4.0 RECOMMENDATIONS & ISSUES ARISING

4.1 Introduction

This final section briefly draws out conclusions arising from the descriptions and discussions of the World Heritage geoconservation values of the TWWHA that have been provided in Section (3.0). In most cases, issues are only briefly highlighted or dot-pointed in this section, so as to provide a simple "check list" of key issues arising. Section (3.0) (and references therein) should be referred to for background details of the various issues and recommendations listed here.

4.2 Recommended Additions to the TWWHA Based on Geoconservation Values, and Areas for Further Consideration

All of the 21 new reserves adjoining the TWWHA, as listed and described in Section (3.3) above, contain features or systems contributing substantially to one of more of the recognised TWWHA World Heritage geodiversity themes (see Section 3.3), and hence they are all recommended for inclusion in an extended Tasmanian Wilderness World Heritage Area (TWWHA) boundary on this basis.

It is additionally recommended that the *Hastings Caves State Reserve* – which immediately adjoins the Hastings Cave reserve extension that is one of the 21 new reserves recommended for inclusion in the TWWHA - be also incorporated within the TWWHA boundary owing to its possession of dolomite karst systems that are physically continuous with, as well-developed, and more accessible than those contributing to the *Karst* World Heritage geoconservation themes within the existing (and now contiguous) Southwest National Park / TWWHA (see Section 3.4). Significantly, this proposal would also add an important ongoing hydrothermal karst system to the TWWHA (see Section 3.4), which is a karst process that is at present poorly represented within the TWWHA, yet is an important element of Tasmania's karst geodiversity.

A number of other areas (on both reserved and unreserved lands), mostly immediately adjacent the TWWHA, also contain important exemplars and/or extensions of features contributing strongly to World Heritage geoconservation themes in the existing TWWHA. The appropriate means of managing the geoconservation values of these areas, which are described in Section (3.4) above, should be considered. A variety of approaches may be appropriate in various cases, including sympathetic cross-tenure management regimes or consideration of the appropriateness of possible future rationalisation of land tenure and / or TWWHA boundaries. Note that, whilst a few of the areas are not contiguous with the TWWHA, the World Heritage Operational Guidelines (UNESCO 1999, p. 5, para. 19) allow for inclusion of non-contiguous sites within a World Heritage area provided they form a related suite of key sites contributing to a World Heritage value.

The areas referred to are:

- *Riveaux Karst (Middle Huon Valley)*
- *Mole Creek Karst*
- *Melaleuca Conservation Area Blanket Bogs, Peat Mounds and Undisturbed Coast*
- *Birches Inlet – Sorell – Pocacker / Spero River Tectonically-Influenced Peat Land Fluvial System*
- *Tyndall Range – West Coast Range Glacial Areas*
- *Mt Field National Park – Junee River Karst*
- *Mt Cripps – Vale of Belvoir Glacio-karst*
- *Non-contiguous Magnesite Karst Areas*
- *Non-contiguous Tertiary Plant Fossil Sites*

4.3 Threats to TWWHA Geoconservation Values, and Management Issues Arising

This section briefly lists the key *ongoing* factors ("threats") causing, or threatening to cause, disturbance or degradation to the World Heritage geoconservation values described in Section (3.2.2). Recommended management responses are outlined in [square brackets].

These are provided here as a reference list of key issues requiring appropriate management responses or prescriptions (where possible) to maintain World Heritage values. See "Condition and Integrity" discussions under each theme and sub-theme in Section (3.2.2) for further information on these issues and their appropriate management.

In this context, "threats" are actual or potential physical or process disturbances threatening the World Heritage values of features within the TWWHA. They do not include cases where the integrity of World Heritage themes are compromised by exclusion of key elements from the TWWHA. To the extent that it is likely to be possible to remedy the exclusion of key features from the current TWWHA boundaries, recommendations to this effect have been made in Section (4.2) above. However there are also cases where such remedies are not likely to be practical, for example in some cases where down-valley glacial landforms and deposits related to glacial features within the TWWHA are located in areas of State forest or freehold where existing tenure, land use and disturbances make inclusion in the TWWHA of the areas concerned impractical or inappropriate (see discussion in Section 3.2.2: *Late Cainozoic "Ice Ages" and Climate Change Record* theme).

Some of the threats or disturbances listed here may not allow of action to restore disturbed values (e.g., existing hydro-electric development on the middle Gordon River), but are listed to highlight their effect on World Heritage values and because in some cases careful management may minimise the disturbance caused (e.g., by focussing more attention on the need for appropriate hydro-electric power station operation to minimise the impact of un-natural discharge regimes on the river landforms and meromictic lakes downstream).

Ongoing Natural Geomorphic and Soil Process Systems Theme

Threats to natural features and ongoing processes of World Heritage significance may arise through both physical disturbance of their surface forms or their fabric (contents), or through disturbance of processes (potentially in areas distant from the features themselves) that affect the ongoing natural rates and magnitudes of change of the features.

Key threats that have been identified are listed below under each Ongoing Process sub-theme:

Ongoing Fluvial Geomorphic Process Systems sub-theme

Key threats and management issues affecting or potentially affecting the integrity and condition of landforms and process systems under this sub-theme are:

- *Inappropriate burning* of sedge lands - especially button grass - may destroy blanket bog peat soils, modifying fluvial hydrology and channels, and causing erosion.

  [Appropriate fire management, supported by ongoing research into the effects of fire on blanket bogs, and of blanket bog soils on fluvial processes, is needed. This is potentially the most important manageable threat to fluvial processes in the TWWHA, due to the very large areas covered by blanket bogs.]

- *Stock grazing* and associated firing has in the recent past caused severe soil erosion in Central Plateau parts of the TWWHA, with consequent disturbance of hydrological and other fluvial processes.

  [Stock grazing should not be permitted in areas of the TWWHA supporting natural ongoing fluvial processes, and disturbed areas should continue to be rehabilitated.]

- *Hydro-electric development*, particularly in the middle Gordon region but also at Lake St. Clair and on the Central Plateau, has severely affected hydrological processes, estuarine circulation and fluvial landforms in limited but important parts of the TWWHA such as the Lower Gordon River, middle Huon River and Serpentine River valley. The World Heritage significance of these parts of the TWWHA must be considered threatened or endangered. Future changes in operation of the Gordon Power Station due to connection to the national grid may further affect fluvial discharges and channel erosion on the Lower Gordon River.

  [Careful attention to power station operation management and associated activities is needed to minimise disturbance and impacts on fluvial processes, however some level of artificial disturbance to affected fluvial systems is probably irreversible.]

- *Tourist boat wakes in the Lower Gordon River* have caused bank erosion.

  [Continued appropriate management of tourist boat operations is necessary to avoid ongoing erosion.]

- *Roads (and walking tracks)* in the TWWHA cause localised physical impacts and hydrological disturbance of streams and catchments.

  [Essentially a minor issue affecting very limited areas, but all roading and high-use walking tracks within the TWWHA should have high-standard drainage works to disperse runoff and minimise associated erosion, new roads should not be constructed, and existing roads should be closed and rehabilitated where-ever possible.]

- *Forestry* occurs within an area near the shores of Lake Gordon surrounded by the TWWHA, potentially affecting fluvial processes locally, although it is unlikely that significant impacts are transmitted to other natural fluvial systems within the TWWHA boundaries.

  [The forestry activities concerned should comply rigorously with the Forest Practices Code standards to minimise any potential process disturbances.]

- *Vegetation cover change* is a potential threat to any fluvial geomorphic system, since it may significantly modify water runoff and infiltration rates in catchments, and cause erosion leading to sediment load changes in watercourses. Deliberate modification of native vegetation cover is mostly absent and is not permitted in the TWWHA, but could occur due to poor fire management. This issue relates to blanket bog firing, as discussed above.

  [Deliberate modification of native vegetation cover should not be permitted in the TWWHA, and management fires should be carefully controlled to avoid destruction of non-fire adapted communities.]

- *Climate change* may affect fluvial processes through changed effective precipitation and modified stream discharges, and through long-term decay of blanket bog peat soils that play a role in fluvial processes in the TWWHA.

  [Whilst global climate change *per se* is not an issue that can be managed in the TWWHA, research should consider likely impacts on TWWHA natural processes and identify any means to minimise these.]

Blanket Bog Peat Land Soil Systems sub-theme

Key threats and management issues affecting or potentially affecting the integrity and condition of peat soils and process systems under this sub-theme are:

- *Firing* can destroy blanket bog peat soils entirely, although it is also argued that fires are important in maintaining blanket bog vegetation communities. Inappropriate firing is the biggest threat to TWWHA blanket bog peat soils.

  [Ongoing research into the (prehistoric) role of natural and anthropogenic fires in maintaining or modifying blanket bog vegetation communities and soils, and into the physical and hydrological response of blanket bog soils to fire, should be continued and used to determine appropriate firing regimes to maintain blanket bog communities without destroying the peat soils. If possible – and if such areas exist or make sense philosophically - blanket bog areas effectively un-modified by historic or prehistoric human activities should be identified and used as "benchmark" sites against which to measure the response of blanket bogs to deliberate management fires.]

- *Climate change* has the potential to cause reduction in the thickness and extent of blanket bog peats over time if increased temperatures are not accompanied by increased rainfall.

  [Whilst global climate change *per se* is not an issue that can be managed in the TWWHA, research should consider likely impacts on TWWHA natural processes and identify any means to minimise these.]

- *Deliberate excavation and artificial drainage* of blanket bog peats has degraded these soils in some overseas areas, although these types of disturbance have only affected minor areas of Tasmanian blanket bog peat.

