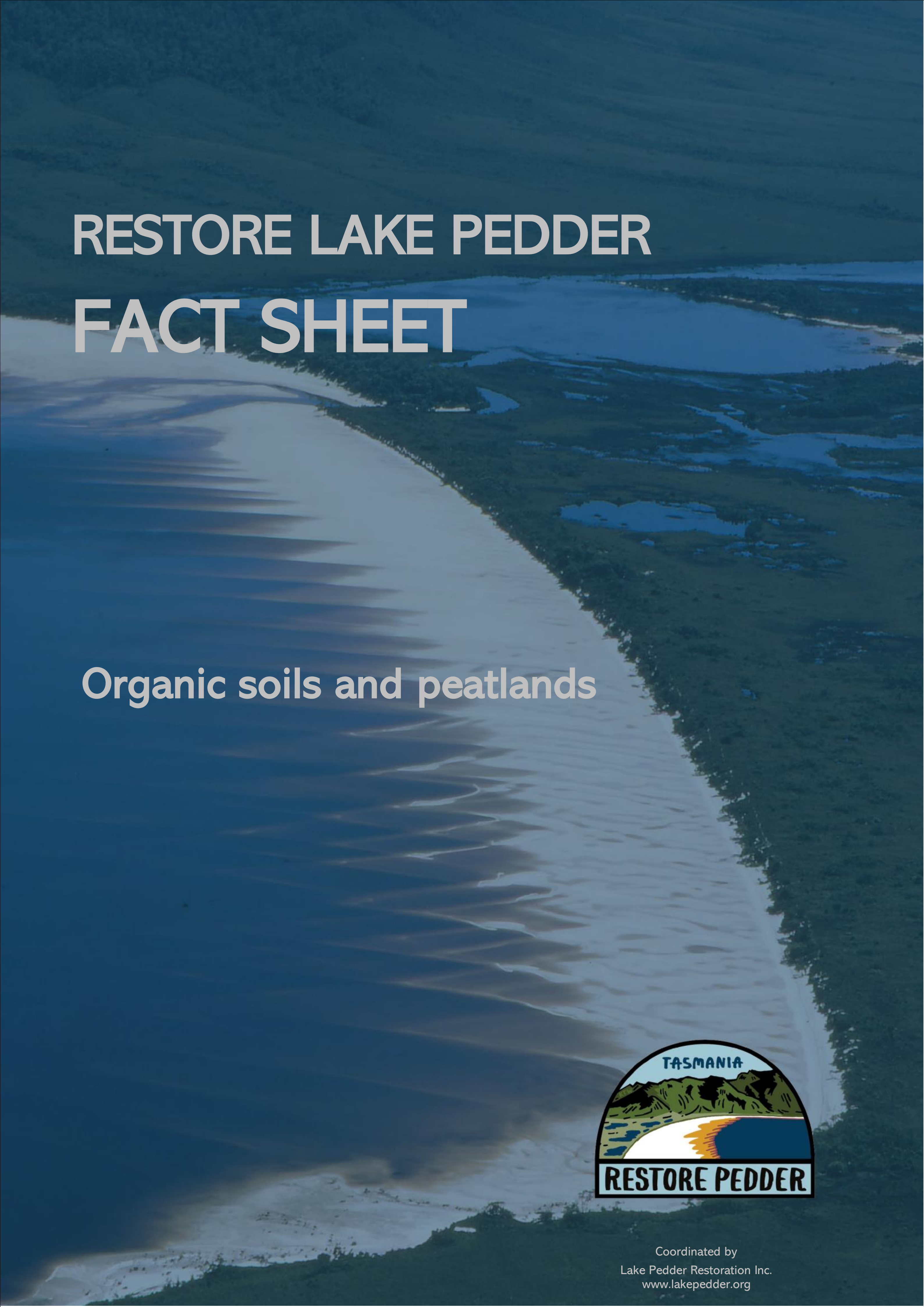

RESTORE LAKE PEDDER

FACT SHEET

Organic soils and peatlands

TASMANIA
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The soils and physical features of Lake Pedder are believed to remain physically intact with soils and vegetation remnants still visible under the tannin-stained waters. Except for a thin cover of sediment of approximately 2-3cm, the lake itself is likely to display most original physical characteristics within a relatively short timeframe of years, chemical and biotic changes will take longer.

