Lake Mackenzie lunettes restoration plan

Prepared by Anita Wild

Wild Ecology Pty Ltd

Current Situation

Hydro Tasmania (HT) seeks to reduce the degree and extent of active erosion and promote natural regeneration on a shoreline at Lake Mackenzie that has considerable Aboriginal cultural heritage values. The location is recognised by the Aboriginal community as a significant site who are seeking to incorporate knowledge gained from many successful past coastal erosion projects to treat the site, whilst also incorporating specialist alpine restoration techniques that are proven to work in the area.

This restoration plan will review existing data and consider risks and constraints of the site and potential mitigation measures for impacts on natural and cultural values and prescribe the treatments for the areas.

Background

Aboriginal Heritage Assessment of the Lake Mackenzie environs was undertaken for Hydro Tasmania's Mersey Forth Water Management Review in 2013 that aimed to review water and land management activities within the hydro-electric catchment. The Aboriginal Heritage Assessment included collating current knowledge and gathering data on Aboriginal heritage values within the catchment, and consulting with key stakeholders including the Aboriginal Community in relation to managing those values and an extensive field survey.

This assessment found that whilst all the surveyed sites are subject to deflation and remobilisation by water during operational periods due to the historically increased (and now fluctuating) water levels, two sites (AH 11828 and 11842) were considered candidates for active management and protection (Entura 2013).

Aboriginal Heritage Site (AH 11828) noted on the eastern shore of Lake Mackenzie is of medium to high significance, likely to retain a high degree of fidelity in onshore areas and contribute to a better knowledge of regional patterning of artefacts. Overall, the site is of potential scientific interest above medium.

Subsequent monitoring using three-dimensional laser scanning at AH 11828 as demonstrated that active erosion of the area is still occurring, and that restoration works could result in a reduction of artefact re-location due to ongoing deflation of the dune areas from wave action. These patterns of wave erosion correspond to periods of high-water levels and the relatively higher spring winds that will result in long wind fetch from the full lake (Figure 3). Additional field observations in 2023 indicate that erosion processes also include frost heave and seepage erosion of the toe of the dunes (Figure 1) and that even the lightly armoured shoreline displays wave action impacts (Figure 2) and gully erosion of drainage channels (survey data).

The alpine lunettes and depositional sand sheets are also of scientific significance. These features were formed from wind-blown glacial outwash and deposits such as dolerite fragments after the last glaciation up to 7000YBP; this period had a drier and cooler climate than present. On the Central Plateau, lunettes or small sand dunes and sand sheet deposits formed on the margins of the lakes and include examples at Lake Ada, Lake Augusta, Lake Crescent, Lagoon of Islands and Little Lake. These Tasmanian features are the only known alpine lunettes in Australia and, together with the glacial landforms, are significant geoconservation features.

Figure 1 Frost heave erosion on the toe of the fore dune escarpment

Figure 2 Lightly-armoured shoreline susceptible to wave action, possibly amplified by ramping of wave energy.

