Gladstone Ports Corporation
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Appendix E

Appendix E – ASS Management Framework

GHD

Acid Sulfate Soil Management – Key Principles

1.1 Purpose and Objectives of the Framework

This framework for Acid Sulfate Soil (ASS) management has been developed to outline the key working principles for managing the Acid Sulfate Soil component of bund construction, dredging and filling of the reclamation area. This framework will form the basis of the Acid Sulfate Soils Management Plan (ASSMP) to be agreed with DERM and put in place prior to the start of construction.

The objectives of this framework are to:

- Outline the principles of ASS management for bund construction;
- Outline the principles of ASS management for dredging;
- Outline the principles of ASS management for the Reclamation Area; and
- Outline validation testing and monitoring for each of the above.

This management framework is based on the information presented in the Western Basin Dredging and Disposal Project Environmental Impact Statement (WB EIS) and in the WB EIS Supplementary Information Document.

The dredging methodology is included in Chapter 5 of the WB Supplementary Information Document.

1.2 Key ASS Management Principles for Bund Construction

The key ASS management principles for bund construction are:

- Excavation of unconsolidated materials forming the mud wave on the seaward side (outside) of the rock bund, as the bund is advanced, to a level such that the majority of the remaining sediments are inundated with each tidal cycle. Where the sediments are not naturally inundated each tidal cycle (likely to occur to the west of the western bund) and where there is a proven potential for that material to acidify, unconsolidated sediment that has been displaced by bund construction will be excavated back to the pre-construction sediment surface level.
- Re-distribution of unconsolidated mud wave material formed on the inside of the rock bund, as the bund is advanced, such that the displaced sediments continue to remain permanently under water or continue to be inundated by the tide on a daily basis as per pre-construction conditions. Where the sediments are not naturally inundated each tidal cycle (such as in the west of the area), unconsolidated sediment will be excavated back to the pre-construction sediment surface level.
- Placement of the excavated unconsolidated material permanently under water within the Reclamation Area, for material where exposure time to the atmosphere has not exceeded the stockpiling guideline limits in *Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines* (Dear and others 2002).
- If necessary, neutralisation treatment of excavated unconsolidated sediments (achieved by mixing with lime), followed by verification sampling and testing, prior to placement within the Reclamation Area.

1.3 Key ASS Management Principles for Dredging

The key ASS management principles for dredging are:

- Confirmation of the delineation and quantification of Potential Acid Sulfate Soils (PASS) sediments within the dredge footprint, prior to dredging.
- Confirmation of the delineation of non-PASS sediments within the dredge footprint, prior to dredging.
- Minimisation of rehandling of sediments identified as containing potential or actual acidity above the action criteria, to reduce the potential of dispersal of sulfide fines.
- No dredging of Actual Acid Sulfate Soil (AASS), if identified. Based on the data presented for the WB EIS, AASS is not anticipated within the dredge footprint.

1.4 Key ASS Management Principles for the Reclamation Area

1.4.1 Overview of ASS within the Dredge Footprint

The sediments within the dredge footprint that reported a net acidity (i.e. >=18 mol H^+/tonne) typically comprise soft silt/clay materials (i.e. Holocene-age marine mud). These sediments have been identified within each of the dredge stages, with net acidity typically in the range 200 to 500 mol H^+/tonne. Sediments that reported levels of oxidisable sulfur above the action criteria of 0.03%S, but with net acidity <18 mol H+/tonne and variable amounts of ANC, include combinations of silty/clayey sands/gravels and sandy silt/clay materials. Values of oxidisable sulfur typically range from 0.05% up to 0.8%S for these sediments.

1.4.2 General Spoil Management

Dredge spoil will be managed by placement into a series of interconnected reclamation cells with adjustable weirs (as required), for flexible management of the dredge spoil and PASS. Placement of non-PASS dredge spoil against the inner face of the rock bund wall can be carried out to create a 'seal' against the geotextile. This will also help to minimise water level fluctuations within the reclamation cells as a result of tidal fluctuations both during reclamation filling and at completion. This will also minimise fines migration out of the bund. During filling of the Reclamation Area, water level control within each cell will also be afforded by the adjustable weirs.

1.4.3 Actual Acid Sulfate Soil (AASS)

- No placement of AASS into the Reclamation Area will occur without prior neutralisation treatment (for example, by thorough mixing with lime).
- Verification testing to confirm successful treatment of AASS will occur prior to placement in the Reclamation Area.

1.4.4 Dredge Spoil Containing Potential Acid Sulfate Soil with Reported Net Acidity

- Strategic burial (sub-aqueous placement) of sediments, identified as having a net acidity >=18 mol H^+/tonne, up to a level not exceeding mean seal level (level to be agreed with DERM prior to the start of dredging) will be required This will ensure saturation and will minimise contact with oxygen in the short-term (during reclamation) and long term (cell completion).

- Saturation of the sediment throughout the placement process will be maintained. This could be achieved by discharge of sediment from multiple, moveable, discharge points, redistribution of any sediment to below the surface water level if beaching occurs and maintenance of a water level above the top of the placed sediment within the reclamation cell during placement through use of the adjustable weirs.
- No sediments identified as having a net acidity >=18 mol H^+/tonne will be placed into the Reclamation Area above mean sea level without neutralisation treatment.
- Sediments will be tested to asses the potential effectiveness of the proposed neutralisation treatment method of injecting lime slurry into the dredge spoil stream (see Section 1.5).
- Should the PASS sediment show signs of drying, a management method appropriate to the planned spoil placement strategy for the cell will be employed. This could be either neutralising any acid that may be produced (such as by application of lime to the sediment surface), or preventing drying by hydration of the sediments with seawater.
- Buried PASS will be capped by non-ASS material (likely to be sourced from dredge spoil) in order to exclude oxygen and to promote the formation of a permanent water table above the level of the top of the placed PASS. The cap is also intended to provide a stable layer on which further dredge spoil can be placed. The geotechnical properties of the PASS to be capped will be considered to ensure that the PASS remains saturated and oxygen excluded.
- Appropriate siltation and erosion control will be used during reclamation and following reclamation cell completion.

