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| SNH Core Areas of Wild Land 2013 Map  **Technical Report**  **Author:** Dr Steve Carver  **Date:** 22nd November 2013  **Client:** The John Muir Trust |  |

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# Introduction

## Scope

This technical report has been commissioned by The John Muir Trust (JMT) in support of their submission to Scottish Natural Heritage (SNH) in response to the consultation on Core Areas of Wild Land (CAWL) 2013 map. The document lays out the technical and conceptual origins of the SNH mapping of wildness in Scotland before analysing the key issues regarding the mapping of wild land leading up to the publication of the CAWL and making a number of recommendations as to how to take the work forward.

## Experience

Dr Carver is the Director of the Wildland Research Institute (WRi) based at the University of Leeds and has 30 years of experience in Geographical Information Systems (GIS) and over 15 years of experience of research into applying GIS to mapping wild land with an emphasis on Scotland, the UK and Europe. He has published widely on the topic and is the author of several key academic papers and technical reports on wild land in Scotland. He has followed the SNH wildness mapping process very closely and provided technical advice at several key stages of this work. He has provided key evidence on wild land and wild land mapping for the EU, EEA, the Scottish Government, SNH and JMT as well as for several planning inquiries where development proposals have potentially impacted on wild land. These include the Allt Duine, Sallachy and Glenmorie wind farm proposals and the Cononish gold mine. He has also worked extensively with the US Forest Service and US National Park Service informing their decision making processes regarding wilderness and landscape character.

# SNH approach and methodology

## Origins and background

The current SNH wildness mapping process has its origins in NPPG14 (1998)[[1]](#footnote-1) which included an early reference to wild land as “Uninhabited and often relatively inaccessible countryside where the influence of human activity on the character and quality of the environment has been minimal.” This was followed up in 2002 by the SNH policy statement on *Wildness in Scotland’s Countryside[[2]](#footnote-2)* which both recognised the value of wild land as “parts of Scotland where the wild character of the landscape, its related recreational value and potential for nature are such that these areas should be safeguarded against inappropriate development or land-use change” (p15). The SNH policy statement goes on to recognise four essential attributes of wildness specific to Scotland which include:

* perceived naturalness of land cover;
* absence of modern human artefacts;
* rugged and challenging nature of the terrain; and
* remoteness from mechanised access.

These also encapsulate the qualities of scenic grandeur and size/scale of area. While the 2002 policy statement provides some indicative maps of remoteness from public and private roads it does not provide any definitive maps. Instead SNH provide a map showing Search Areas for Wild Land (SAWL) that is intended as guidance to local authorities in developing their own regional level maps and analyses to inform the planning process. There is no national designation of wild land, rather wild land is a concept that is to be recognised and applied in considering planning applications likely to affect the special wild character of the landscape in these areas. It is worth noting that the SAWL map was never intended to be used as a tool for making decisions about where and where not to locate large-scale developments such as wind farms, but it appears to have been used as a guide and has often be quoted in environmental assessments and planning proposals. It was, in retrospect, a mistake to digitise the SAWL map provided in Annex 1 of the 2002 policy statement and make it available for public use as a GIS format dataset. The SAWL map was drawn using the personal knowledge of the policy statement’s authors and while being a reasonable approximation of the core wild land areas (i.e. we intrinsically know where these areas are) it is neither robust nor repeatable having being drawn essentially “by hand”. The SAWL map should therefore be replaced by the CAWL map as soon as possible.

Developments in Europe have paralleled those in Scotland over the last five years and serve to support the work carried out by SNH. In February 2009 the European Parliament passed a resolution on Wilderness in Europe with a majority of 538 for versus only 19 against[[3]](#footnote-3). The Scottish Government subsequently commissioned a report on *A review of the status and conservation of wild land in Europe* which was published in 2010[[4]](#footnote-4) and this has since informed EU-level work through the development of the *Guidelines on Wilderness in Natura 2000: Management of terrestrial wilderness and wild areas within the Natura 2000 Network* (2013)[[5]](#footnote-5) and on-going work on the development of a European Wilderness Register. The Guidelines document provides a definition of European wilderness that states “A wilderness is an area governed by natural processes. It is composed of native habitats and species, and large enough for the effective ecological functioning of natural processes. It is unmodified or only slightly modified and without intrusive or extractive human activity, settlements, infrastructure or visual disturbance” (p.10). While this definition might not fit wild land in Scotland, the Wilderness Register draft report recognises that areas not meeting the strict definition of wilderness but retaining significant wild characteristics may be locally or nationally important. These are defined as areas with “a high level of predominance of natural processes and natural habitat. They tend to be individually smaller and more fragmented than wilderness areas, although they often cover extensive tracts. The condition of their natural habitat, processes and relevant species is however often partially or substantially modified by human activities such as livestock herding, fishing, forestry, sport activities or general imprint of human artefacts.” This matches the concept of wild land in Scotland very well.