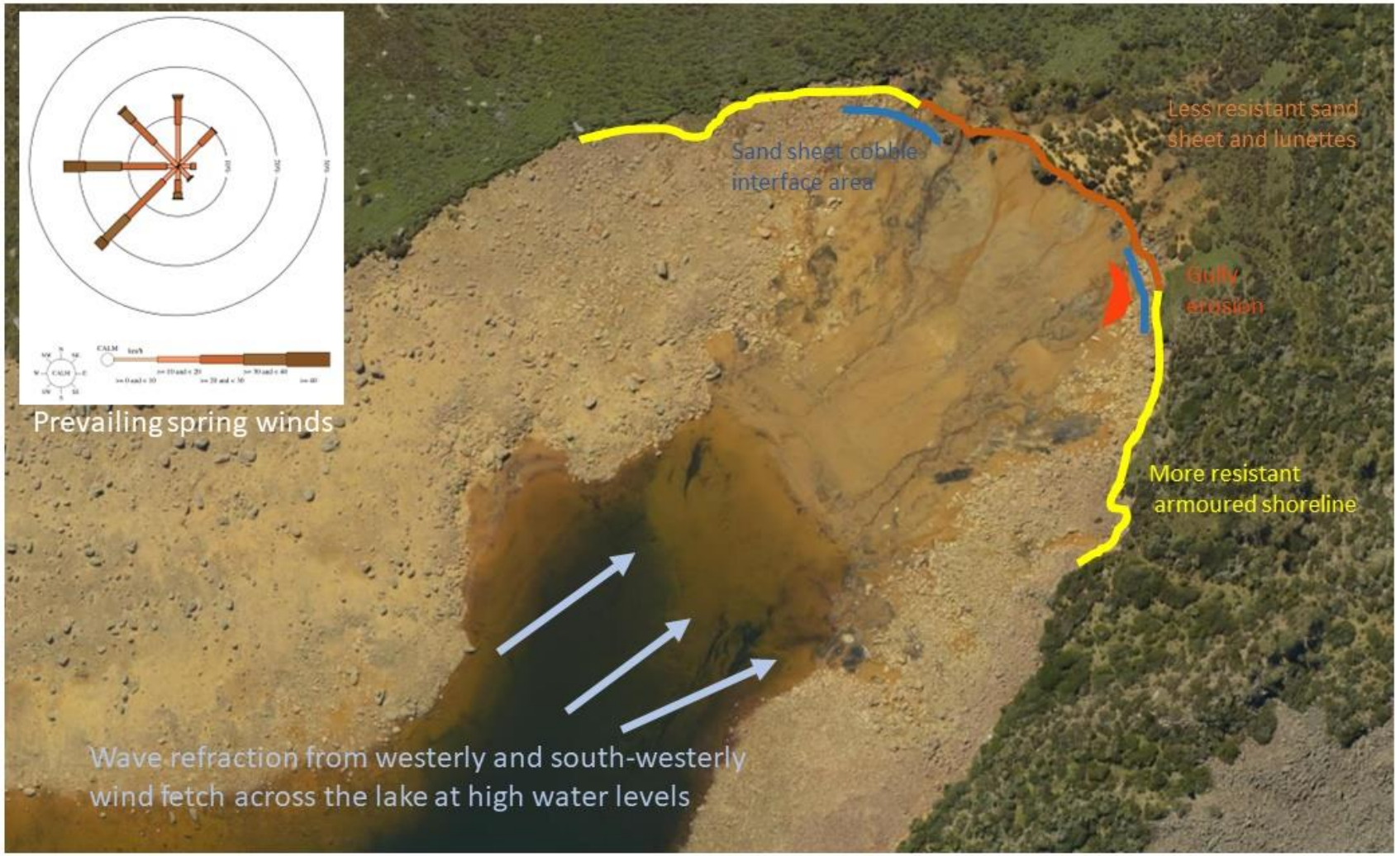

Figure 3 Patterns of wave deflection, prevailing winds and erosion potential of the shorelines in the study area.

Hydrology: rainfall and lake levels at Lake Mackenzie

Rainfall data from the Dam at Lake Mackenzie (station 629.1) and observations of flood debris and scour on drainage lines provide evidence of high daily total (>40mm) rainfall events over the erosion study period, two very high (>80mm) events in January 2022 and November 2022 and an extreme rainfall event of 281mm on 20 October 2022 (Figure 4). Total rainfall was above the 50-year mean in both 2021 and 2022 and was characterised by *La nina* conditions throughout Tasmania.

