5.1 Existing conditions

The proposed mining areas are located on the northern side of Melville Island, on the low-lying coastal dune system, which rises to only a few metres above sea level. Topographic sections are illustrated in Figure 7.2 and 7.3.

The coastal dune systems within and surrounding the proposed mineral sands mining areas comprise a sequence of shore-parallel beach ridges and shore-parallel sand spits (cheniers), locally modified by tidal creeks and drainage channels that drain the hinterland plateau.

5.1.1 Soil types

The beach ridge and chenier land unit, as described by Hollingsworth (2003) comprises predominantly silicious sands with some calcareous sands (Forsci 1999).

Drainage is described as moderate, and there are limitations imposed on development by the potential for flooding. The soils of the mining areas are described as highly leached, nutritionally poor sands with a minor humic surface horizon (the topsoil). Nutrients and moisture-holding capacity are both concentrated in the topsoil. The erosion potential for the mining areas is low to moderate. The soils of the drainage channels and basins are described as peaty organic loams (Hollingsworth 2003).

Hollingsworth (2003) describes the forest and woodland soils as dominantly Kandosols (soils with a gradual texture increase with depth that are not saturated for prolonged periods). At the lowest level of the Australian Soil Classification system, 182 different soil families were identified for forest and woodland areas. These were reduced to seventeen soil families and are described in the Land Capability Study of the Tiwi Islands Hollingsworth (2003). Generally speaking, the soils that dominate the *Eucalyptus* dominated plateau are described by Woinarski (2003a) as red sandy earths to sandy loams.

5.1.2 Tailings Size Analysis

The tailings size analysis of the mine tailings (refer to Table 5.1) shows the tailings to be comprised primarily of medium and fine-grained sand with only a very small proportion (less than 0.5% by weight) classified as very fine sand (Udden-Wentworth classification). Direct replacement of the sand tailings after removal of the mineral sands, without further treatment, will not impact on the groundwater.

Table 5.1: Tailings size analysis - Andranangoo

Size (microns)	Weight retained (g)	% Weight retained	Cumulative % weight retained
500	2.76	1.38	1.38
300	31.55	15.82	17.20
250	40.16	20.13	37.33
212	41.98	21.05	58.38
150	72.46	36.33	94.71
106	9.54	4.78	99.49
90	0.57	0.29	99.78
75	0.15	0.08	99.86
63	0.1	0.05	99.91
-63	0.19	0.09	100
Total	**199.46**	**100**	

5.1.3 Acid sulphate soils

Investigations to assess the presence of acid sulphate soils (ASS) have been undertaken at Andranangoo. Investigations into the presence of ASS at Lethbridge will be undertaken as part of more detailed site work prior to mining being undertaken. However, it is expected that the results for Lethbridge will be similar to those obtained for Andranangoo. The investigations comprised taking soil samples, and analysing the samples by a standard method to determine ASS potential of the soils.

Soil samples were taken using a spilt-spoon, hand auger sampler at four locations, three near existing production bores and one at Goose Lake, located approximately 500 m due south of monitoring bore MM4 (Figure 2.4). Samples were taken at 0.25 m intervals to a depth of approximately 3 m, bagged and preserved by freezing. On-site field tests were not undertaken due to unavailability of hydrogen peroxide. Selective samples below the water table were sent to ALS laboratories for potential ASS testing. Table 5.2 summarises the samples collected and presents results.

The analytical results are presented in full in Appendix B. For all samples, the sulphate trail was below the limits of recording (less than <0.02 % sulphur), which indicated that the samples were not likely to be acid forming. This is also supported by low sulphate levels (less than 2 mg/L) in all bores sampled. It is possible, however, that acid generating environments may exist near wetlands. Further analysis would be undertaken when access to these areas is available, prior to mining.

