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Geodiversity of the Cairngorms National Park

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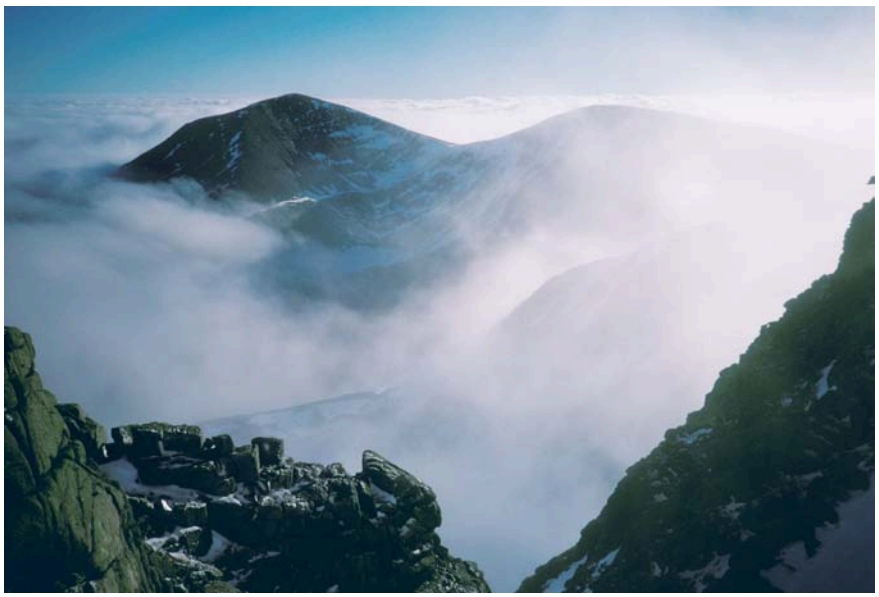

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GEOLOGY AND LANDSCAPE SCOTLAND PROGRAMME

OPEN REPORT OR/10/019

Geodiversity of the Cairngorms National Park

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Front cover

Carn an t-Sabhail (1291 m) from the top of Coire Brochain, Braigh Riabhach, Cairngorm National Park. P689667.

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Foreword

This is the final report derived from a desk study by the British Geological Survey (BGS) working in collaboration with the Cairngorms National Park Authority (CNPA). The project was jointly funded by BGS and the CNPA.

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Summary

This report describes the results of a desk-based geodiversity audit of the Cairngorms National Park commissioned by the Cairngorms National Park Authority (CNPA) and jointly funded by the British Geological Survey (BGS). It represents a first pass at selecting the most important localities for Local Geodiversity Sites in the Cairngorms National Park, based on available information and local knowledge of BGS geologists.

Thirty-five bedrock geodiversity sites (including 23 Geological Conservation Review Sites) and fifty-four Quaternary sites (including 38 Geological Conservation Review Sites) are proposed as Park geodiversity sites. These sites should not be regarded as the final definitive list, but as a framework to which additional sites can be added as more information becomes available.

The main outputs from the project are GIS and database files of the geodiversity sites.

1 Introduction

Geodiversity is the variety of rocks, minerals, fossils, landforms sediments and soils, together with the natural processes which form and alter them (Gordon and Barron, 2010). Geodiversity also links people, landscapes and their culture through the interactions of biodiversity, soils, minerals, rocks, fossils, active processes and the built environment (Stanley, 2004).

1.1 THE CAIRNGORMS NATIONAL PARK

Established in 2003 as Scotland's second national park, the 4,528 km^2 Cairngorms National Park (CNP) is the UK's largest national park, and is over twice the size of both the Loch Lomond and the Trossachs and the Lake District parks.

It is a mountainous area with 36% of the land area over 800 metres and 2% over 1000 metres in altitude. Four of Scotland's five highest mountains are within the Park and there are 55 summits over 900 metres. It contains the largest area of arctic mountain landscape in the British Isles. Currently 39 % of the area of the Park is designated for nature conservation; of this 25 % is designated as being of European importance for nature conservation.

Geological, geomorphological and climatic processes underpin and shape the Park's outstanding landscapes of arctic mountains, hills, glens and straths (Gordon and Wignall, 2006). The Cairngorms contains one of the world's finest assemblage of pre-glacial and glacial landforms; assemblages rarely seen outside arctic Canada. This international significance of the Cairngorm's geodiversity is recognised in their inclusion in the UK Tentative List of World Heritage sites for their exceptional physical features.

1.2 CAIRNGORMS NATIONAL PARK PLAN

The 2007 Cairngorms National Park Plan includes the following vision for geodiversity:

> *'The important geodiversity record in the Park will be widely recognised and will be well managed and conserved'.*

Supporting this geodiversity vision are four strategic objectives that provide a long-term framework for managing the Park:

a) Safeguard the geological and geomorphological features and associated processes that contribute to the landscape of the Park.

b) Raise awareness of the outstanding geology and geomorphology in the Park.

c) Prevent degradation and erosion of soils, particularly vulnerable montane and organic soils.

d) Safeguard against large-scale extraction and removal of mineral resource from the National Park.

In 2009, the British Geological Survey (BGS) and the Cairngorms National Park Authority (CNPA) agreed to prepare a jointly-funded geodiversity audit of the Cairngorms National Park to support these strategic objectives and help realise this long-term vision. At the same time, BGS also contributed to a new Landscape Character Assessment (LCA) of the CNP (Barron et al., 2011)

The outputs of this wholly desk-based audit will be used to inform land management activities in the Park and serve as a future resource for interpretation work. The project covered the entire Park area and a full range of geodiversity topics, but was biased towards:

- Geodiversity sites and landforms that represent the best examples within the Park;
- sites and landforms on lower ground nearer centres of population.

2 Why geodiversity matters

Geodiversity links people, landscape, biodiversity and culture. It exerts a profound influence on the distribution of habitats and species, and is an important control on the economic activities and history of settlement in any given place (Gordon & Barron, 2011). The geodiversity of a region is as important a facet of its natural heritage as its wildlife interests, and it can be one of the most significant areas of heritage interest, especially in areas of high landscape value. Conservation, sustainable management, educational use and interpretation of geodiversity are as important as those of biodiversity and archaeology, and geodiversity interests should be integrated into the management and conservation strategies for such related or parallel interests. Geodiversity information should make a significant contribution to the formation of a wide range of planning and environmental policies.

Considering the impact of geology on our local landscapes and heritage, few geological and landscape features in Scotland have any protection other than those designated as Sites of Special Scientific Interest (SSSIs). Geodiversity is an important environmental asset but is one of the least recognised and appreciated.

The geodiversity of an area is vulnerable to a wide range of threats: forests may be planted; quarries can be infilled; natural overgrowing by vegetation can completely obscure an exposure; and features within an urban environment may be built over.

The general public, Local Authorities, industries and schools have for many years been made aware of the importance of conserving archaeological and wildlife sites for future generations; it is equally important that geodiversity sites are understood, protected and explained to others.

Geoconservation activities in Scotland, and elsewhere in the UK, have traditionally focused mainly on the assessment and management of statutory protected sites (e.g. Ellis et al., 1996; Prosser et al., 2006) and interpretation of the links between geology and landscape (e.g. Gordon et al., 2004).

Increasingly, geodiversity is being recognised to have much wider relevance in a number of key policy areas and, in effect, to form a core element of ecosystem services (e.g. Gordon and Leys, 2001; Gray, 2004; Stanley, 2004; Gordon and Barron, 2010; Birch et al., 2010):

- it provides the physical basis for our varied landscapes (both rural and urban) and scenery, and has a profound influence on habitats and wildlife;
- it provides the basis for many aspects of economic development, including geotourism-based activities;
- it is a strong influence on our cultural heritage as a source of inspiration for art, sculpture, music, poetry and literature, and on the character of our urban areas through the use of different building stones;
- it provides a resource for a variety of recreation and outdoor activities, and therefore delivers benefits for people's health and well-being;
- sustainable management of the land, river catchments and the coast; and
- it can help society to develop adaptations to climate change and to mitigate natural hazards through better understanding of natural processes.

In the past, geodiversity has suffered from a sectoral approach to conservation in which biodiversity and geodiversity have tended to be treated as separate entities, and with a dominant focus on the former (Gordon & Barron, 2011). However, the value of more integrated approaches is now becoming widely recognized at a strategic level; for example, the Convention on Biodiversity and the European Landscape Convention call for a more integrated approach to the conservation of natural resources and landscapes, both within and beyond protected areas.

This is reflected in the growing emphasis on an 'ecosystem approach' in conservation management and, at a more practical level, in Integrated Catchment Management/Sustainable Flood Management (Gordon & Barron, 2011).

Soil conservation and sustainable management of soil resources have become increasingly a priority issue through the European Soil Thematic Strategy and the proposed Soil Framework Directive.

Scotland's geodiversity forms the essential foundation upon which plants, animals and human beings live and interact. The active geomorphological processes that shape our mountains, rivers and coasts also maintain dynamic habitats and ecosystems. Scotland's biodiversity depends on the continued operation of these processes. It is increasingly recognised, therefore, that conservation management of the non-living parts of the natural world is crucial for sustaining living species and habitats.

Geodiversity also links the Earth, its people and their culture. Through the Global Geoparks Network, the cultural and economic importance of geodiversity is being increasingly adopted by UNESCO as a means to deliver geoconservation as part of a wider strategy for regionally sustainable socio-economic and cultural development that safeguards the environment (Eder and Patzak, 2004). There is therefore growing acceptance that geodiversity has a vital place in all aspects of the natural heritage and that it impacts on many sectors in economic development and historical and cultural heritage.

Geodiversity also has key relevance for other strategic issues/programmes, most notably climate change. Potentially important contributions include:

- river basin management plans and sustainable flood management through restoration of natural processes and an understanding of floodplain histories from sedimentary records; and
- understanding carbon dynamics in organic (peat) soils (Scotland's soils contain the majority of the UK soil carbon stock – Chapman et al., 2009)

Many different activities and sectors interact with geodiversity and have an impact on it – agriculture, forestry, industry, transport, recreation, tourism, development planning and flood protection along rivers. The challenge is to raise wider understanding and awareness of geodiversity and that its protection, enhancement and sustainable management are not only relevant, but essential to the people of Scotland and, through the provision of a range of vital services and benefits, how they live their lives.

3 Methodology

The project was divided into four key stages:

1. Literature and data review
2. Compile database and GIS of potential geodiversity sites and landforms
3. Select Potential Local Geodiversity Sites
4. Compilation of this report

3.1 LITERATURE AND DATA REVIEW

Information on potential sites was gathered from:

a) Specialist and general geological literature
b) Geological Conservation Review (GCR) database from SNH
c) SNH SSSI site documentation; SNH Commissioned Report No. 348, The geomorphological heritage of the Cairngorm Mountains (Kirkbride & Gordon, 2010); SNH Commissioned Report No. 064, Geological structure and landscape of the Cairngorm Mountains,(Thomas et al., 2004).
d) BGS 1:10k and 1:25k scanned maps, field slips, and other information such as digital aerial photography and NEXTMap® Britain data from Intermap Technologies

3.2 SITE DATABASE AND GIS COMPILATION

The information gathered during the literature and data review was compiled in Excel tables and plotted as layers within a Geographic Information System (GIS) to give a reasonably comprehensive (within the resource limits of the project) database of sites.

3.3 SELECTION OF POTENTIAL LOCAL GEODIVERSITY SITES FOR THE CNP

Initially it was intended to apply scientific quality/rarity value scoring (Table 1) to sites and landforms to allow selection of the best sites for selection as potential Local Geodiversity Sites. However, this proved difficult to apply objectively in the absence of site visits and the selection of sites and landforms was left to the geologist's expert judgement.

