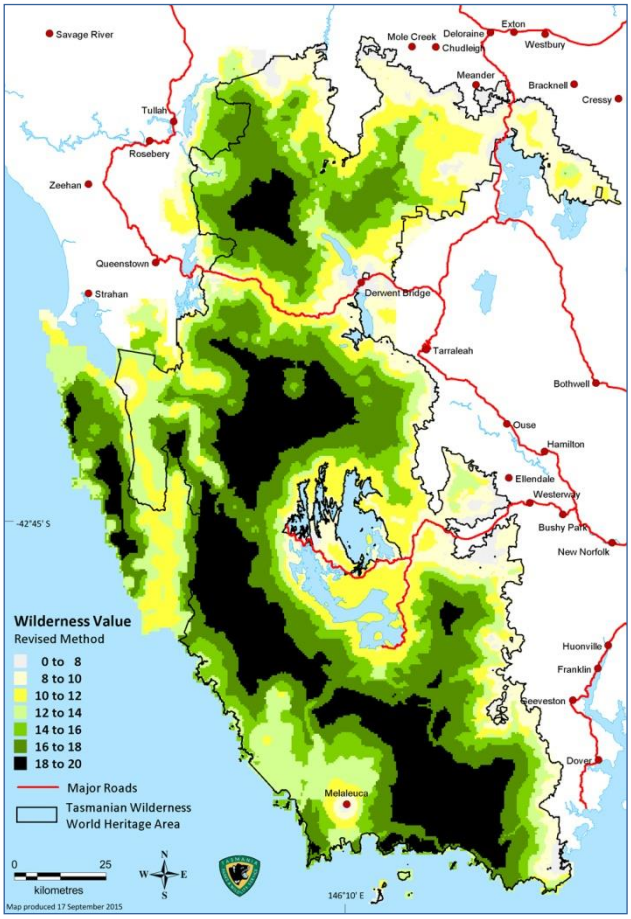
Martin Hawes
Walking Track Design and Management

Tasmanian Wilderness World Heritage Area

Assessment of Wilderness Value

Stage 2: Entire TWWHA



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Summary

Two computer-based methodologies, the National Wilderness Inventory (NWI) methodology and a revised version of this, were used to assess wilderness value across the Tasmanian Wilderness World Heritage Area (TWWHA) and contiguous wild areas based on input geodata that was (mostly) current in 2015. The results were used to assess the current status of wilderness across the region and the changes in wilderness value relative to the results of similar studies undertaken in 1995 and 2005.

The 2015 results were broadly similar to those obtained in 2005, although substantial losses due to post-2005 roading were observed in several areas, particularly the Counsel River area. Gains in wilderness value due to the closure, downgrading or revegetation of roads and vehicle tracks were observed in the area west of Macquarie Harbour, the middle Hansons River area and the area north of Victoria Pass. Numerous apparent changes (mainly losses) in wilderness value were observed due the inclusion in the 2015 data set of features such as residences and areas of disturbed land that were overlooked in the 2005 analysis.

Comparison using the NWI methodology of current wilderness value with the results obtained in 1995 revealed numerous gains and losses, some of which had already been observed in 2005. Substantial gains in wilderness value, mostly due to the closure, downgrading or revegetation of roads and vehicle tracks, were observed in the area southwest of Macquarie Harbour, Moores Valley, Alma Valley, the northern half of the Jane River Track and Little Fisher Valley. Substantial losses, mostly due to huts or vehicle tracks that did not exist in 1995 or were not recorded in the 1995 study, were observed in the area south of Macquarie Harbour, the lower Gordon River, the Davey Gorge area, South West Cape, and the vicinity of Jubilee Road.

Most of the observed increases and decreases in wilderness value relative to 2005 could be explained as the results of changes in the source data, whether or not these corresponded to actual changes in geographical conditions. Minor variations were also observed in some areas due to the reappraisal of travelling times, and hence of Time Remoteness (one of the four components of Wilderness Value using the Revised methodology). By contrast, many of the changes observed relative to the 1995 study could not be explained because the authors did not participate in that study and the source data used in the 1995 analysis were not available.

It is recommended that the wilderness values of the TWWHA and adjacent high-value wilderness areas be periodically reassessed using the Revised methodology, and that the methodology be refined as better data and new computing technologies become available. In particular it is recommended that the methodology be expanded to take account of the impact of viewfield disturbances and aircraft overflights and landings, and that an algorithm be developed to calculate Time Remoteness when the required computing resources become available.

1 Context of the current study

The wilderness values[1] of the region that is now the TWWHA have been assessed several times over recent decades using a variety of methodologies. One of these was the National Wilderness Inventory (NWI) methodology, which was developed by the Australian Heritage Commission in the mid 1990s and has formed the basis for several overseas studies. The NWI methodology was used to assess wilderness values across much of Australia including most of Tasmania in 1995, the results forming part of the basis for the 1997 Tasmanian Regional Forest Agreement (RFA).

In 2005 the authors, assisted by the PWS's Track Monitoring Officer Grant Dixon, used the NWI methodology to reassess the wilderness values of the TWWHA and the changes in wilderness value that had occurred since 1995. They also developed and utilised a revised methodology that corrected some of the deficiencies of the NWI system, principally by taking vegetation and terrain into account when assessing access remoteness[2]. For clarity, the Revised methodology will henceforth be referred to using capitalisation.

In July 2015 the authors were commissioned to use the Revised methodology to assess the wilderness values of the 2012/13 extensions to the TWWHA. The brief for the current study was to assess the wilderness values of the entire TWWHA using both the NWI and Revised methodologies, and to compare the results to those obtained in the 1995 and 2005 studies. Although the Revised methodology has advantages over the NWI methodology, use of the latter has allowed direct comparison with the results obtained in 1995 and hence provides a picture of changes in wilderness value over the past twenty years.

The results of the current study supersede the results of the July 2015 study of the 2012/13 TWWHA extensions, because they are based on a more rigorous analysis of the data set, on more extensive data (for example, additional data became available on the location of recently logged areas), and on a more thorough assessment of Time Remoteness.

[1] See section 2 for a definition of this term.

[2] A report on this study can be found at www.parks.tas.gov.au/file.aspx?id=38815.

2 Definition of 'wilderness' and 'wilderness value'

The 1999 Tasmanian Wilderness World Heritage Area Management Plan notes that 'The commonly recognised qualities of wilderness are naturalness and remoteness'. The Plan states:

> *Wilderness is concisely defined as land remote from access by mechanised vehicles and from within which there is little or no consciousness of the environmental disturbance of contemporary people.*

The Plan recognises that Aboriginal custodianship and customary practices have been, and in many places throughout Australia continue to be, a significant factor in creating what non-Aboriginal people describe as wilderness.

The values associated with wilderness include aesthetic, cultural and spiritual qualities that are largely unquantifiable. Nevertheless it is possible to quantify many of the geographical attributes that contribute to naturalness and remoteness. In this paper the term 'wilderness value' will be used to denote the extent to which an area or locality exhibits the qualities of naturalness and remoteness, as measured by quantifying these geographical attributes. The term will be capitalised when it refers specifically to the numerical value calculated by either the NWI or the Revised methodology.

The NWI and Revised methodologies do not distinguish 'wilderness' from 'non wilderness'. Rather they assess Wilderness Value as a numerical continuum that corresponds to a spectrum of geographical conditions ranging from 'intensively developed' to 'highly remote and largely pristine'. It is recognised that no area on Earth is entirely unaffected by the activities of modern technological society, particularly given the influences of climate change.

3 Overview of the methodologies

The following section provides a broad outline of the methodologies used to calculate Wilderness Value. For details see the appendix.

3.1 The study region

The region across which Wilderness Value was assessed in the current study (using both methodologies) included the entire TWWHA as well as several adjacent wild areas. The latter included the areas west and south of Macquarie Harbour, the West Coast Range, the Tyndall Range, the Granite Tor area, the Reynolds Falls area and the area northeast of Skullbone Plains. These areas were included in the 2005 assessment (and in the 1995 assessment, which encompassed most of the state). The current study also included the Wentworth Hills area, which was not assessed in 2005.

Several parts of the current TWWHA extend beyond the boundaries of the region assessed in 2005. The largest of these are the Dove River Forest Reserve, the Sandbanks Tier – Threshermans Hill region of the Great Western Tiers, Mount Field National Park, and the Styx Valley – Maydena Range area.

The study region included off-shore islands that are part of the TWWHA.

3.2 The data-catchment region

By definition, the Wilderness Value of a location is influenced by geographical factors (such as the presence of roads) in areas remote from that location. The assessment of Wilderness Value within the study region therefore required analysis of geodata in surrounding areas.

For the purpose of the current and 2005 studies, data were analysed in a region that included the study region and extended 30 km from its boundary. The influence of geographical features more than 30 km remote from the study region was negligible and was therefore not assessed.

To reduce file sizes some data files were truncated less than 30 km from the study region boundary, providing it was clear that features outside the truncated area would have no influence on Wilderness Value anywhere within the region. For example, in the 'Buildings' file all buildings east of the Huon estuary were deleted, as it was obvious that no building in that area would be recorded as the closest building to any part of the study region.

3.3 The study grid

The assessment process required construction of a grid covering the study region. The 1995 and 2005 assessments used 200 m and 1 km grids respectively, the disparity due partly to the limited computing power available for the 2005 study. For the current study a 500 m grid was used, for the following reasons:

a) 500 m was considered likely to be the highest resolution at which the analysis would be practical given available computing power.
b) Compared to a 1 km resolution, an analysis based on a 500m grid would provide a more detailed baseline for assessing the impact of future changes such as road closures or the construction of tourism infrastructure.

c) Even if sufficient computing power had been available, an analysis at a resolution finer than 500 m was not considered justified given the likely margin of error in the input data, eg the location of town centres, Time Remoteness contours and impoundment shorelines (see section 4).

The grid was constructed so as to coincide at the 1 km level with the 1995 and 2005 grids, allowing direct comparison of results in areas where the studies coincided.

3.4 Components of Wilderness Value

The NWI and Revised methodologies both define Wilderness Value (WV) as the sum of four independent components. Three of these components are common to both methodologies, although there are differences in the algorithms used to calculate them. The values calculated for the component variables are converted to 'classes' in the range 0-5 and summed to yield an overall Wilderness Value in the range 0-20.

Remoteness from Settlement (RS) is a measure of the remoteness of grid-square centroids from towns, settlements and isolated residences. For the purpose of the current study clusters of residences and other infrastructure were regarded as towns or settlements only if they incorporated public infrastructure such as post offices or fire stations, or if they comprised dense concentrations of residences similar to towns that had such infrastructure.

Apparent Naturalness (AN) is a measure of remoteness from human artefacts such as towns, vehicular tracks, pipelines and areas of disturbed land. Categories of artefacts are weighted to reflect their perceived impact on Wilderness Value: for example, a Class 5 walking track 1 km distant has a slightly lower impact on Apparent Naturalness than a hydro impoundment 10 km distant.

Biophysical Naturalness (BN) is a measure of the physical condition of a particular locality. It was assessed by preparing a data file of polygons associated with disturbances such as land clearing and logging, assigning values to these polygons based on the degree of disturbance, and assigning values to each grid square based on the proportion of the square occupied by each category of polygon.

In the NWI methodology, Access Remoteness (AR) is a measure of remoteness from features associated with access such as roads, vehicle tracks, helipads and walking tracks. As with Apparent Naturalness, categories of features are weighted so that proximity to a road for example has a greater impact on AR than the same proximity to a walking track. AR does not take account of variations in travel speeds due to variations in terrain, walking track standard or vegetation type and density, although these factors can have a huge influence on walking speeds in Tasmania.

In the Revised methodology Access Remoteness is replaced by Time Remoteness (TR), which is a measure of the shortest non-mechanised travelling time from points of mechanised access. As in the 2005 study TR was assessed manually, based on detailed examination of topographic and vegetation-type maps and drawing on the authors' extensive bushwalking experience in Tasmania. TR values were recorded categorically, points in the study region being classified as having a time remoteness of 0-0.5 days, 0.5-1 days, 1-2 days or 2+ days.