## Ethos and purpose

While SNH recognise the qualitative and subjective nature of wildness, they also recognise the paramount importance of clarity of definition and the ability to reliably and robustly map the qualities of wildness and core wild land areas in a repeatable and defensible fashion[[6]](#footnote-6). The Phase I mapping of wildness and the Phase II and III identification of core areas form an integrated programme intended to identify both the spatial variation in the qualities of wildness across the whole of Scotland and inform the identification and mapping of selected core areas. While the Phase I map can inform strategic thinking about wild land at a national level by showing the overall pattern of wildness as a continuum from least wild to most wild, it can also inform local decisions about planning and development. In order to expedite the decision-making process it is necessary to make difficult decisions regarding the fuzzy nature of wildness and draw a line on the map showing the boundary of the core wild land areas. The Phase II and III mapping is intended to meet this need for a map showing CAWL. It is these boundaries and their definition that are currently out for consultation.

## Methodology

The methodological approach taken by SNH in the Phase I mapping is based largely on the local level mapping work carried out by the WRi and colleagues for the two Scottish national parks: the Cairngorm National Park (initially in 2008 and again in 2011 to take into account the southern extension to the park boundary) and the Loch Lomond and The Trossachs National Park (2011)[[7]](#footnote-7). This has been scaled up and generalised to make it applicable to a national level mapping programme. The Phase II and III work is based around a method of SNH’s own design but draws on publications by WRi and common practice in GIS mapping of this kind[[8]](#footnote-8)[[9]](#footnote-9). The following sections identify key issues in the process of mapping wildness and wild land in Scotland, but it is worth noting that the SNH wildness mapping in Phase I and identification of CAWL in Phase II and III represents the most detailed, sophisticated and rigorous mapping of wild land in any country anywhere in the world to date.

The full methodology employed by SNH in developing their Phase I mapping and Phase II and III CAWL maps is fully described in SNH documents which provide both technical and non-technical detail. The approach taken can be summarised as follows:

**Phase I:** equal weighted summation of normalised attribute maps describing the four attributes of wildness as established in the 2002 policy statement to create a wildness continuum showing the spatial variation in wildness from least to most wild.

**Phase II:** partitioning of the Phase I wildness map into eight wildness classes based on the Jenks Natural Breaks Optimisation method followed by comparison with the 2002 SAWL and identification of contiguous areas of classes 7 & 8 (high wildness) of 1000ha or more and 500ha or more south of the Highland Boundary Fault and consideration of classes 5 & 6 where these abut the above areas.

**Phase III:** consolidation of Phase II areas using informed judgement as regards changes since the Phase I mapping, isolated detractors, small inclusions of class 4 areas and inclusion of inland water (sea lochs) followed by drawing of simplified logical boundaries based on recognisable features on the ground such as rivers, lochs, ridgelines, etc.

The work on mapping wildness in the national parks carried out in 2008 and 2011 was in both cases accompanied by a perception survey aimed at elucidating public opinion on the value, understanding and character of wild land in Scotland. The first survey in 2007 questioned 1300 Scottish residents and established that by far the greater majority thought wild land important (91% of Scottish residents and 96% of national park residents) of which a significant number thought wild land very important (70% of Scottish residents and 82% of national park residents) while the second survey in 2011-12 was used to identify patterns in people’s opinions about the relative importance of key attributes of wildness[[10]](#footnote-10).

## Current state of play

The CAWL are currently “out to consultation” until 20th December 2013.

# Key issues

## Scale

Scale is a fundamental concept in all geographical studies. The window of observation and the “lens” through which one views the landscape very much determines the detail that we see. Wildness (and wilderness quality) have been modelled and mapped at a whole range of spatial scales from the global to the local. Global scale mapping such as the *Human Footprint* and *Last of the Wild* maps are drawn using global scale datasets to show the broad major patterns in human impact and the world’s remaining wilderness areas[[11]](#footnote-11). These show up in areas such as Antarctica, Greenland, Siberia, Alaska, the Sahara and Gobi deserts, the Amazon rainforest, etc. but cannot distinguish national level patterns very well nor identify areas of local importance. For example, Scotland doesn’t even show up on the *Last of the Wild* mapping yet we know that Scotland’s wild land is a priceless national asset. Regional scale mapping such as those developed for Europe and North America can show more detail but still rely on relatively broad scale coordinated datasets to show overall patterns and distributions of wildness. The recent maps developed to support the EU Wilderness Register show up the principal core areas in Scotland relatively well (despite Scotland not being able to return any wilderness areas to the Register) but these lack definition in terms of their boundaries and characteristics.

