prior to treating acid sulfate soils, the following must be implemented:

- The treatment area must be impervious and bunded with adequate drainage collection in a suitable location. This is to prevent acidic water leaving the site.
- The treatment of soil should not occur in a sensitive area, for example near a drainage line, stormwater receptor, waterway, wetland, and/ or on steep slopes.

Treatment involves the use of agricultural lime to neutralise the acid by raising the pH to 5.5 or greater. Where no soil analysis has occurred, lime application rates should be in the order of 45 kilogram (kg) per tonne of fine grade (1 or 2) agricultural lime (pH~8.2). However, this may vary depending on the type of soil and its sulfate content (which can be determined from soil analysis arranged by the relevant Environmental Specialist).

The following treatment process will be followed:

1. Excavated acid sulfate soil is to be spread into thin layers (0.15 to 0.30 metres thick) in preparation for treatment.
2. Apply fine grade agricultural lime at a standard rate of 45 kilogram of lime per tonne of soil or otherwise informed from soil analysis. Application of lime should be conducted during calm conditions to minimise the amount of lime blown away.
3. Mix lime into the acid sulfate soil layer thoroughly. Maintaining an even mix of soil and lime for each soil layer is crucial in an effective treatment.
4. If soil is to be reinstated, maintain sediment control until the area is stabilised.

The **lime must contain less than**: 1mg of calcium per kilogram; 0.2 mg mercury per kilogram and 20 mg lead per kilogram. This information can be found on the label for the lime.

Always read the safety data sheet (SDS) for the lime to assess whether additional health and safety controls and/or personal protective equipment are required during handling.

6.5. Remedial action

Following completion of works in acid sulfate soil areas, the site should be monitored to verify that there are no residual impacts on the environment. Health of plant life should be observed near the area of disturbance.

Where there is evidence of negative impacts on plant life, animals, soils, or water near the site, contact the relevant Environmental Specialist **immediately** as specialist advice and/or a site-specific remedial plan may be required. The Environmental Specialist will provide advice on whether an environmental incident has occurred.

6.6. Disposal

If disposal of acid sulfate soil is required, contact the relevant Environmental Specialist for advice on disposal and to arrange for chemical testing by a NATA accredited laboratory if required. Acid sulfate soil should be disposed of at a waste facility licensed by the EPA to receive that type of waste.

The disposal of soil should be completed in accordance with company standards EMS 0007 Waste Management and EMS 0013 Spoil and Imported Material Management. More information on the disposal of acid sulfate soils can be found in Part 4 of the *Waste Classification Guidelines* (NSW EPA, 2014).

Not all EPA licensed waste facilities can accept acid sulfate soils. Review suitably EPA licensed waste facility's prior to transporting and make contact at least one day before delivery of the acid sulfate soils to confirm they can accept the waste and to obtain a booking number from the operator.

6.6.1. Potential acid sulfate soils

Under certain conditions potential acid sulfate soils can be received at an appropriately EPA licensed waste facility without treatment provided that:

- the facility is licensed by NSW EPA to dispose of potential acid sulfate soils below the water table.
- soils have been kept wet at all times during excavation and handling and are received at the proposed disposal point within 16 hours of being excavated.
- soils meet the definition of 'virgin excavated natural material' (VENM).
- soils have not dried out or undergone any oxidation of their sulfidic minerals; and,
- soils have a pH greater than 5.5.

If potential acid sulfate soil does not satisfy the above criteria, or there is no waste facility licensed to accept potential acid sulfate soils in close proximity, it will be required to be treated and disposed as actual acid sulfate soils as detailed in Section 6.6.2.

6.6.2. Actual acid sulfate soils

Actual acid sulfate soils must be treated in accordance with Section 6.4 prior to disposal. After treatment, the actual acid sulfate soils should be assessed in accordance with Step 5 of Part 1 of the *Waste Classification Guidelines* (NSW EPA, 2014) to determine if contaminants are present, other than iron sulfides, which may affect disposal requirements (the relevant Environmental Business Partner can assist with this). Following classification, the waste can be disposed of to an EPA waste facility licensed to accept that class of waste.

6.7. Transport

When transporting acid sulfate soil, the transport time should be minimised, and the load covered to avoid contact with rain and the potential leaching of sulfuric acid.

Documentation is to be provided to the receiving EPA licensed waste facility for each truckload of acid sulfate soil indicating that excavation, transport, and handling have been undertaken in accordance with this Management Plan (the guidance of which has come from the *Acid Sulfate Soil Manual*). The relevant Environmental Specialist can assist with this.

If the acid sulfate soil has been assessed and classified as either Restricted Solid Waste or Hazardous Waste, then it must be transported by an appropriately licensed waste transporter and waste tracking must occur (contact the relevant Environmental Specialist for advice if required).

6.8. Dewatering

Water that has collected in acid sulfate soil excavations or storage areas should not be discharged to stormwater. Removal of this collected water should be completed by suitably licensed liquid waste contractor and disposed of at a waste facility licensed by the EPA to accept this type of waste. The relevant Environmental Specialist can provide further advice if required.

7. References

Acid Sulfate Soil Management Advisory Committee (1998), *Acid Sulfate Soil Manual*, Wollongbar, NSW, Australia

NSW Environment Protection Authority (2014), *Waste Classification Guidelines, Part 1 (Classifying Waste) and Part 4 (Acid Sulfate Soils)*, Sydney, NSW, Australia

NSW Office of Environment and Heritage, <http://www.environment.nsw.gov.au/acidsulfatesoil/riskmaps.htm>

Endeavour Energy, Environmental Guidelines Handbook

Environmental Management Standard EMS 0001 – Environmental impact assessment and environmental management plans

Environmental Management Standard EMS 0007 – Waste management

Environmental Management Standard EMS 0013 – Spoil and imported material management

Protection of the Environment Operations Act 1997 (NSW)

8. Figures

Figure 1 - The presence of mangroves and grey soils is an indicator of acid sulfate soils

Figure 2 - EnviroGIS

Figure 3 - SER Application

Figure 4 - Determining the appropriate management method for acid sulfate soils

Figure 5 - Covered acid sulfate soil stockpile

9. Tables

Table 1-1 - Indicators of potential and actual acid sulfate soils