4 Overview of data sources and discussion of accuracy

Data on the location, type and status of geographical features such as roads, dams, pipelines, jetties, buildings and towers were derived mostly from Tasmanian government GIS files, all in MapInfo format. The majority of these files were sourced from the Land Information System Tasmania (LIST) database. Other sources included PWS and Hydro Tasmania. Most data were listed as current (2015) although some files had not been updated for several years. (See section A2 in the appendix for details.)

Data were generally assumed to be accurate but were checked against the authors' personal knowledge as far as possible, and in some cases checked by consulting ListMap or Google Earth. For example, the 'building_points' file was found to include a shed on the Elliot Range approximately 1.5 km ESE of the summit, but there was no sign of it on ListMap. This was verified as an error and the data point was excluded from the analysis. Similarly the Mt McCall Road was listed in the 'Roads 25k' file as a closed access road, but for the purpose of this study it was classified as an open vehicle track based on knowledge of its access status and surface condition. Large mines were checked on ListMap and the boundaries of mined areas were drawn manually where necessary.

Geodata errors are a potential source of error in the calculation of Wilderness Value, particularly in remote areas. The erroneous omission or inclusion of roads and vehicle tracks is of particular concern because these features influence two of the four components of Wilderness Value (namely AN and either AR or TR). One area where this is relevant is west of Macquarie Harbour, where the condition of a network of old vehicle tracks is unknown. Based on the 2015 data files these tracks were assumed to be defunct, despite the fact that they are visible in open country on ListMap. (It was assumed that the tracks are overgrown in forested and scrubby areas, and that the presence of remnant tracks in open country makes little difference to walking times.)

Another potential source of error is the calculation of Time Remoteness, which involves a degree of subjective judgment regarding optimum routes and walking speeds. For the current study TR values across the study region were recalculated from scratch, although the results were compared to those obtained in 2005 and in some cases adjusted after reconsideration. The 2005 and 2015 boundaries of the half-day, one-day and two-day TR zones generally match to within 1 km but in places differ by several kilometres in areas where no geographical changes have occurred, due to a reappraisal of travelling speeds. This can result in local differences in Wilderness Value of up to 2.64 (see 5.3).

The PWS 'Towns' file includes numerous features that are in reality only localities of dispersed residences (eg Waterloo), and in some cases are entirely devoid of settlement (eg Surrey Hills). In the current study most of these features were not classified as towns or settlements in the calculation of RS, although residences were classified as such. Some localities were identified as residences if residences were not listed in that locality in available data files but were known to occur there (as verified for example by real estate ads). Examples include Glenfern and Gormanston. Some of the observed changes in Wilderness Value since 2005 and 1995 appear to be due to the recent construction of residences in some locations or to the omission of residences from the earlier data sets.

The fact that WV was calculated at the centroids of a 500 m grid introduced error in the sense that remoteness calculations for points within any one grid square could vary by up to 500 m (indeed by up to 700 m along the diagonal). This error was judged to be acceptable given the scale of the study region, but use of a finer grid would be advisable if changes in WV were to be assessed across a smaller region (for example if one were assessing the impact of hut development on the wilderness values of the South Cape Bay area).

The conversion of polyline and polygonal input data to point data (see Appendix A1, Step 6) also introduced error, but the scale of the error was judged to be acceptable given the resolution of the study grid.

5 Results

The TWWHA covers a total area of 15,830 square kilometres (1.58 million hectares). The study grid comprised just under 77,000 500 x 500 m squares and covered a total area of 1.92 million hectares.

5.1 Current Wilderness Value – Revised methodology

Map 1 shows the current distribution of Wilderness Value as calculated using the Revised Methodology (see page 20).

The statistical distribution of Wilderness Value, expressed in terms of area and percentage area of the overall grid, is given in the following table.

Table 1: Distribution of Wilderness Value by area and percentage (Revised methodology)

WV	Area (sq km)	% Total area
0-8	1367	7%
8-10	2680	14%
10-12	2758	14%
12-14	2430	13%
14-16	2622	14%
16-18	4080	21%
18-20	3301	17%

Note that with the exception of the lowest category, the study region is fairly evenly divided between the indicated categories of wilderness value.

To illustrate the significance of these figures, the following table gives examples of locations having approximately the Wilderness Values shown.

Table 2: Examples of locations with the WV values indicated

WV	Sample locations
8	Wombat Pool; Lake Fenton
10	Mt Rufus; Red Knoll[3]
12	Little Hugel; Mt Beattie
14	Waterfall Valley; Mt Rugby
16	Lake Will; Lake Fortuna
18	Mt Achilles; Geeves Bluff
19	Mt Nereus; Upper New River Valley

[3] It might appear strange that Red Knoll, which is close to a road, dam and impoundment, should have higher WV than Lake Fenton for example. The reason is that while both places are close to roads, Lake Fenton is also close to residences (the nearby public cabins), and this proximity reduces the Remoteness from Settlement component of WV.

The three largest regions with WV > 18 encompass much of the Jane and Denison catchments, the Olga and Hardwood catchments, and the Old, New and Crossing catchments. There are also several smaller regions with WV > 18, the largest of which is in the upper Murchison catchment.

The impact on Wilderness Value of major artefacts such as roads and impoundments is evident from the low values in the vicinity of the Scotts Peak Road, Lyell Highway and Pedder Impoundment. Although vehicle tracks have substantially lower weighting in the calculations than major roads, their impact is also clearly evident particularly in the corridor of mineral-exploration tracks between Birchs Inlet and Elliott Bay. The impact of huts is also evident, for example in the 'hole' that surrounds the mineral-exploration hut near the southern end of the Jane River Track. A corridor of reduced WV is evident along the lower Gordon River thanks to the presence of several Hydro huts.

The impact of walking tracks is less immediately evident although the 'tracks' of walking tracks can be seen in a few places such as Moonlight Ridge. Besides having some impact on Apparent Naturalness walking tracks tend to reduce Time Remoteness, as is evident for example in the vicinity of the Pine Valley Track and the Overland Track north of Narcissus.

The impact of motorised boat access is particularly evident in the vicinity of Bathurst Harbour and to a lesser extent along the West Coast south of Elliott Bay. The impact is highest in locations where powered boats can put ashore, as Time Remoteness is zero at points of mechanised access.

Substantial areas of moderate to high Wilderness Value remain outside the TWWHA. Foremost among these are the region south of Macquarie Harbour (where WV exceeds 18 and where wilderness values could substantially increase if vehicle tracks were closed), the West Coast Range and the Granite Tor region. Other significant areas of moderate Wilderness Value outside the TWWHA are the Tyndall Range, the Reynolds Falls area, the Johnsons Lagoon – Little River area, and Wentworth Hills.

5.2 Current Wilderness Value – NWI methodology

Map 2 shows the current distribution of Wilderness Value as calculated using the NWI Methodology (see page 21).

The statistical distribution of Wilderness Value, expressed in terms of area and percentage area of the overall grid, is given in the following table.

Table 3: Distribution of Wilderness Value by area and percentage (NWI methodology)

WV	Area (sq km)	% Total area
0-8	346	2%
8-10	1140	6%
10-12	1886	10%
12-14	2462	13%
14-16	3274	17%
16-18	3563	19%
18-<20	4070	21%
20	2496	13%

Note that representation of the indicated categories tend to be skewed towards high-value wilderness, with the highest category (WV>18) covering the largest area. In particular, 13% of the study region has WV = 20. Recall that RS, AN and AR are truncated at 5, so information on wilderness values in areas where these thresholds are exceeded and where BN also equals 5 is effectively lost. (This is the main reason asymptotic functions were adopted for calculating RS, AN and TR in the Revised methodology).

While the overall distribution of Wilderness Value is similar to that obtained by the Revised methodology, there are substantial differences. The WV = 18 contour as measured by NWI roughly corresponds to the WV = 16 contour as measured by the Revised methodology. As with the Revised methodology the impact on Wilderness Value of major artefacts such as roads and impoundments is clearly evident.

The impact of walking tracks is more evident than in the results of the Revised methodology; see for example the Western Arthurs and the area of reduced WV in the vicinity of the Font in the Spires Range (where there is a short, isolated section of walking track). The small area of reduced WV in the vicinity of Fossil Hill in the Eldon Range is due to the presence of a Hydro helipad in that area.

A major contrast with the Revised methodology is that calculations of Access Remoteness do not take into account the impact of powered boat access in coastal areas. Hence much of the coastline north of Port Davey has WV at or near 20, despite the fact that powered boats can put ashore in places.

5.3 Comparison of current values with 2005 values (Revised methodology)

Comparison of current wilderness values with the 2005 results required conversion to a 1 km grid, since the 2005 study was undertaken at that resolution. The value assigned to each 1 km square for the 2015 results was the mean of the values of the four 500 m squares that comprised it. The differences between the 2015 and 2005 results are shown graphically in Map 3 on page 22. Values were only calculated for squares in the 2005 grid, which was smaller than the grid used for the current study. (The 2005 grid excluded some of the recent TWWHA extensions, notably the Mt Field National Park, the Maydena Range – Styx Valley area and the Sandbanks Tier – Threshermans Hill area of the Central Plateau, as well as the Wentworth Hills area.)

The following tables list the areas where WV has significantly increased or decreased, and indicate the known or assumed causes of the observed changes. Note that the closure, downgrading and/or revegetation of vehicle tracks and walking tracks can increase both AN and TR.

Table 4: Areas with substantial increase in WV since 2005 (Revised methodology)

Area	Cause of increase
Areas west of Macquarie Harbour, particularly Discovery Beach – Birthday Bay	Closed vehicle tracks that were previously recorded as walking tracks no longer listed and assumed to have largely revegetated
Area north of Victoria Pass	Former vehicle tracks have since closed and are assumed to have largely revegetated
Raglan Range	Biophysical Naturalness classified as 1 in 2005, 2 in 2015. (Area selectively logged and badly burnt.)
Lake Nameless	Time Remoteness reassessed
Middle Hansons River	Former vehicle track no longer listed

Table 5: Areas with substantial decrease in WV since 2005 (Revised methodology)

Area	Cause of decrease
Counsel River	Extensive recent logging and roading
Upper Gordon NE of Gell River	Time Remoteness reassessed
Gell River	Closed airstrips included in data. (Excluded in 2005 study because assumed to be revegetated, but still largely bare and clearly visible on ListMap)
Mt Shakespeare	Recent logging and roading
Heals Spur (near Wayatinah)	Additional roading
Lake Ina	Vehicle tracks not recorded in 2005
Lake Fergus / The Cellars	Vehicle tracks not recorded in 2005
Lake Butters	Reassessment of Time Remoteness taking into account powered boat access across Pillans Lake
Brandum / Elephant Rock	Not explained
Lower Hansons River	Proximity of previously unrecorded residence
Maggs Mountain	Residences in valley not recorded in 2005
Liffey River	Several residences not recorded in 2005
Vicinity of Murchison Impoundment	Influence on Time Remoteness of potential kayak access not taken into account in 2005
Sticht Range	Borders of vehicle track recorded as disturbed land in 2015 study; see comment below on the Mt McCall Road
Thomas Currie Rivulet (W Coast Range)	Area of disturbed land apparently overlooked in 2005 study
Corridor east of Kelly Basin Rd	Area of disturbed land apparently overlooked in 2005 study
Southern part of Macquarie Harbour	Ranger station on Sarah Island recorded as residence in 2015 but not in 2005
Mt McCall Rd	See comment following this table
Innes Peak area, Lewis River	Several tracks classified as walking track in 2005 reclassified as vehicle tracks in 2015
Mt Osmund area	Tracks classified as walking tracks in 2005, reclassified as closed vehicle tracks in 2015
Upper Huon River (S of Scotts Peak)	Time Remoteness reassessed
High Round Mountain	Time Remoteness reassessed
Mt Riveaux	Recent forestry roading
South Pictons	Recent forestry roading
Peak Rivulet	Recent forestry roading
Needle Rocks (Maatsuyker Island)	Spurious result due to the fact that the outer edges of the study grids do not coincide

The apparent decrease in wilderness value in the region surrounding the Mt McCall Road highlights the condition of this road as well as the role that disturbed areas of ground can play in the calculation of WV. The Mt McCall Road was classed as a vehicle track in both the 2005 and 2015 studies; the change in WV is due to the presence of several areas of disturbed ground along the length of the road, which were apparently overlooked in 2005. Disturbed areas greater than 1 hectare have a 'Major' weighting in the calculation of Apparent Naturalness, unlike vehicle tracks which are ranked 'Medium'. The fact that the cleared areas effectively give the road a 'Major' ranking highlights the fact that the road's physical footprint is comparable to that of a typical access road, even though it is only accessible to 4WD vehicles.