The scale of mapping covered in the SNH Phase I, II and III maps represents the optimum scale for national level mapping wherein detailed nationally available data can be used in a coordinated fashion using models that are customised and attuned to best suit the national patterns and our understanding of wild land. This is ideal for strategic planning at a national level such as is required in defining the CAWL maps and evaluation of national designations. Local scale studies such as those developed for the two Scottish national parks are more appropriate for these smaller areas where detailed models and data can be further customised to better distinguish the detail required for local strategic planning and decision making. This scale is better suited to making decisions as regards location and permissions for new developments, opportunity mapping, planning policy and restoration projects.

Decisions concerning the scale of core wild land areas have had to be made by SNH in the Phase II and III CAWL mapping when looking at the obvious differences between the Highlands and Lowlands of Scotland. It is obvious looking at the Phase I map that the bulk of the wild land resource is located in the Highlands while the Lowlands are relatively under-represented. Considering the concept of relativity that scale and different windows of observation engender, it is important to ensure a representative spread of core wild land areas between both Highlands and Lowlands in a similar fashion to concerted efforts by the Federal agencies to make sure eastern areas of the USA were better represented in the US National Wilderness Preservation System. SNH therefore make the decision to reduce the size threshold for core areas south of the Highland Boundary Fault from 1000ha to 500ha thus ensuring at least some core areas remain within easy reach of the main conurbations of the Central Belt. This is a logical choice based on the key geographical division represented by the Highland Boundary Fault though the size thresholds are arbitrarily decided on.

## Resolution

Resolution is very much related to scale. The more local the scale, the higher the resolution one can view the landscape, based on both availability of more detailed (higher resolution) datasets and available computer resources. The global and regional studies described above have used 1km resolution data whereas the local mapping for the national parks has used 20m resolution datasets. The mapping work carried out by SNH at a national level has used data resolutions of 25m, 50m and 100m to ensure the highest quality results are available at the national scale while ensuring the analysis is practical on the basis of required computational overheads. While the methodology applied in developing the Phase I mapping is based around the local scale mapping developed for the two national parks some generalisation has been required due to data availability and computational overheads. For example, while the visibility analyses for the two national parks were run at 20m resolution using the NextMap DSM data, this level of analysis would prove too unwieldy at the national scale where runtimes would have proved too long for practical analyses. As a result decisions were taken by SNH to run the visibility analyses at 50m resolution with a 15km search radius and 100m for wind turbines where a wider search radius of 30km was deemed necessary to reliably represent their impact on the wider landscape.

## Attributes and mapping criteria

The SNH Phase I mapping is based around the four attributes of wildness identified in their 2002 policy statement. These and their implications for the CAWL map are discussed below:

### Perceived naturalness of land cover

This attribute deals with how natural the land cover feels to the individual. It is based on a reclassification of the 25m resolution CEH Land Cover Map 2007 into “naturalness” classes and combination of these within a 250m radius zone around the observer. This takes into account the total effect of all land cover within the immediate area around the observer. It is not a measure of the ecological naturalness rather it sis a measure of how natural it looks and feels to the casual observer. For example, montane vegetation is deemed wilder than grazing land which is wilder than arable land which is wilder than built up areas. Some uncertainty is acknowledged by SNH in distinguishing the level of management within land cover classes. For example, heather moor can be natural when unmanaged and only semi-natural when managed for grouse shooting by muirburn. Similarly, the LCM2007 data does not distinguish between natural and artificially impounded water with its associated draw-down line and infrastructure. However, these are justifiable generalisations for a national level mapping exercise and can be better and more confidently distinguished by local level mapping as demonstrated in the mapping work carried out for the two national parks where land cover data can be supplemented by more detailed dataset and “ground truthing” by local experts.