Geodiversity Site selection criteria – Geoscientific Merit		
RARITY	**Rating**	
The abundance or significance of the feature of the site in the global context. *Is the rarity such that the feature is one of only a few in the world, in the UK or in the regional area or is it one of many examples and only of reference or educational significance (because it is on the doorstep)?*	10	World
	8	UK
	6	Regional
	4	Local (LGAP)
	2	Educational / Reference
	0	Not Present / Relevant
QUALITY	**Rating**	
The extent to which a feature is typical or demonstrates 'text-book' features. *World class specimen or poor example?*	10	World
	8	UK
	6	Regional
	4	Local (LGAP)
	2	Educational / Reference
	0	Not Present / Relevant
LITERATURE / COLLECTIONS	**Rating**	
The detail of written literature or material collections relating to the feature.	10	Detailed Studies
	8	Interpretations
	6	Descriptions
	4	Collected Material
	2	Referenced
	0	No Data
Other geodiversity criteria such as access, current site value, community value, educational value, fragility and potential use are also included but not normally scored.		

Table 1 Geodiversity Site selection criteria – Geoscientific Merit

4 Bedrock geodiversity of the Cairngorms National Park

4.1 BACKGROUND

The Cairngorms National Park contains representatives of a remarkably high proportion of the main bedrock geology units that crop out within the Grampian Highlands of Scotland – in many respects the Park presents a microcosm of the entire swathe of bedrock geology that crops out between the Great Glen Fault and the Highland Boundary Fault.

The age of bedrock units in the CNP spans approximately 600 million years; from around 1,000 million years ago to 400 million years ago. In simple terms there are two main components: (i) layers of sedimentary materials that were deposited at Earth's surface and subsequently buried, lithified, metamorphosed and folded; and (ii) numerous bodies of igneous rock that were injected into the metasedimentary rocks from deep within the Earth's crust. The metamorphosed sedimentary rocks consist of an older unit, the Badenoch Group, and a much thicker and more diverse younger unit, the Dalradian Supergroup. The igneous rocks consist of a small number of older granite intrusions, the Vuirich Suite, and a large number of younger and more diverse intrusions of the Caledonian Supersuite. The latter formed in association with the Caledonian Orogeny, a period of major geological upheaval caused by the collision of continents and smaller crustal units during closure of the Iapetus Ocean between 500 and 400 million years ago). The orogeny caused much of the folding and metamorphism that has affected the (meta)sedimentary rocks of the district. The Park also contains a small area of non-metamorphosed sedimentary rocks deposited during the early part of the Devonian Period, which represents a relict of widespread terrestrial deposits that originally blanketed much of the district when the land was uplifted and eroded at the end of the Caledonian Orogeny.

4.2 RECOMMENDED BEDROCK GEODIVERSTIY SITES

Thirty-five sites are proposed to represent the bedrock geodiversity within the CNP (Table1, Figure 1). These are biased towards lower ground nearer centres of population at the request of the CNPA, and to a large extent, on the local knowledge of BGS geologists. Bedrock mapping in the CNP by BGS over the last 40 years or so has concentrated on the Dalradian rocks to the east and south of the Park. One exception to this was the joint study by SNH and BGS on the geological evolution of the Cairngorms Mountains (Thomas et al., 2004). However this concentrated on landscape evolution of the Cairngorm Granite using lithological and structural data, rather than geodiversity.

More than half (twenty-two) of these are existing or proposed GCR sites (sites described in the Geological Conservation Review series (Ellis et al., 1996) that have been considered for notification as SSSI's on the basis of their national or international Earth science significance). The sites fall into several informal categories depending on the type of feature they represent. Most numerous are sites presenting good examples of a particular part of the stratigraphy, and in some cases important structural or depositional relationships. Other categories are: examples of the main families of intrusions, landforms reflecting strong bedrock controls, and sites of historical or cultural relevance (for example quarries that have made an important contribution to the local built heritage). The list of proposed sites is not exhaustive, but should form a framework to which additional sites can be added in future.

A summary of the age, nomenclature and sequence of the major stratigraphical and intrusive divisions in the bedrock geology of the CNP is presented in Figure 1. Many of the proposed bedrock geodiversity sites represent a particular part of the geological record - for example a distinct segment of the lithostratigraphy, or one of the main families of intrusive units. Where this is the case it is indicated on Figure 1. A small number of the main bedrock divisions highlighted on Figure 1 is not represented in the list of proposed sites, namely: the Southern

Highland Group (Dalradian Supergroup), the Northeast Grampian Granitic Subsuite and Northwest Grampian Granitic Subsuite. Additional sites could be identified to represent these units and thereby complete a ‘set’ of geodiversity sites that encompasses all of the major bedrock divisions in the park.

5 Quaternary landforms and deposits of the Cairngorm National Park

5.1 BACKGROUND

The Cairngorm National Park is an area of outstanding geomorphological interest, comprising an exceptional assemblage of pre-glacial, glacial, glaciofluvial, periglacial and paraglacial landforms and deposits. These include planation surfaces, tors and pockets of deeply weathered bedrock that have survived several periods of glaciation, illustrating aspects of longer-term landscape development. It contains a striking assemblage of landforms created by selective glacial erosion, including vast corries, arêtes and breaches, together with those related to the retreat and decay of glacier ice, including moraines, deep drainage channels and deposits formed in temporary ice-dammed lakes. In addition, the Park includes a wide range of periglacial phenomena, both active and relict, that result from repeated freezing and thawing of rocks and soil under the influence of gravity.

The last major glaciation of the Cairngorm National Park occurred between 29 000 and 15 000 BP (calendar years ago). During this 'Main Late Devensian' glaciation, an ice sheet expanded quickly to cover the whole of the Scottish mainland. Ice on the plateaux is believed to have been relatively thin, dry and cold-based. It caused minimal glacial erosion as it flowed predominantly by internal deformation. In contrast, convergent flow within the major glens and across bealachs was wet based, promoting basal sliding and enhancing rates of glacial erosion. The Park includes classic examples of such 'selective linear erosion'.

Following the Last Glacial Maximum at about 22 000 BP there followed a slow glacial retreat under 'Siberian' conditions, especially in the north-east of the Park. Ice sourced in the western Highlands retreated in a general westerly direction, exposing mountaintops and glens in the east before those in the west. There were complex interactions between this actively retreating ice sheet and ice sourced locally over the Cairngorms, Lochnagar and Gaick. Retreat was punctuated by at least one major glacial readvance or stillstand involving Strathspey ice, evidenced by extensive lateral moraines in Glen More. Ice-marginal lakes were ponded up at this time within Gleann Einich and the Lairig Ghru, between active Strathspey ice occupying Rothiemurchus, and local glaciers.

The climate warmed abruptly 14 700 years ago when tundra vegetation was replaced by one of birch and juniper scrubland. However, the climatic amelioration was short-lived and Arctic conditions returned about 12 500 years ago. During the ensuing 'Loch Lomond Readvance' (or 'Younger Dryas') ice caps developed over the Gaick and the West Drumochter Hills, and small glaciers formed in the high corries of the Cairngorms, Lochnagar and Monadhliath mountains. Most of the district remained unglaciated, but repeated freezing and thawing destabilised cohesive glacial deposits, causing them to creep and slip downslope into the glens. The present warm, interglacial climate of the Holocene began abruptly 11 500 years ago. Birch woodland had returned by 10 000 BP, followed later by pine. Though relatively stable, the climate has varied sporadically and has become colder and wetter since 4 300 BP.

5.2 THE LANDFORMS AND DEPOSITS

The imprint of glaciation remains dominant in the Park, from the enormous glacial troughs and corries, to nearly every hump and bump in the landscape. The most widespread deposit laid down directly by the last ice sheet was glacial till. It generally rests on bedrock, covers much of the low ground and extends into the upland glens. Till generally consists of cobbles, boulders and pebbles mixed with clayey sand and silt. Although tills in the Park are very sandy,

particularly on granite bedrock, they are nonetheless relatively impermeable because they have been extremely compacted beneath ice.

Mounds and ridges of more heterogeneous, bouldery gravel and till were laid down as 'recessional' moraines at the margins of the ice sheet and outlet glaciers as they retreated. They are ubiquitous in the glens and straths, where they are generally composed of poorly consolidated, sandy and permeable deposits. The recessional moraines are commonly associated with 'glacial drainage channels' that were cut into the underlying till and bedrock at the retreating ice margins during summer thaws. Most of the channels contain some modern drainage, but most of them are clearly 'misfits'.

Seasonal glacial meltwaters laid down deposits of glaciofluvial sand and gravel during deglaciation that now occur as plateaux, mounds (kames) and ridges (eskers). Glaciofluvial deposits are most common within valleys that have for some reason been protected from subsequent fluvial erosion. The glacial, morainic and glaciofluvial deposits once formed were commonly subsequently 'reworked' by outwash streams to form widespread terraces in many valleys, similar to sandar in Iceland. These terraces are generally underlain by densely-packed, cobble gravel. They are generally distinguished from younger, 'alluvial' terraces by the presence of enclosed hollows (kettleholes) that were formed by the melting of blocks of ice trapped within the sediment. The lower-lying alluvial terraces were formed by braided rivers during the final retreat of the last ice sheet and during the subsequent Loch Lomond Readvance.

Post-glacial processes have superimposed subtle, but distinctive, modifications on the glacial landscape. Steep mountain sides have been modified by rockfalls, soil creep and debris flows, whereas valley floors have been affected by rivers and by the accumulation of alluvial fans at the mouths of tributary streams. Once dense vegetation had become established by about 10 000 BP, most major rivers changed from 'braided' systems to their present, 'single-thread' style. Gravelly alluvium underlies the floodplains of most upland streams in the Park, which are commonly bordered by steep, relatively unstable bluffs up to 25 m high. Most upland streams are fast flowing with beds of cobble and boulder gravel, bifurcating channels and shifting linear bars of shingle. The floodplains of the major rivers of the Park are generally underlain by up to 2.5m of 'overbank deposits' that consist of coarsely laminated, humic, micaceous loam. Former meander channels and ox-bow lakes are filled with organic mud and peat.

5.3 RECOMMENDED QUATERNARY GEODIVERSITY SITES

Fifty-four sites are proposed to represent the Quaternary geodiversity within the CNP (Table 1). Some sixteen of them are pre-existing or proposed GCR sites that have been described in the Geological Conservation Review series (Ellis et al., 1996) and that have been considered for notification as (SSSI's) on the basis of their national or international Earth science significance. The sites fall into several informal categories depending on the type of deposit or feature they represent.

The list of proposed sites is certainly not exhaustive, but should form a framework to which additional sites can be added in future. Unlike the Bedrock geology, which has been re-surveyed in the past forty years or so, only the western half of the Park is covered by modern Superficial mapping. Most of the proposed sites fall within this area, where BGS geologists have walked the ground systematically and have either discovered phenomena that have not been described hitherto, or have been able to reinvestigate ones previously described in the literature. Sites are also biased towards lower ground nearer centres of population at the request of the CNPA. For more detail on the geomorphology of the Cairngorm Mountains and sites with palaeoenvironmental records see Kirkbride & Gordon (2010).

6 Conclusions and recommendations

This desk study is a first pass at selecting the most important localities for Local Geodiversity Sites in the Cairngorms National Park, based on available information and knowledge of BGS geologists. The 35 bedrock and 54 Quaternary sites selected should not be regarded as the final definitive list, but as a framework to which additional sites can be added as more information becomes available and field work is undertaken.

6.1 BEDROCK GEODIVERSITY

Additional sites could be identified within the Southern Highland Group, the Northeast Grampian Granitic Subsuite and Northwest Grampian Granitic Subsuite to give complete coverage of all of the major bedrock divisions in the Park. Also, site coverage is poor in the western half of the Park and could be improved by some targeted fieldwork. There may also be potential to incorporate some localities reported in Thomas et al. (2004).

6.2 QUATERNARY GEODIVERSITY

The eastern half of the Park is not covered by modern BGS Superficial mapping and a targeted survey is recommended (Glen Clova in particular). There is also potential to select additional sites in the core mountain area from Kirkbride & Gordon (2010).