In addition to the areas listed above, close observation of the 2005-2015 comparison map reveals faint lines indicating increases or decreases in WV typically in the range ±1-3. Most of these are the result of minor positional variations in the boundaries of the Time Remoteness categories, which as noted earlier were reassessed in 2015. Variations between the zones '0-0.5 days' and '0.5-1 days' produce the greatest variation in TR (2.64), and hence in WV.

5.4 Comparison of current values with 1995 values (NWI methodology)

As noted earlier, the 1995 study was undertaken at a resolution of 200 m. To facilitate comparison with the 2015 results the comparison was done at a resolution of 500 m, the value assigned to each 500 m x 500 m square for the 1995 data being the mean of the values for the four 200 x 200 m squares that were completely enclosed in it. Values were calculated for most of the 2015 grid, but some parts of the grid were excluded because they were excluded from the original 1995 analysis. The exclusions included hydro impoundments and some areas on the eastern fringes of the TWWHA. The differences between the 2015 and 1995 results are shown in Map 4 on page 23.

Interpretation of the observed differences is constrained by the fact that the geodata used for the 1995 analysis is not available. Hence the reasons proposed for the observed changes are necessarily speculative.

One striking feature of the map is the large proportion of the study region in which Wilderness Value appears to have marginally increased – typically by a value between 1 and 3. This is likely to be an artefact of the analytical process rather than an indicator of geographical changes. However in the absence of the details of the 1995 analysis it cannot be explained.

More substantial changes in Wilderness Value mostly correspond to known or likely changes in the data sets of the 1995 and 2015 analyses. The following tables list the areas of significant increase and decrease in WV, and indicate the presumed causes of the changes. Changes that had previously been observed in the 2005 study (when the results obtained in 2005 were compared to those obtained in 1995) are indicated with an asterisk.

Table 6: Areas with substantial increase in WV since 1995 (NWI methodology)

Area	Cause of increase
Cape Sorell and area SW of Macquarie Harbour	Vehicle tracks now closed and assumed to have largely revegetated
Area SW of Teepookana	Several vehicle tracks no longer listed on maps
Moores Valley	Airstrip now closed
Percy River	Former vehicle tracks assumed to have revegetated
Butlers Gorge area	Not explained
King William Plains	Not explained
Wombat Glen area*	1995 study may have recorded a hut in this area
Alma Valley – Mt Gell*	Vehicle track has been closed
Middle Murchison River	Not explained; Hydro infrastructure may have been recorded in the 1995 study
Dove River area	Not explained
Jane River Track (northern half)	Former vehicle track has been downgraded to a Class 6 walking track
Forth Valley*	Not explained (area of apparent gain is on the steep eastern side of the valley)
Arm River Track	Not explained
Little Fisher Valley*	Former logging roads have been closed
Yeates Track	Vehicle track closed and downgraded to walking track
Plateau above Westrope Road	Possibly due to closure of vehicle track
Bessels Road	Possibly due to closure of vehicle track
Gowan Brae Road	Not explained

Area	Cause of increase
Tibbs Plain	Probably due to vehicle tracks no longer listed on maps
Gell River*	Former airstrips have been closed
Middle Denison Valley*	Not explained. 1995 data may have included Hydro infrastructure in this area
Nine Road (Florentine Valley)	Not explained (Note: WV very low in this area)
SE shore of Gordon Impoundment*	Not explained (Note: WV very low in this area)
East of Mt Wedge	Not explained (Note: WV very low in this area)
Junction Creek & Cracroft Crossing*	Walkers' shelters have been removed
Cox Bight	1995 study may have recorded former mining infrastructure (eg vehicle tracks, huts or cleared land) in this area

Table 7: Areas with substantial decrease in WV since 1995 (NWI methodology)

Area	Cause of decrease
Southern end of Macquarie Harbour shoreline	1995 assessment may not have take account of the jetty and ranger station on Sarah Island.
Birchs Inlet – Elliott Bay*	1995 assessment probably overlooked vehicle tracks in this region
Lower Gordon River*	1995 assessment probably overlooked Boom Camp
Goulds Landing	1995 assessment probably overlooked the hut and/or jetty at Sir John Falls
Sunshine Falls Gorge	1995 assessment may have overlooked the Hydro hut near the gorge
Elliott Range	1995 assessment probably overlooked the hut and tower on the summit
Lower Jane River*	1995 assessment probably overlooked the Hydro hut (now a ruin)
Davey Gorge*	1995 assessment probably overlooked the (then Hydro) hut near the gorge
South West Cape area	Reduction in WV probably due to walking track development
Warnes Lookout*	1995 assessment probably overlooked mineral-exploration hut near end of Jane River Track
Lake Malbena	1995 assessment probably overlooked hut
Raglan Range	1995 assessment probably overlooked huts
Pelion traverse*	Walking track development has occurred in the range
Dome Hill	Hydro helipad not included in 1995 study
Site north of Murchison Impoundment	Not explained
The Font (Spires)	1995 assessment probably overlooked the walking track in this area, although the track predates 1995
Moss Ridge	Not explained
Jubilee Road area	Decrease due to forestry roading
Coopers Marsh area (Mt Field NP)	Decrease probably due to forestry roading

6 Discussion and recommendations

The current study represents the third time that the wilderness values of the TWWHA have been assessed using the NWI methodology and/or a derivative thereof. Examination and comparison of the results indicates that the methodology is basically sound, producing logical results and providing an objective measure both of current wilderness value and of changes in wilderness value over time.

Comments made in the authors' 2005 report on that year's wilderness assessment study regarding the relative merits of the NWI and Revised methodologies remain valid. The latter provides a better picture of the impact of non-mechanised travel times on wilderness value, and provides better information on the distribution of wilderness value at the upper end of the range.

Future use and development of the Revised methodology

It is recommended that future assessments of wilderness value be undertaken using the Revised methodology, and that the methodology be developed and refined as new technologies and better data become available. In particular the methodology should be modified to take account of the impact of viewfield disturbances such as views of roads, impoundments and logging areas. It should also be modified to take account of the impacts of aircraft overflights and landings.

The only advantage of persisting with the NWI methodology in its original form is that this would allow continued comparison of wilderness values with the results obtained in 1995. However, as was found in the 2005 study and as has been confirmed in the current study, the fact that the data used in the 1995 study are not available makes it impossible to verify, and in many cases impossible to suggest, explanations for the observed changes in Wilderness Value.

One limitation of the Revised methodology is that the assessment of Time Remoteness necessarily involves an element of guesswork and relies on the availability of an assessor who has extensive (and preferably first-hand) knowledge of walking speeds and efficient walking strategies across the TWWHA. While computer-based methodologies have been developed overseas to estimate walking times across varying terrain, these are likely to be impractical to run on the scale of the current study, and unlikely to be sufficiently detailed or sophisticated to match the accuracy of human estimates. This situation could change as better algorithms and faster computing speeds become available, and it is recommended that research be undertaken into the practicality of developing an algorithm that can estimate walking times across the range of Tasmanian terrain and vegetation types with reasonable accuracy.

The present (Revised) methodology does not take account of the impact of fire, since natural fires are an inherent component of the Tasmanian ecology and Aboriginal burning practices have played a significant role in shaping the state's ecological landscapes. Nevertheless in the present era intentional burning (whether for fuel reduction, habitat maintenance or other reasons) represents an anthropogenic intervention in areas otherwise subject to largely natural processes; hence a case can be made for taking the frequency and distribution of such burning into account when assessing wilderness value.

A disadvantage of modifying a wilderness-assessment methodology is that the results obtained using different versions of the methodology at different times cannot be directly compared. The major advantage is that the more refined a methodology becomes, the better it will be able to convey an accurate and nuanced picture of the distribution of wilderness values.

It is recommended that better data be actively collected on the location, condition and status of features and disturbances that affect wilderness values in the TWWHA, particularly isolated features in remote areas. In particular data should be obtained on the location, condition and status of:

- vehicle tracks, both in-use and closed, particularly those in the region west and south of Macquarie Harbour;
- logged areas throughout the current study region;
- remote buildings including Hydro huts.

Potential applications of the wilderness-assessment methodology

The Revised methodology or an enhanced version thereof has the following potential applications:

1. Periodically inventorying the wilderness values of the TWWHA and adjacent areas

It is recommended that the wilderness values of the entire study region be re-evaluated every ten years. The study region could be expanded to include some additional contiguous and nearby areas, notably the Black Bluff Range, the Mt Roland Regional Reserve, the Mt Dundas Regional Reserve and the Connellys Point Creek area (southeast of Strahan). These areas registered significant wilderness value in the 1995 study, and probably retain much of that value today. The study region should also be expanded to include more country east of Mt Styx and on the eastern slopes of Wentworth Hills. A case can also be made for assessing the wilderness values of other parts of the state such as the Tarkine and Maria Island.

2. Assessing the potential wilderness impacts of proposed developments

The methodology can and should be used to assess the likely impact on wilderness values of any developments that might adversely affect those values. Examples include:

- the construction of new roads or walking tracks;
- the installation of new buildings or other structures;
- upgrades that would involve a change of status for roads or walking tracks (eg upgrading a walking track from Class 4 to Class 2)
- changes in vehicular access including aircraft landings and increased overflights.