1.4.5 Dredge Spoil Containing Potential Acid Sulfate Soil with no Reported Net Acidity

- Sediments identified as having an oxidisable sulfur acidity of >=18 mol H^+/tonne, but with an ANC 1.5 to 3 times the level of oxidisable sulfur, will be placed below mean sea level if there is available capacity within the Reclamation Area.
- Alternatively, if there is no spare capacity below mean sea level, these sediments will be placed above mean sea level with the appropriate level of neutralisation treatment (if further testing indicates that treatment is required). This will be done using a suitable treatment methodology, determined by review of existing ASS test results and any further tests conducted prior to final placement to confirm their acid generating potential.
- Sediments identified as having an oxidisable sulfur acidity of >=18 mol H^+/tonne, with an ANC more than 3 times the level of oxidisable sulphur, will be placed above mean sea level with the appropriate level of neutralisation treatment (if further testing indicates that treatment is required). Determination of treatment will be done by the review of existing ASS test results and any further testing, conducted prior to final placement, to confirm their acid generating potential (see Section 1.5).
- Mixing of sediments in the reclamation cell will be promoted to maximise the potential for shell fragments to settle with sulfides, and to minimise the potential for the formation of pockets of sulfides without, or with limited, ANC. This could be achieved by the strategic location of multiple discharge points to the reclamation cell.
- Appropriate siltation and erosion controls will be used during reclamation and following reclamation cell completion.

1.4.6 Neutralisation Treatment of Dredge Spoil

- Co-deposition of dredge spoil and lime slurry will be considered by injection of the slurry into the dredge stream at a concentration and rate that will achieve a factor of safety of 1.5 in the placed sediment (see Section 1.5). The lime slurry would be pre-mixed and stored in a tank, to be maintained at the required concentration through regular addition of lime and water.
- Any neutralised sediment will undergo verification testing to confirm that treatment has been successful.

1.5 Further Sediment Testing

Further testing will reduce the risk of uncertainty surrounding successful neutralisation of any acid generated as a result of oxidisation of sulfides, such as to assess the effectiveness of injecting lime slurry into the dredge stream to neutralise acid and the effectiveness of reliance on ANC to neutralise acid. For example:

- Laboratory testing to assess sediment settlement rates and identification of the grade (particle size) of lime required for the slurry that will settle at the same rate as the materials requiring neutralisation.
- Laboratory testing to assess the effectiveness of the lime slurry injection treatment method by verification testing of the neutralised sediment and leachate.
- Laboratory testing of PASS sediments for a range of oxidisable sulfur acidity levels, ANC and material type to confirm their self-neutralising potential. If the results show that acid is not generated from these sediments (i.e. no net acidity and leachate pH no lower than 5.5) then the sediment could be placed above mean sea level without neutralisation treatment.
- On-site pilot tests may also be conducted, particularly for lime slurry injection into the dredge stream, if it is considered beneficial to assessing the risk based on the outcome of the laboratory tests.

1.6 Verification Testing and Monitoring

During Cell Reclamation

- Visual monitoring of sediment will be carried out on a regular basis at discharge points to confirm material types are as expected, and to identify and report any potential concerns.
- ASS field-testing of sediment (pH_F and pH_{FOX}) will be completed on-site as sediment is discharged to the reclamation cell (to be placed above the permanent water table) as an additional level of control and knowledge of the levels of oxidisable sulfur in the reclamation cell. Testing per volume of sediment will be commensurate to the level of risk posed by initial levels of sulfides, ANC in the sediments and/or treatment methodology.
- The pH of water ponded within reclamation cells and at the discharge of the Reclamation Area will be monitored on a daily basis, with the provision to adjust the pH to maintain a water pH between 6.5 and 8.5 within reclamation cells and to maintain a water pH between 8 and 8.4 in the area leading up to the discharge point, by the addition of hydrated lime.

For Completed cells

- The sediment in completed cells will be verification tested (for example by conducting SPOCAS testing) to demonstrate effective neutralisation of acid, whereby the net acidity of the sediment is less

than the Action Criteria (18 mol H^+/tonne). Sampling is likely to be conducted using a drill rig. Testing per volume of sediment will be commensurate to level of risk posed by initial levels of sulfides, ANC in the sediments and/or treatment methodology. The frequency of verification testing will be in the range 1 test per 1,000 m^3 to 1 test per 10,000 m^3.

- The pH of the water in selected drains within the Reclamation Area will be monitored on a daily basis, with the provision to add hydrated lime to maintain a water pH between 6.5 and 8.5, if the pH drops below 6.5.
- The pH of the water prior to reaching the final discharge point from the Reclamation Area will be monitored on a daily basis, with the provision to add hydrated lime to maintain a water pH between 8 and 8.4 if the pH drops below 8.
- There will be provision for neutralisation treatment of sediments, if sediments fail the verification testing. This may be excavation followed by lime neutralisation, or lime injection into the placed sediment.
- Groundwater monitoring bores will be installed for early detection of acid generation through water quality testing (including pH and electrical conductivity, with provision to test for additional analytes such as heavy metals if groundwater is found to be acidic) and to confirm groundwater water levels.