

A REPORT FOR THE DEPARTMENT OF PRIMARY INDUSTRIES,
PARKS, WATER AND ENVIRONMENT

**AN OVERVIEW OF GEODIVERSITY SITES IN THE TASMANIAN
WILDERNESS WORLD HERITAGE AREA, WITH PARTICULAR
REFERENCE TO GEOLOGICAL SITES AND THE IDENTIFICATION OF
ANY GAPS IN THE LISTINGS**



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Cover photo: View over glacial lakes Malana and Wugata on the Denison Range, South-West Tasmania, looking south along the Vale of Rasselas to Mt Wright and The Thumbs, with Mt Mueller and Mt Anne on the horizon. Photo: Keith Corbett.

EXECUTIVE SUMMARY

1. This report is a summary and assessment of the geodiversity sites listed by the Natural Values Atlas within the Tasmanian Wilderness World Heritage Area (TWWHA), compiled as a consultancy contract for DPIPWE through the Geoconservation Section in the period March – July 2013.
2. There are 291 geodiversity sites listed within the TWWHA. These have here been divided according to geological age, with all of the landform sites (fluvial, glacial, karst, coastal, etc) grouped as Quaternary/Recent.
3. There are 203 Quaternary/Recent sites (= 70%), of which the main groupings are glacial regions, landforms and deposits (47), coastal features (45), karst regions, landforms and deposits (22), fluvial landforms and deposits (19), and peat deposits and landforms (11), with many minor categories (e.g. fossils, cliffs and escarpments, gorges, lakes, waterfalls, mass movement features, etc).
4. There are seven Tertiary age sites (four structural features and three basalts); two Cretaceous sites (one based on a poorly dated lamprophyre dyke, and the other being the state-wide site for Cretaceous igneous rocks); seven Jurassic sites (five dolerite contacts, one Jurassic basalt, and one for quartz crystal mineralisation); ten Permo-Triassic sites (six rock types or sequences, three unconformity surfaces, one for sedimentary structures); six Devonian sites (five for mineralisation, one for a fold structure); two Siluro-Devonian sites (one for fossils, one for a type section); eight Ordovician sites (seven rock units, one fossil locality); 16 Cambrian sites (five rock units, four unconformities, four structures, three fossil localities); and 31 Precambrian sites (26 for rock units, two for structures, two for regions, one unconformity).
5. No glaring gaps have been identified in the listings.
6. Attention is drawn within the Quaternary/Recent sites of some apparent randomness in selection of sites in some categories (e.g. River Gorges, Lakes, Cliffs and Escarpments). One of the Regional Mountain Terrains sites is recommended for de-listing because of overlap and lack of internal integrity, a new glacial site is recommended (Schnells Ridge), and the possible inclusion of some lightning strike sites is suggested.
7. Inclusion of the undated lamprophyre of possible Cretaceous age seems unwarranted.

8. Some re-wording and redefinition of several of the Cambrian sites is recommended, to include additional important features at the sites. Two more Cambrian fossil sites, both on the South Coast, are recommended.
9. With respect to the Precambrian sites, several are recommended for re-definition, two are considered as dubious, and one is recommended for de-listing (Jubilee Region) on the basis of a lack of tectonic or palaeogeographic integrity.
10. Two general recommendations are made, one for careful overview of sites, in a 'devil's advocate' style, when they are being nominated, and another for consideration of the production of a layman-accessible 'book', or something similar, of the most important geological sites, appropriately illustrated, so that the general public can also appreciate Tasmania's truly wonderful geological heritage. The present system, which requires a password and significant computer skills, effectively cuts the lay person off from such an appreciation.

INTRODUCTION

The author was contracted by Department of Primary Industries Parks Water and Environment (DPIPWE), through the Geoconservation Section, in March 2013 to undertake a desktop study and provide a review of the listed geodiversity sites in the Tasmanian Geoconservation Database on the Natural Values Atlas within the Tasmanian Wilderness World Heritage Area (TWWHA), with the aim of identifying any gaps in the coverage, particularly with respect to geological or bedrock sites. Two other contractors were to assess the listings for periglacial/glacial sites and soil/regolith sites respectively. A listing of the 291 sites which lie within, or partly within, the TWWHA was provided. The author has divided the 291 sites according to age, from Quaternary/Recent to Precambrian, this being the primary way that geological units and features are classified and mapped by geologists in the state. This allows a broad comparison to then be made to the various rock sequences and units which make up the TWWHA, to give a general guide as to whether any units or sequences may be under- or over-represented in the listing of sites. The groupings of sites are reviewed for completeness and integrity, and suggestions made regarding gaps in the coverage, unnecessary overlaps, and any shortcomings in the site listings. Some general comments are also made on the nature and workings of the geoconservation database.

CLASSIFICATION OF SITES BY AGE AND TYPE

Over two thirds of the sites involve landforms and geomorphological features, which are here grouped as Quaternary/Recent. The remaining sites can mostly be allocated to a particular geological period. Table 1 is a summary list of the sites, and Table 2 lists all sites within their particular categories, with the geosite number of each site shown, plus the proposer's initials and date of nomination (GD= Grant Dixon, JB= Jason Bradley, CS= Chris Sharples, MP= Mike Pemberton, RE= Rolan Eberhard, KK= Kevin Kiernan, PM= Peter McIntosh, AH= Andrew Hammond, KS= Kathryn Storey, CC= Clive Calver).