### Absence of modern human artefacts

This attribute deals with how the landscape visible from any one point is impacted by the visibility of obvious modern human artefacts such as linear features (roads, tracks and railways), buildings, structures (dams, power lines, masts, etc.) and wind turbines. The relative impact of all such human artefacts is calculated based on the proportion of the 360° landscape view around any point over a landscape defined using a 50m resolution terrain model, that is occupied or taken up by these artefacts as opposed to background land cover. This therefore takes both the vertical area (i.e. height) of artefacts visible and the distance from the observer and is calculated using custom software. A maximum search radius of 15km is used for all human features except for wind turbines where a radius of 30km is used. This increased search radius is based on the fact that these very large installations stand out against the surrounding land cover and also move thus making them more visible over longer distances. Both search radii are based on results from research carried out by Bishop et al. (2002)[[12]](#footnote-12). This methodology only differs from that carried out for the two national parks in that plantation forest is not considered at the national level, however these are considered in the deliberations about areas included through the Phase III mapping and are included in the mapping of perceived naturalness. Another query raised in the consultation process has been the decision to base the visibility of wind farms only on installed turbines and not to also include consented turbines. This is justified on the basis that the Phase I map is intended to represent a snapshot of wildness across Scotland at the time of mapping such that this can be used as a baseline against which further encroachments on wildness and CAWL can be judged in the future. Since the consented turbines had not yet been built at the time of mapping (and many still remain unbuilt and could in fact fail to be built as economic circumstances change) the decision was taken not to include consented turbines in the Phase I mapping process. Consented turbines which are ultimately built will have their visual influence and impact on CAWL calculated in the repeat mapping in the future.

### Rugged and challenging nature of the terrain

This attribute deals with how rugged the landscape looks (and by association, how challenging it is to cross). This is modelled directly from the terrain data using standard deviation of total curvature. If the terrain is rugged and complex the standard deviation will be high, if the terrain is smooth and less complex, it will be lower. The measure basically captures the rate of change of altitude in both plan and profile. This works very well at capturing the ruggedness of the landscape in mountainous areas but presents certain difficulties with the concept of “challenging” where flat (and therefore not rugged) but boggy/waterlogged terrain (and therefore challenging) is concerned. This is an area of uncertainty that has been voiced in respondents concerns. However, the effects of relatively low lying, flat and boggy ground such as found in the Flow Country, Claish Moss and Rannoch Moor are relatively localised and largely accounted for in the calculation of the remoteness from mechanised access layer.

### Remoteness from mechanised access

This attribute deals with how remote the landscape is based on how long it takes to walk from the nearest point of mechanised access, usually a public road. The model uses a GIS implementation of the well-known Naismith’s Rule[[13]](#footnote-13) to calculate walking times based on horizontal distance, vertical rates of ascent and descent, the effects of ground cover on walking speeds (e.g. boggy ground and dense forest/shrub have a marked effect in slowing walking speeds), and the influence of barrier features (e.g. lochs, rivers, cliffs, etc.) in impeding progress. It does not take into account the popularity of walking routes and destinations such as mountain summits (e.g. Munros) as these are temporal aspects that change from day to day and so cannot be reliably modelled. Rather the remoteness attribute looks at the effect of inaccessibility and the commitment required on the part of the individual to travel by foot into core wild land areas as an indication of overall remoteness in and across the landscape. Some concern has been voiced here over the ability of the model as applied to represent the remoteness of islands where there is no public road/ferry access. While some of these may be relatively accessible (and therefore not remote) to anyone with a suitable boat, they are considered to be in the remotest class in the SNH Phase I mapping which focuses on remoteness from public roads when travelling on foot. Again, this is a sensible generalisation when looking to map wildness and CAWL at the national scale. Local models such as those developed for the Loch Lomond and The Trossachs National Park where travel by boat on inland and sea lochs is a possibility having taken the use of water craft into account, while remoteness of coasts, inland marine areas and islands has been accurately modelled by WRi for the JMT in Lewis/Harris, the Shetlands and the Skye/Knoydart areas.

## Transparency

Some concerns have been expressed as to the transparency of the Phase I, II and III mapping process. SNH provide two documents on their web pages; a technical document and a non-technical summary[[14]](#footnote-14). These give both the precise details of how the maps were created and a broad, plain-English explanation of the principles used for non-GIS experts. The non-technical summary necessarily simplifies the complexities of the modelling process and in doing so misses out some technical details. It is recognised that modelling wildness is a non-trivial task and while the basic models involved in Phase I, II and III mapping are simple enough in principle, their implementation necessarily requires a series of complicated steps to combine a variety of data streams and spatial models, perhaps giving rise to some appearance of non-transparency in the overall mapping process to non-GIS experts.

## Robustness and repeatability

It is essential that the mapping process undertaken in Phase I, II and III are both robust and repeatable. The results of the Phase I mapping and the Phase II and III identification of core wild land areas represent a tremendous effort and great deal of work on the part of SNH and are, as stated in section 2.3, the most detailed, rigorous and sophisticated mapping of wildness at a national level anywhere in the world to date. It should therefore be considered as robust as practically possible for a country of this size. The aim of the mapping process is to define the pattern and distribution of wildness at a national scale and identify CAWL for a specific point in time (i.e. 2013) in the assumption that the mapping work will be repeated in the future as attributes of wildness change through both development and restoration. It is anticipated that subsequent repeat mapping campaigns (say on a five or ten year cycle) can show up losses and gains to the CAWL and so better inform national strategic thinking on wild land and the threats it faces from development as well as local planning policies and decision-making.