Initial draining of the reservoir will expose large areas of mostly organic soils that will remain relatively unstable, friable and highly erodible until covered by vegetation. The peat formation processes will only reinstate if climatic conditions allow and will follow vegetation re-establishment.

Much of the sediment from eroded soils will initially enter creeks and drainages that feed into the Huon and Serpentine Rivers, but some will enter Lake Pedder, altering its turbidity and nutrient levels. How long the organic soils remain susceptible to erosion will depend on the how quickly vegetation regenerates to provide cover.

Following dewatering, the hydrology of Lake Pedder will likely be similar to what it was prior to the creation of the reservoir; although geomorphological and runoff processes and rates will initially differ until vegetation cover establishes.

The rate and characteristics of the revegetation will depend on soil conditions and climatic trends, which may favour either the original peatland vegetation or vegetation more typical of drier sites.

Perhaps the most significant consequence and influence on the organic soils relates to the risk of wildfire in the interim stages of restoration when the bare peat is exposed. Over the past couple of decades the frequency and size of wildfires in Tasmania have increased markedly; a trend that is highly likely to continue over the coming decades.

The risk of wildfire *in the interim restoration stages* poses the largest anticipated threat to restoration of Lake Pedder because if the organic soils are removed, the natural regeneration potential of vegetation communities and peatland processes that retain water and nutrients will be significantly slowed and reduced.

Organic soils and peatlands

The submerged substrates of the reservoir are soils rich in organic matter and peat. These organic soils remain largely physically intact and because they are generally quite acidic and within cool, dark water conditions the organic components are likely to be decomposing slowly. These characteristics are supported by observations (in 1993, 1996 and 2000) which have shown some intact original vegetation debris and soils surfaces. These findings are supported by other studies elsewhere in the world, such as in the Black Sea and Lake Grosse, an acidic bog-lake in Germany where soils have also remained physically intact.

Dark, bare peat in a dried pool four years after wildfire Image: Anita Wild

The organic soils of the lakebed remain largely intact and ready for revegetation. In the five decades since the flooding of Lake Pedder, the reservoir's water level has been 15 m higher than the natural lake level and has been maintained at a highly regulated operating range with a range of 1.53 m. This small variation in water level over time has greatly reduced wave erosion of the shoreline around the original Lake Pedder and the affected areas vary in extent with slope and aspect but are generally less than five metres wide.

Underwater videography in 2020 confirmed that the amount of accumulated sediment in the Huon-Serpentine Impoundment is relatively low and was approximately 2-3 cm thick in the basin of (the original) Lake Pedder. This, and previous studies, found that other areas of the lakebed contained large amounts of coarse woody debris, such as trunks and branches, intact root mats and a fine layer of silt.

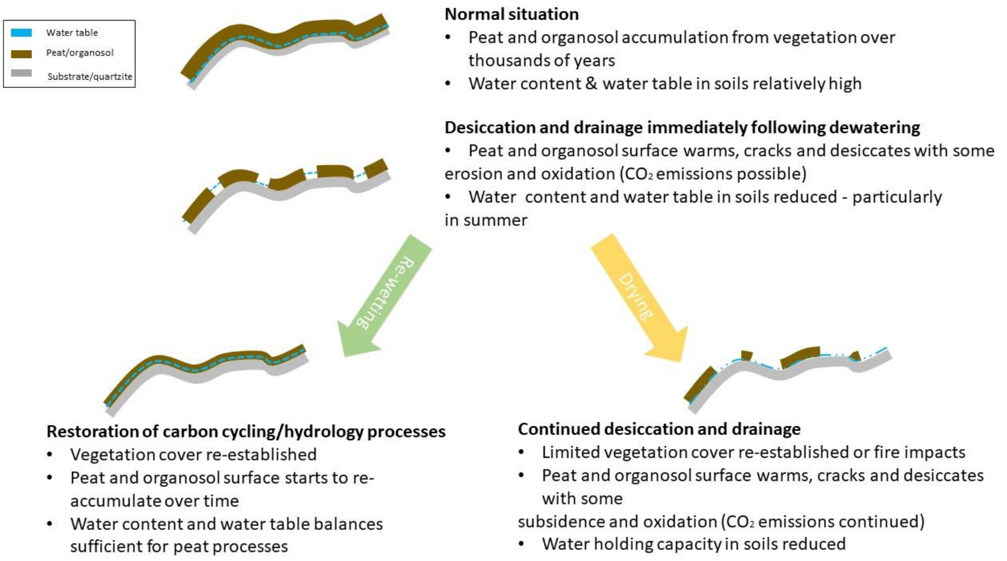
Restoration of peatland function and organic soils