Table 1 Geodiversity sites by age and general category.

Age	Site type	Number of sites
QUATERNARY/RECENT (203 sites, 69.8%)	Fluvial landforms	15
	Fluvial deposits	4
	Coastal dunes	24
	Coastal landforms other than dunes	11
	Coastal karst	2
	Coastal deposits	1
	Marine terraces	2
	Sea caves	5
	Inland dunes and sand deposits	2
	Karst regions and systems	19
	Karst landforms	2
	Karst deposits	1
	Glacial regions	13
	Glacial landforms	28
	Glacial deposits	6
	Solifluction landforms and deposits	3
	Periglacial landforms and deposits	5
	Regional mountain terrains	5
	Quaternary fossils	6
	Cliffs and escarpments	5
	Cross-strike drainage	2
	Alkaline pans	1
	River Gorges	2
	Lakes	4
	Meteorite impact features	2
	Waterfalls	3
	Badlands	1
	Peat deposits and landforms	11
	Mass movement features	6
	Unusual rock outcrops	2
	Unusual beach deposit	1
	Soils	2
	Quaternary minerals	3
Breccia cones	1	
Cuestas	1	
Strike ridges	2	
TERTIARY (7 sites, 2.4%)	Tectonic features	4
	Basalts	3
CRETACEOUS (2 sites, 0.7%)	Rock types	2
JURASSIC (7 sites, 2.4%)	Dolerite contacts	5
	Mineralisation	1
	Jurassic basalts	1
PERMIAN – TRIASSIC (10 sites, 3.4%)	Rock type or sequences	6
	Unconformity surface	3
	Structures	1
DEVONIAN (6 sites, 2.1%)	Minerals and mineralisation	5
	Structure	1
SILURIAN – DEVONIAN (2 sites, 0.7%)	Fossils	1
	Type sections	1
ORDOVICIAN (8 sites, 2.7%)	Rock types, sequences and type sections	7
	Fossil Localities	1

CAMBRIAN (16 sites, 5.5%)	Rock types and sequences	5
	Unconformities	4
	Structures	4
	Fossil localities	3
PRECAMBRIAN (31 sites, 10.6%)	Rock types Tyennan Mesoproterozoic	12
	Rock types and type sections Neoproterozoic	14
	Structures	2
	Regions	2
	Unconformities	1

Table 2 Individual geodiversity sites by category, with geosite number and proposer with year of nomination.

QUATERNARY - RECENT LANDFORMS and DEPOSITS (203 sites = 69.8%)			
Fluvial landforms (15)	Braddon River Floodplain and Terraces	2170	GD1990
	Birchs Inlet Terraces	2177	JB1994
	Horseshoe Bend Incised Meander and Alluvium	2360	JB1994
	Little Eagle Creek Levee	2364	JB1994
	Tuan Gabby Flats	2371	JB1994
	New River Delta and Overbank Deposits	2484	GD1990
	Sprent River Fan Delta	2528	JB2000
	Macquarie Graben Fluvial Geomorphic Systems	2532	CS2005
	New River Undisturbed Fluvial and Karst Systems	2462	GD1995
	Jacksons Creek Drainage	2661	GD1990
	Lower Gordon River Levee Flood Basin System	2801	GD1990
	Lower Gordon Camp Levee	2809	JB1994
	Richardsons Beach Levee Study Site	2812	JB1994
	Myrtle Creek River Capture	3077	GD1992
	Hannant Inlet pre-last Glacial Sediments and Fossil Wood	2884, 3173	GD1990
Fluvial deposits (4)	Lower Eagle Creek Alluvium	2357	JB1994
	Timms Eddy Post Settlement Deposits	2370	JB1994
	Warners Landing Perched Lake Sediments and Karst	2523	JB1994
	Middle Gordon Alluvium	2531	JB2003
Coastal dunes (24)	World Heritage Area Sandy Coasts	2929	MP2004
	Window Pane Bay High-altitude Dune	2791	GD1990
	Window Pane Bay Dunes	3135	MP2004
	Stephens Bay Dunes	3143, 2929	MP2004
	Towterer Beach Stabilised Dunes	2894, 2929	GD1992
	Blowhole Valley Sands	2917	GD1990
	South East Bight Dunes	3144, 2929	MP2004
	Quail Flat Dunes	3145, 2929	MP2004
	Alfild Bight-Towterer Beach-Wreck Bay Dunes	3146, 2929	MP2004
	Mulcahy Bay Dunes	3147, 2929	MP2004
	Nye Bay Dunes	3148, 2929	MP2004
	Sandblow Bay Dunes	3149, 2929	MP2004
	South Cape Bay Dunes	3150, 2929	MP2004
	Granite Beach Dunes	3151, 2929	MP2004
	Surprise Bay Dunes	3152, 2929	MP2004
Osmiridium Beach Dunes	3153, 2929	MP2004	
Prion Beach Dunes	3154, 2929	MP2004	

