

The role of the British Geological Survey in the History of Geoconservation

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Abstract

Over its 172 year history, the British Geological Survey (formerly the Geological Survey of Great Britain) has through underpinning core activities, its archive and databases and its experienced field staff, provided the geological basis for geoconservation. Evolving activities of the Survey from primary survey and collecting to revision mapping to 3D/4D-modelling reflect changing national needs. In turn BGS has developed its capability to provide new geological interpretations and a range of publications raising the profile of earth sciences, both for professionals and for the popular market. Today, BGS's input through networks to geodiversity projects and to newly designated regions such as Geoparks marks a major transition towards a proactive geoconservation agenda in the 21st century.

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[Introduction]

Founded in 1835, the Geological Survey of Great Britain (now the British Geological Survey, BGS) is the world's longest established national geological survey and the United Kingdom's premier centre for earth science information and expertise. Charles Lyell, in his Presidential Address to the Geological Society in 1836, referred to the need for geological survey to be combined with the geographical survey in progress. He noted the value of obtaining accurate geological information not only for the promotion of geological science 'but also as a work of great practical utility, bearing on agriculture, mining, road-making, the formation of canals and railroads, and other branches of national industry'. It would aid the assessment of the national mineral wealth and formulate what we would call today land utilisation policies. Thus the Geological Survey was established by the government expressly for the purpose of producing geological maps of the country based on Ordnance Survey maps as they became available. Accompanying memoirs would be published explaining the geology shown on the maps.

The BGS, its function and history

Geoconservation was not recognised as such in those early years. Indeed the word had not been invented, but although the science of geological conservation or geoconservation has only matured since the 1940s, following the introduction of legislative powers for nature conservation (Gray 2004), the functions of the Survey from earliest times have underpinned the objectives of successful geoconservation. These include:

- Systematic collection, cataloguing and interpretation of representative materials including fossils, minerals and rocks
- Maintenance of petrological thin section collection
- The archive of Geological Photographs started in the 1890s
- The legacy and collections of the Museum of Practical Geology
- Geological records collections and Library
- The development of the stratigraphical framework of Great Britain
- The gathering of field data at a range of large scales from 1:10 000 to 1:50 000 and the publication of Standards at these scales and at smaller scales (e.g. 1:50 000, 1:250 000 and 1:625 000)
- The undertaking of revision surveys to update and publish geological knowledge
- The description of local and regional geology in the form of memoirs, sheet explanations

Today, BGS (which since 1965 has been a component organisation of the Natural Environment Research Council) maintains the UK's National Geoscience Data Centre. This national collection contains the data gathered or generated by BGS and its precursors over more than 170 years of geological survey with records and data that range in age from the early 19th century to the present day. Paper archive held by BGS includes maps, notebooks, photographs, memoirs and reports, borehole logs, mine plans and field slips. Many records are in digital format including the 1:50,000 scale geological maps of Great Britain (DiGMapGB-50, see BGS website www.bgs.ac.uk). With the rapid development of new technologies geological data and interpretation are provided increasingly in digital format and are integrated into customised Geographical Information Systems (GIS). 3-Dimensional modelling software are enabling, for the first time the development of 3-D regional models which have much potential for geoconservation purposes and for geodiversity planning.

This paper outlines aspects of the early history of the Geological Survey and its activities relevant to geoconservation. It shows how, with the post-World War II development of geoconservation concept, the BGS is actively contributing to a better public understanding of geodiversity.

Historical backdrop and some early examples of geoconservation

In the latter part of the 18th century and early part of the 19th century, earth science took a giant leap forward. Scientific understanding and application was sparked by the twin beacons of intellectual enlightenment and industrial revolution. Clever people, true polymaths, discussed, communicated and debated their findings. James Hutton's

observations which supported his *Theory of the Earth* (published in 1795 by the Royal Society of Edinburgh) showed the immense value of geological features and outcrop. These were brilliantly illustrated by his friends John Clerk of Eldin and James Hall (Craig *et al.* 1978).