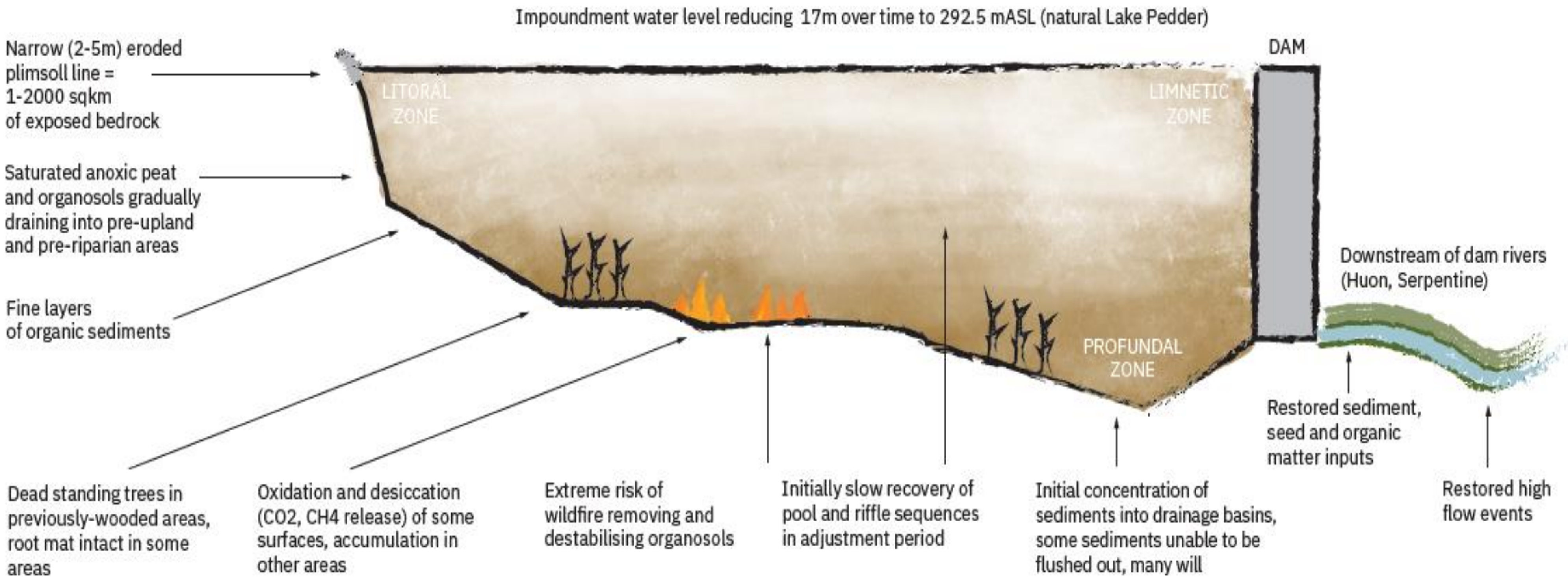
Depending on inflows and climate conditions, water levels are expected to return to those that existed prior to flooding shortly after the reservoir is drained. If the climate regime is such that cool-temperate peatlands could redevelop, then the wetland and terrestrial geomorphic, hydrological *processes* and carbon *cycles* within the landscape should be like their natural state. However, smaller geomorphic *features* such as drainage lines, creeks, pool and riffle sequences will likely vary from those that previously existed as sediments and flows re-establish.

For peatland function and organic matter accumulation to restore, there needs to greater water input than output to maintain waterlogged conditions within the peat soils. Peatlands occur in areas with high relative humidity and considerable annual rainfall which lead to conditions suitable for the production of organic matter at rates higher than decomposition and a net accumulation of plant-derived organic matter.