	Deadmans Bay Dunes	3155, 2929	MP2004
	Louisa Bay Dunes	3156, 2929	MP2004
	Cox Bight Dunes	3157, 2929	MP2004
	New Harbour Dunes	3158, 2929	MP2004
	Hidden Bay Dunes	3159, 2929	MP2004
	Ketchem Bay Dunes	3160, 2929	MP2004
	Wilson Bight Dunes	3161, 2929	MP2004
Coastal landforms other than dunes (11)	Mannigans Inlet	2366	JB1994
	Island Bay Structurally Controlled Coastline	2790	GD1990
	Coffin Bay Raised Shoreline	2889	GD1990
	Port Davey - Bathurst Harbour Ria	2893	GD1990
	Flat Top and Round Islands Structurally-controlled Geomorphology	2900	GD1995
	De Witt Island Coastal Stream Capture	2902	GD1995
	Louisa Bay Tomolo	2907	GD1990
	Granite Beach	2919	GD1990
	Pedra Branca Shore Platform	2925	GD1995
	South Cape Bay Shore Platform	2926	GD1990
	Ile du Golfe	2928	RE2003
Coastal karst (2)	Surprise Bay Coastal Karst	2912	CSI996
	Rocky Boat Inlet Karst	2927	RE2003
Coastal deposits (1)	Wrights Bay Latest Holocene Deposits - mouth of Gordon	2373	JB1994
Marine terraces (2)	Isolated Hill Stranded Marine Terraces and Cliff near Mulcahy Bay	2892	GD1990
	Louisa River Terraces	2904	GD1990
Sea caves (5)	Sarah Island Sea Caves	2172	GD1995
	Berry Head Sea Cave	2891	GD1990
	Louisa Island Collapsed Sea Cave	2899	GD1995
	Flat Top Island Sea Caves	2905	GD1995
	Walker Island Blowhole	2910	GD2005
Inland dunes and sand deposits (2)	Central Plateau Lunettes	2703	JB2004
	Lake Ada Dunes	3134, 2703	GD1990
Karst regions and systems (19)	Algonkian Rivulet Karst	2347	GD1990
	Precipitous Bluff Limestone Sequence and Karst	2481	GD1990
	Manuka Creek - Blakes Opening - Mt Picton Karst	2542	CSI996
	Hastings - Upper Creekton Rivulet Karst	2543	CSI996
	Picton River Karst	2544	CSI996
	North Lune and Lune Plains Karst	2547	CSI996
	Cook Creek Karst	2552	CSI996
	Exit Cave - D'Entrecasteaux Valley Karst Area	2553	GD1990
	Riveaux - Blakes Glaciokarst	2558	KK2004
	Mole Creek Karst	2685	JB1994
	Lower Franklin Valley Karst	2800	GD1990
	Champ Cliff Limestone and Karst	2802	JB1994
	Lower Maxwell Valley Karstland -dolomite	2815	RE2010
	Mt Weld Karst - dolomite	3035, 3045	CSI996
	Upper Styx Karst Systems - dolomite	3038	CSI996
	Weld River Basin Karst and Fluvial Systems - dolomite	3045	CS2005
	Mt Anne - North East Ridge Glaciokarst - dolomite	3073, 3045	GD1990
	Junee - Florentine Karst Systems	3081	CSI996
	Wargata Mina - Judds Cavern Karst System	2485	GD1990
Karst landforms (2)	Neils Tunnel Natural Bridge	3185	RE2011
	Olga River - Weld River Arch	3076, 3045	CS2005
Karst deposits (1)	March Fly Pot Bone Deposit - Lune Sugarloaf	3183, 2160	RE2011

Glacial regions (13)	Southwest Tasmania Glacial Areas	2787	CSI996
	Central Highlands Cainozoic Glacial Area	2953	GD1996
	Cradle Mountain Glacial Features	2942	GD1990
	Frenchmans Cap Glacial Area	2363	GD1990
	Liffey- Poatina Glacial Areas	2508	CSI996
	Lower Weld Valley Glacial Site	2537	CSI996
	Mt Geryon - Acropolis Glacial Geomorphology	2656	GD1990
	Julian Lakes Dead Ice Topography	2662	GD1990
	Labyrinth Glaciated Terrain	2664	GD1990
	Walls of Jerusalem Last Glacial Ice Window	2677	GD1990
	Western Arthur Range Glaciated Terrain	2788	GD1990
	Snowy Range Glacial Systems	3034	CSI996
	Mt Anne Massif Glacial Landforms	3072	GD1990
Glacial landforms (28)	Lake Tahune Glacio-karstic Cirque	2350	GD1990
	Chalice Lake Rock Basin Lake	2658	GD1990
	Forth Valley Glacial Trough	2660	GD1990
	Junction Lake Glacial Valley Step	2663	GD1990
	Lake Adelaide Glacial Rock Basin Lake	2665	GD1990
	Lake Explorer Rock Basin Lake	2666	GD1990
	Lake Helios Glacial Striae	2667	GD1990
	Lake Leonis Pressure Release Chasm	2668	GD1990
	Lees Plains Glacial Valley Profile	2669	GD1990
	Lobster Rivulet Ice Spillover Area	2670	GD1990
	Moses Creek Stepped Valley	2672	GD1990
	Mt Rogoona Nunatak	2673	GD1990
	Narcissus Valley Fluted Moraines	2674	GD1990
	Pillinger Bog End Moraine	2696	CSI996
	Wurragarra Creek Glacially Disrupted Drainage	2697	CSI996
	Upper Mersey Overridden Valley Walls	2698	CSI996
	Chapter Lake Hanging Valley	2699	CSI996
	Talinah Lagoon End Moraine Complex	2701	CSI996
	Cuvier Valley Moraine Complex	2708	GD1990
	Cynthia Bay Moraines	2709	GD1990
	Lake Rufus Glacial Trough	2710	GD1990
	Lake St Clair Glacial Trough	2711	GD1990
	Narcissus Valley - ? Esker	2715	GD1990
	Upper Franklin Valley Glacial Features	2716	GD1990
	Surprise Valley Glacial Trough	2717	GD1992
	Mt Olympus Cirques	2718	JB1994
	Hamilton Range Dolerite Lag Boulders	2797	GD1990
	Mt Curly Glaciated Surface	3074	GD1990
Glacial deposits (6)	Redan Hill Erratics	2353	GD1990
	Stonehaven Creek Glacial Sediments	2354	GD1990
	Double Lagoon Ground Moraine	2498	GD1990
	Lake Ada Ground Moraine	2499	GD1990
	Blakes Opening Glacial/Interglacial Sequence	2567	PM2007
	Moses Creek Deformation Till	2695	CSI996
Solifluction landforms and deposits (3)	The Boomerang Solifluction Steps	2486	GD1990
	Mt Rufus Solifluction Terraces	2712	GD1990
	Wilson Bight Palaeocolluvium	2911	GD1990
Periglacial landforms and deposits (5)	Moonlight Ridge Periglacial Features	2487	GD1990
	Pine Lake Glacis	2500	GD1990
	Mt Olympus Rock Glaciers	2714	GD1990
	Frenchmans Cap - Summit Nivation Cirque	2349	GD1990
	Mt La Perouse Nivation Site	2918	GD1990