  [Deliberate excavation or drainage of blanket bog peats should be avoided in the TWWHA, and where it occurs for legitimate management reasons, disturbed areas should be rehabilitated with the original peat soil being replaced on the disturbed surfaces where-ever possible.]

Ongoing Coastal Geomorphic Process Systems sub-theme

Key threats and management issues affecting or potentially affecting the integrity and condition of coastal landforms and process systems in the TWWHA under this sub-theme are:

- *Weed vegetation on beaches and dunes* may significantly modify natural dune geomorphology. Incipient infestations of marram grass (*Ammophila arenaria*) and Sea Spurge (*Euphorbia paralias*) have appeared on some TWWHA beaches, but have not yet had significant geomorphic impacts within the TWWHA. Weed infestation on sandy shorelines is the most important manageable threat to ongoing coastal processes known to be a current issue in the TWWHA.

[TWWHA sandy coastlines should continue to be monitored for incipient growths of marram grass, sea spurge and other weed species, and these should be removed as quickly as possible when identified.]

- *Construction of infrastructure, and erosion related to walking tracks, campsites and vehicle use* may affect ongoing coastal geomorphic processes, particularly on sandy coasts and dunes. Existing impacts of these sorts are very localised on the TWWHA coast, although walking track and campsite impacts on dunes are a concern in a few places.

  [No infrastructure capable of affecting coastal processes should be permitted on TWWHA coasts. The use of recreational or other vehicles on TWWHA sandy coasts should not be permitted. Erosion due to campsites and walking tracks should be managed by suitably hardening tracks and campsites where appropriate, and closing and rehabilitating tracks and campsites where possible.]

- *Fire and stock grazing* may cause dune erosion and initiate un-natural dune blowouts.

  [Stock grazing on TWWHA coastal dunes is inappropriate and should not be permitted. Deliberate management burning should be avoided on TWWHA coastal dunes.]

- *Climate change* is probably already causing erosion of sandy shorelines and dunes in the TWWHA due to sea level rise and changes wave climates, and may initiate dune blowouts.

  [Global climate change *per se* is not an issue that can be managed in the TWWHA, and there is little point in trying to halt TWWHA coastal erosion caused by sea level rise. Coastal changes in the TWWHA due to climate change should be allowed to run their course, but should be carefully monitored for the insights these changes may give into coastal behaviour in response to climate change. The information obtained may be of value for managing coastal developments outside the TWWHA.]

Ongoing Karst Geomorphic Process Systems sub-theme

Key threats and management issues affecting or potentially affecting the integrity and condition of karst landforms and process systems in the TWWHA under this sub-theme are:

- *Surface catchment management* is a key management issue affecting the integrity and condition of karst landforms and process systems – in the TWWHA or elsewhere – since surface and ground water is the primary agent controlling ongoing karst processes.

  [The surface (fluvial) catchments of all TWWHA karsts should be protected from impacts on flow rates, water chemistry or sediment load occasioned by any of the potential impacts on fluvial geomorphic processes that have been outlined above. This includes avoidance of any deliberate modification of natural vegetation communities on karst systems or in their catchments – for example by firing – that may affect surface waters or soil waters.]

- *Deliberate mechanical disturbances* such as excavation and quarrying may have major impacts on karst geomorphic processes, as well as physically degrading karst landforms. Disturbance of this sort has been a major issue in the World Heritage area at Exit Cave, however this disturbance has ceased and the quarry and cave system are the subject of an active rehabilitation program (see Section 3.2.2). The vast majority of karst areas in the TWWHA have never been subject to quarrying or excavation, and this would not be permitted under the TWWHA Management Plan (PWS 1999). Minor vandalism and theft of materials has occurred in a few sites (e.g., the Mt Weld crystal caves), however this is illegal and actively managed against.

[Deliberate mechanical disturbances including quarry and excavation should continue to be avoided and disallowed in TWWHA karst areas, and this management prescription should be actively enforced.]

- *Visitor and recreational impacts* in caves can disturb and degrade cave features and processes in frequently visited caves. This is particularly an issue in tourist show caves (e.g., Marakoopa in the TWWHA at Mole Creek), where large visitor numbers can lead to process disturbances simply by their breathing – which can change CO_2 concentration and modify chemical precipitation and dissolution processes in the cave – as well as due to infrastructure placed in caves to facilitate tourism. However, the majority of karst areas in the TWWHA receive very little visitation, which helps to protect their value as undisturbed karst geomorphic process systems.

  [Management planning for tourist show caves in the TWWHA should continue to place emphasis on minimising visitor impacts on karst features and processes. Cavers visiting "wild" caves in the TWWHA should continue to be required to adhere to appropriate minimal impact caving techniques. Other management strategies, including cave classification for management purposes, regulation of visitor numbers, secrecy, and prohibition of certain caves or cave passages to un-managed access, should continue to be used as appropriate to protect undisturbed and / or highly sensitive caves.]

- *Agricultural and forestry impacts* may impact on karst systems in a variety of ways, which can broadly be summarised as range of mechanical disturbances and impacts on water catchments of karst systems (as above). Agriculture and forestry do not generally affect TWWHA karst systems – which is an important aspect contributing to their high significance as undisturbed process systems – however these sorts of disturbances are relevant to the Mole Creek karst (see Figure 15), which lies partly in the TWWHA, but partly in adjacent farmlands and State forest (see also Sections 3.3 & 3.4).

  [The Natural Heritage Trust Mole Creek Karst Integrated Catchment Management Strategy (Eberhard 2003, Gray 2003, p. 359-360) should continue to be developed and implemented so as to manage parts of that karst which lie outside the TWWHA in sympathy with those adjoining and hydrologically connected parts inside the TWWHA.]

Ongoing Lacustrine Geomorphic Process Systems sub-theme

Key threats and management issues affecting or potentially affecting the integrity and condition of present day lacustrine landforms and process systems in the TWWHA under this sub-theme are:

- *Catchment management*: Undisturbed lake systems depend in part on undisturbed water runoff from their catchment. In most parts of the TWWHA it is a major virtue that lake catchments are generally undisturbed, and this is a key factor allowing TWWHA lakes to contribute to the World Heritage significance of the *Ongoing Natural Geomorphic and Soil Process Systems* theme.

  [Fluvial catchments in the TWWHA should continue to be managed to protect their undisturbed status, as per the management issues for fluvial systems outline above.]

- *Hydro-electric development*: A number of lacustrine process systems within the TWWHA have been modified by artificially damming them to raise their levels. The extreme case is the inundation of Lake Pedder (see Figure 1), but lacustrine processes in Lake St. Clair have also been disturbed by lake raising. Lacustrine processes in the highly significant meromictic lakes on the Lower Gordon river floodplain are endangered by the effects of

upstream operation of the Gordon Power Station, in that modified river discharges are affecting the estuarine salt water wedge which maintains meromixis in those lakes (see *Ongoing Lacustrine Geomorphic Process System* sub-theme discussion in Section 3.2.2).

[It has been shown that natural lacustrine processes in Lake Pedder could be restored if the Huon-Serpentine Impoundment were drained (Tyler 2001, Kiernan 2001b), and the same is likely to be true for other artificially raised lakes in the TWWHA. However since this is unlikely to be politically feasible in the near future, attention should be paid to minimising impacts on lacustrine processes by managing these raised lakes so as to keep the degree of lake level fluctuation within the range of natural level fluctuations. The impact of modified water discharges from the Gordon Power Station on meromictic lakes along the Lower Gordon River should be investigated with a view to determining whether power station operations can be modified so as to minimise impacts on meromixis.]

Ongoing Periglacial Geomorphic Process Systems sub-theme

Ongoing periglacial processes in the TWWHA today mainly involve small-scale landform features in restricted high altitude alpine situations. Key threats and management issues affecting or potentially affecting the integrity and condition of periglacial landforms and process systems in the TWWHA under this sub-theme are:

- *Fires* in alpine areas can significantly degrade ongoing periglacial phenomena since vegetation commonly plays a role in binding and maintaining the form of periglacial features such as the stone terraces or "stripes" on the Boomerang mountain (Mt Bobs area). Firing (associated with stock grazing) has degraded soils and periglacial features in alpine areas of the Central Plateau.

  [No management burning should be permitted to affect alpine areas, and the avoidance of alpine wildfires should be a high priority for TWWHA management. Rehabilitation and restoration of eroded soils on the Central Plateau should continue to be actively facilitated and monitored.]

- *Walkers trampling* in alpine areas can physically degrade small-scale periglacial landforms, and has done so in locations such as Moonlight Ridge. Stock trampling has previously done the same thing on the Central Plateau.

  [Formed walking tracks in alpine areas should be rationalised to as few tracks as possible, and these should be suitably hardened so as to restrict walker pressures on alpine periglacial features to the minimum area possible. TWWHA management should endeavour to avoid proliferation of unplanned and unhardened tracks in alpine areas. Stock grazing and trampling should not be permitted in any alpine area of the TWWHA.]

Outstanding Biological Habitats Theme

The condition and integrity of landforms and soils which provide the basis of the *Outstanding Biological Habitats* theme is dependant upon maintaining the natural ongoing geomorphic and soil processes pertaining to each type of landform or soil system concerned. In essence, from a geoconservation perspective the threats to places considered significant under the *Outstanding Biological Habitats* theme are those identified for the various ongoing natural process sub-themes (above), and from a geoconservation perspective the appropriate management for each such habitat involves consideration of the various management issues outlined above as they pertain to each particular habitat in question.