Whether or not peatland species re-establish, and peat is maintained and resumes accumulation around Lake Pedder will depend on the future climate – predominantly temperature and rainfall characteristics

Climatic conditions during the first few years after draining the reservoir will greatly influence how rapidly vegetation re-establishes in the area around Lake Pedder. Experience from dam removal projects in the United States show that areas with good access to moisture, such as those alongside the water courses or in wetlands tend to restore rapidly. Fortunately, the Lake Pedder area was a system of many small streams and wetlands and average rainfall remains relatively high.





Conceptual model of the anticipated responses and potential impacts on organic soils during and immediately after drawdown of the Huon-Serpentine Impoundment to restore Lake Pedder.

Potential issues impacting the restoration of Lake Pedder and surrounds

Slow and/or variable revegetation

The newly exposed peat surfaces will be subject to the erosive forces of wind, desiccation, water and waves until vegetation re-establishes. Without vegetative cover, organosols are particularly vulnerable to such physical disturbances, especially where these remove roots or standing dead plants. Once organosols dry out, a crust may form on the soil surfaces which in turn can increase water runoff and reduce water infiltration, but also reduce further soil loss. However, cracks in the soils can provide safe sites for seeds to settle and germinate. Once vegetation begins to establish, these impacts will be reduced.

The future is less certain

Sufficient water input and retention to support natural peatland processes may be less likely in the future. The latest global climate models are all tracking the 'worst-case' or 'business as usual' scenario, which for south-eastern Australia means a decrease in annual rainfall and higher temperatures. Modelling for Tasmania suggests a similar scenario, with temperatures predicted to increase uniformly across the state, on average by 2.6-3.3° C late this century. Annual rainfall, however, is predicted to be quite variable across the state and after 2050, winter rainfall on the west coast is predicted to increase while summer rainfall decreases. This trend is likely to result in seasonal water deficits. For the Lake Pedder region, this means higher temperatures and drier summers, conditions that will slow, hinder or halt peatland formation. These conditions may also result in active desiccation and oxidation, or destruction, of peat surfaces. Another consequence of these climatic trends is the increasing likelihood of fire, as was seen in 2016 and 2019.

In short, the climate will determine whether or not peatlands are able re-establish. This will also determine if these peatlands become a sink of carbon or a source. Current and predicted trends suggest that over the longer term, these peatlands, like many others in warming temperate regions worldwide, are most likely to become a source of carbon unless climatic trends are reversed (see the *Understanding Climatic Changes and Restoration* Information Sheet).

Wildfire

During the initial stages of restoration where large areas of peat soils are exposed, the risks of wildfire are most significant. Peatlands and desiccated organic soils are highly flammable. Once a fire starts in these systems, it can smoulder for years under the surface. Fires in cold and cool-climate peatlands have tended to be uncommon, but since 2000 extensive areas of peatlands have burned in places such as Greenland, Alaska, Canada, Siberia, Sweden and of course the Australian Alps and, in 2016 and 2019, southwest Tasmania.

Unfortunately, the frequency and severity of fire in Tasmania has increased over the past couple of decades and this trend is likely to continue, therefore, it is important to manage the fire risks in the initial stages of restoration.

Erosion of organic soils

During dewatering of the impoundment, the drop in water levels is likely to accelerate wave erosion on the re-exposed shorelines, streams, and sand dunes of the original Lake Pedder. The extent and severity of this will depend on the rate of drawdown, as well as wind direction, wind fetch and slope of the lake floor (refer to *Understanding Drawdown* information sheet). As the water level drops, wave action along the retreating shoreline may destabilise previously inundated trees, many of which have remained standing and rooted in the intact peat mats. However, the re-emergence of these trees will also act to interrupt the wind fetch and reduce the wave action in some instances.

Potential mitigating factors and actions

The most effective and long-term solution to protecting peat soils is by ensuring that vegetation cover is established as rapidly as possible. This will stabilize and protect areas of exposed peat soils. One way to speed up this process is to inoculate soils and seed material with microbes, such as nitrogen fixing bacteria and mycorrhizal fungi. This could increase both the number of plants that survival and their growth rates. Even with this method, however, it may take from years to decades before decomposition rates and microbial activity reach levels similar to what existed in the original peatlands.

Active restoration

Thermal fluctuations and excessive evaporation – especially on north facing, exposed slopes and dry areas – could be reduced by shading peat soils in priority areas. Whilst the scale of restoration and costs would prohibit intensive restoration interventions, shading using secured organic materials such as tree branch mulches and straw may prove economical and effective in reducing temperature, evaporation and maintaining soil moisture. An assisted revegetation program would be necessary. Although much of the detail of such a program cannot be determined until after the reservoir has been drained, land managers must be prepared, and most importantly, sufficiently resourced, to intervene.