Regional mountain terrains (5)	Mt Picton - Southern Ranges Terrain	2480	GD1990
	Massif Mountain Geomorphology	2671	GD1990
	Central Plateau Terrain	2684	GD1990
	Upper Mersey - King William Range Terrain	2707	GD1990
	Denison Range Lower Palaeozoic Terrain	3060	GD1990
Quaternary fossils (6)	Coal Head Pleistocene Plant Fossil Site	2178	CS1996
	Mersey/Cathedral Pleistocene Plant Fossil Site	2654, 3173	GD1990
	Melaleuca Fossil Flora	2786, 3713	GD1990
	Cox Bight Fossil Trees	3165, 3173	CS2011
	Cenozoic Plant Macrofossils of Tasmania	3173	RE2011
	Melaleuca Late Pleistocene Plant Fossil Site	3208, 3173	RE2011
Cliffs and escarpments (5)	Frenchmans Cap Cliff	2348	GD1990
	Precipitous Bluff Dolerite Cliffs	2479	GD1990
	Great Western Tiers Escarpment	2504	AH1996
	Scarp West of D'Aguilar Range	2814	JB1994
	Eliza Plateau	3054	GD1990
Cross-strike drainage (2)	Middle Franklin River Cross-strike Drainage	2352	GD1990
	Middle Gordon River Cross-strike Drainage	2799	GD1990
Alkaline pans (1)	Upper Maxwell Valley Alkaline Pans	2355	GD1990
River Gorges (2)	First Gorge Structure - Gordon River	2358	JB1994
	Gordon River Gorge above Cataract Creek	2805	JB1994
Lakes (4)	Lake Morrison - Lower Gordon	2362	JB1994
	Lake Sydney Glacio-karstic Lake	2483	GD1990
	Lake Fidler and Sulphide Pool Meromictic Lakes	2808	JB1994
	Lake Pedder - the Original	3088	CS1996
Meteorite impact features (2)	Darwin Crater	2346	GD1990
	Darwin Glass Strewn Field	2375	CS1996
Waterfalls (3)	Vanishing Falls	2482	GD1990
	Liffey Falls and Surrounds	2501	JB1994
	Rocky Sprent Falls	2813	JB1994
Badlands (1)	Bradleys Hill Badlands - Tertiary sediments	2525	JB1994
Peat deposits and landforms (11)	Western Tasmania Blanket Bogs	2527	GD1996
	Moore's Valley 'Stone Sheep' - Lag Boulders and Peat Mounds	2529, 3184	JB2000
	Spero River Peat Mounds	2530, 3184	CS2003
	Zion Vale Bog	2678	GD1990
	Clarence Lagoon String Bogs	2725	KS2007
	Spica Hills Peat	2793	GD1990
	Melaleuca Peat Mounds	2794, 3184	MP20000
	Louisa Plains Blanket Bog and Peat Mounds	2903, 3184	GD1990
	Birchs Inlet Peats	2982	GD1990
	Crossing Plains Peat Mounds	3175, 3184	KS2011
Southwest Tasmania Peat Mounds	3184	KS2011	
Mass movement features (6)	Cathedral Mountain Landslip	2657	GD1990
	Falling Mountain Rockfall	2659	GD1990
	Nells Bluff Slab Topple	2675	GD1990
	Mt King William I Dilation Trench	2713	GD1990
	Badger Creek Collapsed Gorge and Enclosed Basin	2789	GD1990
	De Witt Island Mass Movement Landforms	2896	GD1995.
Unusual rock outcrops (2)	Toad Rock Tor	2676	GD1990
	South West Cape Granite Weathering Features	2906	GD1990.
Unusual beach deposit (1)	Lake Flora hematite	2682	JB1994
Soils (2)	Wayatinah Dolerite Soils	2720	JB1994
	Maatsuyker Island Soils	2897	GD1990