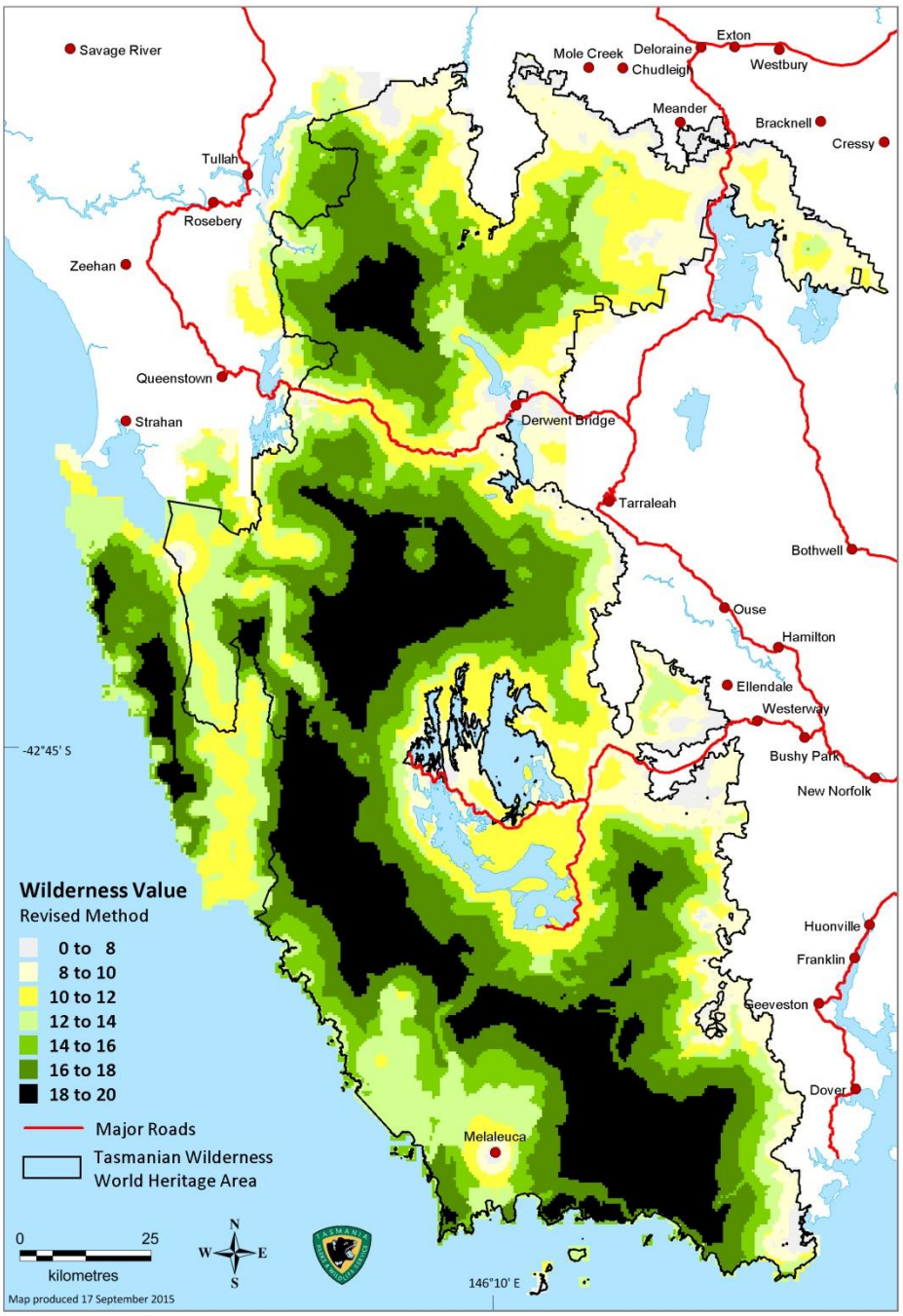
3. Assessing the potential for wilderness restoration

Wilderness Value can increase when roads and walking tracks are closed or downgraded, when structures such as towers and buildings are removed, and when disturbed areas such as former logging coups substantially revegetate. Examples of recent wilderness restoration include the

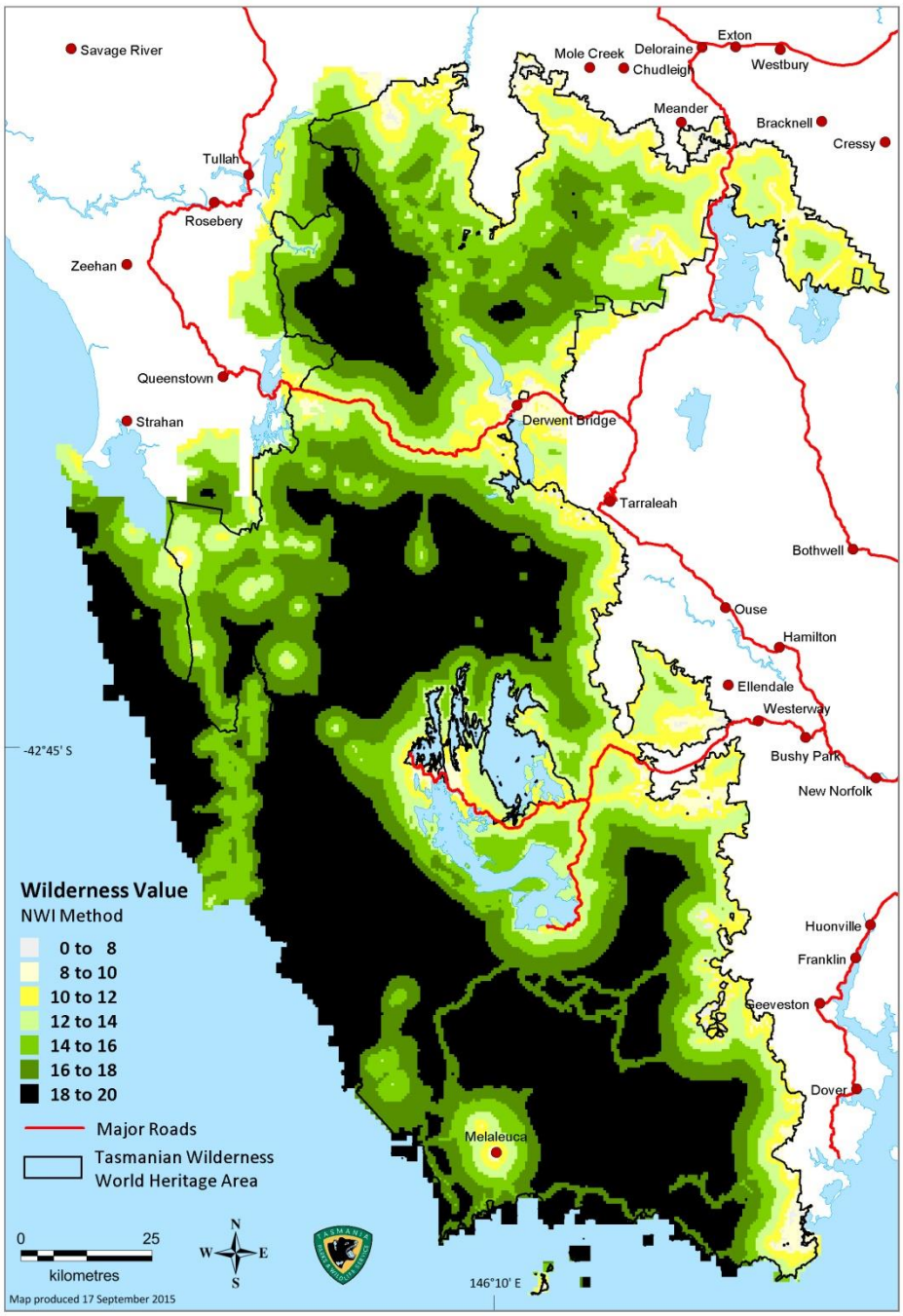
gains in Wilderness Value observed in the Gell River and Alma Valley-Mt Gell areas since 1995 due to the closure of vehicle tracks and airstrips. Examples of areas where there is the potential for further significant wilderness restoration include the region south of Macquarie Harbour (by closure of vehicle tracks), the Gordon River (by removal of Hydro huts), Mt McCall (by closure of the Mt McCall Road), and Warnes Lookout (by removal of the mineral-exploration hut).

Local gains in wilderness value could also occur around the fringes of the TWWHA due to the closure of logging roads and long-term recovery of logged areas that are now within the TWWHA boundary. Examples include South Cape Bay, where a substantial gain in wilderness value would result from closure and rehabilitation of logging roads and logged areas to the northeast. (In the context of a wilderness analysis, these areas will probably be classified as 'disturbed' for several decades hence.)

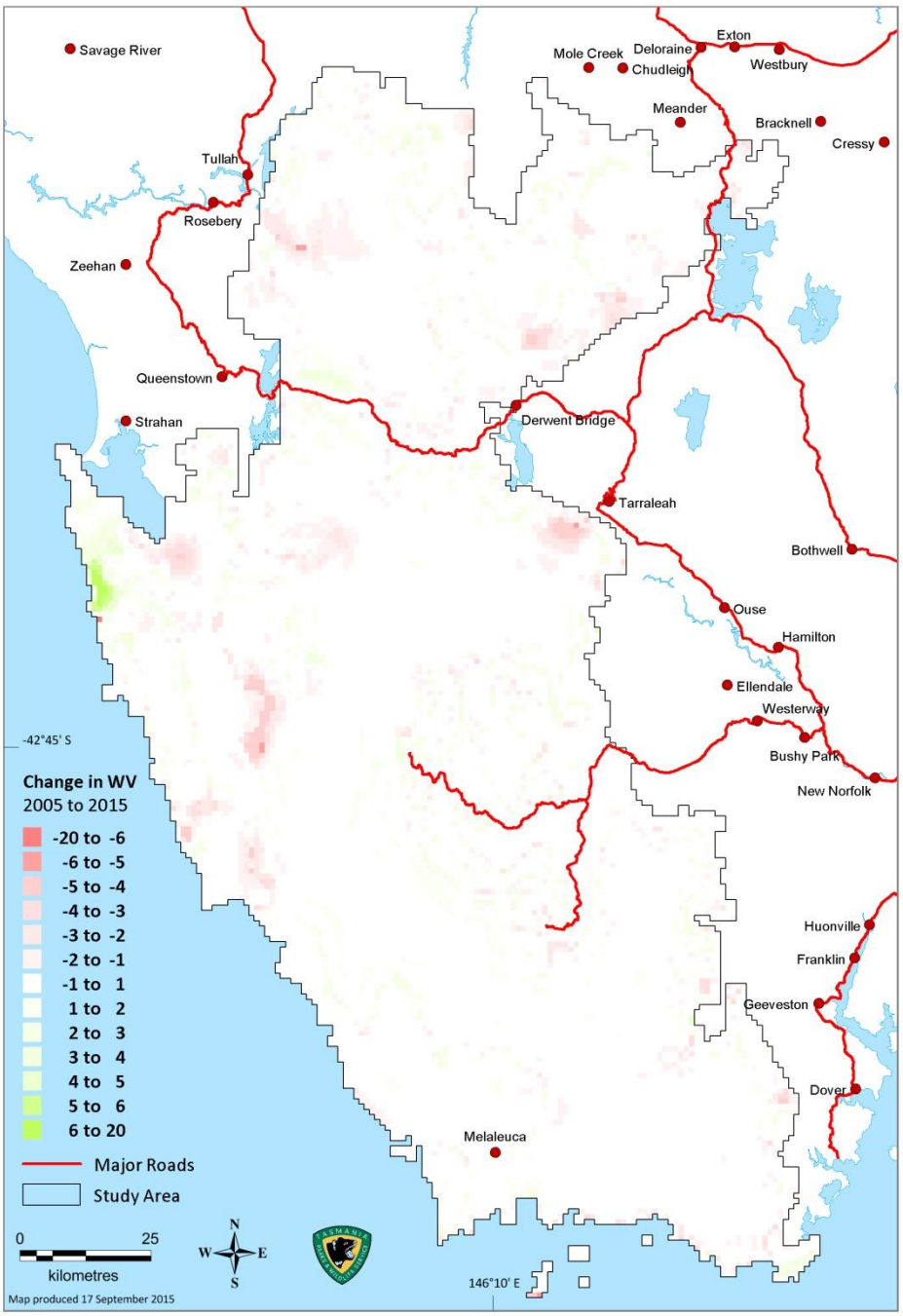
Map 1: Distribution of Wilderness Value across the Tasmanian Wilderness World Heritage Area in 2015 (Revised methodology)