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Table 2 Recommended Bedrock geodiversity sites

Recommended Bedrock geodiversity sites							
No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B1	Ailnack Gorge	Section of the Water of Ailnack (south of Tomintoul) stretching from The Castle to Delnabo.	N/A	N/A	Natural section and Natural landform	The gorge cut along this part of the Water of Ailnack is a notable geomorphological feature formed by channeling of glacial meltwater. The gorge provides a geological section through top-Grampian and Appin Group stratigraphy, and non-metamorphosed Devonian sedimentary rocks which unconformably overlie the Dalradian strata.	The site presents an excellent geological section through a substantial part of the Dalradian stratigraphy in the CNP, and part of the Tomintoul outlier of overlying Devonian sedimentary rocks.
B2	Atholl – Mar	The hill country between Blair Atholl and Braemar	N/A	N/A	Natural exposures and Natural landforms	The area is underlain by strongly folded and lithologically diverse strata of the Dalradian Supergroup, and the rugged landscape reflects the unequal response to erosion of the different rock types. Most notably, folded layers of quartzite (an extremely hard rock that is highly resistant to erosion) underlie most of the highest summits, including nearly all the Munros (e.g. Beinn a' Ghlo, Carn an Righ, Beinn Iutharn Mhor, An Socach, Carn Bhac). Pale quartzite scree draping high summits and ridges is a distinctive feature of the landscape in the area.	A good example of bedrock control on large-scale landscape evolution.
B3	Benty Roads–Bousty Ley	Watershed between Boustie Ley and Benty Roads on the north side of Glen Clova.	N/A	N/A	Natural exposure	The site contains the remains of a layer of ancient silcrete (a siliceous soil horizon), now fragmented and forming stratified blocks up to 30 cm across and rarely more than 15 cm thick. The matrix is commonly fine red chert or jasper. The silcrete probably formed in a semi-arid Devonian (c. 400 million year old) landscape, which is here coincident with the current topography.	Silcrete is rare in the geological record in Scotland, but the site is also important for what it represents - a relictof an ancient land surface. The silcrete's presence indicates that uplift of the crust in this region due to the Caledonian Orogeny had virtually ceased by the time it was deposited, and also that the Caledonian land surface had by that time eroded approximately to the level seen at the present day. The site, along with a few others in north-east Scotland, provides direct evidence that much of the present landscape in the Grampian Highlands may be largely as it was at the end of the Caledonian Orogeny.
B4	Boat of Garten and Tore Hill	Strathspey, between Laggantygowan and Tore Hill.	N/A	N/A	Natural exposures	Scattered outcrops of grey granodiorite and granite belonging to the Boat of Garten and Tore Hill intrusions.	These two small masses are poorly exposed and have not been studied in detail, however their lithology (largely biotite-hornblende granodiorite) and certain geochemical characteristics suggest they belong to the Argyll–Northern Highlands Subsuite; if so, they are the only representatives of that suite in the park.

Recommended Bedrock geodiversity sites							
No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B5	Burn of Gowal	Upper reaches of Glen Clova, south of Broad Cairn	N/A	N/A	Natural landform and natural exposures	A glen on the flanks of which gently dipping sheet joints formed parallel to the land surface of a pre-glacial shallow river valley are truncated by the classically U-shaped form of a glacially incised valley. The area also contains good exposures of the contact between the Lochnagar Granite Pluton and its country rocks (Dalradian Supergroup).	A good example of glacial modification of a pre-glacial landscape (perhaps one of the best in the CNP outwith the Cairngorm Mountains). Also one of the best examples in the CNP of the contact between a major intrusion and its host rocks.
B6	Cairn Broadlands	Upper Glen Clova	N/A	N/A	Natural landform and natural exposures	A large, impressive, well-exposed landslip formed across the contact of the Glen Doll Dioritic Pluton and its country rocks, including the thermal aureole of the pluton.	The site combines an excellent example of a dynamic landform (landslip) with good exposures of contrasting bedrock types and their relationships.
B7	Cnoc Fergan Quarry	West bank of River Avon c. 3 km north of Bridge of Avon	N/A	N/A	Artificial Quarry Works	Disused quarries cut into Dalvrecht Slate Formation (Lochaber Subgroup, Dalradian Supergroup) from which stone was formerly extracted for use as roofing slate and flagstones. Slabs measuring 2 m in length are recorded. The slates are used locally for roofing, for example in Tomintoul.	Stone from the quarries makes a distinctive and important contribution to the local built heritage. No other quarries in the UK provide material of similar character.
B8	Dorback	Allt Iomadaidh, between Dorback Lodge and Bridge of Brown	N/A	N/A	Natural exposures	Exposures in the small Letteraitich Diorite-granodiorite Pluton (part of the Dorback Cluster).	The site encompasses the only significant occurrence within the CNP of appinitic igneous rocks. These are relatively rare rocks, in Scotland and globally, characterised by abundant large crystals of the mineral hornblende in intrusions of broadly dioritic composition. They are thought to be a product of fluid-rich magmas derived from the mantle. The Letteraitich pluton is also a representative of the South Grampian Subsuite of late-Caledonian intrusions.
B9	Glen Gelder Quarry	In Glen Gelder, c. 700 metres south-east of Princess Royal's Cairn	N/A	N/A	Artificial Quarry Works	One of several disused quarries in Glen Gelder which probably were the source of stone used in constructing Balmoral Castle.	Locally significant as probable source of building stone for Balmoral Castle. The rock is representative of the Lochnagar Granite Pluton (L2 component), hence the site represents the pluton and its parent unit, the Deeside Subsuite.
B10	Glen Tilt	Segment of Glen Tilt between Balaneasie and Creag an Duibh	N/A	N/A	Natural landform	The site encompasses the deepest and most dramatic segment of Glen Tilt, which here forms a large, straight, V-shaped valley. The glen is underlain by the Loch Tay Fault, one of several large, late-Caledonian NE-SW trending faults to affect the rocks of the Grampian Highlands.	The site presents a clear example of fault-controlled erosion in the development and appearance of a major glen.

Recommended Bedrock geodiversity sites							
No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B11	Inver Quarry	Near Inver, c. 3.5 km south-west of Balmoral Castle	N/A	N/A	Artificial Quarry Works	Disused quarry cut into pale granitic rocks at the margin of the Lochnagar Granite Pluton. The quarry opened in the late 19th century to provide stone for Crathie Church (built 1893).	Stone from the quarry makes an important contribution to the local built heritage, notably as a major source of building stone for the 'B' listed Crathie Kirk and possibly other late 19th century buildings in the district.
B12	Lower Glen Gairn	Ground around West Milton Burn and Hill of Candacraig	N/A	N/A	Natural exposures	The ground is underlain by part of the Coilacreich Granite Pluton, scattered exposures of which contain unusual minerals and mineral associations associated with geochemically highly evolved magma and hydrothermal alteration. A ferrous lithium mica forms up to 20% of the rock locally. Greisen (strongly hydrothermally altered rock) with associated quartz veins occurs in ground around West Milton Burn and south towards Creag na Creiche. Unusual minerals associated with the alteration include topaz, fluorite and blue beryl.	The style of granite alteration (greisenisation) and the assemblage of minerals are unique to the CNP and rare in Britain.
B13	Morven–Cabrach	The site includes that part of the outcrop of the Morven–Cabrach Gabbroic Pluton that lies within the CNP, extending from Tom Garchory in the south to Hill of Three Stones in the north.	N/A	N/A	Natural exposures	The pluton is a large, probably laccolithic, intrusion of layered ultramafic and mafic rocks, which is sheared locally. Within the boundary of the CNP it crops out over approximately 130 km^2. It is generally very poorly exposed, hence the entire intrusion forms the site rather than a particular exposure or area.	The intrusion is the only representative within the CNP of the large, laccolithic intrusions of mafic and ultramafic rock comprising the Northeast Grampian Basic Subsuite.
B14	Forest Lodge	In the vicinity of Forest Lodge, Glen Tilt	Confirmed	2068	Natural section	Exposures of granitic rocks and their Dalradian country rocks in the bed of the River Tilt within a section of the river between approximately 800 m upstream and 300 m downstream of Forest Lodge. The GCR volume 'Caledonian igneous rocks of Great Britain' (Stephenson et al., 1999) contains a full description of the site.	The site is of international importance on historical grounds. It was here in 1785 that James Hutton first found and documented field evidence to support his theory that granite was intruded into country rocks in a hot, fluid state, i.e. magma, and that this matter was able to flow within Earth's crust, veining, disrupting and recrystallizing pre-existing rocks. The conclusion that granite is not universally the earliest formed rock effectively ended one of the major geological controversies of the time.

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No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B15	Red Craig	Glen Doll	Confirmed	2499	Natural exposures	The site lies at the eastern margin of the Glen Doll Dioritic Pluton, a member of the South Grampian Subsuite of late Caledonian intrusions. The area exhibits a range of igneous rock types, with transitions from quartz-diorite through quartz-monzodiorite to granite. The GCR volume 'Caledonian Igneous Rocks of Great Britain' (Stephenson et al., 1999) contains a full description of the site.	Long recognized as providing well-exposed and easily-accessible evidence of the interaction between component magmas of a basic to intermediate intrusion. The igneous rocks contain fragments of their country rocks (xenoliths) and provide excellent examples of the interaction between the inetrmediate part of the pluton and the host Dalradian metasedimentary rocks.
B16	Blargie Craig	~2 km WNW of Laggan, the site extends from Coull Farm north-eastwards for about 3 km to Gergask Craig.	Confirmed	2704	Natural exposures	Scattered exposures in SE-facing crags and small cliffs rising to 750 metres, including key sections at Blargie Craig and Coull Farm. The site contains evidence for an unconformity separating Dalradian rocks from an underlying crystalline basement (Glen Banchor Subgroup/ Badenoch Group), and excellent examples of key lithologies on either side of the unconformity. The site also contains good evidence for major stratigraphical omission (>5 km of Grampian Group strata) across an unconformity between Appin Group strata and Glen Banchor strata. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The evidence preserved at this site for a major break in Dalradian sedimentation is critical in elucidating the geometry of Dalradian sedimentary basins in the Northern Grampian Highlands, and their subsequent deformation during the Caledonian Orogeny. The site also preserves features of a major zone of high ductile strain, the Grampian Shear Zone, in the Glen Banchor strata.
B17	Bridge of Avon	The River Avon and adjacent areas around Bridge of Avon, WNW of Tomintoul.	Proposed	0	Natural section and Natural exposures	The site encompasses Dalradian strata exposed along some 1.4 km of the River Avon, extending from downstream of the old General Wade bridge, up river almost to below the abandoned lime quarry at Creag Chalcaidh. It also includes the lowermost part of Allt na Cluaine and some small crags marginal to alluvial terraces. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The site presents an excellent geological section through a condensed sequence of strata in which most elements of the Ballachulish and Blair Atholl subgroups (Appin Group) are represented. The strata are deformed by two sets of large folds, providing a good example of a kilometre-scale fold interference pattern. The Bridge of Avon site and nearby Bridge of Brown GCR site are complementary, and together form a natural focal point in the Dalradian outcrop of the North-east Grampian Highlands.

