Appendix K

Acid sulfate management plan

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Acid Sulfate Soil Management Plan for Georges Cove Marina

Management of Acid Sulfate Soil is an important aspect of the construction and operation processes. A geotechnical investigation would be required to identify the presence of Acid Sulphate Soils on the site, and within the area where works would occur. If Acid Sulfate Soil is present on-site, an Acid Sulfate Soil Management Plan would be required.

Acid Sulfate Soil is the common name given to sediment and soil containing iron sulfide. The exposure of iron sulfides to air will result in oxidation and the generation of sulfuric acid. Acid leachate can strip metals such as aluminium and iron from the soil matrix and release them into water bodies. Toxic concentrations of these metals will affect water quality and adversely affect aquatic organisms (disease or death) that inhabit the water body.

When saturated mud, gravel or sand containing iron sulfides is disturbed by excavation, dredging or dewatering and exposed to air, the generated acid leaches from the soil (Acid Sulfate Soils Planning Guidelines, 1998). Acid leachate can cause severe environmental degradation and/or contamination. In discussion of acid sulfate soils the following definitions are important (ASSMAC, 1998):

Acid Sulfate Soils (ASS) include actual acid sulfate soils and potential acid sulfate soils. Actual and potential acid sulfate soils are often found in the same soil profile, with actual acid sulfate soils generally overlying potential acid sulfate soil horizons.

Actual Acid Sulfate Soils

These are soils containing highly acidic (pH ” 4) soil horizons or layers resulting from the aeration of soil materials that are rich in sulfides, primarily iron sulfide. This oxidation produces hydrogen ions in excess of the sediments capacity to neutralise the acidity of the soil. These soils can usually be identified by the presence of pale yellow mottles and coatings of jarosite.

Potential Acid Sulfate Soils

These are soils which contain iron sulfide material which have not been exposed to air and oxidised. However they pose a considerable environmental risk when disturbed, as they will become severely acidic when exposed to air and oxidised. Exposure of acid sulfate soils to the atmosphere (lowering of the watertable or disturbance through dredging/excavation) has the potential to produce acid generating conditions that may adversely affect the local environment.

<u>Acid Sulfate Soils Management Techniques</u>

The Acid Sulfate Soils Planning Guidelines (1998) have a hierarchy of management techniques for dealing with ASS. These are listed as follows:

1. Avoid land where acid sulfate soils occur:

If the preliminary soil survey indicates that the site contains high levels of acid sulfate soils, the most environmentally responsible action may be to investigate alternative feasible sites that meet the operational needs of the applicant.

This principle applies equally when selecting routes for drains, roads or pipelines or for

individual sites for residential developments, infrastructure projects, agricultural enterprises or
quarries. In the case of quarries, dredging or other operations which have the potential to result in moving acid sulfate soils problems on to another site, the onsite mitigation measures prior to transport plus the cost of quality assurances programs will need to be factored into the project along with the costs associated with the liability for damages if acid is generated at the other site.

2. Avoid disturbing ASS if present on land

To develop effective avoidance strategies, a more detailed investigation is required to understand the soils, surface and sub-surface water characteristics on the site and the sensitivity of the surrounding environment.

In many cases, the site should be mapped indicating the depth to sulfide material and groundwater and the variation in the soil characteristics including the concentration of the sulfidic material. The advantage of an “avoidance” approach is that there is no ongoing mitigation required. Possible avoidance mitigation options include the following options:

- Undertake shallow soil disturbance so as not to disturb acid sulfate soils;
- Redesign existing drains so they are shallow and do not disturb acid sulfate soils;
- Avoid activities which result in the fluctuation of groundwater, in particular the lowering of groundwater;
- Cover acid sulfate soils with clean fill material so as not to disturb them;
- Set aside acid sulfate soil areas and not disturb them;
- Set aside highest sulfide areas and disturb only the lowest.

3. Prevent the oxidation of sulphide

Mitigation strategies to prevent oxidation depend on maintaining the sulfidic material in an aerobic environment. However, soils or soil layers with existing acidity from previous oxidation of sulfide (indicated by field pHF < 4.5) are more difficult to prevent further oxidation by denial of oxygen alone, as oxidation may proceed by electron transfer between compounds at different oxidation states. Usually some addition of a neutralising agent will also be necessary when acidity has already been produced.

If acid sulphate soils are encountered on site they can be safely disposed into the existing dredge ponds. Planning consents and Department of Environment and Climate Change approvals exist for this activity. Protocols are set out below.

4. Disposal of Potential Acid Sulfate Soils (PASS) underwater Operating Conditions

- Soil that has been assessed by a Certified Practicing Soil Scientist (CPSS) in accordance with the ASSMAC guidelines and determined to be PASS and

- The premises must receive documentation for each truck load of PASS received at the premises (see reporting conditions) that demonstrates that the excavation of PASS and its transport and handling was conducted in accordance with the NSW Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, August 1998) to prevent the generation of acid.

- PASS must be disposed of at least 1 metre below the permanent water table level at the premises.

- Any PASS received at the premises must be placed below the water table within 24 hours of the time of its excavation at the originating site.

PASS Limit Conditions

- Any PASS which has dried out, undergone any oxidation of sulfidic minerals or which has a pH of less than 5.5 must not be disposed-of at this premises.

- The pH of the PASS immediately prior to under-water disposal must be not less than 5.5.

- The pH of the water into which the PASS is placed must not be less than 6.0 at any time.

- If the pH of the water falls below 6.5 the licensee must not receive any more PASS at the premises until approval to continue is received in writing from the EPA.

PASS Monitoring Conditions

- The pH of each load of the PASS must be tested at the disposal site immediately prior to its placement under water using the test method referred to in NSW Acid Sulfate Soil Manual (Method 21A and/or Method 21Af).

- The pH of the water into which the PASS is placed must be monitored using the sampling method, unit of measure, and sampling frequency, specified in the table below:

- Pollutant Unit of measure Frequency Sampling method pH Special Frequency 1 Grab sample Special Frequency 1 is daily during the PASS placement into water and thereafter weekly for a period of six months from the date the last load of PASS was placed underwater.

- The Licensee must monitor the pH of up and down gradient ground waters at the premises at least once per every 3 months and for a minimum of 1 year after the last load of PASS has been disposed-of.