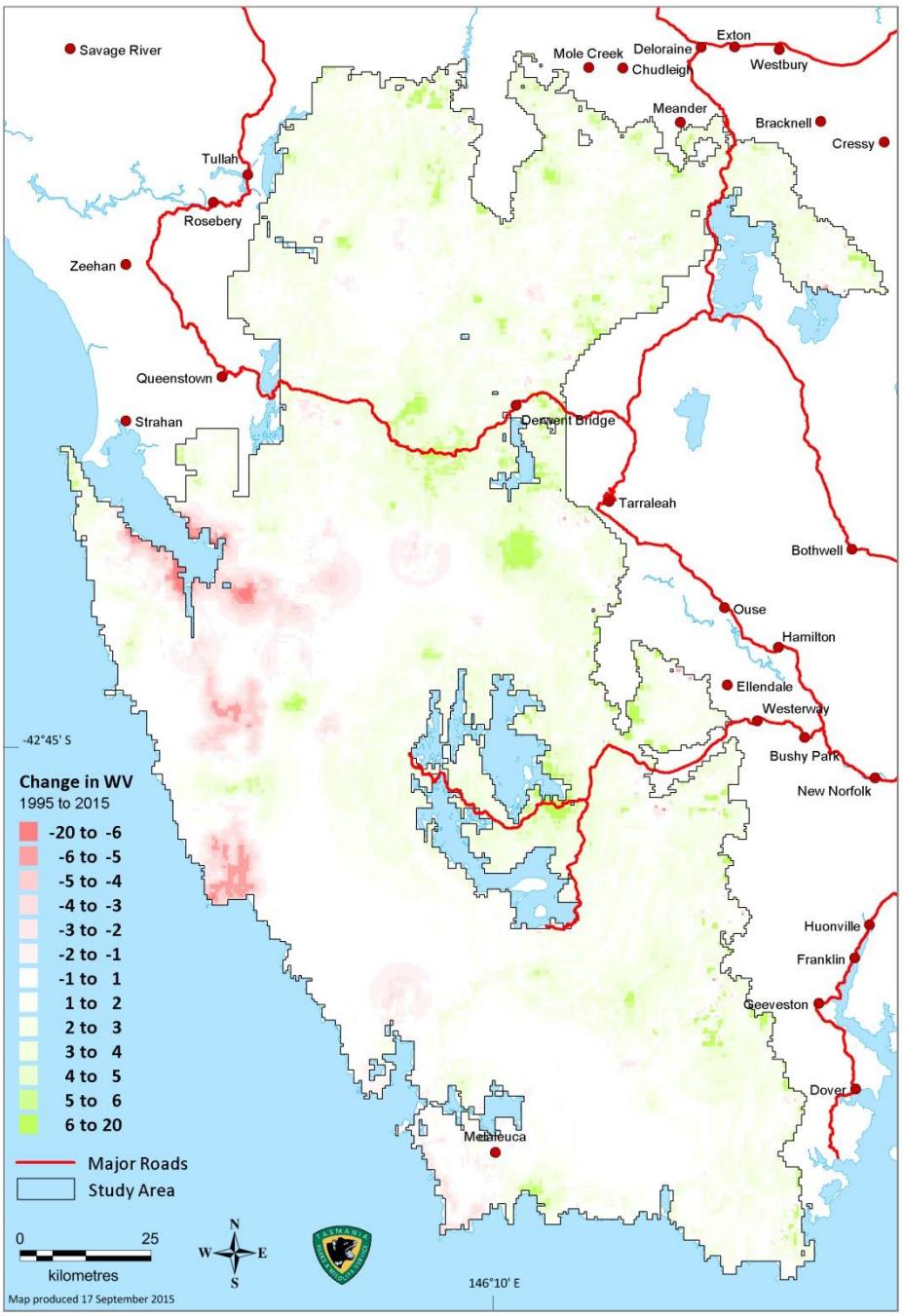
Map 2: Distribution of Wilderness Value across the Tasmanian Wilderness World Heritage Area in 2015 (NWI methodology)



Map 3: Changes in Wilderness Value 2005-2015 (Revised methodology)



Map 4: Changes in Wilderness Value 2005-2015 (NWI methodology)



APPENDIX – DETAILS OF THE METHODOLOGY

A1 Workflow of the assessment process

Step 1: Identify types of geodata required

Data was required on the location and status/condition of a wide range of geographical features that influence Wilderness Value, as defined by the two methodologies. A list was compiled of the types of data required, such as information on the location and status of roads. The list was based on a version compiled in 2005, which in turn was based on information about the NWI process published by the Australian Heritage Commission.

Step 2: Identify and obtain source data

Data files containing the required data were sourced from the LIST, PWS records and other sources. The relevant source files are listed in A2.

Step 3: Extract relevant data from source files and sort into 'feature' files

Many of the source files contained data relating to more than one type of geographical feature, which in some cases had different weightings in the calculation process. For example the file 'Artificial_Watercourse_Area' contained data on canals and drains, which are weighted differently in the calculation of Apparent Naturalness. It was therefore necessary to extract and segregate the required data using SQL statements.

Data for some types of geographical feature were sourced from several different source files. For example, data on buildings were sourced from the 'building-points', 'building-polygons' and several other files. Once the required data was extracted from the source files it was recombined into new files, each of which contained data on a specific category of geographical feature (eg towns with population >100). The resulting 'feature' files are listed in A3, and the criteria for selecting data from the source files are detailed in A4.

Step 4: Combine data according to weighting

A new set of files was created combining data for all types of geographical feature having the same weighting for particular components of wilderness value. For example, the file A09 contains data on single-lane unsealed 2WD roads, railways, airstrips and jetties , all of which have a 'Medium' ranking in the calculation of Remoteness of Access under the NWI methodology.

A total of 17 such 'combined feature' files were prepared, labelled A01-A15, D01 and D02. These are listed in section A5. The 'A' files contained data required for calculations of RS, AN and AR, which require distance calculations. The 'D' files contained data for assessing TR and BN.

Four of the 'A' files, relating to towns and residences, were used in assessing Remoteness from Settlement under both methodologies (although the weightings used in the calculations were different).

Step 5: Prepare grid file

As noted in 3.3, a 500 m x 500 m grid was prepared covering the study region, and the centroids of each grid square were generated.

Step 6: Convert all objects in 'combined feature' A-files to point data

Many of the 'A' files contained combinations of point, polyline and region (polygon) objects. To facilitate least-distance calculations it was convenient to convert all objects to points. Polylines were converted to points at their vertices. Large regions such as impoundments were converted to 500 m lattices of points and smaller regions to 100 m lattices, unless they were very small in which case they were replaced by their centroids. The 'A' files were further simplified so that there would be at most one point within any 100 m grid cell (25 of which comprise each grid square). This substantially reduced calculation times.

Step 7: Calculate least distances

For each of the 'A' files, the distance was calculated from each grid-square centroid to the nearest object (i.e. point) in the file. This was done using the Distance Calculator tool (version 1.2) provided with MapInfo 12.5. The calculated distance in kilometres was entered into a field with the same name as the input file.

Step 8: Calculate High-Grade Equivalent Distances

Each distance calculated in Step 7 was converted to a High-Grade Equivalent Distance (HGED) using the formula and weightings shown in A6. Distances to 'Major' feature-types such as highways were left unchanged by this formula (because the weighting is 1) but distances to 'Intermediate', 'Minor', 'Low' and 'Very Low' feature-types were increased, reflecting the fact that these feature-types have less influence on wilderness values.

Step 9: Calculate least High-Grade Equivalent Distances

For each methodology and for each distance-based component of Wilderness Value, the minimum was calculated of the sets of values of HGED referred to in Step 10. For example, for RS under the NWI methodology, the minimum was calculated of the values of HGED associated with the 'MAJ', 'INT', 'MIN' and 'RES' components of RS.

Step 10: Calculate Time Remoteness

As noted in 3.4 and explained in more detail in A6, Time Remoteness (TR) was calculated manually and recorded as regions in a file (D01). To transfer the data in this file to the grid it was necessary to determine which region occupied the greatest proportion by area of each grid square, and to assign the value of that region to the centroid of the square. Squares less than 50% of which were occupied by any region were assigned the value 0, indicating less than half-day remoteness.

Step 11: Calculate Biophysical Naturalness

A similar process was used to calculate Biophysical Naturalness (BN). The centroid of each grid square was assigned the value of the region type in the file D02 that occupied the greatest

proportion by area of the square. Squares less than 50% of which were occupied by any region were assigned the value 5, indicating 'pristine'.

Step 12: Calculate 'class' values for all components

The 'class' values are the final values of each of the components of WV and were calculated using the formulas in A6. The class values of RS, AN and AR were calculated from the least High-Grade Equivalent Distances referred to in Step 9; TR Class was calculated from the remoteness in days; BN Class was the value calculated in Step 11. The class values of all components can range from 0 to 5.

Step 13: Calculate wilderness value

For each methodology, the wilderness value of each grid-square centroid was calculated as the sum of the class values of the four components of WV.

A2 List of source files

The Wilderness Value calculations were based on analyses of spatial data in the data-catchment region, as defined in 3.2. Data (in MapInfo format) were sourced mainly from the Tasmanian government's Land Information System Tasmania (LIST) database and PWS files. The following table lists the source files, the sources by agency, the type of spatial information derived from these files and the currency of the data. See A4 for further information on the source data.

Code for sources: H = Hydro Tasmania; L = LIST; O = Other; P = PWS/DPIPWE

File name	Source	Geographical features for which data were derived	Currency	Comments
AccessCoast	P	Sections of coastline where powered boats can put ashore	2015	Compiled by M Hawes based on anecdotal information such as blogs
AccessWways	P	Inland waterways accessible to powered boats	2015	Compiled by M Hawes; see A5 for details.
Artificial_Watercourse_Area	L	Drains, Canals	2015	
Artificial_Watercourse_Line	L	Drains, Pipelines, Penstocks	2015	
Aurora High Voltage Conductor	O	Powerlines	2004	
Aviation Infrastructure	P	Airstrips, helipads, helispots, helibases	2015	
Beacons	L	Towers, Navigation lights, Trig points, Cairns, Spires, Poles, Pillars, Buildings (Fire cabins)	2015	Towers include microwave, fire, television, radio and mobile phone towers.
Boat_Ramps	H	Boat ramps, jetties	2015	
Building_points	L	Buildings, Residences, Ruins, Lighthouses	2015	
Building_polygons	L	Buildings, Residences, Ruins	2015	
Buildings	H	Buildings	2015	
Buildings PWS	P	Buildings, Residences	2015	
Canal	H	Canals	2015	
Canals_Area	L	Canals	2015	
Canals_Line	L	Canals	2015	
Category 3 Exploration (Quarry)	O	Mines	2015	Source: Mineral Resources Tasmania. Location and extent of mines checked on ListMap. Boundaries of mined areas modified to match GE data where necessary.
Comms Towers	P	Towers	2015	
Communications_ Infrastructure	H	Towers	2015	
Coupes_Status	O	Logged coupes	2013	Source: Environment Tasmania
Dam_Locations	H	Dams (barriers), Weirs	2015	
Dams_Area	L	Dams (barriers), Weirs	2015	
Dams_Points	L	Weirs	2015	

File name	Source	Geographical features for which data were derived	Currency	Comments
DisturbedAreas2005Mod	P	Logging coupes, selectively logged areas, cleared land	2005 2015	Compiled by M Hawes in 2005, updated in 2015. Based on Tas veg maps and augmented with data from ListMap and 'Coupes_Status' file.
Hydro Assets WHA	H	Pipelines, Canals, Airstrips, Helipads, Jetties/Boat ramps, Weirs, Hydro impoundments, Mines, Buildings, Trigs, Survey Pillars	2012	
InaccessCoast	P	Sections of coastline where powered boats cannot put ashore	2015	Compiled by M Hawes.
Jetty	H	Jetties	2015	
Marine Infrastructure	P	Jetties/Boat ramps, Lighthouses, Navigational lights	2015	
Mining Leases	O	Mines	2015	
Pipelines_and_Penstocks	H	Pipelines, Penstocks	2015	
Roads_25k	L	Roads, Vehicular tracks, Closed vehicular tracks, Railways open/closed	2015	
SOWHARV_lt10yr_inTWWHA	O	Clearfelled areas of forest	2015	Source: Forestry Tasmania
Spillways	H	Spillways	2015	
Standing camps	P	Standing camps	2015	
Tas_Vegetation	P	Cleared land, clearfelled areas, agricultural land, plantations, urban land	2013	Data also used in calculations of Time Remoteness
Towns	P	Towns	2015	Classified by population size based on data from the ABS/Census, internet, topographic maps and the 'Buildings' files.
Transend Transmission Lines	O	Powerlines	2015	
Walking Tracks	P	Walking tracks (Classes 1-6)	2015	

A3 List of 'feature' files

Data from the source files listed in A1 was extracted and where necessary recombined into a new set of files, each of which contained data on a specific category of geographical feature. The following table lists these 'feature' files, the source files from which the data were obtained, the relevant category of geographic feature, and the weightings assigned to that category. See A6 and A7 for information on how these weightings are applied.