Late Cainozoic "Ice Ages" and Climate Change Record Theme

This theme comprises the record of past environmental conditions in the TWWHA, which is preserved in sedimentary deposits and landform features that are relict or "fossil", in the sense that the natural processes which formed them (eg, glaciation) are no longer operating today. Hence, the key management priority for these features is the protection of their forms (morphology), their spatial relationships, and their fabric (e.g., sedimentary contents), since it is these attributes which characterise the features and preserve their record of past conditions (see Section 2.1). In contrast to those geomorphic and soil systems of the TWWHA which are valued as ongoing process systems, the relevance of ongoing processes to the protection of relict or fossil landforms and deposits is that disturbance of ongoing processes may be detrimental to the extent that it leads to artificially accelerated erosion or degradation of the relict features.

On this basis, key threats and management issues affecting or potentially affecting the integrity and condition of Late Cainozoic relict or "fossil" landforms and sedimentary deposits in the TWWHA under this theme are listed below. These are general threats and management issues which apply across the whole range of sub-themes pertaining the *Late Cainozoic "Ice Ages" Record* theme:

- *Mechanical disturbances* of landform surfaces and contents (e.g., sedimentary contents) are the key threat to the integrity of all landforms and deposits contributing to this theme, as it may alter their defining forms and spatial relationships, and may remove key parts of the features[56]. Mechanical disturbances as understood here may include excavations, placing of fill over natural surfaces, moving of boulders, knocking pieces or samples off features, erosion of tracks into features by walker trampling, vehicular rutting on the surface of landforms, and a range of other artificial mechanical impacts.

  [Deliberate mechanical disturbances of landforms and sedimentary deposits within the TWWHA should be limited to the minimum essential for management purposes (e.g., construction of hardened walking tracks). Ideally, any necessary disturbances should be preferentially concentrated in previously-disturbed areas, and landforms or deposits of particularly high significance to this theme should not be disturbed at all unless no alternative for essential management works is available.]

- *Ongoing geomorphic and soil process disturbances* may degrade Late Cainozoic landforms and sedimentary deposits by accelerating natural erosional or depositional processes. Although the Late Cainozoic landforms, sediments, speleothems, fossils and other features that contribute to this theme were formed by processes no longer operating, under environmental conditions no longer pertaining, they nonetheless exist in environments such as caves, fluvial basins and coasts that are subject to ongoing natural geomorphic and soil processes. These ongoing processes are slowly eroding, covering or otherwise modifying the Late Cainozoic features at natural rates and magnitudes of change. However, artificial disturbance of such ongoing natural processes has the potential to cause accelerated erosion, excessive covering, or other changes to the Late Cainozoic features. While such changes to relict features may ultimately occur at natural rates under

[56] Artificial excavation of sedimentary deposits and other "relict" geological features is commonly considered to enhance their geoheritage value by better displaying their contents, which contain much of the information about their origins and development (e.g., sediment sequences, fossils, etc). While this is undoubtedly appropriate and valuable in many (relatively modified and disturbed) situations, artificial exposure of sediments and landform contents is not necessarily appropriate within the TWWHA, where the over-riding priority is maintenance of not only natural processes but also the natural character and landscape values of the region. In this situation, it is desirable that access to exposures of landform and sedimentary deposit contents be largely restricted to natural exposures (e.g., in river and stream banks, shoreline exposures, natural landslide headwalls, etc).

undisturbed natural conditions, acceleration of such processes constitutes a degradation of their natural values.

Examples of artificially accelerated erosion of Late Cainozoic features in and adjacent the TWWHA, by disturbance of ongoing natural processes, include:

- the accelerated shoreline erosion of moraines at Lake St. Clair due to artificially raised lake levels (disturbed ongoing lacustrine processes);
- accelerated erosion of Tertiary sediments and Quaternary periglacial slope deposits due to burning of peat soil mantles in parts of south-west Tasmania (disturbed ongoing blanket bog and fluvial processes);
- accelerated dissolution of old speleothems in tourist show caves due to artificially modified cave atmospheres (disturbed ongoing karst processes);
- river bank erosion on the Lower Gordon River due to power station operation (disturbed ongoing fluvial processes);
- artificially triggered landslides in periglacial slope deposits, due to inappropriate roading and disturbance of vegetation cover (disturbed fluvial processes); and
- erosion of lunette dunes on the Central Plateau due to stock grazing and burning of peat and vegetation (disturbed fluvial and soil processes).

[All the threats to and management issues for ongoing natural processes in the TWWHA, as listed previously above, are pertinent management issues for Late Cainozoic features in the context described here.]

- *Inundation for hydro-electric development* is a key disturbance in the TWWHA, since hydro-electric impoundments such as the Huon-Serpentine Impoundment (see Figure 5) have submerged a variety of significant landforms including the natural glacio-fluvial and lacustrine landforms of Lake Pedder and the meandering channel of the Serpentine River. Whilst it has been shown that the form and fabric of the inundated landforms currently remain intact (Tyler 2001, Kiernan 2001b), these landforms are no longer accessible or visible, they are no longer exposed to natural sub-aerial processes, and continued artificial inundation must be considered a long term threat to their integrity.

  [Whilst most landforms inundated beneath artificial impoundments in the TWWHA are located beneath wave base and are effectively insulated from any additional medium-term disturbance, significant inundated landforms in shallow water above wave base may be subject to artificially accelerated degradation through wave erosion. This is particularly the case at Lake St Clair, where raised lake levels have resulted in severe shoreline erosion of parts of the Thule-Baffin moraine complex at Cynthia Bay. Kiernan (2001b) has also documented severe erosion of natural slopes around the artificial shoreline of the Huon-Serpentine Impoundment in the TWWHA (see Figure 5). In order to minimise such degradation which results from artificial inundation, water level fluctuations in artificial impoundments and raised lakes within the TWWHA should be maintained within the smallest possible range (to minimise the zone of wave attack on natural landforms).]

Diverse Karst Landform and Process Systems

This theme partly overlaps with the *Ongoing Karst Geomorphic Process Systems* sub-theme and the *Glacio-karstic Phenomena* sub-theme, and additionally includes other relict or "fossil" features such as ancient palaeo-karst deposits. The relevant threats and appropriate management responses pertaining to the *Diverse Karst Landforms and Process Systems* theme are as for the *Ongoing Karst Geomorphic Process Systems* sub-theme and the *Late Cainozoic Ice Ages Record* theme, as described above.

4.4 Interpretation Opportunities and Limitations

No focussed or systematic assessment of geodiversity interpretation opportunities and limitations has been undertaken in the course of this project, however a number of basic themes seem particularly relevant to contemporary issues, and are worth briefly stating:

Opportunities

The geoheritage of the TWWHA provides a number of broad themes that are of likely public interest, or which are of significant educational value, including:

- The fact that the ongoing natural condition of many geomorphic and soil processes in the TWWHA is globally unusual for a region of such extent, provides an opportunity to highlight the degree to which humans have modified Earth's environment elsewhere. This interpretation theme has the potential to create awareness of why proper environmental management is prudent everywhere – i.e., because humans are an agent of far greater change in the Earth's environment than is sometimes realised.

- The diverse landforms contributing to the *Late Cainozoic Ice Ages and Climate Change Record* theme provide an outstanding opportunity to create an awareness that the Earth (and its climate system) have undergone continual change over geological time, and that Tasmania's environment has in many respects been radically different in the not too distant past. This is a significant educational theme, as many members of the public have a tendency to believe the Earth's environment is essential stable and unchanging over time.

- The environmental changes recorded in the *Late Cainozoic Ice Ages and Climate Change Record* theme have sometimes occurred over time periods that are not as long as people sometimes imagine are required (eg, only centuries or a few millennia). This educational theme is particularly pertinent in the current context of global climate change, with many people accepting that climate change is occurring but failing to recognise the scale of changes that may occur within their lifetimes, and the risks they may incur by ignoring these (e.g., by building on shorelines vulnerable to sea level rise).

- Visible changes due to climate change are already become evident in coastal landforms in the TWWHA, and may begin to appear in fluvial process systems and blanket bog soils (see Section 3.2.2). Interpretation of these changes again provides an opportunity to educate the public about the implications of climate change.

Limitations

From the perspective of geoheritage management, a key limitation on any interpretation program is that it should not compromise the natural values of the things being interpreted, for example by encouraging excessive visitation to vulnerable sites. Some degree of discretion needs to be exercised in selection of features to interpret, whether in the field or in an interpretation centre, so as to avoid encouraging excessive visitation to inappropriate (sensitive) sites.

4.5 Priorities for Ongoing Research and Assessments

Priorities for ongoing work are grouped into two categories below, namely:

1.
Further assessment of the geoconservation significance and World Heritage value of certain themes and sites in the TWWHA is needed. These are themes or sites that have previously been cited as having World Heritage values (in the 1989 TWWHA nomination: DASETT 1989), or have been listed as having world level significance on the Tasmanian Geoconservation Database (TGD 2001), but which the present writer considers have not yet been adequately justified as having such significance (see Section 2.3.2). These are listed in Section (4.5.1) below.

2.
Scientific information regarding the distribution of or natural processes governing certain sites or themes of World Heritage significance is currently inadequate to ensure appropriate management and protection of their World Heritage values. These areas of inadequate information are highlighted in Section (4.5.2) as priority areas for ongoing scientific research aimed at improving the management of TWWHA World Heritage geoconservation values.

4.5.1 *Further Assessments of Heritage Significance Required*

The following themes have previously been cited as having World Heritage values (in the 1989 TWWHA nomination: DASETT 1989), however in the writers opinion they have not been adequately justified to date (see Section 2.3.2). Note however, that whilst some features cited in the 1989 nomination are considered by the present writer to clearly not have World Heritage values (see Section 2.3.2), those themes listed below are ones which may have World Heritage significance, however further justification is required to establish this.