Recommended Bedrock geodiversity sites							
No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B18	Bridge of Brown	WNW of Tomintoul	Proposed	0	Natural section	The site encompasses Dalradian strata exposed around Burn of Brown where it flows through a narrow incised gorge in the area where the original (General Wade) road crossed the burn. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The site presents a geological section through an important part of the Dalradian stratigraphy. It is one of the few coherent sections through the Grampian Group - Appin Group boundary, and demonstrates the transitional nature of the boundary in this part of the Grampians. The Bridge of Brown site is complementary to the nearby Bridge of Avon GCR site in that it extends the stratigraphical section down through the lower part of the Appin Group and into the Grampian Group. It also continues the structural cross-section to a lower level.
B19	Cairn Leuchan to Pannanaich Hill	~5 km SE of Ballater	Proposed	0	Natural exposures	Scattered crags and small exposures on the upper slopes of Cairn Leuchan. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The site encompasses rocks that have made a major contribution to the understanding of conditions of high-grade regional metamorphism, both in the Grampian Terrane and globally. Most notably: (i) it lies within the area where Barrow established the concept of metamorphic zones and index minerals; (ii) it lies close to the trace of the kyanite-andalusite isograd, which effectively defines the boundary between the Barrovian and Buchan styles of metamorphism in the Grampian Highlands; (iii) the temperature (~820 ºC) and pressure (>8 kbar) during peak metamorphic conditions are the most extreme so far recorded in the Scottish Dalradian.
B20	Ord Ban	Ord Ban, on the north-west side of Loch an Eilein	Confirmed	2701	Natural exposure and Artifical quarry	A lime kiln and small disused quarries in limestone. The Loch an Eilean trail runs beside the Ord Ban quarry/exposures. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	A rare example of Precambrian (Neoproterozoic) limestone in Scotland, and the only limestone unit in the Grampian Group (Dalradian Supergroup).
B21	Pollagach Burn	Pollagach Burn, c. 4 km ESE of Ballater.	Former	2666	Natural exposures	Exposures in and around the burn display distinctive mineral assemblages produced by thermal metamorphism when the Ballater Granite Pluton was emplaced into metapelite, calcsilicate-rock and amphibolite of the Tayvallich Subgroup (Argyll Group, Dalradian Supergroup). The minerals wollastonite, diopside, idocrase and grossularite occur in hornfelsed calcsilicate rocks, while andalusite, cordierite and, more rarely, sillimanite and corundum occur in hornfelsed pelitic rocks.	A good example of the distinct and unusual mineral assemblages that result in contrasting metasedimentary rock types due to thermal metamorphism

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No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B22	An Suidhe, Kincraig	Ground to the south and east of An Suidhe, north-west of Kincraig.	Confirmed	2917	Natural exposures	An area of several square kilometres containing a mixture of scattered exposures, small quarries, walling pits and cliff sections. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The bedrock in this area straddles a key section in the northern Grampian Highlands, where the relationships between pre-Dalradian basement rocks (the Glen Banchor Subgroup/Badenoch Group) and their cover (Corrieyairack Subgroup/Grampian Group/Dalradian Supergroup) were first documented - the evidence now points to a major orogenic unconformity. The site is also the type area for the Kincraig Formation - a distinctive succession of heterogeneous metasedimentary and meta-igneous rocks which forms the local base to the Dalradian.
B23	Ben Vuirich (GCR site)	Ben Vuirich, c. 13 km WNW of Blair Atholl	Confirmed	0	Natural exposures	The site encompasses that part of the outcrop of the Ben Vuirich Granite Pluton and its thermally metamorphosed Dalradian country rocks that lies within the CNP (the CNP boundary runs across the summit of Ben Vuirich). The outcrop provides excellent exposures of the deformed and foliated granite, and its country rocks. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The pluton is of considerable geological significance for two reasons. (1) It is the 'type' intrusion of the Vuirich Suite (c. 600 Ma granite plutons in Scotland and North America that formed during crustal extension before the Iapetus Ocean opened). (2) It pre-dates all deformation associated with the Caledonian Orogeny, however its country rocks preserve an early tectonic fabric which is at the centre of an ongoing debate about whether Dalradian rocks were deformed by an older (pre-600 Ma) orogenic event. The outcome of that debate has profound implications for the tectonic history of the Grampian Terrane.
B24	Gilbert's Bridge, Glen Tilt	Glen Tilt	Confirmed	2693	Natural section	Good exposures of bedrock along a river section in the floor of Glen Tilt encompassing the Boundary Slide, an important tectonized junction (zone of high strain) between the Grampian and Appin groups of the Dalradian Supergroup. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., in 2010) contains a full description of the site.	The River Tilt at Gilbert's Bridge provides a classic and historically significant section through the Boundary Slide. The junction constitutes a major geological boundary throughout much of the Grampians, and its structural and stratigraphical significance have been the subject of much debate amongst geologists for more than a century. The site at Gilbert's Bridge is one of the best exposed, and the conclusions drawn from it have implications for this and other parts of the Dalradian succession; it is therefore of national importance.
B25	Glen Ey Gorge	Glen Ey, south-west of Braemar	Confirmed	2814	Natural section	Good bedrock exposures along a narrow gorge, generally less than 10 m deep but with steep to vertical sides, that extends for around 2 km along the Ey Burn on either side of the feature known as The Colonel's Bed. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	This gorge provides one of the best-exposed sections through the Boundary Slide, a zone of highly strained rocks, which separates the Grampian Group from other, more lithologically variable, parts of the Dalradian throughout much of the Grampian Highlands. The Glen Ey gorge section is particularly valuable because it provides a continuous section from the top of the Grampian Group into the base of the Appin Group, unlike some sections further south-west.

Recommended Bedrock geodiversity sites							
No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B26	Kinloch Laggan Road	Beside the A86 road at Kinloch Laggan	Proposed	0	Natural exposure	A small roche moutonnée beside the A86 is the type locality for the Kinlochlaggan Boulder Bed, which occurs within a near-vertical, NNE-striking succession of quartzite, metasemipelite, metacarbonate-rock and calcsilicate rock. The Neoproterozoic boulder bed is interpreted to be of glacial origin. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The site is of national importance in demonstrating the earliest recorded glacial influence within the Dalradian succession. The significance of this and other boulder beds in the Dalradian succession lies in the record they preserve of Earth's glacial history and in their potential value as chronostratigraphical markers.
B27	Kymah Burn	Ladder Hills	Proposed	0	Natural section	Exposures along and adjacent to an incised gorge holding Kymah Burn, overlooked in its lower part by crags of The Eachrach. The gorge contains a spectacular cross-section through a large-scale refolded fold affecting the lowest units of the Argyll Group. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The site is of national importance as it documents some unique stratigraphical variations in the Islay Subgroup, contains good evidence of mafic volcanism coeval with the widespread mid-Dalradian glaciation, and provides a valuable insight into the overall structure of this part of the north-east Grampian Highlands. It is also the type section for the Kymah Quartzite Formation.
B28	The Slochd	Ground around Slochd	Proposed	0	Natural exposures	The GCR site encompasses the A9 road cutting at Slochd and natural exposures within an area stretching approximately 2.5 km to the south and south-east. The CNP boundary lies south of the road cutting, but many of the natural exposures in the GCR site lie within the park. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	The site contains perhaps the best and most accessible examples of Dava Subgroup strata in the CNP, which are the oldest rocks in the park. The Dava rocks include gneissose strata, spectacular examples of migmatitic (partly melted) rocks, minor fold structures and shearing within the Grampian Shear Zone. The site also includes non-gneissose rocks within the basal strata of the Dalradian Supergroup. The Slochd site has played an important role in the development of ideas regarding the structural and stratigraphical relationships of the basal Dalradian and older strata in the Northern Grampian Highlands.
B29	A9 Road Cuttings and River Garry Gorge	Road cuttings between Calvine and Dalnaspidal	Confirmed	2692, 2694	Artificial and Natural sections	This site is noteworthy for its wealth of minor folds and sedimentary structures, which can be used to demonstrate the position and geometry of some of the major folds that make up the central part of the Grampian fold belt. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	Of national, if not international, importance since they form an almost continuous section through the Grampian Group rocks. Instrumental in providing vital evidence to help understanding of the complex Grampian Group geological structures

Recommended Bedrock geodiversity sites							
No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B30	Muckle Fergie Burn	Muckle Fergie Burn, ~5 km SSE of Tomintoul	Confirmed	2667	Natural section	Exposures in and adjacent to Muckle Fergie Burn, which present a natural geological section through upper Appin Group (Blair Atholl Subgroup) and lower Argyll Group (Islay Subgroup and Easdale Subgroup) stratigraphy. The GCR volume 'Dalradian rocks of Scotland' (Stephenson et al., 2010) contains a full description of the site.	This is probably the best section through this important and lithologically variable part of the Dalradian Supergroup within the CNP. The section includes most of the lithological types represented within the Dalradian Supergroup. It includes several beds of Precambrian glacial deposits (metadiamictite) and preserves the earliest record of mafic volcanism in the Argyll Group.
B31	Lecht Mine	c. 7 km SE of Tomintoul	Confirmed	2427	Artificial mine workings	Former mine workings from which iron (1730-1737) and manganese (1841 to 1846) were extracted. The mine employed over 60 men and boys at its peak, however lack of investment in a railway from Tomintoul prevented the mine re-opening in the 1860's to supply iron to ironworks in England. The ore is a seepage-bog type deposit of manganiferous ironstone. The main orebody is hosted in an intrusion-breccia pipe which acted as a channel-way for iron- and manganese-rich solutions formed by weathering of local Dalradian strata. The GCR volume' Mineralogy of Scotland' (Smith and Livingstone, in prep) contains a full description of the site.	The largest manganese mine ever worked in Scotland, possibly with substantial reserves of Fe and Mn ore remaining. The ore is an excellent example of a large bog iron ore deposit, and is unique in Britain. The ore contains relatively common iron- and manganese oxide and oxyhydroxide minerals, and a range of unusual minerals including complex Zn-Mn oxides and Li-Mn oxides. The Tomintoul Museum holds leaflets about the mine, and there is a small interpretive display within the mine building, but no machinery remains.
B32	Creag nam Ban	Creag nam Ban, ~7 km WSW of Ballater.	Proposed	3103	Natural exposures	Crags and other scattered exposures on Creag nam Ban. The GCR volume 'Mineralogy of Scotland' (Smith and Livingstone, in prep) contains a full description of the site.	The site provides fine examples of the rare amphibole mineral cummingtonite
B33	Gairnshiel Bridge	Glen Gairn	Proposed	3100	Natural exposures	Localised, vein-hosted W-Sn-Mo-Bi-Ag mineralisation occurs within zinnwaldite-bearing granite that crops out over ~1 km^2 at Gairnshiel, near the centre of the Caledonian Glen Gairn Granite Pluton. The minerals wolframite, cassiterite and scheelite are well exposed in quartz veins and silicified wallrocks. A later mineral assemblage filling cavities in the veins and dissolution zones in the granite comprises either molybdenite or sphalerite, with pyrite, chalcopyrite, and cassiterite, rare stannite and silver-bearing cosalite. The GCR volume' Mineralogy of Scotland' (Smith and Livingstone, in prep) contains a full description of the site.	The site contains a rich assemblage of metalliferous minerals, including relatively rare ones. Two types of mineralisation occur, neither of which is known to be developed to the same degree in association with Caledonian magmatism elsewhere in the UK.

Recommended Bedrock geodiversity sites							
No.	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
B34	Loch Kander	Glen Callater upstream of Loch Callater, and Coire Loch Kander	Proposed	3101	Natural exposures	At Allt an Loch, bedded barite-quartz rock (4.5 m thick in a drill intersection) can be followed for 0.7 km in a layer of graphitic schist. A 15 m thick band of barian quartzite in Coire Loch Kander displays a mineralogy unique to Britain, including armenite, hyalophane (barium feldspar), barite, salitic pyroxene and tremolite-actinolite (as well as common sphalerite, galena and iron sulphide minerals).	This locality is the northwestern-most expression (and the only occurrence in the CNP) of the stratabound barite mineralisation (of sedimentary exhalative type) which is mined commercially at Foss Mine near Aberfeldy. The assemblage of barium-rich minerals in Coire Loch Kander is unique to Britain
B35	Loch Avon	N &W slopes of Beinn Mheadhoin to the SE shore of Loch Avon	Confirmed	708	Natural exposures	The Cairngorm Pluton is composed of a main and three subordinate phases. Although the Loch Avon area lies entirely within the Main Granite, it is underlain by three distinct varieties. Two of these are rich in microgranite and granite pegmatite veins that typically occupy vertical or steeply inclined joints in the host granite, and range in width from a few centimetres to several metres. The pegmatites are very coarse grained (up to 15 cm), comprising aggregates of quartz, alkali feldspar, muscovite and occasional biotite. Spectacular graphic intergrowths of quartz and orthoclase may be present, ranging from micropegmatite to coarse graphic granite. The quartz is dark in colour and includes smoky, citrine and cairngorm varieties, with distinctly euhedral crystals resulting from growth into open cavities. Cairngorm crystals are not confined to pegmatites, being also present in miarolitic cavities in the Main Granite, and in the crags on the east side of Loch Avon, according to Heddle (1901), are accompanied by topaz Al2SiO4(F, OH)2. Heddle (1901) also recorded that small crystals of beryl (Be3Al2Si6O18) are imbedded in cairngorms in the Loch Avon area, and describes a fist-sized mass of blue topaz in an old stream course of the River Avon. The GCR volume' Mineralogy of Scotland' (Smith and Livingstone, in prep) contains a full description of the site.	Granite pegmatites in the Loch Avon area of the Cairngorms are an established source of gem-quality cairngorm and beryl. Moreover, this is one of the few locations in the United Kingdom to yield blue topaz. Although the gemstones were the basis of an important 19th century industry in the district, precise locations of the workings in the Loch Avon area are not recorded. Rolled cairngorm, topaz and beryl crystals in the gravels of the River Avon, almost certainly derived from the Loch Avon area, now represent the most accessible source of material for research.