Quaternary minerals (3)	Pedra Branca Mineralogy	2914	GD1990
	Adamsfield Workings Mineralogy	3051	GD1990
	Reward Creek - Jane River Mineralisation	2706	GD1990
Cuestas (1)	Stepped Hills Cuesta	3078	JB1995
Strike ridges (2)	Prince of Wales Range Strike Ridge	2526	CSI996
	Tiger Range Classical Fold Strike Ridge	3086	CSI996
TERTIARY (7 = 2.4%)			
Tectonic features (4)	Macquarie Harbour Graben	2173	JB1994
	Cloister Lagoon - Chapter Lake Fault Trace	2647	GD1990
	Great Pine Tier Tertiary Fault Trace	2655	GD1990
	Lake Edgar Fault	2784	GD1990
Basalts (3)	Liawenee Hill Basalt Flows	2497	GD1990
	Ibbotts Rivulet Basalt Jointing - near Lake Augusta	2642	GD1990
	Knyvett Falls Basalt Flow	2940	GD1990
CRETACEOUS (2 = 0.7%)			
Rock types (2)	Tasmanian Igneous Rocks of Cretaceous Age	2208	JB2010
	Trappes Inlet Lamprophyre - Lake Gordon - age unknown	3064	GD1990
JURASSIC (7 = 2.4%)			
Dolerite contacts (5)	Mt La Perouse - Maxwell Ridge Dolerite Contact	2488	GD1992
	Mt Gould Intrusive Contact	2650	GD1990
	Mt Pelion East Dolerite Columns Imprint	2679	GD1992
	South Cape Intrusive Contact	2922	GD1990
	Mt Sarah Jane Dolerite Contact	3063	GD1990
Mineralisation (1)	Mt Weld Crystal Caves	3024, 3045	CS2005
Jurassic basalts (1)	Lune River Area Jurassic Basalts and Gemfield Association	2548	CSI996
PERMIAN – TRIASSIC (10 = 3.4%)			
Rock type or sequence (6)	Goulds Sugarloaf Parmeener Supergroup Section	2342	GD1990
	Mt La Perouse - Moonlight Ridge Parmeener Supergroup Exposures	2478	GD1990
	The Temple Remnant Triassic Sandstone	2653	GD1990
	Lake Will Oil Shale	2937	GD1990
	Little Horn Late Palaeozoic Scree	2938	GD1990
	Mt Inglis Permian Type Section	2939	GD1990
Unconformity surface (3)	King William Saddle Palaeozoic Glaciated Surface	2705	GD1990
	Barn Bluff - Mt Inglis Late Palaeozoic Glacial Valley	2935	GD1990
	Lake Ellen Palaeozoic Surface	2936	GD1990
Structures (1)	Moonlight Ridge Triassic Sedimentary Structures	2477	GD1990

DEVONIAN (6 = 2.1%)			
Minerals and mineralisation (5)	Bubs Hill Quartz Crystal Locality	2338	GD1990
	Commonwealth Creek Copper Workings	2648	GD1990
	Oakleigh Creek Mine	2651	GD1990
	Pelion Plains Copper Workings	2652	GD1990
	Lindsay Hill Sulphide Vein - Joe Page Bay	2785	GD1990
Structure (1)	Olga Syncline	2798	GD1990
SILURIAN DEVONIAN (2 = 0.7%)			
Fossils (1)	Victoria Pass Graptolites	2372	JB1994
Type sections (1)	Tiger Range Group Type Section	3087	CS1996
ORDOVICIAN (8 = 2.7%)			
Rock types, sequences and type sections (7)	Bubs Hill Fossiliferous Limestone and Karst	2337	GD1990
	Surprise Bay Deep-water Limestone	2916	GD1990
	Precipitous Bluff Limestone Sequence and Karst	2481, 2562	GD1990
	Precipitous Bluff Beds Type Section	2555	CS1996
	New River Beds Type Section	2556	CS1996
	Prion Beach Beds Type Section	2913	CS1996
	Florentine Valley Formation Type Site	3059	GD1990
Fossil Localities (1)	Marriott Hill Fossil Locality - near Adamsfield	3061	GD1990
CAMBRIAN (16 = 5.3%)			
Rock types and sequences (5)	Huon River Cambrian Turbidites - not actually within TWWHA	2560	CC2005
	Mewstone Granite - unknown age	2909	GD1995
	Adamsfield Open Cut Palaeoplacer	3049	GD1990
	Adamsfield - Serpentinite Creek Ultramafics	3050	GD1990
	Denison Range Flysch Sequence	3069	GD1990
Unconformities (4)	Elliott Range Palaeozoic Unconformity	2341	GD1990
	Mt McCutcheon Palaeozoic Unconformity	2343	GD1990
	Mulcahy Bay Unconformity	2895	GD2005
	Denison Gap Unconformity	3053	GD1990
Structures (4)	Clytie Cove Sedimentary Structures	2783	GD1990
	De Witt Island Folding	2901	GD1995
	Osmiridium Beach Shear Zone	2920	GD1990
	Point Vivian Sedimentary Structures	2923	GD1990
Fossil localities (3)	Flagstone Knoll Cambrian Fossils	3055	GD1990
	Junction Hill Cambrian Fossils	3058	GD1990
	Trial Ridge Cambrian Fossil Locality	3065	GD1990