			Assigned weighting					
'Feature' file	**Source files**	**Category of geographical feature**	NWI RS	NWI AN	NWI RA	REV RS	REV AN	BN
01_Towns_A	Towns	Population ≥100	MAJ	MAJ	VLO	MAJ	MAJ	
02_Towns_B	Towns	Population 10-99	INT	MAJ	VLO	INT	MAJ	
03_Towns_C	Towns	Population 1-9	MIN	MAJ	VLO	MIN	MAJ	
04_Towns_D	Building_points Building_polygons Buildings PWS	Residences	RES	MAJ		RES	MAJ	
05_Roads_A	Roads_25k	2+ lane or sealed		MAJ	MAJ		MAJ	
06_Roads_B	Roads_25k	1 lane unsealed 2WD		MAJ	MED		MAJ	
07_Roads_C	Roads_25k	Vehicular/dozer tracks		MED	LOW		MED	
08_Roads_D	Roads_25k	Closed road/Closed VT		MIN	VLO		MIN	
09_RailwaysOpen	Roads_25k	Railway/Railway Siding/Tramway – in use		MAJ	MED		MAJ	
10_RailwaysClosed	Roads_25k	Railway/Railway Siding/Tramway – disused		MIN			MIN	
11_Pipelines	Artificial_Watercourse_Line Hydro Assets WHA Pipelines_and_Penstocks	Water pipeline or penstock		MAJ			MAJ	
12_Canals	Canals_Area Canals_Line Hydro Assets WHA Canal [Hydro]	Canal					MAJ	
13_Drains	Artificial_Watercourse_Area Artificial_Watercourse_Line	Drain		MED			MED	
14_Tracks1to4		Walking track Class 1-4		MIN	VLO		MIN	
15_Tracks5to6		Walking track Class 5-6		MIN	VLO		VLO	
16_Airstrips	Aviation Infrastructure Hydro Assets WHA	Airstrips		MAJ	MED		MAJ	1
17_Helipads	Aviation Infrastructure Hydro Assets WHA	Helipads, helispots, helibases		MIN	LOW		MIN	
18_Jetties	Marine Infrastructure Hydro Assets WHA Boat_Ramps Jetty [Hydro]	Jetties/boat ramps		MAJ	MED		MED	
19_Dams	Dams_Area Dam_Locations	Dams (barriers). Small dams in rural locations not included.		MED			MAJ	
20_Weirs	Hydro Assets WHA Dams_Area Dams_Points Dam_Locations Spillways	Weirs, spillways		MED			MIN	
21_Impoundments	Hydro Assets WHA Drainage Polygons 25K	Hydro & other impoundments		MAJ	VLO		MAJ	1

'Feature' file	Source files	Category of geographical feature	Assigned weighting					
			NWI RS	NWI AN	NWI RA	REV RS	REV AN	BN
22_AccessWways	Port Davey Vessel Zones	Inland waterways accessible to powered boats			VLO		MIN	
23_InaccessCoast		Coastline inaccessible to offshore vessels					VLO	
24_AccessCoast		Coastline accessible to offshore vessels					MIN	
25_DistLandOver 1ha	Coupes_Status Tas_Vegetation SOWHARV_lt10yr_inTWWHA DisturbedAreas2005Mod	Cleared, clearfelled, agric land, plantations; area of disturbance ≥1ha		MAJ	VLO		MAJ	1
26_SelLogged		Land subject to repeated selective logging or moderate grazing		MAJ	VLO		MED	2
27_MinesLge	Hydro Assets WHA Category 3 Exploration (Quarry) Mining Leases	Mines & quarries (≥ 1ha)		MAJ			MAJ	1
28_MinesSmall	Hydro Assets WHA Category 3 Exploration (Quarry) Mining Leases	Mines & quarries (<1 ha)		MED			MED	1
29_TransLines	Aurora High Voltage Conductor Transend Transmission Lines	Transmission lines		MAJ			MED	
30_Buildings	building_points building_polygons Buildings PWS Hydro Assets WHA Beacons (for fire cabins) Buildings [Hydro]	Buildings (see separate document for details)		MAJ			MED	
31_StandCamps		Standing camps		MIN			MIN	
32_Ruins	building_points building_polygons	Ruins		MAJ			MED	
33_Lighthouses	Marine Infrastructure building_points	Lighthouses		MAJ			MAJ	
34_Towers	Comms Towers Beacons Communications_ Infrastructure	Towers (comms, fire towers)		MAJ			MED	
35_NavLights	Beacons Marine Infrastructure	Navigation lights		MAJ			MIN	
36_Trigs	Beacons Hydro Assets WHA	Cairns, poles, pillars; Survey pillars		MIN			VLO	
37_AirstripsX		Airstrips – disused		MED			MED	1
38_DistLandLess1ha	Tas_Vegetation	Cleared, clearfelled, agric land, plantations; area of disturbance <1ha		MED			MED	1
39_TimeRem	Time Remoteness	Time Remoteness						

A4 Data selection criteria

This section details the criteria that were used to select data from the source files listed in A1.Where no details are supplied it may be assumed that the selection criteria were trivial and/or self-explanatory.

Feature type:	Towns
Source files:	Towns
Feature files:	01_Towns_A, 02_Towns_B, 03_Towns_C

- Districts or localities with dispersed residences and little or no public infrastructure were generally not listed as towns, although residences in these districts were included in the 'Residences' file (04_Towns_D). Examples: Liena, Waterloo, Lune River.
- Dense concentrations of residences were generally listed as towns, even if they had little or no public infrastructure. Examples: Harveytown, Brandum.
- Some localities were included in the '04_Towns_D' file to represent residential areas, if most buildings in those localities were classified as 'Unknown' yet there was good evidence (eg real estate ads) that residences occurred. Examples: Glenfern, Gormanston, Lonnavale.
- Towns were listed as point data. In some cases points were moved to better coincide with town centres.
- Calculations of Remoteness from Settlement require towns and settlements to be classified by population. If not listed on the ABS website, populations were estimated from sources such as the internet (eg news items and Wikipedia entries), the size of street grids and the number of residences.
- In estimating the population of small towns an occupancy rate of 2.5 persons per residence was assumed.
- Shack occupancy was assumed to be 0.25 persons per shack (full-time residency equivalent).

Feature type:	Residences
Source files:	Building_points, Building_polygons, Buildings PWS
Feature files:	04_Towns_D

- Residences were identified in the 'buildings_points' and 'building_polygons' files by the data BUILD_TY = "Residence".
- The type of many buildings was listed as 'Unknown'. Such buildings were not included as residences unless there was good reason to believe that they were.
- Vehicle-accessible shacks were included as residences.
- Vehicle-accessible rental accommodation was included as residences.
- Remote huts such as walkers' huts, ranger huts & trackworker huts were not included as residences.
- The Sarah Island ranger quarters was included as a residence.
- See also 'Buildings, ruins, residences' (30_Buildings) below.

Residences in the 'Buildings PWS' file were identified by the following criteria:

AssetTypeID	AssetSubTypeID
Housing	House, building with single tenancy
Housing	House, short term single tenancy-staff or lease
Housing	Staff boarding/guest/hostel >300m or >12 people
Housing	Staff quarters, in a class 5,6,7,8 building
Housing	Staff, shared accommodation <300m or <12 people
Public Accommodation	PA, boarding/guest/hostel >300m or >12 people
Public Accommodation	PA, house with single occupancy
Public Accommodation	PA, Public Accommodation - Privately owned
Public Accommodation	PA, shared accommodation <300m or <12 people

Feature type:	Roads & vehicle tracks
Source files:	Roads_25k
Feature files:	05_Roads_A, 06_Roads_B, 07_Roads_C, 08_Roads_D

The NWI and Revised methodologies require roads to be classified according to number of lanes and surface type. The 'Roads_25k' file does not identify the number of lanes, but this information can be broadly inferred from data in the other fields and for the way known roads have been classified. The following table lists the categories of roads and vehicle track that were included in each 'feature' file. 'TRAN_CLASS' and 'SURFACE_TY' are the names of fields in the 'Roads_25k' file.

Feature file: 05_Roads_A Feature category: Roads 2-lane or Sealed (or both)

TRAN_CLASS	SURFACE_TY	COMMENTS
Access Road	Sealed	• Mostly minor roads near towns or other high-grade roads. Includes Mt JukesRd, part of Arve Loop. • Closed Access Roads were not included.
Arterial Road	[All Sealed]	
Collector Road	Sealed	
Collector Road	Unsealed	• Includes some fairly narrow (hence arguably 1-lane) roads, eg Lake Dobson Road. The option of excluding some narrow roads from this category was considered, but not deemed justified given the fairly arbitrary grounds on which such exclusions would be made.
Local Road	Sealed	
Local Road	Unsealed	• Similar comment to 'Collector Road – Unsealed'.
National/State Highway	[All Sealed]	
Sub Arterial Road	Sealed	
Sub Arterial Road	Unsealed	
SQL Query:		(TRAN_CLASS = "Collector Road" OR TRAN_CLASS = "Arterial Road" OR TRAN_CLASS = "Sub Arterial Road" OR TRAN_CLASS = "National/State Highway" OR TRAN_CLASS = "Local Road" OR (TRAN_CLASS = "Access Road" AND SURFACE_TY = "Sealed")) AND STATUS = "Open"

Feature file: 06_Roads_B Feature category: Roads 1-lane unsealed 2WD

TRAN_CLASS	SURFACE_TY	COMMENTS
Access Road	Unsealed	Mostly forestry roads.
SQL Query:		TRAN_CLASS = "Access Road" AND SURFACE_TY = "Unsealed" AND STATUS = "Open"

Feature file: 07_Roads_C Feature category: Vehicular tracks (open)

TRAN_CLASS	SURFACE_TY	COMMENTS
Vehicular Track	4WD required	
Vehicular Track	Unsealed	• Includes Mt McCall Rd (officially named the Franklin River Road; listed as a closed Access Road but accessible to public 4WDs by permit)
SQL Query:		(TRAN_CLASS = "Vehicular Track" AND STATUS = "Open") OR PRI_NAME = "Franklin River Road"

Feature file: 08_Roads_D Feature category: Closed roads & vehicle tracks

TRAN_CLASS	SURFACE_TY	COMMENTS
<any>	<any>	• Closed Access Roads • Closed Local Roads • Closed Vehicular Tracks. • Mt McCall Rd excluded from this category
SQL Query:		(TRAN_CLASS = "Access Road" OR TRAN_CLASS = "Local Road" OR TRAN_CLASS = "Vehicular Track") AND STATUS = "Closed" AND PRI_NAME <> "Franklin River Road"

Additional comments

- A small number of roads were classified in the Roads_25k file as TRAN_CLASS = "Access Road" and SURFACE_TY = "4WD required". The only road segments in this category were short and in locations that would not affect wilderness value in the TWWHA; hence there were excluded from the analysis.
- Railways, tramways and walking tracks in the 'Roads' file were excluded from the roads analysis.
- A section of vehicle track between Lake Ada and Talinah Lagoon, and a section of the South Mole Creek (Yeates) Track on the ascent to the plateau, were treated as closed vehicle tracks.