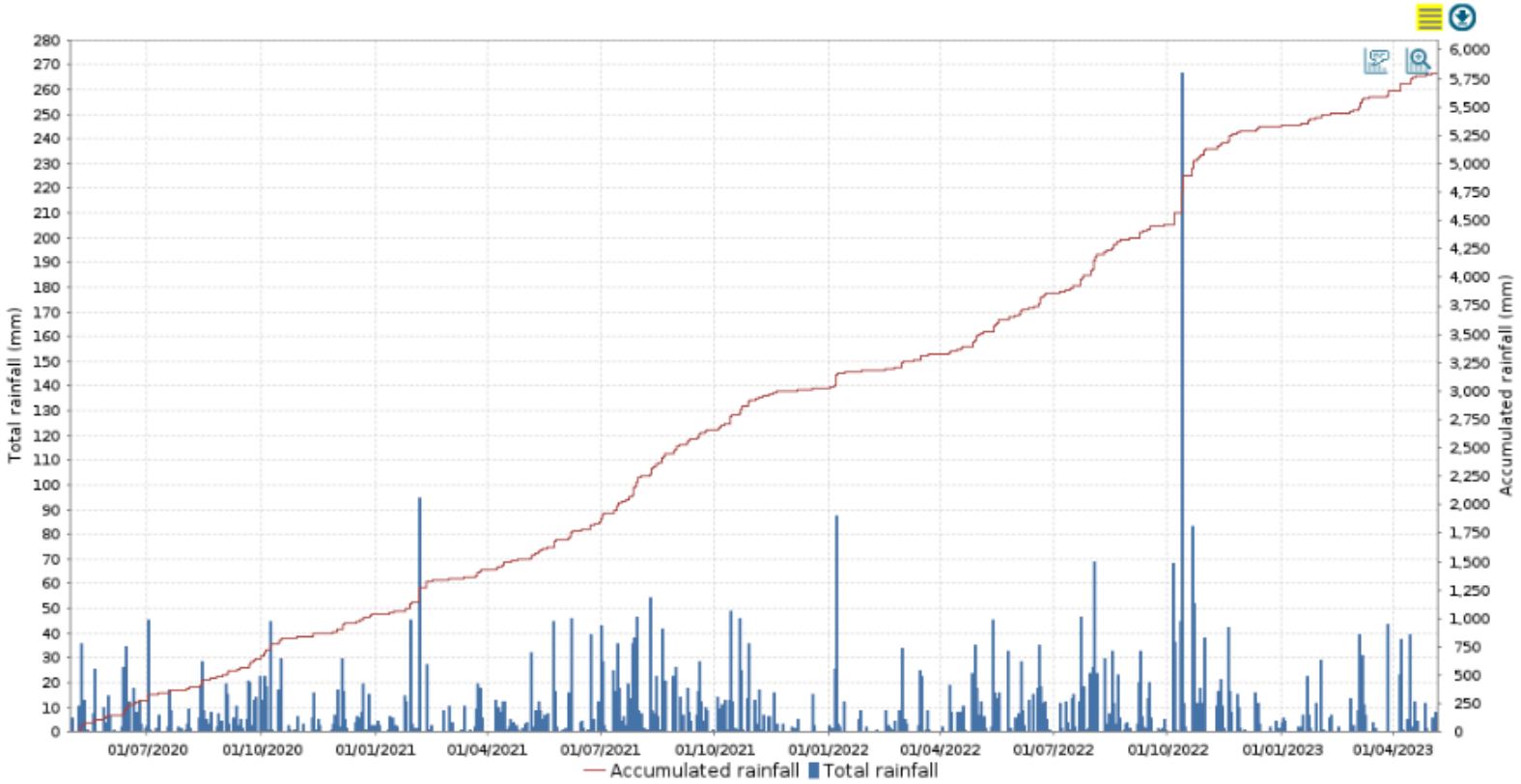

Figure 4 Rainfall daily totals and annual accumulation rainfall for Lake Mackenzie at Dam (Station 629.1) for 1/4/2020 to 04/07/2023. Data: BOM.