PRECAMBRIAN (31 = 10.6%)			
Rock types Tyennan Mesoproterozoic (12)	Bills Creek Eclogite	2336	GD1990
	Cardigan Flats Schist	2339	GD1990
	Collingwood River White Schist	2340	GD1990
	Mt Arrowsmith - Scotchfire Metamorphics	2719	JB1994
	Bond Bay Schist	2883	GD1990
	Nye Bay Mylonite Zone	2885	GD1990
	Payne Bay Dolerite	2886	GD1990
	Trumpeter Islets Porphyroblasts	2887	GD1990
	Maatsuyker Island 'Ribbon Rock'	2898	GD1995
	Wilson Bight Schist	2908	GD1990
	Atkins Range Ironstone	3052	GD1990
	White Spur Clastic Dykes - Lake Gordon area	3068	GD1990
	Rock types and type sections Neoproterozoic (14)	Blakes Opening Agate in Precambrian Dolomite - age uncertain	2549
Huon River Neoproterozoic Glacigenic Rocks		2561	CC2005
Humboldt Divide Stromatolite-bearing Dolomite Locality		3056	GD1990
Upper Weld Valley Mixtite - Dolomite Association		3066	GD1990
Annakananda Formation Type Section		3089	CSI996
Gomorrhah Dolomite Type Section		3091	CSI996
Lake Judd Formation Type Section		3092	CSI996
Lake Timk Formation Type Area		3093	CSI996
Lonely Tarns Formation		3094	CSI996
Sarah-Jane Quartzite Type Section		3095	CSI996
Scotts Peak Road Member		3096	CSI996
Styx Dolomite Type Section		3097	CSI996
Twin Creeks Formation Type Section		3098	CSI996
Devils Eye Dolomite Type Area		3099	CSI996
Structures (2)	Raglan Range Precambrian Fold Hinge	2345	GD1990
	Wallaby Bay Remnant Sedimentary Structures	2888	GD1990
Regions (2)	Jubilee Region	3025	GD1990
	Tyennan Region	3080	GD1990
Unconformities (1)	Mt Anne Precambrian Unconformity	3062	GD1990

COMMENTS ON THE GROUPINGS AND SITES

I. Quaternary/Recent sites

Some 203 of the 291 TWWHA sites, or 70%, represent geomorphological features. This reflects the great diversity of landscapes and processes within the TWWHA, with a large range of important glacial (47 sites), fluvial (19), coastal (45), karst (22) and other landforms present. It probably also reflects the preponderance of specialist interests within the group involved in developing and maintaining the geoconservation database, but this is not seen as a negative factor. There are many important sites, a lot of research has been done, and the sites must stand on their individual merit. Some general and detailed comments on the sites follow.

Although there are 13 glacial regions listed, it is perhaps surprising that Schnells Ridge is not listed, considering the important recent dating work on erratic moraine boulders which has been done there (Kiernan et al, 2004).

The Regional Mountain Terrains site 'Upper Mersey King William Range Terrain' (2707) includes much of the headwater country of the Forth, Murchison, King, Franklin and Derwent Rivers, as well as the Mersey. It is separated into two areas, has considerable overlap with the 'Central Highlands Cainozoic Glacial Area' (2953) and 'Central Plateau Terrain' (2684), but seems to have little in the way of unity or integrity to justify its nomination. It is recommended that it be removed. The justification for such large sites generally needs to be carefully considered, since they may only be warranted where there are clear boundaries and a strong internal consistency.

The 'Cliffs and Escarpments' grouping seems to be a rather random selection, with Frenchmans Cap (2348) represented but not Federation Peak, and several dolerite escarpments (Precipitous Bluff, Great Western Tiers) but not such places as Eldon Bluff, Traveller Range, Mt Olympus, Mt Geryon, The Acropolis, etc. This seems to demonstrate a degree of arbitrariness in the selection of such sites.

Similarly, the 'River Gorges' group has two sites, both from the Gordon River (First Gorge and the Lower Gordon Gorge), but doesn't include the Dove River Gorge (a spectacular quartzite gorge nowadays used for canyoning), Franklin Gorge, the Gordon Gorge at The Thumbs, the Anne River Gorge etc. The question of what constitutes a listable gorge site needs to be considered. Different types of geology transected should perhaps be a factor.

Similarly for 'Lakes' - four lakes are nominated (Lake Morrison and Lake Fidler on the Lower Gordon, Lake Sydney, and the original Lake Pedder). But many of our other lakes could be equally important and special - Lake Rhona, Lake Curly, Lake Judd, Lake Oberon, Crater Lake, Lake Will etc. Are lakes really geodiversity sites, and what criteria should be applied in selecting them for nomination?

Similar considerations apply to the selection of sites for the 'Waterfalls', 'Mass Movement Features', 'Strike Ridges' and 'Unusual Rock Outcrops' categories.

One category not represented but which is worthy of consideration is Lightning Strike sites. Two such sites known to the author, at Little Plateau near Cradle Mountain, and at Mt Sarah Jane, are of considerable interest in demonstrating the power of lightning to move and shatter rocks, and to produce ground features related to steam flashing.

2. Tertiary sites

The seven sites include four which are based on significant Tertiary fault structures which have a clear surface expression (Macquarie Harbour Graben, Cloister Lagoon - Chapter Lake Fault Trace, Great Pine Tier Tertiary Fault Trace, Lake Edgar Fault) and three sites based on basalt lava flow features (Liawenee Hill, Ibbotts Rivulet near Lake Augusta, and Knyvett Falls). All seem reasonably well based.