Feature type:	Drains, pipelines, penstocks, canals
Source files:	Artificial_Watercourse_Area, Artificial_Watercourse_Line, Canal [Hydro], Canals_Area, Canals_Line, Hydro Assets WHA, Pipelines_and_Penstocks
Feature files:	11_Pipelines, 12_Canals, 13_Drains

Data were selected from the files below and assigned to 'feature' files using the criteria indicated:

Source file: Artificial_Watercourse_Line

Feature type (HYDLNTY2)	Assigned category
Drain	Drains
Water channel	Drains
Water race	Drains
Water pipeline	Pipelines
Siphon	Pipelines
Penstock	Pipelines
Canal	Canals
Spillway	Canals
Flume	Canals
Sluice	Canals
Water tunnel	N/A

Source file: Artificial_Watercourse_Area

Feature type (HYDARTY2)	Assigned category
Drain	Drains
Water channel	Drains
Water race	Drains
Siphon	Pipelines
Canal	Canals
Spillway	Canals
Sluice	Canals

Source file: Hydro Assets WHA

Feature type	Assigned category
Canals	Canal
Spillway	Canal
Flumes	Canal
Pipelines/Penstocks	Pipelines

- Note: The 'Pipelines/Penstocks' data in the' Hydro Assets WHA' file contained no information that was not also contained in 'Artificial_Watercourse_Line'.

Feature type:	Walking tracks
Source files:	Walking Tracks
Feature files:	14_Tracks1to4, 15_Tracks5to6

- All data on walking tracks was derived from the PWS 'Walking Tracks' file.
- Only tracks of Class 1-6 were included in the analysis. (Hence 'Routes' and 'Unclassified' tracks were excluded.)
- Linear features in the 'Roads_25K' file listed as TRANS_CLASS = 'Walking' were not included as walking tracks unless they were also listed, and assigned a Class of 1-6, in the Walking Tracks file.
- The above category includes a network of old, closed vehicle tracks in the region west of Macquarie Harbour. Many of these tracks are visible on satellite images in open country, but were probably overgrown in scrub and forest. It was assumed that these tracks have effectively disappeared in forested and scrubby terrain, and that walking on them does not provide a significant advantage in open country.

Feature type:	Airstrips (Open/Closed)
Source files:	Aviation Infrastructure, Hydro Assets WHA
Feature files:	16_Airstrips, 37_AirstripsX

The following table lists known airstrips and shows the category to which they were assigned.

Airstrip location	Open	Closed	Not listed	Comments
Melaleuca	✓			
Scotts Peak			✓	Revegetation is advanced (as evident on ListMap).
Cradle Mountain		✓		This former airstrip has been converted into a car park. Excluding it from the analysis would not affect estimates of Wilderness Value.
Gell River (2)		✓		These airstrips were excluded from the 2005 analysis on the grounds that they had been rehabilitated. However rehabilitation efforts have clearly had little effect, because both strips are still highly visible on ListMap.
Moores Valley		✓		This airstrip is still highly visible on ListMap but is no longer usable.

Feature type:	Jetties & Boat ramps
Source files:	Boat_Ramps, Hydro Assets WHA, Jetty, Marine Infrastructure
Feature files:	18_Jetties

Features in the file 'Marine Infrastructure' were included or excluded according to the following criteria:

AssetSubTypeID	Included
Boat Ramp - Natural Landing	✓
Jetty - Minor	✓
Jetty - Major	✓
Boat Ramp - Hardened	✓
Floating Jetty	✓
Navigation Aid	X
Lighthouse	X
Boat Slip	X
Mooring	X

- The 'Bathurst Channel Waterpoint' at Watering Bay (Port Davey) was not included, as it is only a location and does not comprise infrastructure.
- The 'Boat_Ramps' file contained one feature that was clearly not a boat ramp (on the slope above Poatina). This was excluded from the analysis.

Feature type:	Weirs
Source files:	Dams_Area, Dam_Locations, Dams_Points, Hydro Assets WHA, Spillways
Feature files:	20_Weirs

Data on weirs was selected from the following tables using the criteria indicated:

Source file	Criteria
Dam_Locations	Sub_Type = "Weir" or Sub_Type = "Spillway"
Dams_Area	HYDARTY2 = "Weir"
Dams_Points	Dam Type = "Weir"
Hydro Assets WHA	Feature = "Spillway" or SubType = "Weir" or SubType = "Spillway"

Feature type:	Impoundments
Source files:	Drainage Polygons 25K, Hydro Assets WHA
Feature files:	21_Impoundments

In addition to hydroelectric impoundments, the following were included in this 'feature' file:

- Edgar Pond
- Minor impoundments on the West Queen River

Feature type:	Waterways accessible to powered watercraft
Source files:	N/A
Feature files:	22_AccessWways

- Official limits to powered craft on the Gordon, Davey, Spring, North and Old Rivers were taken from the 1999 TWWHA Management Plan and the 2015 Draft TWWHA Management Plan.
- The 2015 Draft Plan provides a grid reference (Easting only) that places the limit for powered boats on the Old River well above the island, and above sections of shingle banks and rapids. This may be erroneous. As powered boats are unlikely to get this far upstream in normal conditions, the upstream end of the island was taken to be the limit as per the 1999 Plan.

Feature type:	Disturbed land
Source files:	Coupes_Status, DisturbedAreas2005Mod, Tas_Vegetation, SOWHARV_lt10yr_inTWWHA
Feature files:	25_DistLandOver 1ha, 38_DistLandLess1ha

- The data set mainly comprises areas listed in the 'Tas Vegetation' file where VEG_GROUP = "Agricultural, urban and exotic vegetation".
- The data also includes clearfelled areas in the TWWHA, as identified in the files 'Coupes_Status','SOWHARV_lt10yr_inTWWHA' and 'DisturbedAreas2005Mod'.
- Data was not available on the location or condition of logged areas outside the TWWHA, other than the information that could be inferred from the 'Tas Vegetation' file.

Feature type:	Selectively logged areas
Source files:	N/A
Feature files:	26_SelLogged

- Data from the2005 analysis was recycled for the current one. No additional information was available.

Feature type:	Mines & quarries
Source files:	Category 3 Exploration (Quarry), Hydro Assets WHA, Mining Leases
Feature files:	27_MinesLge, 28_MinesSmall

- Quarries in the 'Hydro Assets WHA' file were selected by the criterion Feature = "Quarry".
- There was substantial overlap between the data in the files 'Mining Leases' and 'Category 3 Exploration (Quarry)'. Duplicated data was deleted.
- The original data sets show the boundaries of mining leases, not all of which may have been mined (at least not above ground). The boundaries of actual mined/quarried areas were mapped from ListMap in locations where they were likely to affect Apparent Naturalness.
- Mines were only included if they were visible on ListMap.
- The data sets analysed include some mines that may be disused and partly revegetated.

Feature type:	Transmission lines
Source files:	Aurora High Voltage Conductor, Transend Transmission Lines
Feature files:	29_TransLines

- Includes all data from the files 'Aurora High Voltage Conductor' and 'Transend Transmission Lines'.
- Data from the file 'Aurora Low Voltage Conductor' were not used because the lines in this file were all in locations (adjacent to roads etc) where they would not affect wilderness values.

Feature type:	Buildings, ruins, residences
Source files:	Beacons (for fire cabins), Buildings [Hydro], building_points, building_polygons, Buildings PWS, Hydro Assets WHA
Feature files:	30_Buildings, 32_Ruins, 04_TownsRES

Data was selected from the files below using the criteria indicated. Some buildings may be duplicated from different files, but this would not affect wilderness value calculations.

Source file: buildings_point

Building type	Included in 04_TownsRES	Included in 30_Buildings	Comments
Commercial		Y	
Community		Y	
Hothouse		Y	Unlikely to affect wilderness values.
Industrial		Y	
Lighthouse		Y	
Other		Y	Includes Melaleuca bird hide, Lake St Clair cabins, numerous structures in Lake Dobson/Mawson ski fields area.
Public Toilet			Excluded because some items listed as public toilets do not include significant structures.
Pumphouse		Y	
Remote Shed		Y	Only a handful of structures in this category are in the study region, and all are close to roads.
Residence	Y	Y	
Ruin			The Hydro hut above Humbaba Gorge was classified as a ruin.
Rural Large Shed		Y	
Rural Small Shed			Inclusion would be unlikely to have a significant effect on wilderness values, even locally.
Shed		Y	Includes structures on Clumner Bluff, Mt King William 1, Elliot Range; at Bond Bay; and in the Scotts Peak area.
Silo		Y	
Unknown		Y	
Walking Hut		Y	

Source file: Hydro Assets WHA

All items for which the field Feature = "Buildings" were included.

Source file: buildings_polygons

Building type	Included in 04_TownsRES	Included in 30_Buildings
Commercial		Y
Community		Y
Hothouse		Y
Industrial		Y
Other		Y
Public Toilet		
Pumphouse		Y
Residence	Y	Y
Ruin		
Rural Large Shed		Y
Rural Small Shed		
Shed		Y
Silo		Y
Unknown		Y

Source file: Buildings [Hydro]

Building type	Included in 04_TownsRES	Included in 30_Buildings
Boat Shed		Y
Buildings		Y
Camp		
Clubhouse		Y
Control Building		Y
Emergency Response Centre		Y
Emergency Shelter		
Gatehouse		Y
Hut		Y
Hut Accomodation		Y
Hydro Store		Y
Intake Building		Y
Meteorolgical		
Office		Y
Pump House		Y
Shack		Y
Shed		Y
Store		Y
Store Shed		Y
Unassigned		Y
Valve House		Y
Winch House		Y
Winch/Winchhouse		Y
Workshop & Store		Y

Source file: Buildings PWS

Building type	Included in 04_TownsRES	Included in 30_Buildings
Cafe and/or Retail Shop		Y
Camp Kitchen		
Caravan		
Dangerous Goods Store		
Emergency Shelter Overnight - <300m and <12 people		Y
Field Base Small Workshop Facility		Y
Field Centre or Region Workshop		Y
Field Office		Y
Fuel Store/Bunkers		
Garage, of greater than 3 car storage area		Y
Garage, up to 3 car storage area		Y
Gas Storage		
Generator Shed		
House, building with single tenancy	Y	Y
House, short term single tenancy-staff or lease	Y	Y
Information &/or self registration/fee collection		
Information and/or Fee Collection, Staffed		Y
Information Booth - Non Staffed		
Information Centre - Non Staffed		Y
Miscellaneous Building		Y
PA, boarding/guest/hostel >300m or >12 people		Y
PA, house with single occupancy		Y
PA, Public Accommodation - Privately owned		Y
PA, shared accommodation <300m or <12 people		Y
Radio - Remote base/repeater		
Registration Booth		
Registration Booth and Information - Non Staffed		
Remote Base Workshop facility		Y
Shelter - Basic (Day Use)		Y
Shelter - Complex (Day Use)		Y
Staff boarding/guest/hostel >300m or >12 people		Y
Staff quarters, in a class 5,6,7,8 building	Y	Y
Staff, shared accommodation <300m or <12 people	Y	Y
Store		Y
Toilet - Alternating Batch		Y
Toilet - Clivus Multrum		Y
Toilet - Enviro-loo		Y
Toilet - Fly out		
Toilet - Fly out squat bin		
Toilet - Gough System		Y
Toilet - Non Accredited System		
Toilet - Pit		
Toilet - Pump out		Y
Toilet - PWS #3		Y

Building type	Included in 04_TownsRES	Included in 30_Buildings
Toilet - Septic System		Y
Toilet - Sewered		Y
Toilet plus cold showers - Basic		Y
Toilet plus hot/cold showers - Complex		Y
Visitor Centre		Y
Visitor Centre and Office		Y
Visitor Centre, Office and Leased Area		Y
Walkers Hut (overnight) - <300m and <12 people		Y
Walkers Hut (overnight) - >300m and >12 people		Y

- Ranger huts not counted as residences.
- Proposed toilets not included as buildings.

Feature type:	Navigation lights
Source files:	Beacons, Marine Infrastructure
Feature files:	35_NavLights

- Two items were selected from the Marine Infrastructure file: the Teds Island Navigation Beacon and the Scotts Peak Navigation Beacon.