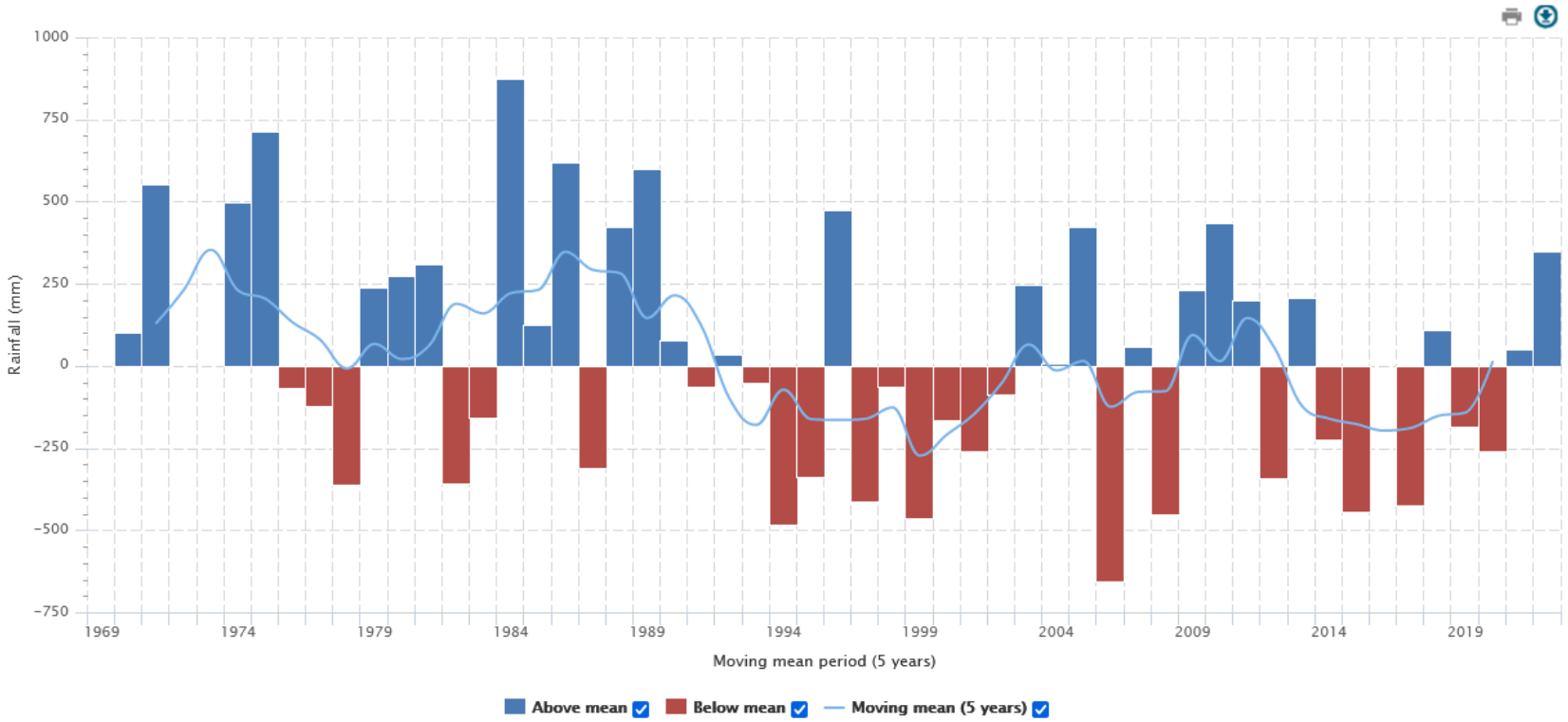

Figure 5 Difference from mean analysis (1970 to July 2023) and five-year running mean for rainfall at Lake Mackenzie Dam (station 629). Data: BOM

Lake levels over this time generally reflected the above long-term average conditions with the storage being at FSL for long durations, particularly over winter and spring (Figure 6 and Figure 7; duration data not presented).