3. Cretaceous sites

The one main site is based on a lamprophyre dyke exposed on the Gordon River Road at Trappes Inlet (3064), with an assumed Cretaceous age. This rock has not been dated, however, and its inclusion seems unwarranted. Most of the lamprophyres in Western Tasmania once assumed to be Cretaceous have been found, after dating, to be of Devonian age.

4. Jurassic sites

Although a large portion of the TWWHA is occupied by Jurassic dolerite, it is not unreasonable to find only seven Jurassic sites, since the extensive dolerite displays few variations of interest. Five of the sites relate to dolerite basal contacts, typically on rocks of the Parmeener Supergroup. The dolerite contact on Precambrian quartzite which is well exposed on the eastern flank of Cradle Mountain, and similar contacts against Precambrian rocks at Mt Anne-Mt Eliza, should also be considered.

5. Permian - Triassic sites

Permian - Triassic rocks are widespread within the TWWHA. The ten listed sites, comprising six rocks/sequences, three unconformity surfaces and one for sedimentary structures, appear justified, and generally reflect those areas where work has been done on the sequences. Some additional sites may be identifiable in the Pyramid Mountain - Rocky Hill area, after work on the Lyell Sheet (Calver et al, 1987).

6. Devonian sites

Five of these six sites are for mineral occurrences or old mines. The Bubs Hill Quartz Crystal site (2338) entry lacks any detailed information and seems of dubious value, considering there are very many sites where such crystals are collected (R.S. Bottrill, pers. comm.). The other four sites - Commonwealth Creek, Oakleigh Creek, Pelion Plains and Lindsay Hill - all relate to relatively small occurrences of temporarily commercial minerals, probably of Devonian age, in Precambrian host rocks. Considering how many such small old workings there are around Tasmania (many hundreds), most of which have not been considered for inclusion in the geoconservation database, it would seem that a good argument needs to be made that each site is of sufficient interest or uniqueness to warrant inclusion. It would appear to require more than just the fact that they occur within the TWWHA?

The Olga Syncline site (2798) is included as a classic Devonian fold structure, which it is. The faulted eastern boundary of the structure should be noted, however. The Tiger - Gordon Range synclinal structure is somewhat similar, but is listed in the Quaternary landscapes as the Tiger Range Classical Fold Strike Ridge site (3086).

7. Silurian - Devonian sites

Only two sites are listed, for the Victoria Pass Graptolites (2372) and the Tiger Range Group Type Section (3087). The author is not aware of other possible sites.

8. Ordovician sites

Ordovician siliciclastic sequences and overlying limestone sequences are important components of the TWWHA geology, mainly preserved in large Devonian synclinal folds,

e.g. the King – Franklin – Gordon - Olga area, the Rasselas Denison Range area, and the New River area. The siliciclastic units generally sit on top of Late Cambrian rocks of similar type, making up the Denison Group, and tend to be included in Cambrian sites, e.g. the Denison Range Flysh Sequence (3069). There are places, however, where only Ordovician rocks are present beneath the limestone e.g. western side of Olga Syncline, Giblin Syncline, and there is a good case for recognition of one or more sites representative of this situation.

There are seven sites representing the limestone sequences, mainly from the South Coast - Precipitous Bluff area, with one at Bubs Hill and one on the TWWHA boundary at Florentine Valley. One Ordovician fossil locality, near Adamsfield, has been recognised.

9. Cambrian sites

Although most of the state's Cambrian rocks- particularly the Mt Read Volcanics belt - lie outside the TWWHA, important sequences are found on the South Coast east of New River, in the Ironbound Range area, at Bathurst Harbour, in a few small areas around the Weld River, and in the Adamsfield - Mt Wedge - Denison Range area. Although the West Coast Range site appears on the list of TWWHA sites, it is essentially outside, and is not considered here. The Huon River Cambrian Turbidites (2560) site touches the TWWHA boundary at its western end, but is essentially outside the TWWHA.

Of the 15 remaining sites, five are rock units or sequences, four are 'structures' (two tectonic and two sedimentary), four are unconformities, and three are fossil localities. Excluding the unconformities, there are four sites from the South Coast and islands, one from the Bathurst Harbour sequence, and six from the Adamsfield - Denison Range area. There are no sites listed for the Ironbound Range sequence, perhaps reflecting the lack of detailed study.

The Mewstone Granite site (2909) is considered dubious, as the granite has not been dated (best guess by J. Everard, pers. comm., is Cambrian) and does not appear to have any special characteristics.

The De Witt Island Folding site (2901) is based on the tectonic folds seen in this very well exposed proximal flysch sequence, but it would seem better to include the rock sequence as a whole, since the sedimentary features (massive to graded conglomerate beds interbedded with siltstones and graded sandstones with a variety of structures) and compositional characteristics are also of considerable interest and value.

This also applies to the Point Vivian Sedimentary Structures site (2923), which has been nominated on the basis of the well-exposed sedimentary structures but would be better expanded, or re-worded, to encompass the formation as a whole.

It is similarly recommended that the Osmiridium Beach Shear Zone site (2920), nominated for the tectonic structure, should be expanded to encompass the unusual serpentinite-bearing multi-coloured conglomerates and sandstones of the Tyler Creek Beds within which the shear zone is located. The cliffs of these rocks are an impressive feature of Osmiridium Beach, and the formation is important on a state-wide basis.