Table 3 Recommended Quaternary geodiversity sites

Recommended Quaternary geodiversity sites							
No	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
Q1	Loch an Duin Breach	Loch an Duin and adjacent An Dun, Gaick Forest	N/A	N/A	Landform assemblage	The glen occupied by Loch an Duin is a major glacial breach through the main east-west watershed of the Grampian Highlands, whereas the slopes of the mountain to the west, An Dun, have been affected by many Rock Slope Failures	The Loch an Duin Breach is a good example of a glacial breach and it, together with related features, are important in the study of long-term landscape evolution of the Grampian Highlands. An Dun and surrounding hills boast excellent examples of rock slope failures and tension cracks.
Q2	Gaick Plateau	High plateau lying to the east of the Pass of Drumochter	N/A	N/A	Landform assemblage	The Gaick Plateau is underlain by a sandy in situ weathering product (regolith) of the micaceous psammite bedrock that supports a rich sward of Sub-Arctic-Alpine vegetational communities.	The Gaick Plateau is an excellent example of high level plateaux in Scotland. The plateau includes a fragile mosaic of vegetation, peat and bare ground with both relict and active periglacial features.
Q3	Gaick Lodge (Central Gaick Breach)	The steep-sided glen bisecting the Gaick Plateau centred on Gaick Lodge and including Loch an t-Seilich and Loch Bhrodainn	N/A	N/A	Landform assemblage	The glen centred on Gaick Lodge forms part of a major glacial breach through the main east-west watershed of the Grampian Highlands. The glen includes a wide range of slope-related features, glaciofluvial landforms and moraines. Notable rock slope failures occur on buttresses west of the lodge and within the glen of the Allt Gharbh Ghaig, to the east, where there is a jumbled array of steep-sided, boulder-strewn, conical mounds	This glen is a good example of a glacial breach and it is important in the study of long-term landscape evolution of the Grampian Highlands. The glen also contains excellent, pristine examples of alluvial fans, debris cones, rock slope failures and tension cracks. The latter rise and branch diagonally up the flanks of Srón Bhuirich and A' Chaoirnich and are indicative of weak slope deformation and compression.
Q4	Edendon Alluvial Fan	A dissected alluvial fan 1.3 km south of Sronphadruig Lodge in the valley of the Edendon Water	N/A	N/A	Natural section and landform	An uncommon section through the toe of an alluvial fan exposing several units separated by palaeosols that have been radiocarbon-dated	Important site for research into the rates of accumulation, timing and causes of fan-building events during the Holocene.
Q5	Southern Gaick Sections	River cliff sections in the valleys of the Allt a' Chireachain and Allt Glas Coire, 5 km north of Dalnamein Lodge	N/A	N/A	Natural sections	Exposures of sand, gravel, silt and clay of glaciofluvial deltaic origin underlying till of the last regional glaciation.	These sections provide unique evidence of events immediately prior to the Gaick Plateau becoming inundated by ice during the Main Late Devensian Glaciation and which have a bearing on research modelling the last ice sheet
Q6	Beinn Dearg Blockfield	Summit of Beinn Dearg, Forest of Atholl	N/A	N/A	Natural landform	Beinn Dearg is capped by an extensive boulder-field rising to the summit at 1008 m by way of several high, concentric ramparts. Blockfields are mountaintop accumulations of blocks produced by the frost shattering of underlying rocks	A good example with blocks up to 3 m across. The blockfield probably largely predates the last regional glaciation and invites comparison with the partially eroded blockfields and tors that occur on the Cairngorms

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No	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
Q7	Upper Tarf Moraines	The valley of the Tarf Water upstream of Falls of Tarf, notably on the SW slopes of Sron na Macranaich	N/A	N/A	Landform assemblage	A suite of low, arcuate, recessional moraine ridges and parallel, shallow glacial drainage channels	These features record the final decay of the last ice cap concentrically toward the upper reaches of the valleys of the Tarf Water and Bruar Water. They have a bearing on research modelling the last ice cap to cover the Gaick Plateau.
Q8	Glen Loch Moraines	The floor of Glen Loch in the vicinity of Loch Loch	N/A	N/A	Landform assemblage	A distinctive set of sharp-crested moraine ridges occur in Glen Loch, where some allow passage across Loch Loch at low water levels.	These features are probably De Geer moraines that formed at the margin of ice that retreated northwards towards an ice divide situated across the eastern Gaick. Features such as these are not common and formed at ice fronts that terminated in water
Q9	Beinn a' Ghlo landslides	The northern and eastern flanks of Beinn a' Ghlo, especially within the steep sided valley of the Allt Fheannach	N/A	N/A	Landform assemblage	Several large rock slope failures, including creep, antiscarps and open tension cracks. A relatively recently formed tension crack [NN 9575 7450] was observed behind the main backscarp of one of these landslides.	An atypical cluster of landslide features that requires further research to fully explain. Landslides have influenced the long-term landscape evolution of the region and they tend to cluster within relatively recently formed glacial breaches
Q10	Coire Cas-eagallach	Coire Cas-eagallach, on the eastern side of Beinn a' Ghlo	N/A	N/A	Landform assemblage	Small pristine corrie with bouldery terminal moraine and possible relict rock glacier deposit	Good example of a corrie that most would agree was probably last occupied by ice during the Loch Lomond Stadial, unlike others in the Cairngorm and Gaick
Q11	Coire Mhic-sith	Glen lying to the NE of Dalnaspidal Lodge in the Pass of Drumochter	N/A	N/A	Natural exposure and landforms	A river cliff section revealing >3.1 m of rhythmically laminated, fine-grained deposits beneath till The glaciolacustrine unit becomes increasingly compact, sheared and disturbed upwards, displaying overturned folds. Subhorizontal features etched into the surrounding hillsides may represent former ephemeral lake shorelines	A critical site regarding research into the former extent of glaciers and ice-dammed lakes during the Loch Lomond Stadial. The sense of thrusting is towards the east, indicating that the ice that dammed a lake in the glen advanced from the Loch Garry basin to the west. There are good examples [NN 676 764] of glacial overflow channels at 787m OD leading into a valley to the east (Glas Mheall Spillways).
Q12	Drumochter Hummocky Moraine	Pass of Drumochter	N/A	N/A	Landform assemblage	The Pass and glens to the west contain numerous hummocks of bouldery moraine that formed during ‘active’ glacial retreat by flows of debris from the glacier surface and ‘bulldozing’ of loose debris at glacier margins. The moraines are associated with meltwater channels that were eroded parallel to ice margins. Although appearing to be chaotic, the mounds form chains arranged en enchelon across valley sides.	The Pass is commonly cited as containing textbook examples of Hummocky Moraine formed during the Loch Lomond Stadial, but both the origin and age of this excellent suite of features remains controversial and an active field of research. Taken together, the features provide a record of glacial recession across the district.

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No	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
Q13	Drumochter Debris Cones	The NE slopes of An Torc (the Boar of Badenoch)	N/A	N/A	Landform assemblage	Steep, cone-shaped accumulations of rock fragments lie at the foot of gullies on the sides of the 'Boar' and the 'Sow of Atholl', to the south. Debris cones are mainly formed catastrophically during heavy rainfall as a result of landslides that develop quickly downslope into debris flows; many cones are bounded by levées up to 2.5 m high	These cones are good examples that have been studied in detail and that are important in studies of paraglacial processes, Holocene climate change, and possible impacts on the landscape resulting from changing landuse and climate.
Q14	Mega- roche moutonnée of Ralia	Creagan a' Choin and Ordan Shios, 2-3 km south of Newtonmore	N/A	N/A	Landforms	Two distinctive mega- roche moutonnée features, Creagan a' Choin and Ordan Shios, which unusually have tails of glacial till stretching south-westwards in the former up-ice direction.	Striking indicators of former ice flow during the last regional glaciation. Not to be confused with crag-and-tail features.
Q15	Caisteal a' Choire channels	The southern flanks of An Sligearnach, 5 km NNE of Bruar Lodge, Atholl	N/A	N/A	Landform assemblage	A complex network of shallow, branching and anastomosing glacial meltwater channels occurring across the hillside and incised into decomposed granite bedrock.	An excellent suite of features described in the literature and important for reconstructing the characteristics of the last ice cap to cover the area.
Q16	Chomhraig and Dubh-chadha channels	The eastern slopes of Gleann Chomhraig and the valley of the Allt an Dubh-chadha, 4 km WSW of Glenfeshie Lodge.	N/A	N/A	Landform assemblage	Shallow glacial meltwater channels, characteristically curved in plan view, asymmetric in cross profile, and occurring in flights across hillsides, where higher channels truncate, or feed into, lower ones, indicating that they formed progressively as the ice margin retreated. Many occur as benches on steeper slopes (one-sided channels) or as isolated flights of short channels that loop into the hillside ('in-out-channels').	Good examples of channels thought to have been eroded at, or closely within the margins of receding, typically cold-based, subpolar ice sheets or outlet glaciers. Features such as these are important for reconstructing the characteristics of the last ice sheet to cover the area.
Q17	Chreagdhubh Lodge panorama	Strathspey in the vicinity of Chreagdhubh Lodge and the Woods of Glentruim, 5 km SW of Newtonmore.	N/A	N/A	Landform assemblage	A suite of pristine glacial, fluvioglacial and alluvial features, including eskers, kettleholes and kame terraces.	This visually attractive suite of features is visible from the Cluny's Cave carpark, where a interpretive display board could be erected. The landforms were mainly formed at the snout of an outlet glacier, flowing from the west, that existed for a while during ice-sheet deglaciation.
Q18	Raitts Burn	Valley of Raitts Burn, 4 km NNE of Kingussie	N/A	N/A	Natural section	River cliff section revealing glacitectonically-disturbed, rhythmically laminated glaciolacustrine deposits. Associated with a suite of glacial meltwater channels, curved in plan view, asymmetric in cross profile, where higher channels truncate, or feed into, lower ones, indicating that they formed progressively as the ice margin retreated.	Detailed micromorphological research work on the main section has revealed polyphase deformation of the laminated deposits, which were laid down in a lake that was ponded up by an active outlet glacier that existed in Strathspey for a while during ice-sheet deglaciation.