Ordovician Stratigraphy/palaeo-environment theme

Tasmanian Ordovician limestone sequences were cited in the 1989 TWWHA nomination (DASETT 1989) as having World heritage value because they comprise the longest and most complete sedimentary record in the southern hemisphere of environmental conditions during the entire Ordovician Period (see Section 2.3.2). However, whilst many of the significant karst systems of the TWWHA are developed in Ordovician limestone, the most complete documented stratigraphic type sections in these limestones lie outside the TWWHA, at Mole Creek and the Florentine Valley (Eastoe 1979), hence it is difficult to justify a World Heritage value for the TWWHA on this stratigraphic (as opposed to karst) basis. On the other hand, the TWWHA does contain a unique tidal to deep water palaeo-environment transect through the Ordovician limestones (at Lune River – Precipitous Bluff – Surprise Bay) which is found nowhere else in Tasmania (Burrett *et al.* 1989).

To justify World Heritage value for the Ordovician limestone stratigraphy of the TWWHA, it will be necessary to confirm that it is the most complete record of its type, and that adequate representative parts of the sequence are contained within the TWWHA.

Permo-Carboniferous Glaciation theme

The Permo-Carboniferous glacio-marine sedimentary sequences of the TWWHA (Lower Parmeener Supergroup) were cited in the TWWHA nomination (DASETT 1989) as being of outstanding universal value in providing outstanding evidence of a major stage of the Earth's history, the Permo-Carboniferous glaciations (see Section 2.3.2). However, whilst the TWWHA contains sections through Late Carboniferous and Permian sedimentary rocks, and exposes exhumed portions of the Late Carboniferous glacial landscape surface (eg, at Gallagher Plateau and

near Cradle Mountain), the best studied sections of these sequences in Tasmania lie outside the TWWHA, and it is unclear that those located within the TWWHA adequately represent the range of important and representative features of this sequence in Tasmania. Indeed, many of the TWWHA Permo-Carboniferous sequences are generally thinner than those elsewhere in Tasmania. It is also not clear that the Tasmanian sequences are as important or more important than equivalent sequences in Antarctica and elsewhere.

To justify World Heritage significance for the Permo-Carboniferous glacio-marine sequences of the TWWHA, it will be necessary to show that these adequately represent the Tasmanian sequence, and that this in turn is outstanding globally.

Gondwana Break-up Theme

The association of Permo-Triassic (Parmeener Supergroup) fossiliferous sedimentary rocks and Jurassic dolerite sheets that is spectacularly exposed in parts of the TWWHA was cited in the 1989 TWWHA nomination (DASETT 1989) as being of outstanding universal value in providing an outstanding and accessible record of fossil Gondwana flora and fauna, and of the processes which initiated the break-up of Gondwana (see Section 2.3.2). Whilst excellent exposures of this association do occur in the TWWHA, at the Southern Ranges, Mt Anne, Du Cane Range, Central Plateau and elsewhere, the Permo-Triassic sequences in the TWWHA tend to be thin compared with elsewhere in Tasmania, and it was also not made clear in the 1989 nomination that the Tasmanian associations are as important or more so than equivalent associations in Antarctica and South Africa.

To justify World Heritage significance for the Permo-Triassic sedimentary sequence / Jurassic dolerite association of the TWWHA, it will be necessary to show that these adequately represent the Tasmanian associations, and that these in turn are outstanding globally.

Weld Valley Group dolomites and mixtites (& correlates in TWWHA – Jane Dolomite, Hastings Dolomite)

The thick association of Late Precambrian dolomites and glacigenic mixtites of the Weld River Group in the Weld Valley (Calver 1989), and correlated units elsewhere in the TWWHA, were cited in the 1989 TWWHA nomination (DASETT 1989) as being of outstanding universal value in providing an extensive and outstanding exemplar of a geological association representing a Late Precambrian period of unprecedented global environmental change (see Section 2.3.2). Whilst the Weld River dolomites are the substrate for karst systems that have been identified in this review as having World Heritage value (Section 3.2.2), and the TWWHA does indeed contain the most complete and extensive parts of this sedimentary rock sequence in Tasmania, equivalent sequences occur in a wide variety of locations globally including extensive occurrences on mainland Australia.

No justification was provided to show that the Tasmanian sequences are amongst the best of their type globally in terms of the palaeo-environmental record they contain, however this is necessary to show that they are of World Heritage value for their stratigraphic attributes (as opposed to their karst systems).

Denison Range Cambro-Ordovician fan-delta flysch sequence Adamsfield Trough tectonic melanges

The above two geological associations were cited in the 1989 TWWHA nomination (DASETT 1989) as being of World Heritage value in providing outstanding examples of their type at global level. However, no comparative assessment was provided and it is the writer's opinion that a more

detailed justification of the geoheritage significance of these associations is needed before they can be accepted as having World Heritage significance.

The following three geological features were not cited in the 1989 TWWHA nomination (DASETT 1989), but have subsequently been listed on the Tasmanian Geoconservation Database (TGD 2001) as features of World Level significance. However, each is an isolated geological feature which does not obviously contribute to any larger theme of World Heritage significance that has been identified in the TWWHA to date. As such, their significance as isolated geological phenomena would need to be very well substantiated in a global context before they could, in the present writer's opinion, be justified as features of World Heritage significance. Such an assessment has yet to be carried out. The three features are (TGD 2001):

- Collingwood River White Schist
- Reward Creek mineralisation
- Adamsfield Workings Mineralogy

4.5.2 *Further scientific information required for identification and management of World Heritage values*

Scientific information regarding the distribution of or natural processes governing certain sites or themes of World Heritage significance is currently inadequate to ensure appropriate management and protection of their World Heritage values. These areas of inadequate information are highlighted below in thematic categories as priority areas for ongoing scientific research aimed at improving the management of TWWHA World Heritage geoconservation values.

Ongoing Fluvial Geomorphic Process Systems

- *Anthropogenic effects on TWWHA fluvial processes*: There is a lack of detailed investigations or understanding of anthropogenic influences on fluvial (and other) geomorphic processes in the TWWHA – particularly in regard to the effects of anthropogenic blanket bog peat soil burning (and consequent substrate erosion) on fluvial processes (see Sections 2.4 & 3.2.2). Understanding of the effects of pre-historic Aboriginal activities (especially firing of button grass / blanket bog soil environments) on fluvial processes is particularly poorly understood, to the extent that it is difficult to speculate on what Pleistocene and Holocene TWWHA environments would have been like had humans actually been absent from Tasmania at those times. Studies aiming to identify the nature and degree of both pre- and post- European settlement anthropogenic influences on TWWHA fluvial processes, and to identify areas free of anthropogenic influence and thus of highest geoconservation significance for their natural process integrity, would be of particular importance both in improving our scientific understanding of the geomorphic (and botanical) history of the TWWHA, and in providing criteria for designing present day management strategies aimed at maintaining natural processes (see Section 2.3.3). See also under Ongoing Blanket Bog Peal Land Soil Systems" below.

- *Ongoing fluvial process studies*: As noted in Sections (2.4) and (3.2.2), whilst most previous fluvial geomorphic studies in Tasmania have focussed on geomorphic history and development, the knowledge and understanding of the natural geomorphic processes that form and maintain contemporary TWWHA fluvial landform systems has been a neglected area of study. However, such process studies will provide the essential information for assessing the sensitivity of fluvial systems to a variety of potential disturbances – and

hence, for enabling protective management of their geoheritage values to be assured. Recent realisation of the potential importance of the widespread blanket bog peats of the TWWHA in fluvial processes has led to initiation of a study of river processes in peat lands, which it is hoped will provide insights into the effects that peat-land firing has had and could have on fluvial processes (K. Jerie, DPIWE, *pers. comm*). However this study is still in its early stages. Other aspects of TWWHA fluvial processes remain neglected and poorly understood.

- *Climate change impacts*: It is likely that climate change will modify stream discharges and fluvial processes over time (see section 3.2.2). As part of any investigation of fluvial geomorphic processes in the TWWHA, attention should be paid to monitoring fluvial hydrology and processes to enable identification of the effects of climate change and determine likely impacts these may have on fluvial landforms in the TWWHA.

Ongoing Blanket Bog Peat Land Soil Systems

- *Blanket Bog mapping:* The full extent of Tasmania's blanket bogs has never been properly mapped. All attempts to map the extent of these soils have simply used the distribution of associated plant communities (eg, button grass moorland) as a surrogate for blanket bog distribution. This approach is subject to all the limitations of any available vegetation mapping, and moreover ignores areas of blanket bog occupied by non-characteristic vegetation types. Some of the latter may prove important for understanding blanket bog processes, for example if rainforest is colonising blanket bogs on valley-side slopes. Beyond this, it is important to know the full extent of blanket bogs in order to plan appropriate management for particular areas. Direct mapping (as opposed to "surrogate" vegetation mapping) of blanket bog soils should be commenced within and adjacent the TWWHA. Since many extensive areas of blanket bogs are well-recognised already, direct mapping would be best directed at "marginal" areas where the boundaries and extent of blanket bogs cannot be confidently determined from vegetation patterns.