## Qualitative vs quantitative definitions

It is recognised at various levels and at various stages in SNH thinking that wildness and wild land are essentially a qualitative concept that will inevitably vary from person to person and between stakeholder groups and organisations. This may be used an argument to say that it is pointless to map it since the concept is too vague to be reliably quantified. The alternative and stronger argument is that wildness and wild land in Scotland’s countryside is too valuable a resource not to at least attempt to quantify it and therefore be able to map it sufficient detail and rigor such that it can best be delimited and protected. There are many difficulties associated with mapping wildness and wild land as is amply demonstrated by the work SNH has done and the amount of interest and comment generated; both supportive and critical. What is true, and a fact that we cannot deny, is that if left unmapped and unprotected, Scotland’s wild land resource will be at great risk of steady erosion from numerous developments, not least of which are those from the renewable energy sector, but also from estate management (e.g. proliferation of hill tracks), mineral exploitation (e.g. mining, quarrying, etc.), communications (e.g. cell masts) and urbanisation[[15]](#footnote-15). It is clear from the two perception studies that the majority of Scottish residents believe wild land is a value asset and ought to be protected. This lends the weight of “being in the national interest” to the SNH mapping work. There has been some discussion as to whether the boundaries presented in the Phase III CAWL maps should be regarded as discrete or fuzzy (i.e. vague). Certainly the concept of wildness is fuzzy and it is difficult to see how the transition from non-wild to core wild land areas can ever be mapped with 100% certainty, but for planning and decision making purposes a discrete and definitive line on the map is required. This is not without precedent in Scotland or abroad. In Scotland, national parks and other protected areas with which certain planning and development restrictions are linked, are defined sharp boundaries on definitive maps in planning offices. In the USA, designated wilderness areas are similarly defined (for example in Death Valley National Park, legally designated wilderness begins 500 feet from the road)[[16]](#footnote-16). Protection of wildness and core wild land areas in Scotland needs, despite the uncertainties associated with mapping a vague and fuzzy concept, a definitive line on the map.

# Recommendations

It is strongly recommended that we accept the SNH Phase I, II and II mapping work and the CAWL map that arises therefrom. The reasons for this recommendation are given in detail in the sections above, but are summarised below:

* Wild land is a highly valued and distinctive aspect of Scotland’s culture and countryside that is sensitive to development. The majority of Scotland’s population thinks wild land is important and requires protection.
* Informed decisions about protection depend heavily on high quality mapping. The SAWL provided in Annex I of the 2002 SNH policy statement on wild land was only ever intended as a preliminary search map for areas of wild land and should never have been released for use in digital form.
* The SNH Phase I, II and III mapping of wildness and wild land in Scotland represents the most detailed and rigorous national mapping exercise of its kind in the world to date. Scotland may therefore be seen as a world leader in this field and therefore the work of SNH should be given the fullest support possible.
* The approach for the Phase I mapping is based on proven and accepted methods developed for the Cairngorm National Park and the Loch Lomond and The Trossachs National Park, but has been generalised to facilitate scaling up to map the whole of Scotland. This generalisation is wholly warranted and driven by scale, data availability and computational considerations.
* The four attributes of wildness have been mapped using the most up-to-date datasets and spatial models. SNH acknowledge that there are some uncertainties within these that are generated from data limitations and generalisations, but these are accounted for either within other attributes or within the Phase II and III mapping.
* The Phase II mapping represents a logical, robust and repeatable approach to identifying the core wild land areas from the Phase I continuum map based on wildness and size with a sensible approach to recognising the differences in core areas in both the Highlands and the Lowlands across the Highland Boundary Fault.
* Phase III introduces human input from landscape experts scrutinizing the Phase I and II mapping to makes decisions about the final boundaries presented in the CAWL maps. This is necessary to produce sensible boundaries based on local geographical knowledge and features recognisable on the ground as well as performing a final check for features and anomalous geographies not picked up in the more automated Phase I and II mapping.
* The SAWL should be withdrawn and replaced by the 2013 CAWL map as the basis for informing current and future decisions regarding wild land, its wider protection and proposals impacting upon it.

Dr Steve Carver, Director, Wildland Research Institute. 22nd November 2013

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