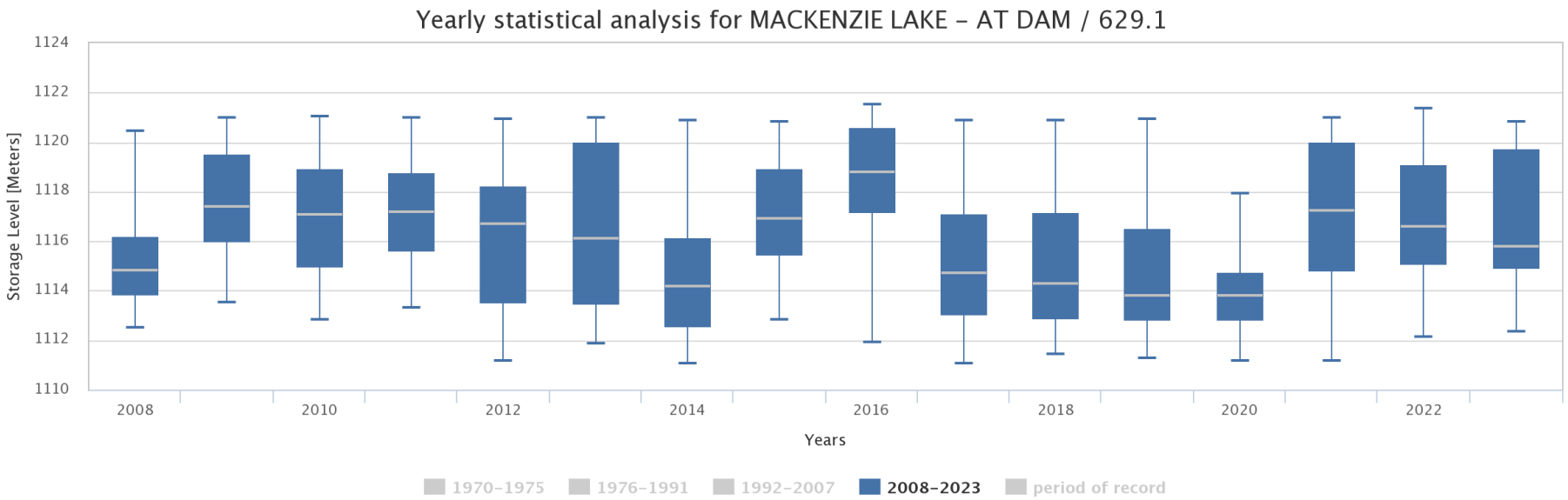

Figure 6 Box plots showing minimum, 25th percentile, median (grey line), 75th percentile and maximum annual storage levels at Lake Mackenzie from 2008 to 2023. Data: BOM.

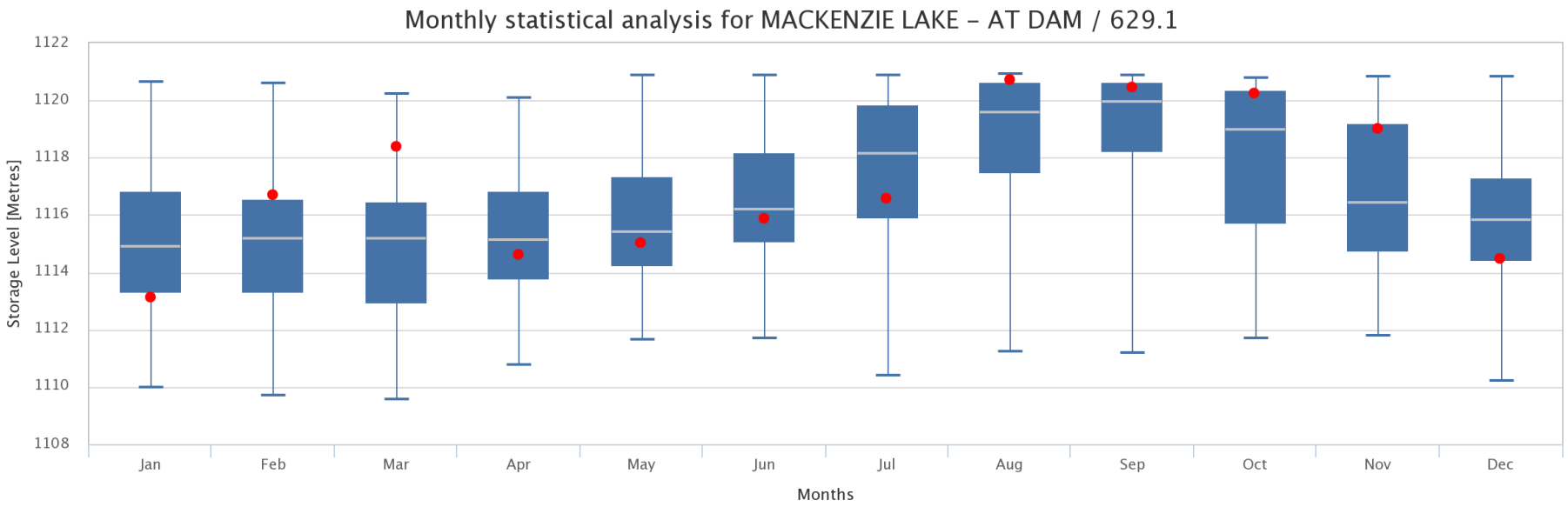

Figure 7 Box plots showing minimum, 25th percentile, median (grey line), 75th percentile and maximum storage levels at Lake Mackenzie monthly storage level pattern for 2021. Data: BOM

Wind patterns: speed and direction

Stronger (higher speed) spring and winter winds are a regular pattern in Tasmanian and are also reflected in alpine areas (Figure 8) and coincide with winter low pressure systems and cold fronts that bring much of the rainfall. These strong westerly winds also occur when Lake Mackenzie is generally at its peak water levels, thus impacts on the eastern shoreline are greatest at this time.