Knowledge gaps, essential knowledge and studies required

Fire risk

A recent study in Tasmania has confirmed that the main factor controlling the combustibility of organic soils is their moisture content and that Tasmanian organic soils are likely to be combustible in most areas in most summers. Given the risks posed by fire in the initial stages of restoration, this is a key consideration for the restoration project and would need to be incorporated into the current TWWHA fire planning and resources that are implemented by the Tasmanian Parks and Wildlife Service.

A fire management and risk plan would specifically need to address the changes of flammable areas in the landscape, assess fuel loads and address the vulnerability of the moorlands and exposed peat to fire. Any plan and the responses would also need to acknowledge the increased importance of maintaining the peat soils for restoration and the greater vulnerability in the initial recovery phases when vegetation cover is sparse and soil temperatures high and moisture content relatively low.

Sediment budgets and distribution

Prior to any restoration, accurate data on sediment volume and distribution will be necessary because sediments below the offtake levels will remain in the Lake Pedder basin and associated lake system. Given that the sediments are easily resuspended in the water column by waves, wind and current, sediments will persist in the short term.

How quickly should the impoundment be de-watered to reduce risks to organic soils?

Whilst there are still a lot of uncertainties about how the system would respond to restoration, it is useful to assess how the rate of dewatering would likely affect the different values of the lake system. The optimum rate of dewatering is likely to vary greatly between the various environmental factors; what may be best for one factor may not be the best for others. The rate could also be varied at different stages in the process to manage specific risks based on the shape and slope of the impoundment's shoreline.

The following table assumes a relatively constant rate of drainage and shows the optimum rate of dewatering from the minimum practical time of 100 days to a nominal 24-month period. The table lists the main environmental components, the risk mitigation aims and the likelihood of achieving them at the different dewatering rates. The likelihood is colour coded as follows: Green: optimal or preferred rate, highest chance of meeting aim - Orange: sub-optimal, less certainty of meeting the aim - Red: worst rate, lowest likelihood of meeting aim.

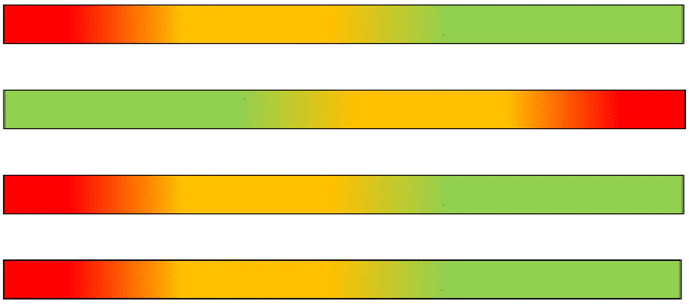
More details on the specific assessments are provided in the *Organic Soils and Substrates* Review and the *Understanding Dewatering* Information Sheet.

Component	Risk mitigation aim	100 days	6 mths	12 mths	24 mths
Natural regeneration	Maximise natural vegetation regeneration and expansion				
Erosion	Minimise wave and wind erosion risks to shorelines				
	Minimise slumping and solifluction erosion of glacial features				
	Minimise slumping and delamination of peat surfaces				
	Minimise desiccation and subsequent oxidation of peat				
	Minimise seepage erosion of Lake Pedder dune system				
Wildfire risk (during initial restoration stage)	Maximise wetted area from groundwater and capillary action				
	Minimise oxidation of peat surfaces from desiccation				

Does the season matter?

The seasonality of dewatering assessment, presented below, represents the time when the maximum surface area exposed over the dewatering period and assumes that vegetation cover will establish quickly on exposed surfaces. For example, dark peat surfaces will absorb heat and dry out more quickly in summer, so it would be best to reduce the amounts of bare peat exposed in summer if possible; spring is also a time of high winds, so large areas of shoreline exposed would increase erosion risk.

Risk mitigation aim	Summer	Autumn	Winter	Spring
Minimising wildfire risk				
Minimising wind action erosion risks to shoreline				
Minimising desiccation of peat surface				
Minimising extreme peat surface temperatures				



Further Reading

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For more information go to www.lakepedder.org.