Feature type:	Towers
Source files:	Beacons, Comms Towers, Communications_ Infrastructure
Feature files:	34_Towers

- Towers were selected from the ‘Beacons’ file where the ‘Description’ field had the value "Fire tower", "Micro-wave tower", “Mobile telephone tower", "Radio tower" or "Television tower".
- Towers were selected from the ‘Communications_Infrastructure’ file where the ‘Subtype’ field had the value "Communications Tower" or "Fire Tower".

Feature type:	Trigs, cairns, pillars, poles
Source files:	Beacons, Hydro Assets WHA
Feature files:	36_Trigs

- Trigs were selected from the ‘Beacons’ file where the ‘Description’ field had the value "Cairn", "Pillar" or "Pole".
- Trigs were selected from the ‘Hydro Assets WHA’ file where the ‘Feature’ field had the value "Survey Pillar".

A5 List of 'combined feature' files

The following table lists the 'combined feature' files and the 'feature' files that comprise them. Each of the 'A' files comprises geographical features with a common weighting for calculating one of the components of wilderness quality. For example, file A06 comprises features ranked 'MED' (Medium) for calculating AN under the NWI methodology.

Files D01 and D02 contain features required for calculating Time Remoteness and Biophysical Naturalness respectively. Owing the nature of the calculations involved, these files contain features with more than one value.

File name	Methodology	Component of wilderness value	Grade	Component 'feature' files
A01	Both	RS	MAJ	01_Towns_A
A02	Both	RS	INT	02_Towns_B
A03	Both	RS	MIN	03_Towns_C
A04	Both	RS	RES	04_Towns_D
A05	NWI	AN	MAJ	01_Towns_A 02_Towns_B 03_Towns_C 04_Towns_D 05_Roads_A 06_Roads_B 09_RailwaysOpen 11_Pipelines 16_Airstrips 18_Jetties 21_Impoundments 25_DistLandOver1ha 26_SelLogged 27_MinesLge 29_TransLines 30_Buildings 32_Ruins 33_Lighthouses 34_Towers 35_NavLights
A06	NWI	AN	MED	07_Roads_C 13_Drains 28_MinesSmall 37_AirstripsX 38_DistLandLess1ha 19_Dams 20_Weirs
A07	NWI	AN	MIN	08_Roads_D 10_RailwaysClosed 14_Tracks1to4 15_Tracks5to6 17_Helipads 31_StandCamps 36_Trigs

File name	Methodology	Component of wilderness value	Grade	Component 'feature' files
A08	NWI	RA	MAJ	05_Roads_A
A09	NWI	RA	MED	06_Roads_B 09_RailwaysOpen 16_Airstrips 18_Jetties
A10	NWI	RA	LOW	07_Roads_C 17_Helipads
A11	NWI	RA	VLO	01_Towns_A 02_Towns_B 03_Towns_C 08_Roads_D 14_Tracks1to4 15_Tracks5to6 21_Impoundments 22_AccessWways 25_DistLandOver1ha 26_SelLogged

File name	Methodology	Component of wilderness value	Grade	Component 'feature' files
A12	REV	AN	MAJ	01_Towns_A 02_Towns_B 03_Towns_C 04_Towns_D 05_Roads_A 06_Roads_B 09_RailwaysOpen 11_Pipelines 12_Canals 16_Airstrips 19_Dams 21_Impoundments 25_DistLandOver1ha 27_MinesLge 33_Lighthouses
A13	REV	AN	MED	07_Roads_C 13_Drains 18_Jetties 26_SelLogged 28_MinesSmall 29_TransLines 30_Buildings 32_Ruins 34_Towers 37_AirstripsX 38_DistLandLess1ha
A14	REV	AN	MIN	08_Roads_D 10_RailwaysClosed 14_Tracks1to4 17_Helipads 20_Weirs 22_AccessWways 24_AccessCoast 31_StandCamps 35_NavLights
A15	REV	AN	VLO	15_Tracks5to6 23_InaccessCoast 36_Trigs
D01	REV	TR	All	39_TimeRem
D02	Both	BN	1	16_Airstrips 21_Impoundments 25_DistLandOver1ha 27_MinesLge 28_MinesSmall 37_AirstripsX 38_DistLandLess1ha
		BN	2	26_SelLogged

A6 Formulas and weightings

High Grade Equivalent Distance

When calculating Remoteness from Settlement (RS), Apparent Naturalness (AN) and Remoteness of Access (RA), categories of geographical feature were weighted to reflect their relative impact on the variable in question. The quantity High Grade Equivalent Distance (HGED) is derived from actual distance using the formula

$$HGED = (D + 1)/W - 1$$

where D is the distance of a grid-square centroid to the nearest feature of the specified type and W is the weighting factor.

Weighting factors for geographical features

The following weighting factors were applied to the geographical-feature categories indicated:

Weighting factors for Remoteness from Settlement

Town/settlement category	NWI	REV
Major (MAJ)	1.00	1.00
Intermediate (INT)	0.80	0.67
Minor (MIN)	0.74	0.48
Isolated Residence (RES)	0.66	0.38

Weighting factors for Apparent Naturalness

Feature category	NWI	REV
Major (MAJ)	1.00	1.00
Medium (MED)	0.40	0.50
Minor (MIN)	0.16	0.18
Very Low (VLO)	N/A	0.10

Weighting factors for Remoteness of Access

Feature category	NWI
Major (MAJ)	1.00
Medium (MED)	0.71
Minor (MIN)	0.33
Very Low (VLO)	0.20

Calculating Class

In the NWI methodology Class is calculated from HGED using the formula

$$Class = 4 \times \sqrt{(HGER /F)}$$

where F takes the values 15, 10 and 6 for RS, RA and AN respectively.

In the Revised methodology Class is calculated from HGED using the following formulas:

RS Class = 5 x (1 - exp (-0.10 x HGED)), where HGED is measured in km
AN Class = 5 x (1 - exp (-0.15 x HGED)), where HGED is measured in km
TR Class = 5 x (1 - exp (-1.5 x TR)), where TR is measured in days

TR can take the values 0, 0.5, 1 and 2; hence TR Class can take the values 0, 2.64, 3.88 and 4.75.

See below for an explanation of how BN Class is calculated.

Estimating Time Remoteness

Time Remoteness is the distance in non-mechanised travelling time from the nearest point of mechanised access. It was estimated manually by studying digital topographic maps in tandem with spatial data on roads, walking tracks and vegetation types. Estimates took into account likely vegetation density and terrain factors such as slope steepness and the presence of cliffs or gullies.

Points of mechanised access included roads, (open) vehicle tracks, open airstrips, jetties, the shorelines of inland waterways accessible to powered boats, and sections of coastline where powered boats are known to be able to put ashore. Railways were not counted as access points; nor were helipads, since these are generally accessible only for occasional management purposes.

Lines were drawn traversing geographical points estimated to be 0.5 days, 1 day and 2 days remote by non mechanised travel (i.e. walking or in some cases paddling) from the nearest points of mechanised access. These times were interpreted as 3 hours, 6 hours and 12 hours of walking time respectively exclusive of all breaks. Once the lines were drawn they were used to delineate regions having the designated TR categories.

In estimating travel times the following generic walking speeds were assumed, in lieu of estimates based on direct experience:

Walking speeds assumed in estimating Time Remoteness

Environment type	Walking speed (km/hour)
Closed vehicle track; walking tracks class 1-3	3.0
Walking tracks class 4-6; open heath or sedge	2.0
Open woodland (mainly Central Plateau)	1.0-1.5
Dense forest and scrub	0.5

An additional hour was allowed for every 300m gain in altitude.

It was assumed that non mechanised craft (most likely kayaks) can travel at 4 km/hour on the Murchison Impoundment, which is road-accessible but off-limits to powered craft.

Calculating BN

Areas were classified according to the degree of physical disturbance to which they had been subjected. Class values were awarded using the criteria in the following table:

Values of Biophysical Naturalness

Condition of area	BN Class
Largely undisturbed	5
Selectively logged	2
Clearfelled, cleared, agricultural land, plantation, hydro impoundment, urban vegetation	1

Each grid square was awarded the BN Class corresponding to the region that occupied the largest percentage by area of the square.

Note that only a small number of fairly small regions were designated as selectively logged.

Calculating Wilderness Value

Wilderness Value (WV) was defined as the sum of RS Class, AN Class, BN class and either AR (using the NWI methodology) or TR (using the Revised methodology). Note that under the Revised methodology WV cannot exceed 19.75, since TR cannot exceed 4.75.

A7 Grid-file field list and formulas for calculating field values

Field group A – Map distances (from centroid of grid square to nearest object in table)

For each field (eg field A05), the values entered for each grid-square centroid are the distances from that centroid to the nearest point in the 'combined feature' file with the same name as that field (eg file A05).

Field ID	Methodology	Component of wilderness value	Weighting
A01	Both	RS	MAJ
A02	Both	RS	INT
A03	Both	RS	MIN
A04	Both	RS	RES
A05	NWI	AN	MAJ
A06	NWI	AN	MED
A07	NWI	AN	MIN
A08	NWI	RA	MAJ
A09	NWI	RA	MED
A10	NWI	RA	LOW
A11	NWI	RA	VLO
A12	REV	AN	MAJ
A13	REV	AN	MED
A14	REV	AN	MIN
A15	REV	AN	VLO

Field group B – High-grade equivalent distances

Field name	Methodology	Component	Weighting	Formula
B01	NWI	RS	MAJ	= A01
B02	NWI	RS	INT	= (A02 + 1)/0.80 - 1
B03	NWI	RS	MIN	= (A03 + 1)/0.74 - 1
B04	NWI	RS	RES	= (A04 + 1)/0.66 - 1
B05	NWI	AN	MAJ	= A05
B06	NWI	AN	MED	= (A06 + 1)/0.40 - 1
B07	NWI	AN	MIN	= (A07 + 1)/0.16 - 1
B08	NWI	RA	MAJ	= A08
B09	NWI	RA	MED	= (A09 + 1)/0.71 - 1
B10	NWI	RA	LOW	= (A10 + 1)/0.33 - 1
B11	NWI	RA	VLO	= (A11 + 1)/0.20 - 1
B12	REV	AN	MAJ	= A12
B13	REV	AN	MED	= (A13 + 1)/0.50 - 1
B14	REV	AN	MIN	= (A14 + 1)/0.18 - 1
B15	REV	AN	VLO	= (A15 + 1)/0.10 - 1
B16	REV	RS	MAJ	= A01
B17	REV	RS	INT	= (A02 + 1)/0.67 - 1
B18	REV	RS	MIN	= (A03 + 1)/0.48 - 1
B19	REV	RS	RES	= (A04 + 1)/0.38 - 1

Field group C – Least High-Grade Equivalent Distances

Field name	Methodology	Component	Formula
C01	NWI	RS	= min (B01, B02, B03, B04)
C02	NWI	AN	= min (B05, B06, B07)
C03	NWI	RA	= min (B08, B09, B10, B11)
C04	REV	AN	= min (B12, B13, B14, B15)
C05	REV	RS	= min (B16, B17, B18, B19)

Field group D – Area assessments

Field name	Methodology	Component	Comments
D01	REV	TR	Value in days (0.5, 1, 2)
D02	Both	BN	Value expressed as integer (1, 2, 5)

Field group E – Class values

Field name	Formula
E01nwiRS	= min (4 x sqrt (C01/15), 5)
E02nwiAN	= min (4 x sqrt (C02 /6), 5)
E03nwiRA	= min (4 x sqrt (C03/10), 5)
E04revAN	= 5 * (1 - exp (-0.15 * C04))
E05revRS	= 5 * (1 - exp (-0.10 * C05))
E06TR	= 5 * (1 - exp (-1.5 * D01))
E07BN	= D02

Field group F – Wilderness values

Field name	Formula
F01nwiWV	= E01nwiRS + E02nwiAN + E03nwiRA + E07BN
F02revWV	= E04revRS + E05revAN + E06TR + E07BN