- *Prehistoric anthropogenic effects on Blanket Bogs*: A lack of relevant palaeo-environmental and palynological studies of blanket bog moor lands (eg, coring, dating, palynology and charcoal studies of cores through deep low altitude valley-bottom bogs) limits our ability to identify and distinguish between those blanket bog areas significantly modified as a result of Aboriginal burning practices, and those areas where the blanket bogs and associated plant communities (eg, button-grass) are natural edaphic climax communities essentially un-modified by human influences. Palaeo-environmental and palaeo-botanical studies should be undertaken with a view to conclusively identifying (or refuting) areas where extensive blanket-bog / button-grass associations pre-date human influence in western Tasmania. Such studies might involve pollen, charcoal and dating studies of cores from blanket bog peats in locations thought likely to have supported edaphic bog/button-grass associations prior to human arrival in Tasmania (well prior to the Last Glacial maximum).

- *Effects of fire on Blanket Bogs*: Fire has been used widely as a management tool on blanket bogs in the TWWHA, from pre-historic times to the present, and for a variety of reasons un-related to soil management. However this practice may have caused severe degradation of blanket bog soils in some areas. There is a need to gain a better understanding of the response of blanket bogs to fire at different times and under different conditions. Management planning needs such information in order to be able to allow for the use of fire in the TWWHA as necessary for other conservation purposes, without these practices resulting in degradation of the blanket bogs. Work aimed at improving understanding of the response of blanket bog soils to fire regimes is currently underway.

This work should be continued to the point where it is possible to confidently plan fire management of the TWWHA in such a way as to avoid degrading blanket bog soils or causing substantial changes to their ongoing natural pedogenic processes.

- *Climate change effects*: Given that the TWWHA Blanket Bogs have developed in a marginal environment, it is possible that climate change may cause accelerated decay of blanket bog peat soils, reducing their thickness and extent over time (Bridle *et al.* 2003). As part of other investigations into Blanket Bog processes, monitoring should be initiated with a view to detecting any impacts of climate change on blanket bogs, and determining the consequences this may have for ecological processes in the TWWHA.

Ongoing Coastal Geomorphic Process Systems

The undisturbed nature of the TWWHA coastal geomorphic process systems provides an ideal "benchmark" environment for studies aimed at improving knowledge of the Holocene and Pleistocene development of south-east Australian coastlines generally. Such research would derive considerable scientific benefits from the lack of artificial process disturbance which gives the TWWHA coasts their outstanding universal value.

More specifically:

- *Coastal effects of sea level rise*: Given the lack of any other significant anthropogenic process disturbances, the TWWHA coastline provides a unique "benchmark" natural system in which to monitor and study the coastal effects of sea level rise in an environment free of the "noise" created by other human disturbances, which complicate attempts to isolate and identify sea level rise impacts on coasts subject to a diversity of human process disturbances (see also Sections 3.2.2 & 4.3). Understanding the likely future effects of sea level rise on coasts generally is a key issue for coastal management globally, especially where valuable human infrastructure or significant coastal ecosystems may be at risk. It is recommended that monitoring of geomorphic change on key TWWHA beaches be undertaken or supported in order to contribute significantly to global and regional understanding of these key issues.

Karst Theme and sub-themes

Ongoing exploration, mapping and study of TWWHA karst systems generally will continue to enhance knowledge of their values. However from the perspective of management, the most problematical issues in regard to TWWHA karst relate to those karsts vulnerable to substantial pressures or anthropogenic disturbances. These are mostly (but not only) karsts which straddle the TWWHA boundary into non-reserved lands, where a variety of disturbances not managed by the TWWHA Management Plan may impact on TWWHA karst areas. The most important such karsts are the Mole Creek, Mt Picton – Riveaux and Hastings karsts. Optimum management of these vulnerable karsts requires detailed knowledge of karst hydrology and the spatial relationships of significant features such as important caves. Consequently, a key ongoing area of research for TWWHA karsts is:

- *Mapping of vulnerable TWWHA karsts*: TWWHA karsts vulnerable to disturbances and impacts, especially those straddling the TWWHA boundary such as Mole Creek, Hastings and Riveaux, should continue to be the focus of detailed mapping and research aimed at identifying and mapping the spatial distribution of key features such as important caves and significant cave contents (sediments, speleothems, etc), and understanding the hydrological relationships within these karsts. This information should be used to improve management prescriptions aiming to protect the values of vulnerable karsts.

In contrast undisturbed karst areas in remote parts of the TWWHA should not be vulnerable to anthropogenic disturbance, and there is an argument for minimising exploration of these karsts in order to protect them from visitor impacts.

Ongoing Lacustrine Geomorphic Process Systems

Sediments in undisturbed TWWHA lakes are a valuable source of palaeo-environmental information, as noted in Section (3.2.2), and studies of such lake sediments should be encouraged subject to strict application of minimal impact techniques to minimise disturbance of the lakes and their sediment records. Such studies are likely to improve knowledge of the *Late Cainozoic Ice Ages Record* theme, albeit they are not essential for management purposes. On the other hand, one lacustrine process study in particular stands out as important from a management perspective:

- *Meromixis studies in Lower Gordon River floodplain lakes*: Studies of meromictic lake processes on the Lower Gordon river should be encouraged with a view to identifying any possible means of minimising the impact of power station operation upstream on meromictic processes in these highly significant lakes (see Section 3.2.2).

Glacial and Glacio-fluvial Landforms

- *Glacial landform map digitising*: The lack of a consolidated map of Tasmanian glacial and glacio-fluvial landforms and sediment deposits is a hindrance to effective conservation management of these features. Collation of the various scattered sources of glacial map data for Tasmania should be consolidated into a single digital map form which will be of value both the management (by identifying the location of significant features) and to ongoing scientific research.

- *Glacial landform field mapping*: Ongoing mapping of glacial landforms in "neglected" areas of the TWWHA such as Frenchman's Cap and the Arthur Ranges may be of value in helping to identify the most important glacial landform assemblages, from a geoconservation perspective, in the TWWHA. For example, some glacial landform assemblages extend from the TWWHA into adjoining tenures; the ability to identify glacial landform assemblages entirely contained within the TWWHA – say from cirques down-valley to outwash terraces – would be useful, since such complete assemblages would have especially high conservation significance and thus management priority.

Late Cainozoic Coastal Landforms and Sediments

One of the sub-themes of the *Late Cainozoic Ice Ages Record* theme whose component landforms and sediments are very poorly studied to date in the TWWHA are the uplifted palaeo-shorelines, marine terraces and other related features of the TWWHA coastal regions (see Section 3.2.2). Although these are known to be present, they have only been mapped at reconnaissance levels, and their scientific information has barely been tapped.

- *Field mapping and studies of Late Cainozoic coastal landforms*: Further research into TWWHA Late Cainozoic coastal landforms should be encouraged. Not only will this be useful in terms of scientific information on Late Cainozoic coastal evolution and changes, but from a management perspective it will provide better mapping of significant features, which will aid in protecting their values in the context of minimising potential disturbances such as peat fires which may – for instance - allow accelerated erosion of significant features to occur.

4.6 Recommended Additions and Modifications to the Tasmanian Geoconservation Database

Many of the particular sites, features and systems noted in this review have been previously listed on the Tasmanian Geoconservation Database (TGD; see Section 2.1), and indeed the geoconservation significance assessments previously documented in the TGD were a major source of information for this World Heritage significance review of the TWWHA (see Appendix A1.0).

A number of particular sites or natural systems of the TWWHA that have been identified by this review as having World Heritage significance were previously listed on the TGD as significant features at a World Level. These include the Blanket Bogs as a whole, Exit Cave, Mt Anne (NE Ridge) Glacio-karst, Lake Pedder, several Lower Gordon River meromictic lakes, the Central Plateau glacial terrain and the Cynthia Bay Thule-Baffin moraines (see Section 3.2.2).

However, as a result of the present review, the existence in the TWWHA of a small number of additional features or systems of World Heritage significance in their own right has been justified. Some of these were also previously listed on the TGD, but at lower levels of significance (e.g., the Birches Inlet – Sorell - Pocacker – Spero River fluvial process system), whilst others have not been previously listed on the TGD at all (e.g., the New / Salisbury Rivers fluvial process system).

There is little doubt that other previously unlisted features of geoconservation significance – many contributing to World Heritage themes – exist in the TWWHA, and could be listed on the TGD at local to national significance levels. However the focus of this review has been primarily directed at identifying features or themes of World Heritage significance, and hence no previously unlisted features at other levels of significance have been identified in the course of this review.

Elements of geodiversity in the TWWHA that are now recommended as new TGD listings at world-level significance, and existing TGD listings recommended for upgrading to world level significance, are as briefly listed below; see Section (3.2.2) for further details and significance justifications for each:

- *New / Salisbury River Basin Fluvial Process System*: Large effectively pristine source-to-sea fluvial landforms and catchment basin, significant in its own right as outstanding exemplar of the *Ongoing Fluvial Geomorphic Process Systems* sub-theme. New TGD listing.

- *Precipitous Bluff – Salisbury River Karst Process System*: Extensive effectively pristine Ordovician limestone hill flank karst process system, within pristine New / Salisbury River Basin Fluvial Process System catchment (see above). Significant as outstanding exemplar of the *Ongoing Karst Geomorphic Process Systems* sub-theme. New TGD listing, either separately or as additional value of *New / Salisbury River Basin Fluvial Process System* listing (above).

- *Weld River Catchment Basin Karst Process System*: Very extensive high-relief effectively pristine dolomite karst within an extensive undisturbed old growth – forested fluvial catchment basin. Significant as outstanding exemplar of the *Ongoing Karst Geomorphic Process Systems* sub-theme. New TGD listing, including but much larger than the area of the existing TGD listing of the Mt Anne (NE Ridge) Glacio-karst.