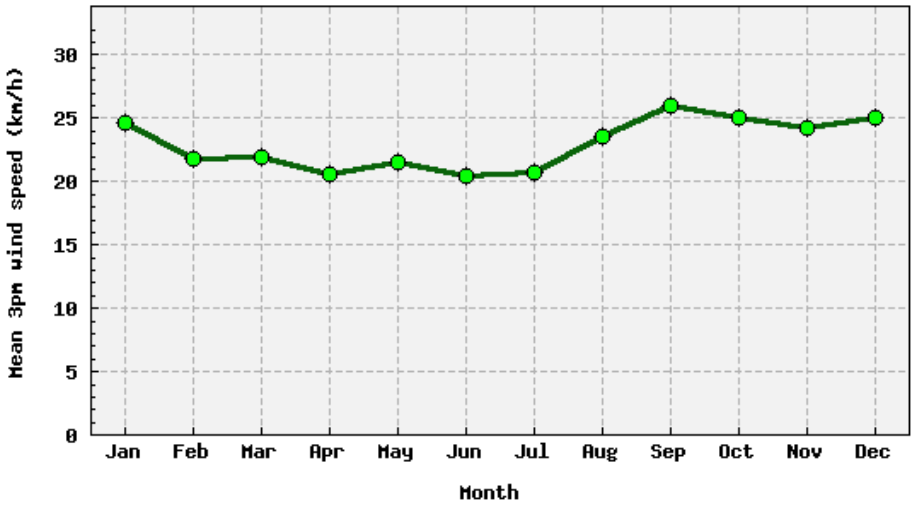

Figure 8 Plot of long-term average monthly 3pm wind speed at Liawenee BOM station.

Restoration principles for Aboriginal Cultural Sites

The proposed restoration area is a well-documented and valuable cultural heritage site, as such, restoration activities need to be undertaken in a sensitive manner to reduce potential impacts on artefacts and landscape cultural values. These principles have been developed by Caleb Pedder and TALSC (sic) following restoration project implementation on Tasmania's west coast and adopted from other works on sensitive vegetation communities (Wild 2023).

These principles include:

- Identifying the extent of the physical/tangible values (i.e. artefacts) and other values (i.e. landscapes) at the site
- Understanding potential impacts from off-site works that may affect values (i.e. changes in hydrology, wind patterns, wave deflection etc.0
- Plan the works to avoid direct impacts on the sites if possible
- Use bio-degradable materials where possible
- If non-biodegradable materials are used, have a removal plan AND budget to remove them once restoration activities are completed
- Undertake photo-monitoring of sites for future evaluation and assessment
- Undertake routine maintenance and monitoring of restoration treatments and be prepared for some maintenance activities
- Include "event-based" monitoring to check treatments following disturbances such as extreme rainfall events and bushfire.

Aboriginal Heritage site AH 11828 is considered a priority for management intervention to protect the onshore deposits from further erosion and disturbance.

Periods of high inflows and subsequent high lake levels generally occur seasonally and coincide with the winter/spring peak of high winds. This coincidence will result in greater impacts from wave wash on the lunettes.

High frequencies of rapid water level drawdowns will also result in increased seepage erosion of the front dunes as infiltrated groundwater exits the lunettes.

Restoration planning must incorporate restoration principles for Aboriginal Cultural Sites to ensure the best outcomes.

Proposed activities and rehabilitation techniques

Restoration activities on, and near, the lunettes should aim to reduce the erosive energy of waves on the dune faces seepage erosion and frost heave and potential solifluction on the dune toes and gully erosion of drainage lines on the outwash area Restoration treatments will incorporate three techniques: tea tree fencing between 1-1.5m out from the (existing) dune face to reduce wave action (Figure 9 and Figure 10), potentially small coir logs on the dune face to reduce seepage erosion and frost heave (Figure 11, although see discussion below) and small rolled coir weirs to reduce gully erosion and the formation of head cuts (Figure 12).