Similar comments apply to the Clytie Cove Sedimentary Structures site (2783), in Bathurst Harbour, which would be better named the Clytie Cove Group Flysch Sequence to encompass all the important aspects of the rocks.

The area encompassed by the 'Denison Range Flysch Sequence' site (3069) includes the shallow marine Great Dome Sandstone lying above the Singing Creek flysch formation, and the Reeds Conglomerate fluvial formation lying above this again, so that the name is misleading. It is desirable to have the full sequence represented, since it is the best exposure of the flysch to non-marine transition in Tasmania, and has been the subject of several research papers. I suggest it be re-named the 'Denison Range Flysch - Paralic - Fluvial Sequence', and that references to papers on the slump sheets and thick-bedded sandstones be added (Corbett, 1972, 1973).

Three Cambrian fossil locality sites (Flagstone Knoll, Trial Ridge, Junction Hill) have been nominated, but it would be desirable to add the two important Late Cambrian sites from the South Coast, i.e. the Powena Beds at Point Cecil, with abundant trilobites, and the younger Wierah Formation at Prettys Point, also with trilobites. The fossil descriptions have been updated by J.R. Laurie (Laurie, 1996), and field descriptions of the rocks are given by Berry and Harley (1983) and Bischoff (1983).

10. Precambrian sites

Precambrian rocks are by far the most abundant type within the TWWHA, making up over 50% of the total area. Most of the rocks are of the metamorphosed Mesoproterozoic Tyennan type, but there is also a fair proportion of younger, relatively unmetamorphosed, Neoproterozoic sequences, with dolomitic units prominent, particularly in the Jubilee Region.

Of the 31 Precambrian sites, 12 are rock units of the Mesoproterozoic Tyennan type, 16 are rock units and type sections from the Neoproterozoic, two are regions (Tyennan and Jubilee), two are structures, and one is an unconformity.

The Jubilee Region site (3025) seems difficult to justify, since this refers to an area where the younger Precambrian rocks are exposed, in somewhat scattered fashion through cover rocks, east of the Tyennan Region. It seems likely that the same sequences are present beneath the younger cover up the eastern flank of the Tyennan block to the north, and that there is some connection to the same sequences in the north west of the state. It seems unlikely that the area represents any sort of tectonic or palaeogeographic entity (unlike the Tyennan Region, which was a tectonic entity during the Tyennan Orogeny, and a palaeogeographic high during the Late Cambrian) and the author recommends that it be removed.

The Tyennan Region site (3080) needs to be updated to include the Cradle Mountain section of the region, which is generally accepted as an integral part of it.

The 'Trumpeter Island Porphyroblasts' site (2887) should be re-named as the Trumpeter Island Porphyroblastic Schist.

The Maatsuyker Island 'Ribbon Rock' site (2898) seems dubious, as such banded schists and phyllites are not uncommon, e.g. there are good examples at Dove Lake.

The Atkins Range Ironstone site (3052) is based on small outcrops of schist with specular hematite aligned on a cleavage. The origin of these has not been investigated, but it seems they are not like the prominently banded chemical iron stones of the Pilbara and elsewhere, which seems to be implied in their recognition as worthy of nomination?

The 'Wallaby Bay Remnant Sedimentary Structures' site (2888) needs to have a proper reference citation (Williams, 1982).

GENERAL CONCLUSIONS AND CONSIDERATIONS

1. The high proportion of Quaternary/Recent sites (70%) seems to be mainly a reflection of the great variety of geomorphological features preserved in the TWWHA. However, there appears to be a degree of randomness involved in the selection of some sites.
2. No glaring gaps have been identified in the listings from the older rock units - partly a reflection of the fact that most of these units are better represented outside the TWWHA. However, some possible additional sites from areas within the TWWHA have been suggested.
3. Attention is drawn to some sites which do not appear to be justified or sufficiently clearly argued.
4. There would appear to be a need for a careful overview of sites, both within the database and when they are being nominated, to ensure that the nominations are sensible, clearly justified, properly documented and not overlapping or ambiguous. It seems to be necessarily the case that nearly all sites are nominated by members of the Tasmanian Geoconservation Database Reference Group - the same group responsible for vetting the nominations - and it is suggested that an informal 'devil's advocate' role within this group might be worthwhile.
5. The author sees a need for information about the sites, or at least the important and more visually impressive ones, to be made more accessible to the general public. At the moment there is a fairly difficult, computer-based process involved in accessing information about our important geological sites. This process requires a password to be allocated by the Natural Values Atlas group, and is thus basically unavailable to the interested layman. Even if accessed, there are few images of the features involved to show what they look like.

If we have such an array of wonderful geodiversity sites, on a world scale, shouldn't we make something of this available to all those who have ownership of our wilderness areas - not keep it within a small 'elite' group, and use it basically for administrative purposes, as is essentially the case at the moment? The original small book on

'Geological Monuments in Tasmania', produced by the Geological Society of Australia Tasmanian Division in 1979, was the last time the general public was able to see what Tasmania had in the way of important geological features. This book dealt with 60 sites *outside the National Parks*, and was state-wide in coverage. Any update would probably also need to be state-wide.

I believe it should be possible to distil a manageable number of the best sites from the very large inventory now available, and present them to the public in an easily accessible form, with images and explanations, so that all can appreciate something of our world-class geological heritage.

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