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No	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
Q19	Glen Luibeg	Glen Luibeg upstream of Luibeg Bridge, 3 km WNW of Derry Lodge, Cairngorms	N/A	N/A	Landform assemblage and natural sections	An excellent suite of meltwater channels incised into bedrock occurs on the southern slopes of Glen Luibeg. The channels are associated with moraine ridges and flat-topped deltaic deposits. Natural sections reveal glacitectonically-deformed, laminated sediments.	This suite of features has been studied and interpreted in the literature. They probably mark a stillstand position of the Luibeg outlet glacier following its separation from the Derry outlet glacier during ice-sheet deglaciation. The laminated sediments formed in an ice-marginal lake ponded by ice remaining to the south.
Q20	Gleann Ballach Moraine	River cliff section in Gleann Balloch, 7 km WNW of Newtonmore	N/A	N/A	Natural section	Section through one of a suite of WNW-ESE aligned recessional moraines revealing glacitectonic structures indicative of ice push from the south. Convolute bedding, dewatering structures and slumps affect a unit of silt at the top of the section, clearly post-dating normal faults and glacitectonites at lower levels.	An important exposure for determining the deglacial history of the region, when a powerful outlet glacier sourced to the west separated from ice sourced locally in the Monadhliath Mountains to the north. A proglacial lake existed for a while at the head of Gleann Ballach, ponded by ice that still occupied Glen Banchor. Dewatering occurred when the lake emptied following retreat of the ice westwards.
Q21	Glen Shirra eskers	WNW of Loch Crunachdan to the park boundary at Dirc an Uillt Fhearna	N/A	N/A	Natural landforms	A discontinuous ribbon esker extends ENE along the northern side of the divide between Coire Ardair and the Spey. It traverses high above Coire a' Chaorainn and Coire an t-Slugain, linking with a minor channel cut across the col south of Meall a' Chaorain Mór and passing into Dirc an Uillt Fhearna. The meltwaters that passed through this channel laid down several flat-topped mounds, terraces and an esker between it and Loch Crunachan, to the ESE.	An excellent example of a linked esker and subglacial drainage channel system that links with Dirc an Uillt Fhearna [NN 520 932], a deep glacial meltwater channel that forms a remarkable cleft in the mountain panorama.
Q22	Dirc Mhor channels	Dirc Mhór and Dirc Bheag, 5 km NW of Dalwhinnie.	N/A	N/A	Natural landforms	Dirc Mhór [NN 590 860] and Dirc Bheag, 600 m to the NW, cut north-eastwards across the col to the west of Dalwhinnie. Both are over 80 m deep with precipitous walls and are partly filled with scree.	Although marginally outside the National Park, these two clefts enormous are remarkable features in the mountain panorama viewed from the Park. These ice-directed channels would have been scoured out by ice during the last glaciation and re-trimmed by meltwaters, but have a long history spanning several glaciations.
Q23	Strath Mashie Overflow Channel	The floor of Strath Mashie between Kinloch Laggan and Strath Mashie.	N/A	N/A	Natural landform	A flat-bottomed 'misfit' valley that was created by water flowing from Loch Laggan when it was much larger and unable to drain westwards as it does currently. The feature has been partially re-occupied by the rivers Mashie and Pattack, but a short stretch in the vicinity of Feagour remains intact beneath peat.	A very good example of a glacial overflow channel that was last occupied during the Loch Lomond Stadial at the time when the famous Parallel Roads of Lochaber (Glen Roy) were being created. Water ponded up in Glen Spean by ice centred in the western Highlands had to flow via this route into Strathspey.

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No	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
Q24	Gynack Channels	The ground between Loch Gynack and Glen Banchor, 2 km NW of Kingussie	N/A	N/A	Natural landform assemblage	A complex network of branching and anastomosing glacial meltwater channels cut across the hillsides and incised deeply into bedrock. The channels are associated with boulder-strewn moraine ridges and eskers.	Good examples of channels thought to have been eroded at, or closely within the margins of receding, typically cold-based, subpolar ice sheets or outlet glaciers. Features such as these are important for reconstructing the characteristics of the last ice sheet to cover the area, and the pattern of deglaciation.
Q25	Anagach Eskers	Woods of Anagach Country Park, 1.5 km SE of Grantown-on-Spey	N/A	N/A	Natural landform assemblage	A network of gravel ridges (eskers) occur within the Woods of Anagach Country Park. The eskers are typically 5 to 10 m high and lie parallel to one another with few bifurcations.	Good examples of parallel eskers, which were either deposited within subglacial tunnels within a stagnant, decaying ice lobe, or within channels cut into the surface of buried ice.
Q26	Dulnain Bridge Roches Moutonnèes	Roches Moutonnèes tourist interpretation locality, Dulnain Bridge	N/A	N/A	Natural landform assemblage	Ice-scoured and plucked knolls of rock are widespread along the lower flanks of Strathspey to the east of Dulnain Bridge. Better examples of roches moutonnèes actually occur to the north-east of the tourist site, within Gaich Wood.	Good, easily accessible examples of roches moutonnèes. These features were clearly scuptured by ice flowing north-eastwards down the strath, probably at a relative late stage in the glaciation of the district. This contrasts with the regional flow at the Last Glacial Maximum when ice flowed northwards across the main watershed directly towards the inner Moray Firth.
Q27	Shleanaferan Channel	Deep dry valley linking the upper reaches of the Achnahannet valley with Glenbeg, 5 km NNW of Dulnain Bridge	N/A	N/A	Natural landform assemblage	Glenbeg merges upstream with a deep, sinuous, steep-sided, peat-filled glacial drainage channel. The channel is the main conduit within a system of channels and related glaciofluvial features. The channels are dissected into a thick, kettled spread of glaciofluvial sand and gravel that extends up into a col (Tobar Alain) in the regional watershed at about 340 m above OD.	A good example of an ice-marginal glacial drainage channel and former site of an extensive proglacial lake. Water was ponded across the main watershed whilst Strathspey ice remained to the south and Moray Firth ice lay to the north towards Lochindorb. The Spey ice margin subsequently retreated southwards, allowing meltwater to flow from the west into Glenbeg, cutting the main channel.
Q28	Tullochgribban Eskers	Tullochgribban Plantation, 4 km west of Dulnain Bridge	N/A	N/A	Natural landform assemblage	A network of predominantly north-east orientated , 4 to 6 m-high gravel ridges (eskers) is preserved within the Tullochgribban Plantation. They are generally parallel, with minor branches towards the north-east, and are associated with some large peat-filled kettleholes in the vicinity of Loch Mor.	A good example of eskers and associated kettleholes
Q29	Creag Coille na Maoile Crag-and-Tails	Several crags, including Creag Coille na Maoile, 4 km north of Duthil, near Carrbridge.	N/A	N/A	Natural landform assemblage	A clutch of large crag-and-tails to the north of Creag Coille na Maoile	These excellent ice moulded features formed when ice flowed northwards across the regional watershed towards the inner Moray Firth. An esker lying to the west of the B 9007 road provides a convenient location [NH 9353 2945] to view the crag-and-tails to the south-east.

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No	**Site name**	**Locality**	**GCR Status**	**GCR No**	**Type**	**Description**	**Justification**
Q30	The Beum a' Chlaidheimh Breach	The col on the main watershed utilized by the B 9007 road, between Duthil and Lochindorb.	N/A	N/A	Natural landform assemblage	A major glacial breach from which several deep, winding glacial meltwater channels with interlocking spurs cut into bedrock descend toward the north. An esker winds its way northwards towards Beum a' Chlaidheimh.	An excellent, easily-accessible example of a glacial breach and of a 'leeside' glacial drainage channel that starts at the watershed, suggesting that it was functioning when Strathspey ice had retreated southwards to the watershed and ground immediately to the north was essentially ice free. The esker would have been formed by subglacial meltwaters converging on the col from the south.
Q31	Slocht Mor	The Slocht col used by the A9 Trunk road.	N/A	N/A	Natural landform assemblage	A deep glacial breach that leads eastwards from the summit of the col into a very deep glacial drainage channel (Slocht Channel) that is followed by the railway.	This well-known feature is important for understanding events that took place during ice-sheet deglaciation. It carried a large volume of meltwater from ice that remained to the north of the regional divide into the Spey catchment. This contrasts with the situation at the Beum a' Chlaidheimh [NH 937 305] col, to the east, where meltwaters flowed northwards across the watershed into an area largely vacated by ice.
Q32	Creag na h-Iolaire Channels	The southern spur of Creag na h-Iolaire and the mountainside lying to the NE towards the Beum a' Chlaidheimh col	N/A	N/A	Natural landform assemblage	Deep, winding and branching channels cut into rock cross the southern spur of Creag na h-Iolaire, one of them 40 m-deep and partially blocked by a substantial rock fall [NH 8999 2725]. The channels lead NE towards an extensive suite of ice marginal channels, benches and associated ridges of blocky boulder moraine that descend obliquely across the south-eastern slopes of Carn Mheadhoin and Carn Allt Laoigh.	Good example of a suite of features that formed sequentially at the retreating margin of a huge piedmont outlet glacier that occupied Strathspey upstream of Grantown for a while during ice sheet deglaciation.
Q33	Dulnain Bridge Varves	River cliff and landslide back-scar on the S bank of the River Dulnain, 600 m west of Dulnain Bridge.	N/A	N/A	Natural section	Rhythmically laminated sand, silt and clay with dropstones, capped by gravelly glacial deposits. The laminae are interpreted as glacial varves (formed annually) in a seasonally frozen ice-dammed lake.	An excellent and comparitively rare exposure of thick glaciolacustrine varves. Varved sequences such as this contains an important palaeoenvironmental record for research into palaeoclimate and for reconstructing the characteristics of the last ice sheet to cover the area, and the pattern of deglaciation.
Q34	Loch Vaa kettle-lake	Loch Vaa and surrounding country, 5 km NNE of Aviemore	N/A	N/A	Natural landform assemblage	Loch Vaa occupies a large kettlehole and is surrounded by numerous smaller irregularly-shaped kettleholes associated with mounds and ridges (eskers) of glaciofluvial sand and gravel.	A good example of a kettlehole occupied by a lake within classical 'kame-and kettle' terrain. The kettlehole formed when a large mass of ice buried within glaciofluvial deposits melted out. The deposits were laid down in front of the retreating Spey outlet glacier during ice sheet deglaciation
Q35	Inchriach Terraces	Bench features and associated channels on the mountainside south of Loch an Eilein.	N/A	N/A	Natural landform assemblage	A staircase of boulder-strewn benches and associated glacial meltwater channels, where higher channels truncate, or feed into, lower ones, indicating that they formed progressively as an ice margin retreated.	Good examples of kame terraces and related features formed at the retreating margin of the Spey outlet glacier during ice-sheet deglaciation.

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Q36	Edendon Recessional Moraines	Edendon Water between Sronphadruig Lodge and Leac nan Cliabhan	N/A	N/A	Landform assemblage	A suite of sharp-crested, arcuate, recessional moraine ridges and parallel, glacial drainage channels	These features record the northward retreat of an active outlet glacier of the last ice cap. They have a bearing on research modelling and dating the last ice cap to cover the Gaick Plateau, probably during the Loch Lomond Stadial
Q37	Ghlas Choire Recessional Moraines	Allt Glas Choire north of the old sheilings	N/A	N/A	Landform assemblage	A suite of sharp-crested, arcuate, recessional moraine ridges and parallel, glacial drainage channels	These features record the north-westward retreat of an active outlet glacier of the last ice cap. They have a bearing on research modelling and dating the last ice cap to cover the Gaick
Q38	Féith Ghorm Ailleag	Feith Gorm Ailleag, 5 km north-west of Bruar Lodge	N/A	N/A	Natural sections	Very compact, ferruginous, clast-supported diamicton resembling regolith that crops out from beneath till and orange-brown sandy gravel	This unit (Ailleag Diamicton Member) is probably a head deposit that predates the last regional glaciation of the area
Q39	Glen Feshie	The floodplain, river terraces and alluvial fans within Glen Feshie	Confirmed	2217	Natural landforms	Four areas provide key understanding of very active gravel-bed rivers 1) Braided channel with rapid planform changes 2)River terraces & fan terraces 3) Wandering channel 4) confluence with Spey	Fluvial Geomorphology of Scotland, GCR site 2217 (Gregory, 1997). Cairngorms and Cairngorms East SSSIs - Part II: Fluvial & Mineralogy
Q40	Luibeg Burn	Glen Luibeg, upstream of Derry Lodge	Confirmed	2214	River bed and adjacent natural features	Good example of a steep boulder bed mountain stream with documented major sediment transport events in 1829 & 1956 dominate landforms.	Fluvial Geomorphology of Scotland, GCR site 2214 (Gregory, 1997). Cairngorms and Cairngorms East SSSIs - Part II: Fluvial & Mineralogy
Q41	Quoich Water Fan	Alluvial fan of the Quoich Water, Linn of Quoich, 3 km west of Braemar	Confirmed	2215	River bed and adjacent natural features	Good example of an alluvial fan with reduced channel slope & confinement after 1829 flood adjustments to channel.	Fluvial Geomorphology of Scotland, GCR site 2215 (Gregory, 1997). Cairngorms and Cairngorms East SSSIs - Part II: Fluvial & Mineralogy
Q42	Derry Burn	Glen Derry upstream of Derry Lodge Glen Derry upstream of Derry Lodge	Confirmed	2216	River bed and adjacent natural features	Good example of a river system adjusting to planform controls, close to braid-meander threshold.	Fluvial Geomorphology of Scotland, GCR site 2216 (Gregory, 1997).Cairngorms and Cairngorms East SSSIs - Part II: Fluvial & Mineralogy
Q43	Allt Mor	Allt Mor, 2 km SSE of Glenmore Lodge	Confirmed	2221	River bed and adjacent natural features	Good example of steep mountain torrent with freely available sediment	Fluvial Geomorphology of Scotland, GCR site 2221 (Gregory, 1997). Glenmore forest SSSI
Q44	Dorback Burn	Dorback Burn, 8 km ESE of Nethy Bridge	Confirmed	2222	River bed and adjacent natural features	Good example of migrating gravel-bed river	Fluvial Geomorphology of Scotland, GCR site 2222 (Gregory, 1997). Abernethy Forest SSSI