The necessity of geological maps was recognised in the early years of the 19th century. William Smith in the making of his seminal geological map of England, Wales and southern Scotland (1815), was able to interpret the geology and demonstrated how the form of the land was determined by the rocks. In later years (1819-24) Smith issued larger scale county maps, coinciding with the issue and distribution of Greenhough's map of England, sponsored by the Geological Society of London (1819). In 1815 Richard Griffith had prepared a Geological Map of Ireland but it does not seem to have been printed or published. Formal government support of geological survey began the year before in 1814 when John Macculloch was appointed Geologist to the Trigonometrical Survey of Great Britain and started his work in Scotland. Although his mission was not to make a geological survey of Scotland, his fine map issued posthumously in 1835 is regarded as the first that was supported, if not commanded, by the British Government. Meanwhile with the establishment of the Ordnance Survey in 1791, opportunity arose to utilise new One inch to One Mile base maps of southern England. Under the direction of Colonel Colby several members of the Ordnance staff acquired some geological knowledge and geological information was being recorded on some maps. In 1832 Joseph Portlock was appointed to the Survey in Ireland and from then on Henry De la Beche, under the direction of the Board of Ordnance, began the colouring of Ordnance Survey maps of the West of England (Flett 1937). With the political momentum and support of the establishment, the Geological Survey was established in 1835 with De la Beche as its first Director.

Thus began systematic geological surveying, budgets permitting, of the geology of Great Britain, initially in England and Wales but with survey in Scotland from the 1850s (Wilson 1977). The true foundation of the British landscape was being discovered. In years to come, the new insights into the understanding of the landscape came with the revelation by Louis Agassiz in the 1840s that much of Britain had been glaciated so that, for example, the Drifts defined by Roderick Murchison could be interpreted in the context of a glaciated terrain.

The excitement of these early years galvanised the public to ensure the preservation of fine landscape features. Even before the formation of the national geological survey, there are examples of actions which would now be called geoconservation. These included the saving, by legal action in 1819, of Salisbury Crags below Arthur's Seat in Holyrood Park, Edinburgh from being quarried away (McMillan *et al.* 1999). Here action was directly influenced by concerned citizens for their threatened city landscape. Much later the establishment of the Boulder Committee under the auspices of the Royal Society of Edinburgh initiated a process to identify glacial erratics in Scotland that appeared remarkable in terms of size and superficial markings and to recommend measures for their conservation (Milne Home 1872*a,b*). Preservation of the Agassiz Rock in the city also received much attention from the Edinburgh Geological Society from

earliest days both to protect the features and to inform the public of the significance of glacial striae (Gordon 1992). In another early example of geoconservation, the preservation of the Carboniferous lycopod (*Stigmaria*) stumps at Fossil Grove, Whiteinch, Glasgow (discovered in 1887) owed much to the efforts of palaeontologists such as R. Kidston and J. Young (formerly a Survey Assistant Geologist and latterly Keeper of the Hunterian Museum) and also to the local authorities for the shelter which was later built to protect the fossil trees (Macgregor & Walton 1948).

The Geological Survey's role in geoconservation

Important early actions of the Geological Survey from its inception in 1835 may be seen to have directly aided both contemporary and future 'geoconservation' activities.

Museums and collections

Properly maintained and catalogued geological materials collections form a significant resource. They are in their own right examples of geoconservation and serve to provide essential reference for field geoconservation. The BGS is custodian of extensive collections of records, materials and data pertaining to the geology and hydrogeology of the UK, its continental shelf and many countries overseas. The collections are of national and international significance. One of the first actions of the newly fledged Survey was the development of a museum at Craig's Court, Whitehall to house De La Beche's collections and the building stone specimens assessed for the then new Houses of Parliament (see below). The collections soon filled the space available and the case was made for new premises. This resulted in the opening by the Prince Consort in 1851 of the Museum of Practical Geology in Jermyn Street, (221, Piccadilly). Subsequently the museum was relocated to South Kensington where the new building for the Museum of Practical Geology and the Geological Survey of Great Britain was opened by the Duke of York in 1935. It now forms the Earth Galleries of the Natural History Museum. The major reference collections were transferred to Keyworth, Nottingham following the move of BGS there in 1985. The Natural History Museum at South Kensington retained economic specimens, gemstones, minerals and building stones. Successive curators recognised the value of holding and displaying systematic collections of the rocks and fossils and economic minerals for public benefit and instruction.

In Scotland, the close relationship with the Royal Scottish Museum (formerly the Science and Art Museum and now the National Museum), Chambers Street, Edinburgh resulted in the allocation of gallery space to the Geological Survey of Scotland in 1889 for the display of regional Scottish geology. This was enhanced in 1896 with addition of Professor Heddle's magnificent collection of Scottish minerals (Flett 1937). The resultant collection has been of major value to generations of students of Scottish geology.

Although displays and exhibitions now meet different objectives to engage the modern museum-going public, the underpinning collections still form the basis for geoscientific research. BGS continues to maintain the Reference collections at its headquarters in

Keyworth, Nottingham and in Edinburgh together with representative onshore and offshore borehole core.