- *Macquarie Graben Fluvial Geomorphic System*: The discussion of the *Ongoing Fluvial Geomorphic Process Systems* sub-theme (Section 3.2.2) justified the tectonically-influenced peat-land fluvial systems of the Macquarie Graben (Birches Inlet – Sorell-Pockacker-Spero River region) as having outstanding universal value in their own right.

Several features and areas within the system have previously been listed on the TGD at state levels of significance (See Appendix A1.0), however Bradbury (1996) previously recommended that the entire system be listed at world significance level. This recommendation is supported by the review in Section (3.2.2), and it is now recommended that the entire tectonically – influenced peat-land fluvial geomorphic systems of the Macquarie Graben, including the Sorell – Spero – Wanderer river systems and related features such as the D'Aguilar Range Fault Scarp and Birches Inlet marine terraces, be listed on the TGD as a system of outstanding geoconservation significance at world level. The term "Macquarie Graben Fluvial Geomorphic System", similar to that proposed by Bradbury (1996), may be an appropriate name for this listing. Given that parts of this system are already listed on the TGD at lower significance levels, this is effectively an upgrade rather than an entirely new TGD listing.

- *TWWHA Sandy Coastal Geomorphic Systems*: The undisturbed ongoing coastal geomorphic systems of the TWWHA – especially the sensitive sandy shores – have been justified as having World Heritage significance under the *Ongoing Coastal Geomorphic Process Systems* sub-theme (see Section 3.2.2). The TWWHA coastal dune systems were approved for listing on the TGD by the TGDRG at the meeting of 13th December 2001. However, the listing was approved as the "World Heritage Area Dunes", at a National significance level. It is now recommended that the listing be modified to include the beaches as well as the dunes, since these form an interdependent and interacting system. The significance level should be upgraded to World significance, as justified in Section (3.2.2) of this report.

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A1.0 APPENDIX –TWWHA GEOHERITAGE THEMES, SYSTEMS AND SITES LISTED ON THE TASMANIAN GEOCONSERVATION DATABASE

A1.1 Contents

This Appendix is an extract from the Tasmanian Geoconservation Database (TGD 2001), listing all sites (at all levels of significance) on the Database that lie within the TWWHA boundaries (including proposed extension areas described in Section 3.3)

A1.2 Introduction and Explanatory Notes

The following tables list all geological, geomorphic and soil sites, assemblages and systems within the TWWHA or proposed TWWHA extension areas (see Sections 3.3) that have been listed as having geoconservation significance on the Tasmanian Geoconservation Database (see Section 2.1). The listings are organised into thematic groups which correspond, as far as possible, with the World Heritage themes identified in Section (3.2.2) of this report. However, note that many sites (especially bedrock geology sites) do not contribute to any identified themes of World Heritage significance in the TWWHA. These are sites which are not identified to date as being of World Heritage significance either in themselves or as contributors to a World Heritage theme, but nonetheless contribute to the overall geoconservation significance of the region. Such sites are organised into thematic groupings which do not necessarily correspond to World Heritage themes. Some of these sites may in future be found to contribute to themes of World Heritage significance, depending on further assessment of certain themes whose World Heritage significance could not be established within the framework of this project (see Section 4.5.1).

For each site listed in the following tables, the following information is provided from the Tasmanian Geoconservation Database (version 3.0, 2001):

GIS Code: Identifier code as used in the TGD.
Name: Site or feature name as used in the TGD.
Significance Code: Overall site level of geoconservation significance, as provided in the TGD (version 3.0); see explanation below.
Sensitivity Code: Overall site sensitivity, as provided in the TGD (version 3.0); see explanation below.

Significance Codes:
The conventional means of assigning levels of significance to features of geoconservation significance is described in Section (2.2) of this report. The overall significance assigned to sites listed on the Tasmanian Geoconservation Database has been recorded in the following tables in the format:

significance (*level*)

Where:

Significance may be:	R	Representative
	O	Outstanding
	R/O	Both representative and outstanding
	L	Low
	U	Unknown

Level may be:	W	World
	N	Australia (i.e., National)
	S	Tasmania (i.e., State)
	R	Regional
	L	Local
	U	Unknown

Thus for example, "R(S)" means "Representative at a State Level", whereas "O(W)" means "Outstanding at a World Level" (and thus likely to be of World Heritage value).

Note that most sites listed on the Tasmanian Geoconservation Database have not been assigned "World" significance in their own right. However, certain assemblages of features, which are not individually of World significance, may contribute in their totality to an over-arching theme which is of World geoheritage significance (see discussion of "wholistic vs reductionist significance assessment" in Section 2.2). Where individual sites have been listed on the TGD as having World significance in their own right, these have either been accepted as having World Heritage significance in their own right in this report (Section 3.2.2), or have been identified as requiring further assessment of their significance (Section 4.5.1).

Sensitivity Scale Codes:
The sensitivity of geoconservation values to human disturbance is discussed in Section (2.1) of this report. The Tasmanian Geoconservation Database assigns a broad sensitivity category to each listed site, ranging from 1 (highly sensitive to disturbance) to 9 or 10 (highly robust to disturbance). The scale of sensitivity reflects the potential for geoconservation values to be degraded based on differing intensities and patterns of disturbance entailed in a range of land use practices. In understanding sensitivity it is essential to distinguish between a *site*, which is a geographical area, and the *value* that the site contains. In some cases certain types of disturbance of a *site* will not degrade the particular conservation *values* present. It is the sensitivity of the *value*, not that of the *site* that is identified by the sensitivity category.

These sensitivity categories are indicative only, and should not be considered absolute; some elements of each feature may be more or less sensitive than indicated, or may be more or less sensitive to disturbances of a type not envisaged at the time their sensitivity ratings were assigned.

The sensitivity of sites on the Tasmanian Geoconservation Database are categorised according to a 10-point scale of sensitivities provided by Dixon & Duhig (1996), which is based on a scheme developed by Kevin Kiernan (1997a), as follows:

1 *Values sensitive to inadvertent damage simply by diffuse, free ranging human pedestrian passage, even with care.*
Examples: fragile surfaces that may be crushed underfoot, such as calcified plant remains; gypsum 'hairs' in some karst caves that may be broken by human breath.

2 *Values sensitive to effects of more focussed human pedestrian access even without deliberate disturbance.*
Examples: risk of entrenchment by pedestrian tracks; coastal dune disturbance; drainage changes associated with tracks leading to erosion by runoff; defacement of speleothems simply by touching their surface.

3 *Values sensitive to damage by scientific or hobby collecting or sampling, or by deliberate vandalism or theft.*
Examples: some fossil and mineral sites; speleothems.

4 *Values sensitive to damage by remote processes*
Examples: degradation of geomorphic or soil processes by hydrological or water quality changes associated with the clearing or disturbance of catchments; fracture/vibration due to blasting in adjacent areas (e.g. to stalactites in caves); karst sites susceptible to damage if subsurface seepage water routes change due to creation of new fractures.

5. *Values sensitive to damage by higher intensity shallow linear impacts, depending upon their precise position.*
Examples: features whose values would be degraded by vehicular tracks, minor road construction, or excavation of ditches or trenches.

6 *Values sensitive to higher intensity but shallow generalised disturbance on site. (This might involve either the removal or addition of material.)*
Examples: values which may be degraded by: clear felling of forests and replanting, but without stump removal or major earthworks; light snig tracks and associated drainage changes; land degradation such as soil erosion due to bad management practices; natural revegetation, covering and/or weathering of artificial exposures or by human-promoted site rehabilitation (resulting in degradation of significant bedrock exposures in quarries or road cuttings).

7 *Values sensitive to deliberate linear or generalised shallow excavation*.
Examples: values which may be degraded by minor building projects; simple road construction; shallow borrow pits; plantation establishment involving the removal of stumps.

8 *Values sensitive to major removal of geo-material, or large scale excavation or construction*.
Examples: values which may be degraded by quarries; sites of large dam construction.

9 *Values sensitive only to very large scale contour change*.
Examples: values which may be degraded by very large quarries or open cut pits; large water impoundments where the value is rendered inaccessible through inundation beneath an artificial reservoir, and its natural processes are rendered inoperative, although the physical characteristics of the site may remain intact.

10 *Special Cases*
Examples: values which would only be destroyed by erosion caused by sea-level rise from humanly - induced greenhouse warming, or by catastrophic events such as meteorite impacts. Large regions whose geoconservation values reside essentially in their large scale form (e.g., very large structural landforms) will commonly have a sensitivity of 10.

A1.3 Bedrock Geology Themes

A1.3.1 *Mineralogy*

Mines – Mineralogy exposures

MER02	Commonwealth Creek Copper Workings
MER05	Oakleigh Creek mine
MER06	Pelion Plains Copper Workings
NIV02	Reward Creek Mineralisation
WED03	Adamsfield Workings Mineralogy
WED09	Humboldt Mine

Miscellaneous

FRA04	Bubs Hill Quartz Crystal Locality
FRA41	Darwin Glass Strewn Field
MER40	Lake Flora hematite
OLD03	Lindsay Hill Sulphide Vein
SCP21	Pedra Branca Mineralogy
HUO42	Blake's Opening Agate in Precambrian Dolomite

Petrology

Igneous – Intrusive

SCP14	Mewstone granite
WED16	Trappes Inlet Lamprophyre
PTD05	Payne Bay dolerite

Igneous – Volcanic

Tertiary basalts

MEA01	Ibbots Rivulet basalt jointing
SOP06	Knyvet Falls Basalt Flow
MEA02	Liawenee Hill Basalt Flows (?)