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Q45	Allt Dubhaig	NW of Dalnaspidal Lodge between the Sow of Atholl and the A9	Confirmed	2218	Natural landforms	Provides a superb example of a small gravel bed burn in which the very rapid downstream fining of bed material can unequivocally be attributed to selective transport	Fluvial Geomorphology of Scotland, GCR site 2214 (Gregory, 1997). Drumochter Hills biological SSSI
Q46	Cairngorms	The Cairngorm Mountains	Confirmed	2284	Natural features	Finest assemblage of glacial & periglacial landforms, tors & erosion surfaces in Britain. 'Pre-glacial' plateaux; glacial troughs, watershed breaches & corries; deglaciation moraines, meltwater channels & deposits; relict peri-glacial landforms.	Quaternary of Scotland, GCR site 2284 (Gordon and Sutherland, 1993). Cairngorms SSSI
Q47	Muir Of Dinnet	Landforms and lochans near lochs Davan and Kinord, 8 km ENE of Ballater	Confirmed	370	Natural landforms	Good example of an assemblage of fluvioglacial landforms, kettles, eskers, kames, channels from downwasting Devensian ice. Vat, spectacular pothole from meltwaters. Pollen record.	Quaternary of Scotland, GCR site 370 (Gordon and Sutherland, 1993).. Muir of Dinnet SSSI
Q48	Lochnagar	Lochnagar	Confirmed	369	Natural landforms	Good examples of glacial and periglacial landform assemblages from the Loch Lomond Stadial	Quaternary of Scotland, GCR site 369 (Gordon and Sutherland, 1993).
Q49	Loch Etteridge	Lochs and topographical depressions on Phones Estate, 6km SSW of Newtonmore	Confirmed	2103	Natural landforms	Deadice hollow with associated kame terraces and eskers. Loch sediments yield long pollen record from initial deglaciation. Basal ^{14}C date 13151BP shows ice melt date.	Quaternary of Scotland, GCR site 2103 (Gordon and Sutherland,1993). Loch Etteridge SSSI
Q50	Morrone	Topographical depressions within Morrone Birkwoods NNR, 1.5km S of Braemar	Confirmed	2750	Natural landforms	Pollen history from peat & ^{14}C record for last 12500 years. Good vegetation evolution record.	Quaternary of Scotland, GCR site 2750 (Gordon and Sutherland, 1993). Morrone Birkwood SSSI
Q51	Abernethy Forest	Topographical depressions between Loch Garten and Loch Mallachie	Confirmed	367	Natural landforms	Long pollen and ^{14} C record of Flandrian and Late glacial stratigraphy	Quaternary of Scotland, GCR site 367 (Gordon and Sutherland, 1993). Abernethy Forest SSSI
Q52	Coire Fee	Topographical depressions in the floor of Coire Fee, Glen Doll	Confirmed	1247	Natural landforms	Pollen record of Flandrian vegetation history, particularly montane flora. Supported by radiocarbon dating. Moraines of Loch lomond Stadial age.	Quaternary of Scotland, GCR site 2746 (Gordon and Sutherland, 1993). Caenlochan SSSI

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Q53	Tomintoul	Confluence of the Marl Burn and River Avon, 650 m NW of Inchrory	Confirmed	1247	Natural sections	A 6 m tufa deposit laid down by the Marl Burn containing 6 soil horizons, one of which contains charcoal which gave a radiocarbon date of 7360 ± 60 B.P. A unique site in Scotland contrasting strongly with English localities & their mollusc diagrams.	Quaternary of Scotland, GCR site 1247 (Gordon and Sutherland, 1993).
Q54	Carn Dubh, Ben Gulabin	E slopes of Carn Dubh, Ben Gulabin, 2 km NNE of the Spittal of Glenshee	Confirmed	3267	Natural landforms	A translational failure in steeply dipping metasedimentrary rocks, a type of rockslide that is fairly widespread in the Scottish Highlands. The distinctiveness of this site arises from the unusual form of debris runout, which takes the form of two thick debris tongues bounded by steep levees.	Mass-movement GCR sites in Precambrian and Cambrian rocks, GCR Site 3267 (Cooper, 2007)

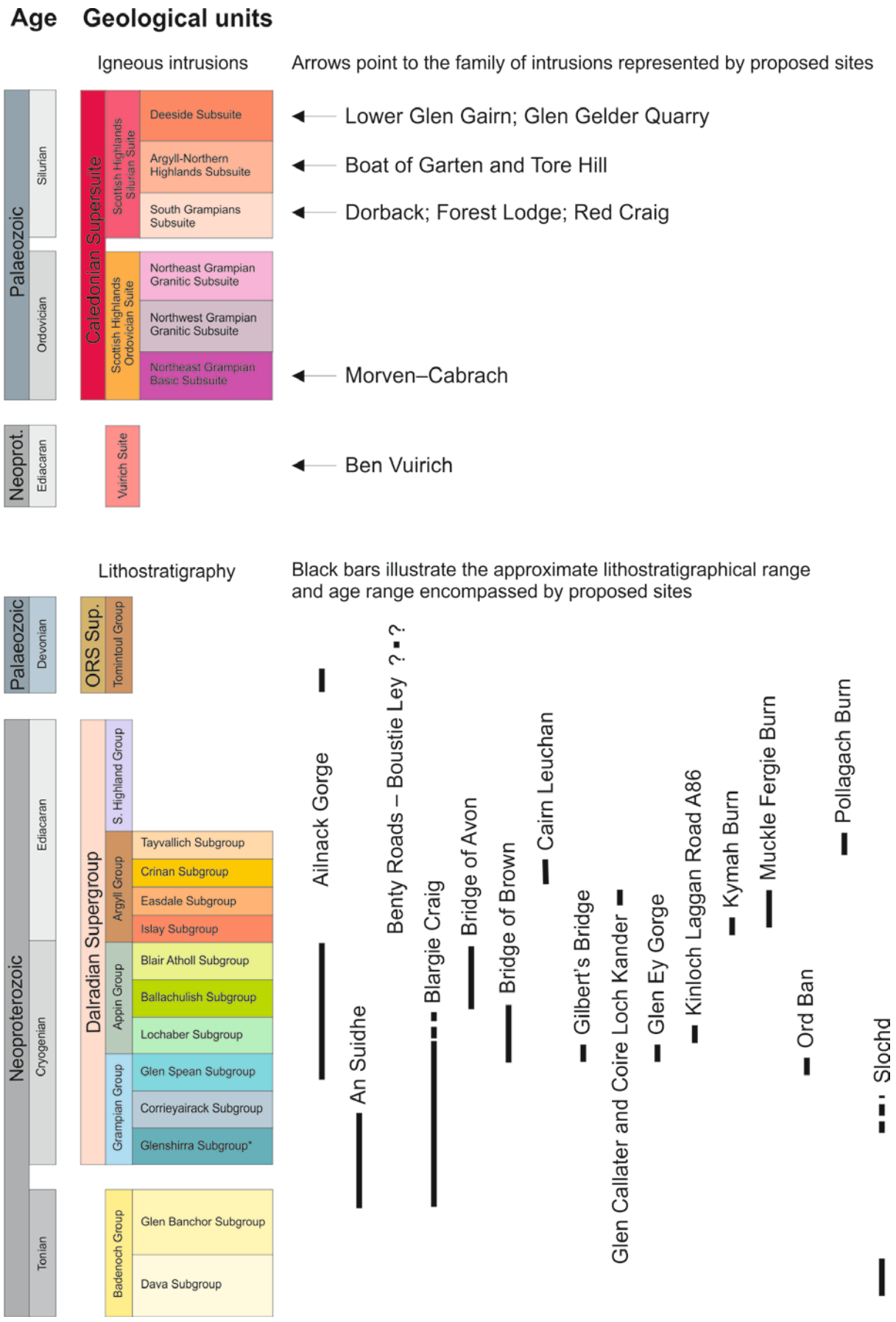

Figure 1 Major stratigraphical and intrusive divisions in the bedrock geology of the CNP, and geological and chronological affiliations of proposed bedrock geodiversity sites