Table 5.2 Potential Acid Sulphate Soil Testing – Andranangoo

	MM4	Site 1(P)	Site 4(P)	Site 7(P)	Goose Lake
Sample Interval, mbgl	2.25-2.50	2.25-2.50	2.50-2.75	2.75-3.00	1.75-2.00
Sample Type	Sand	Sand	Sand	Sand	Sand
Sulphate trail result	<0.02	<0.02	<0.02	<0.02	<0.02

mbgl = metres below ground level

5.2 Objectives and standards

The post-mining objectives for physical environment are to:

- Return the topography and landform to pre-mining condition, consistent with obtaining a stable profile for rehabilitation, recognising that there will be a loss of approximately 150 mm from the topographic profile due to the extraction of the mineral sands;
- Replace the soil layers, comprising mine tailings and topsoil, in the original sequence, such that the land is capable of supporting the pre-mining flora and fauna occurring naturally in this area; and
- Where it is not possible to achieve successful rehabilitation by reinstating the pre-mining landform, for example, where slopes are too steep for revegetation, re-contouring works will be undertaken that are compatible with the surrounding landscape.

5.3 Definition of issues and impacts

In order to access the mineral sands it will be necessary to strip off the vegetation and topsoil. The vegetation and a minimum scraping of 50 mm top soil will be pushed separately to one side (Figure 2.2) for later spreading and use as a brush cover and seed bank in the site rehabilitation. Organic or fibrous material screened by the trommel will also be separated out and stockpiled for later respreading for rehabilitation purposes.

The soil layers containing the mineral sands will then be extracted and the minerals recovered by physical separation methods. This will have a significant localised impact on the existing topography, landform and soils during mining, but a minor impact post-mining following the implementation of the Rehabilitation and Mine Closure Plan (RMCP).

The pre-mining landform will be extensively altered during mining, but will be reconstructed as part of the rehabilitation program. The net reduction of approximately 150 mm in the elevation of the original surface level will have a minor impact on the landscape, but this difference is unlikely to be detectable

once the land has been revegetated. There will also be a minor increase in the potential for inland penetration of storm surge. This is discussed further below.

The clearing and stockpiling of the soil may result in loss of soil structure and potentially loss of stored nutrients, and also loss of viability of seeds contained within the organic horizon. This may have implications for post-mining rehabilitation.

5.4 Management

The management of physical impacts on topographic, landform and soils of the proposed mined areas is addressed in the RMCP, which is described in Section 21. In order to reconstruct the mined areas, the excavated sand tailings will be dewatered and replaced in the mined areas (refer Figure 2.2). The tailings will be reshaped so as to re-create the original ridge and swale formation.

As there will be a net loss of topographic elevation of approximately 150 mm as a result of the extraction of the mineral sands and replacement of the soils, there will need to be minor contouring of the surface profile along the edge of the mined areas. The angles of the slopes will be such that the reshaped contours are compatible with the surrounding landform, and such that erosion will be minimised and rehabilitation will be successfully achieved.

Cleared and stockpiled topsoil containing material will then be replaced over the shaped surface. The topsoiled areas will then be covered with stockpiled cleared vegetation. Organic or fibrous material screened out by the trommel during site clearing will also be re-spread.

Rehabilitation works will be undertaken progressively in order to limit the amount of time that topsoils are stockpiled. Reinstatement of soil ideally occurs within one season to facilitate germination of seed stored in the topsoil (Metcalfe 2005a); this will be readily achieved for the project.

Over-compaction of the soil, particularly the topsoil, will be avoided. In the event that excess compaction occurs the topsoil will be ripped to loosen the surface prior to reseeding and the placement of brush.

5.5 Commitments

Matilda commits to restoring disturbed areas back to the original landform contours, where possible. Where this is not possible, the reshaped contours will be compatible with the surrounding landform (Section 5.2).

Matilda commits to investigating the possible presence of ASS at Lethbridge as part of more detailed site work prior to mining being undertaken. In addition, further analysis for the presence of ASS soils would be undertaken near any wetlands, when access to these areas is available, prior to mining in these areas (Section 5.1.3).

Rehabilitation commitments are discussed further in Section 21 – Rehabilitation and mine closure.