Sedimentary

CSL01	Macquarie Harbour Abrupt Tertiary Lithological Transition
HUO01	Moonlight Ridge Triassic Sedimentary Structures
OLD01	Clytie Cove Sedimentary Structures
PTD07	Wallaby Bay Remnant Sedimentary Structures
SCP16	Wilson Bight Palaeo-colluvium
SCP20	Ile du Golfe Fossiliferous Limestone
SCP23	Surprise Bay Deep-water Limestone
SCP28	Pedra Branca cemented breccia cones
SCP30	Point Vivian Sedimentary Structures
SOP03	Lake Will Oil Shale
SOP04	Little Horn Late Palaeozoic Scree
WED01	Adamsfield Open Cut Palaeoplacer

WED04	Atkins Range Ironstone
WED18	Upper Weld Valley Mixtite - Dolomite Association
WED20	White Spur Clastic Dykes
WED21	Denison Range Flysch Sequence

Metamorphic

FRA01	Bills Creek Eclogite
FRA05	Cardigan Flats Schist
FRA06	Collingwood River White Schist
NIV15	Mt. Arrowsmith - Scotchfire Metamorphics
PTD01	Bond Bay Schist
PTD03	Nye Bay Mylonite Zone
PTD06	Trumpeter Islets Porphyroblasts
SCP03	Maatsuyker Island "ribbon rock"
SCP13	Wilson Bight Schist

Structure

CSL07	Macquarie Harbour Graben
FRA11	Raglan Range Precambrian Fold Hinge
FRA24	First Gorge Structure
MER01	Cloister Lagoon - Chapter Lake Fault Trace
OLD02	Lake Edgar Fault
OLG23	Scarp West of D'Aguilar Range (?)
SCP06	De Witt Island Folding
SCP19	Ile du Golfe Syncline
SCP27	Osmiridium Beach Shear Zone
WED02	Adamsfield - Serpentinite Creek Ultramafics

Relationship

Intrusive contacts

HUO14	Mt La Perouse - Maxwell Ridge Dolerite Contact
MER04	Mount Gould Intrusive Contact
MER07	The Temple Remnant Triassic Sandstone
MER37	Mt Pelion East Dolerite Columns Imprint
SCP29	South Cape Intrusive Contact
WED15	Mt Sarah Jane Dolerite Contact

Unconformity exposures

FRA07	Elliott Range Palaeozoic Unconformity
FRA09	Mt McCutcheon Palaeozoic Unconformity
WED05	Denison Gap Unconformity
WED14	Mt Anne Precambrian Unconformity

Exhumed erosion surfaces (re-exposed unconformity surfaces)

NIV01	King William Saddle Palaeozoic Glaciated Surface
SOP01	Barn Bluff - Mt Inglis Late Palaeozoic Glacial Valley
SOP02	Lake Ellen Palaeozoic Surface

Other types

OLG03	Hamilton Range Dolerite Lag Boulders

Stratigraphy

FRA08	Goulds Sugarloaf Parmeener Supergroup Section
HUO02	Mt La Perouse - Moonlight Ridge Parmeener Supergroup Exposures
HUO48	Precipitous Bluff Beds Type Section
HUO49	New River Beds Type Section
SCP18	Prion Beach Beds Type Section
SOP05	Mt Inglis Permian Type Section
WED11	Florentine Valley Formation Type Site
WED41	Pandani Group Type Area
WED42	Weld River Group Type Area
WED43	Mt Anne Group Type Area
WED45	Annakananda Formation Type Section
WED46	Devils Eye Dolomite Type Section
WED47	Gelignite Creek Member Type Section
WED48	Gomorrah Dolomite Type Section
WED49	Huon River Formation Type Section
WED50	Lake Judd Formation Type Section
WED51	Lake Timk Formation Type Section
WED52	Lonely Tarns Formation
WED53	Lot Formation Type Section
WED54	Mt Bowes Formation Type Section
WED55	Sarah-Jane Quartzite Type Section
WED56	Scott's Peak Road Member
WED57	Styx Dolomite Type Area
WED58	Twin Creeks Formation Type Area

Cainozoic Sedimentary and Palaeobotanical Record

CSL12	Coal Head Pleistocene Plant Fossil Site (in situ forest)
FRA12	Darwin Crater
MER08	Mersey/Cathedral Pleistocene Plant Fossil Site
OLD04	Melaleuca Fossil Flora
PTD02	Hannant Inlet Pre-Last Glacial Sediments

Palaeontology

FRA38	Victoria Pass Graptolites
WED07	Flagstone Knoll Cambrian Fossils
WED08	Humboldt Divide Stromatolite-bearing Dolomite Locality
WED10	Junction Hill Cambrian Fossils
WED13	Marriott Hill Fossil Locality
WED17	Trial Ridge Cambrian Fossil Locality

A1.4 Geomorphic Themes

Structural Landforms

Davies defined two broad structural landform provinces in Tasmania; these are not adequate for describing all of Tasmania's landform types, but are a useful framework in which to classify some of Tasmania's structural landforms:

"Fold Province" Landforms (Strike Ridge and Valley Fluvial Landscapes)

WED33	Tyennan Terrane
OLG29	Prince of Wales Range Strike Ridge
OLG04	Olga Syncline
TYE02	Jubilee Terrane
WED12	Denison Range Lower Palaeozoic Terrane
WED39	Tiger Range Classical Fold Strike Ridge
WED30	Stepped Hills Cuesta

HUO50 Fault/Fold Structure Provinces Boundary

"Fault Province" Landforms

MER42	Central Plateau Terrane
MER09	Great Pine Tier Tertiary Fault Trace
NIV03	Upper Mersey - King William Range Terrane
HUO06	Mt Picton - Southern Ranges Terrane
WED06	Eliza Plateau
MEA10	Great Western Tiers Escarpment

Fluvial Landforms and Processes

Ongoing Fluvial Geomorphic Process Systems (World Heritage Sub-Theme)

New / Salisbury River Ongoing Fluvial Geomorphic System

The New/Salisbury River system has been identified as having World Heritage significance in its own right (Section 3.2.2), and the whole system is recommended for listing on the TGD. Currently, however, only one fluvial feature within this overall system is listed on the TGD, as below. Note however that HUO07 (Precipitous Bluff Limestone Sequence and Karst) and HUO08 (Vanishing Falls) also lie within this fluvial system and are listed on the TGD for their karst values.

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
HUO10	New River Delta and Overbank Deposits	O(L)	4

Gordon River Fluvial Geomorphic system

The Gordon River Fluvial Geomorphic system is one of the most important in the TWWHA, but it's values have been threatened by hydro-electric development and tourism impacts (see Section 3.2.2 & 4.3). Although the system as a whole has not been listed on the TGD, numerous individual elements are listed (below). Many of these elements were identified by Bradbury (1994) and Dixon (1991).

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
FRA23	Eagle Creek	O(L)	5
FRA26	Horseshoe Bend	O(S)	6
FRA28	Lake Morrison *limnological / fluvial significance*	O(W/R)	4/7
FRA30	Little Eagle Creek Levee	O(L)	4
FRA31	Lower Tuan Gabby Reach Bed forms	O(L)	4
FRA32	Mannigan's Inlet	O(U)	2
FRA36	Timm's Eddy Post Settlement Deposits	R(L)	4
FRA37	Tuan Gabby Flats	O(S)	4
FRA39	Wrights Bay Latest Holocene Deposits	O(S)	2
OLG07	Lower Gordon River Levee - Flood Basin System	R/O(W)	4
OLG14	Gordon River Gorge above Cataract Creek	O(L)	8
OLG15	Gould's Landing Bar	R/O(L)	4
OLG17	Lake Fidler & Sulphide Pool Meromictic Lakes	R/O(W)	4
OLG18	Lower Gordon Camp Levee	R(R)	2
OLG21	Richardson's Beach Levee Study Site	R/O(N)	4
OLG31	Sprent River Fan Delta	R(S)	6
OLG05	Middle Gordon River Cross-Strike Drainage	R/O(N)	9
FRA18	Middle Franklin River Cross-Strike Drainage	O(N)	9
OLG22	Rocky Sprent Falls	O(R)	8
WED29	Myrtle Creek River Capture	O(S)	8

Birches Inlet – Sorell – Pocacker / Spero River Tectonically-influenced Peat Land Fluvial System

As a whole, this ongoing fluvial process system is considered to have World Heritage geoconservation value in its own right (see Section 3.2.2). The system as a whole has not been listed on the TGD, but the fluvial features listed below are integral parts of the system. In addition to these strictly fluvial features, the Birches Inlet Marine Terraces (CSL11), Fault Scarp near D'Aguilar Range (OLG23) and a lithological transition in Tertiary sediments (CSL01), listed elsewhere in this appendix, are probably related features.

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
CSL02	Braddon River Floodplain and Terraces	R/O(S)	6
OLG24	Sorell - Pockacker Fluvial Landforms	R/O(S)	4
OLG28	Bradley's Hill Badlands	O(S)	4

Other Ongoing Fluvial Process Sites

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
MEA07	Liffey Falls and Surrounds	R(R)	7
OLD08	Badger Creek "Pseudokarst" Landform (collapsed fluvial gorge)	O(S)	7

Karst Landforms and Processes (World Heritage Themes and Sub-themes)

Many of the karst landforms and process systems listed below contribute to more than one of the Karst World Heritage Themes and Sub-themes identified in Section (3.2.2), hence they are not here grouped according to World Heritage themes.