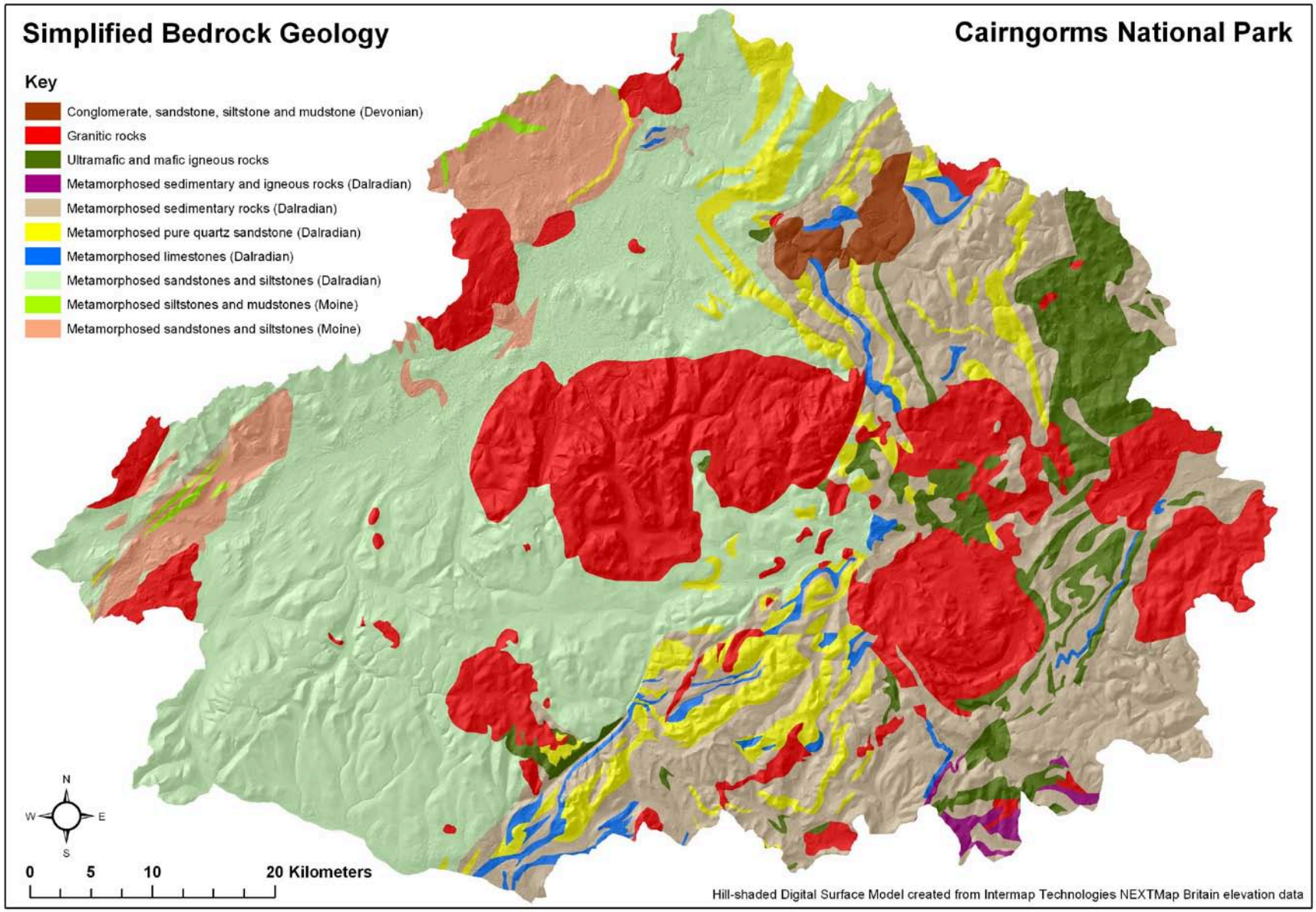

Figure 2: Simplified bedrock geology of the Cairngorms National Park

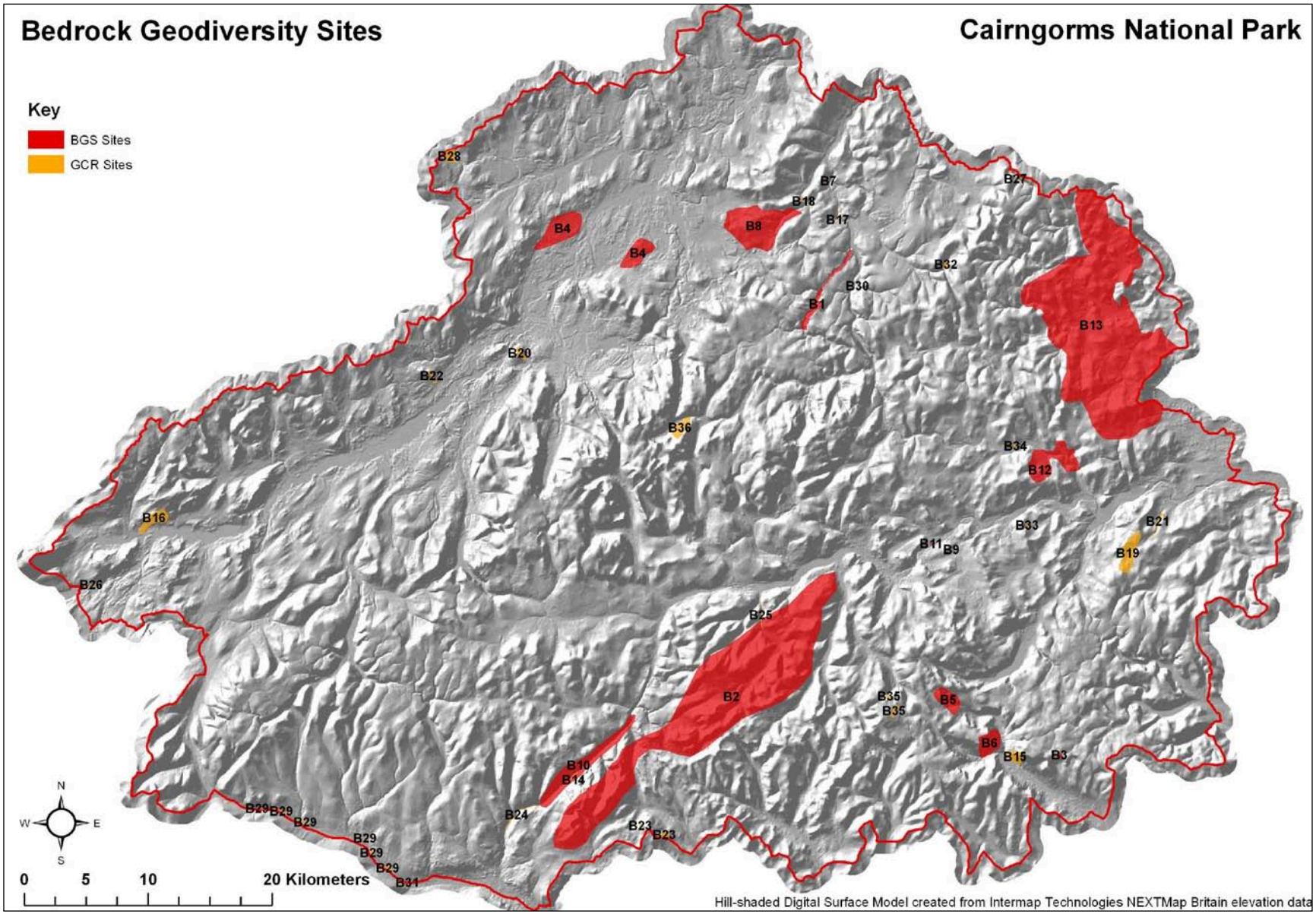

Figure 3: Bedrock geodiversity sites

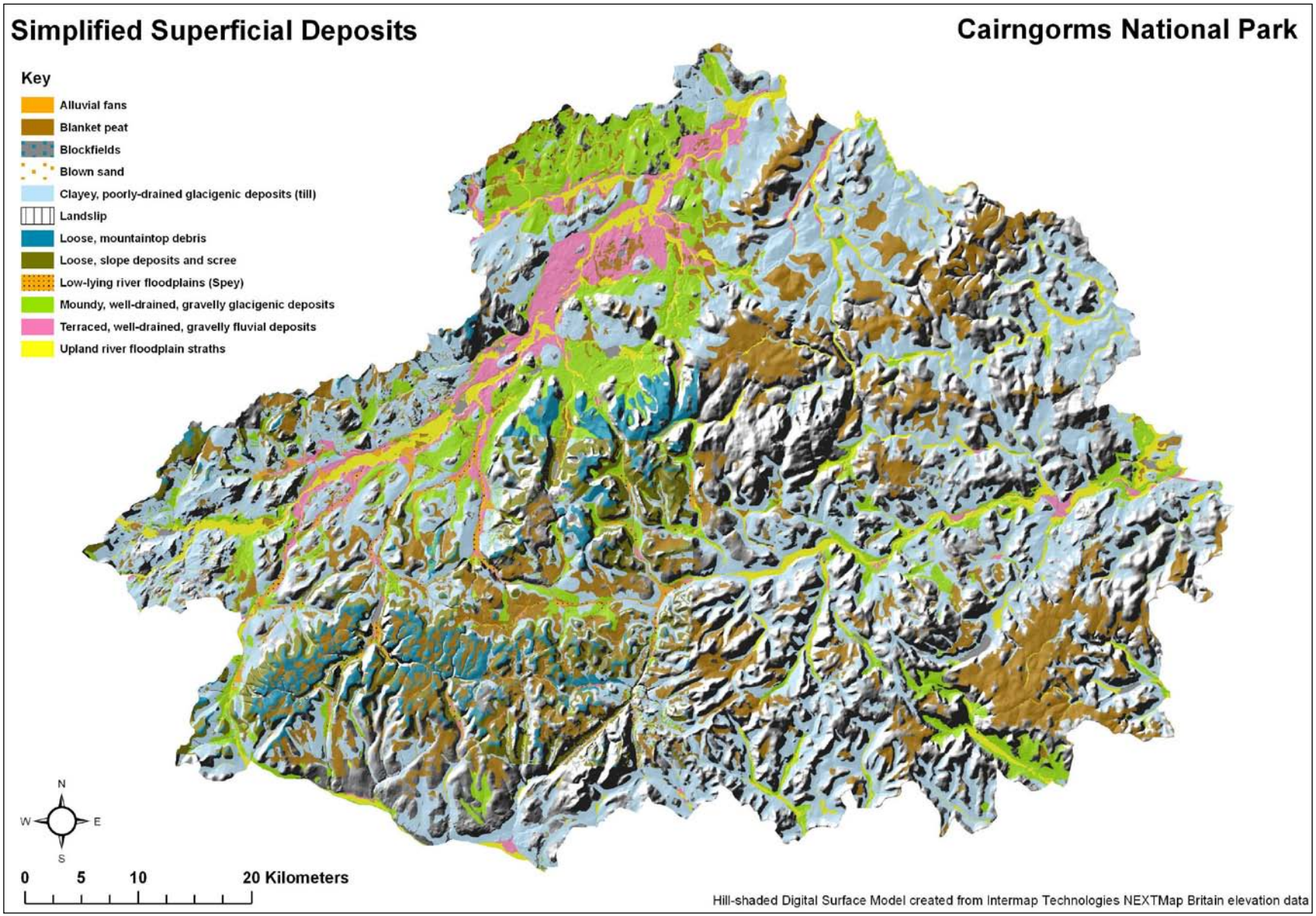

Figure 4: Simplified superficial deposits of the Cairngorms National Park

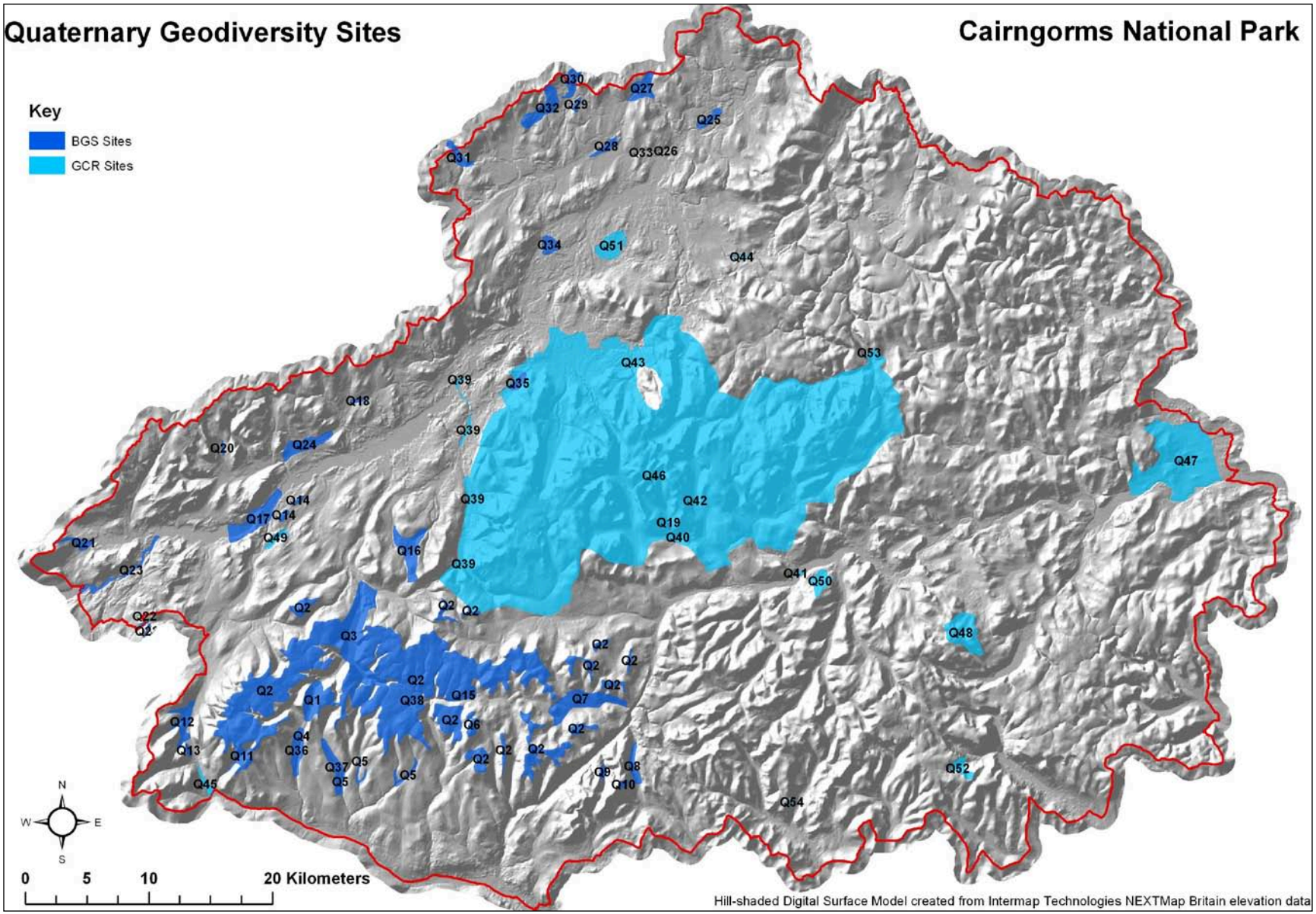

Figure 5: Quaternary geodiversity sites