Figure 9 Vertical scrub fence protecting a coastal dune from further impacts on Tasmania's west coast (Photograph: Caleb Pedder)

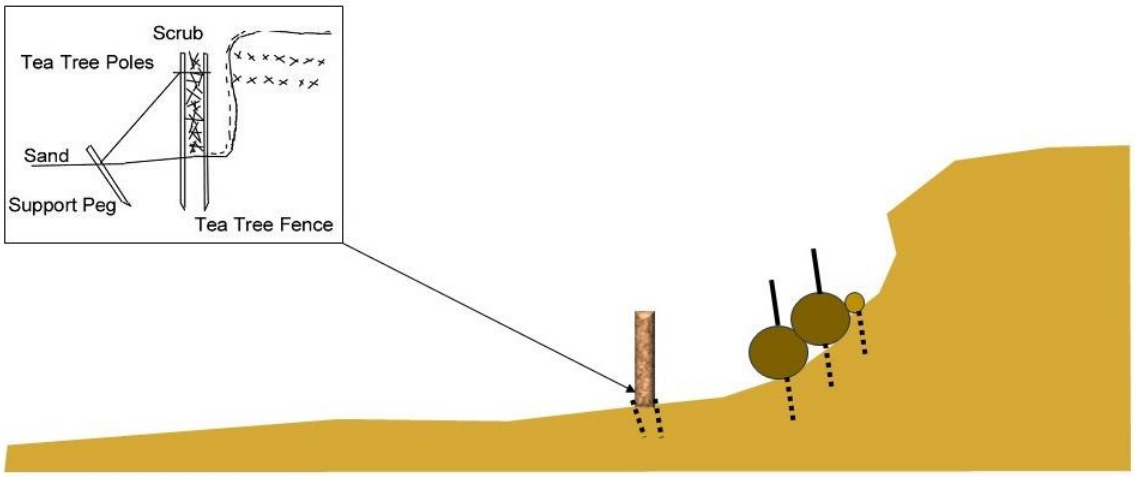

Figure 10 Diagram of proposed tea tree fence used to protect dune face (tea tree fence diagram from Pedder 2009) and large and small coir logs at dune toe.

Figure 11 Small coir logs reducing frost heave and supporting a deflated pool at Pine Marsh Bay, Lake Mackenzie

Figure 12 Small coir logs acting as weirs to slow overland flow in area of gully erosion at Ritters Plain, Lack Mackenzie. This is the proposed treatment for the gully erosion on the lake bed adjacent to the dunes.

Due to the high intensity and erosive potential of the waves from the long wind-fetch distance at Lake Mackenzie, it is likely that heavy-duty coir logs would perform better on the dune toes. These logs are used extensively in coastal areas, including those with wave action and should be considered in this treatment, therefore costs are also included in this plan and it is recommended that an engineering assessment is done prior to installation.

Figure 13 Large pre-formed coir logs that should be considered for the dune face at Lake Mackenzie

Recommended restoration treatments include tea tree fencing that has been used on coastal areas in Tasmania and small coir logs that have been used on land and small drainage lines at Lake Mackenzie.

Due to the high wave energy action, it is recommended that robust and larger pre-made coir logs are considered for the dune toe treatment. This treatment should increase the longevity of the treatments and reduce the risk of remobilisation of 'logs' due to wave action.

This treatment should be further assessed for engineering by HT regional engineering staff.

References

Entura (2013) *Mersey Forth Aboriginal Heritage Assessment: Lake Mackenzie Aboriginal sites survey.* Report prepared for Hydro Tasmania. Entura Cambridge, Tasmania.

Pedder, C (2009) *Protecting and Preserving Coastal Aboriginal Heritage Sites*. Report prepared for Tasmanian Aboriginal Land and Sea Council by Caleb Pedder, Aboriginal Heritage Officer.

Pharo, E (1990) *Plant dynamics on Alpine sand dunes, Central Plateau, Tasmania*. Unpublished B.Sc. Honours Thesis, University of Tasmania, Hobart

Wild, AS and Wahren C-H (2023) *Post-fire restoration techniques for alpine soils in Tasmania: Lake Mackenzie Field Trials 2020-2023*. Unpublished report for the Department of Natural Resources and Environment prepared by Wild Ecology Pty Ltd, Hobart.