Dolomite Karst

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
FRA13	Algonkian Rivulet Karst	R/O(S)	4
HUO34	Manuka Creek – Blake's Opening – Mt Picton Karst	R(R)	4
HUO45	Cook Creek Karst	R(R)	4
TYE13	Mt Weld Karst	O(S)	3
WED28	Weld River Arch	O(S)	6
HUO35	Hastings – Upper Creekton Rivulet Karst	R/O(S)	4
TYE16	Upper Styx Karst Systems	R(R)	4

Limestone Karst

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
FRA03	Bubs Hill Fossiliferous Limestone and Karst	R/O(R)	4
HUO07	Precipitous Bluff Limestone Sequence and Karst	R(S)	4
HUO08	Vanishing Falls	O(N)	4
HUO11	Wargata Mina (Judd's Cavern) Karst System	R/O(N)	4
HUO46	Exit Cave - D'Entrecasteaux Valley Karst Area	R/O(W)	4
OLG06	Lower Franklin Valley Karst	R/O(S)	4

OLG09	Champ Cliff Limestone and Karst	R(R)	5
SCP17	Surprise Bay Coastal Karst	O(L)	5
HUO32	Lune River Plains Karst Hydrology	O(S)	4
HUO40	North Lune and Lune Plains Karst	U(U)	4
MER44	Mole Creek Karst	R/O(N)	4

Hydrothermal Karst

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
TYE01	Mt Weld Crystal Caves	R/O(S)	3

Glacio-karst

A great deal of Tasmanian karst has some glacio-karst influence; sites listed here are those in which the glacio-karst aspects have been particularly significant.

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
FRA16	Lake Tahune Glacio-karstic Cirque	R/O(N)	7
HUO09	Lake Sydney Glacio-karstic Lake	R/O(N)	4
WED25	Mt Anne (North East Ridge) Glaciokarst	R/O(W)	6
OLG26	Warners Landing - Perched Lake Sediments and Karst (glacial sediment fill?)	O(S)	4

Marine & Coastal (incl. Coastal Aeolian) Landforms and Processes

Ongoing Coastal Geomorphic Process Systems (World Heritage Sub-Theme)

Contemporary Southwest Coast Beach-Dune Systems

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
-	World Heritage Area Dunes (i.e., South West Barrier Beaches, approved for TGD listing by TGDRG Meeting 13th December 2001)	R(N)	5
OLD14	Window Pane Bay Dunes	R(R)	2
PTD09	Stephens Bay - Noyhener Beach Dunes	R/O(S)	4
SCP12	Louisa Bay Tombolo	R/O(R)	6
SCP26	Granite Beach	R(R)	7
PTD13	Towterer Beach Stabilised Dunes	O(R)	4
OLD13	Window Pane Bay High-altitude Dune	O(S)	6

Contemporary Rocky Coastal Landform Systems

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
CSL06	Sarah Island Sea Caves	O(L)	7
PTD10	Berry Head Sea Cave	R(R)	8
SCP04	Louisa Island Collapsed Sea Cave	R(L)	8
SCP10	Flat Top Island Sea Caves	R/O(R)	8

SCP01	De Witt Island "Pseudokarst" Mass Movement Landforms	O(S)	6
SCP15	Walker Island "Blowhole"	O(L)	8
SCP07	De Witt Island coastal stream capture	R(S)	8
SCP32	Pedra Branca Shore Platform	O(R)	8
SCP33	South Cape Bay Shore Platform	R(R)	8

Structurally Controlled Coastal Landforms

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
OLD09	Island Bay Structurally-controlled Coastline	R/O(L)	8
SCP05	Flat Top & Round Top Islands Structurally-controlled Geomorphology	R(S)	9

Macquarie Graben Fluvial, Tectonic & Marine Process System (*see also Fluvial themes*)

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
CSL11	Birch's Inlet Terraces	O(N)	7

Late Cainozoic Coastal Landforms and Sediments (World Heritage Sub-Theme)

High Level (Uplifted and/or Relict) Coastal Landforms

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
PTD08	Coffin Bay Raised Shoreline	R(L)	7
PTD11	Isolated Hill Stranded Marine Terraces and Cliff	R/O(R)	8
SCP09	Louisa River Terraces	R/O(L)	8
SCP24	Blowhole Valley Sands	O(U)	5

Drowned Terrestrial Landform Systems

GIS Code	Name	Significance (TGD v.3)	Sensitivity (TGD v.3)
PTD12	Port Davey - Bathurst Harbour Ria	R/O(S)	9

Glacial Landforms and Deposits

Late Cainozoic "Ice Ages" and Climate Change Record (World Heritage Theme)

Glacial and Glacio-fluvial Landforms (World Heritage Sub-Theme)

SOP19	Central Highlands Cainozoic Glacial Area
SOP08	Cradle Mountain Glacial Features
NIV19	Central Plateau – Upper Derwent – Upper Gordon Glacial Areas
FRA19	Redan Hill Erratics
FRA20	Stonehaven Creek Glacial Sediments
MEA03	Double Lagoon Ground Moraine
MEA04	Lake Ada Ground Moraine
MER13	Chalice Lake Rock Basin Lake
MER10	Mt Geryon - Acropolis Glacial Geomorphology
NIV04	Cuvier Valley Moraine Complex
NIV05	Cynthia Bay Moraines
MER17	Julian Lakes Dead Ice Topography
MER18	Junction Lake Glacial Valley Step
MER19	Labyrinth Glaciated Terrain
MER22	Lake Adelaide Glacial Rock Basin Lake
MER23	Lake Explorer Rock Basin Lake
MER24	Lake Helios Glacial Striae
MER28	Lobster Rivulet Ice Spillover Area
MER29	Massif Mountain Geomorphology
MER30	Moses Creek Stepped Valley
MER31	Mount Rogoona Nunatak
MER32	Narcissus Valley Fluted Moraines
MER35	Walls of Jerusalem Last Glacial Ice Window
MER61	Talinah Lagoon End Moraine Complex
NIV07	Lake St Clair Glacial Trough
NIV11	Narcissus Valley (?)Esker
NIV12	Upper Franklin Valley Glacial Features
NIV13	Surprise Valley Glacial Trough
NIV14	Mount Olympus Cirques
NIV06	Lake Rufus Glacial Trough
MER64	Forth River Glacial Area
MER15	Forth Valley Glacial Trough
MER63	Mersey – Upper Meander River Glacial Areas
MER27	Lees Plains Glacial Valley Profile
MER55	Moses Creek Deformation Till
MER56	Pillinger Bog End Moraine
MER57	Wurragarra Creek Disrupted Drainage
MER58	Upper Mersey Overridden Valley Walls
MER59	Chapter Lake Hanging Valley
OLD05	Southwest Tasmania Glacial Areas
FRA29	Frenchman's Cap Glacial Area (See also FRA16 Lk Tahune Glacio-karstic Cirque)
FRA14	Frenchman's Cap – Cliff
WED44	Lake Pedder (the original)
WED24	Mt Anne Massif Glacial Landforms See also northeast Ridge glacio-karst WED25
OLD07	Western Arthur Range Glaciated Terrain
WED26	Mt Curly Glaciated Surface
TYE12	Snowy Range Glacial Systems

HUO25	Huon Valley Glacial Systems
HUO26	Picton Valley Glacial Systems
HUO28	Lune Valley Glacial Systems
HUO29	D'Entrecasteaux & Catamaran Valleys Glacial Systems

Periglacial & Mass Movement Processes

Ongoing Periglacial Process Systems

FRA15	Frenchmans Cap - Summit Nivation Cirque
SCP25	Mt La Perouse Nivation Site
HUO12	The Boomerang Solifluction Steps
HUO13	Moonlight Ridge Periglacial Features
NIV08	Mount Rufus Solifluction Terraces
MER52	Lake Nameless Patterned Ground

Contemporary Mass Movement Processes (non-coastal)

MER12	Cathedral Mountain Landslip
MER14	Falling Mountain Rockfall

Relict (Pleistocene – Early Holocene) Periglacial & Mass Movement Landforms

HUO03	Precipitous Bluff Dolerite Cliffs
MER33	Nells Bluff Slab Topple
MEA05	Pine Lake Glacis
NIV10	Mt Olympus Rock Glaciers
NIV09	Mt King William 1 Dilation Trench
MER16	Jacksons Creek Drainage
MER25	Lake Leonis Pressure Release Chasm

Relict (Pleistocene to Mid-Holocene) inland aeolian landforms

MER31	Lake Ada Dunes Mid-Holocene

Weathering

Although all the themes under which geomorphic types and processes have been categorised in this report and in the Tasmanian Geoconservation Database involve weathering processes, features have been categorised in a "Weathering" theme where the value of the feature relates in particular to weathering products.

MER34	Toad Rock
MEA12	Great Western Tiers Cliff and Cave Complexes
SCP11	South West Cape Granite Weathering Features
OLG20	Mt Discovery Tors

A1.5 Soils

Contemporary Soil Process Systems (Theme)

Representative contemporary mineral soil process sites

NIV16 Wayatinah Dolerite Soils
SCP02 Maatsuyker Island Soils

Alkaline Pans

FRA21 Upper Maxwell Valley Alkaline Pans

Organic Soils

Western Tasmania Blanket Bogs

The entire assemblage of western Tasmania blanket bog areas are listed on the TGD as:
OLG30 Western Tasmania Blanket Bogs;

Component sites belonging to or related to this theme that are listed in the TGD are:
SPE01 Birch's Inlet Peats
OLD16 Spica Hills Peat
SCP08 Louisa Plains Blanket Bog and Peat Mounds
OLD17 Melaleuca Peat Mounds
OLG32 Moores Valley "Stone Sheep" Lag Boulders and Peat Mounds

Other Peats

MER36 Zion Vale Bog