The BGS Palaeontological Collection, numbering 2.5 million specimens, is the most important collection of British fossils in the world. Their integral association with the Survey's 160 year history of mapping British Geology means that they are the fundamental biostratigraphical basis for the geological maps which provide the framework for every geological endeavour in Britain. Early Palaeontologists of note include Edward Forbes, appointed 1844 followed by John Salter, T.H. Huxley, Robert Etheridge and C.J. Stubblefield. The collections have been enhanced by donations to be held in trust in perpetuity for the nation, some of which predate the Survey. These include specimens from the Geological Society of London Collection received in 1911, and specimens figured and described by Murchison in his *Silurian System* published in 1839. The British collection of the Geological Society of London (Moore *et al.* 1991) contains material from such luminaries as Banks, Buckland, Conybeare, Lyell, Murchison, Sedgwick, J. and J. de C. Sowerby and over 600 of the other principal figures of 19th century geology. The great bulk of this collection, around 25,000 items, with many type and figured specimens, still remains with the Survey.

Reference collections of rocks, minerals and thin sections are held in a suite of petrological collections held at BGS, Keyworth and Edinburgh. Borehole core has formed part of the Survey collections since its inception. As of 2000, the drill core collection comprised 106,000 one metre boxes holding materials from 2,934 boreholes (Hollyer & Wheatley, 2000). Indeed the earliest material predates the formation of the Survey and refers to a borehole drilled at Chatham Dockyard, Kent in 1821. Access to minerals and water boreholes by BGS is encompassed by two Acts of Parliament, Section 23 of the Mining Industry Act 1926 and Section 9 of the Petroleum (production) Act 1934. This entitles BGS staff access to log and sample material of any borehole drilled for minerals (including hydrocarbons) over 30m in depth; Section 205 of the Water Resources Act 1991 allows the same access to boreholes drilled for water greater than 15 m in depth.

Identification of resources

Over the past three centuries with the rapid increase in use of mineral resources to feed firstly the development of the industrial revolution, the requirement to locate, understand and quantify resources became essential. In 1835 the quest for such knowledge was identified as one of the key factors in the establishment of the Geological Survey of Great Britain. One of the most celebrated building stone resource assessments was that conducted by a Select Committee set up to recommend stone for the building of the Houses of Parliament (1839 – c.1852) (Barry *et al.* 1839). Barry's account was the first published detailed survey of the building stone industry of Britain (Lott & Richardson, 1997). Although the outcome of the survey was less than satisfactory (the variable quality of the dolomitic limestone recommended resulted in serious differential decay in the building stone), the collection of assessed building stones provided the successful case for the establishment of a Survey Museum in Craig's Court, Whitehall opened to the public in 1841 (Flett 1937).

Stratigraphy

Pioneering stratigraphical studies, resulting from the Primary Survey in Wales during the 1830s, included the development in part of the now familiar Lower Palaeozoic nomenclature and definitions of Sir Roderick Murchison (later to become the second Director-General of the Geological Survey). In the 1870s, revision of the biostratigraphy by Charles Lapworth, a Scottish schoolmaster, in the Southern Uplands of Scotland resulted in the establishment of the Ordovician Period. Murchison and Sedgwick also named the Devonian Period and discovered fossil fish from the Old Red Sandstone of Scotland. Regional memoirs and sheet explanations accompanied the geological mapping and research. In addition Sir Archibald Geikie, as Director General in his Annual Report for 1883, set in train the ideas for stratigraphical memoirs and the first of these extremely valuable monographs appeared seven years later (Reid 1890). Coinciding with the Centenary of the Geological Survey (1935) and the new exhibitions of regional geology at Exhibition Road, the introduction of British Regional Guides proved popular (Department of Scientific and Industrial Research 1936). Aimed at both the interested general reader and as background for the specialist, revised regional guides to 20 onshore regions have served to introduce British stratigraphy to a wider public.

The Geological Survey's contributions to Geoconservation in the 20th century

With the enactment in 1949 of the statutory basis for nature conservation, opportunity arose for geoconservation to be formally promoted. The Geological Sub-committee of the Nature Reserves Investigation Committee identified some 390 geological localities (including 104 of geomorphological or Quaternary significance) in England and Wales that should be protected as geological reserves. In 1948, Professor J.G.C. Anderson of the Geological Survey identified 60 sites for Scotland. Both lists were very much provisional or ad hoc (Gordon 1992). By 1954, with further consideration by the Geological Survey, the official list for Scotland had risen to 169. More systematic surveys were carried out in the 1960s (a precursor to the Geological Conservation Review which began in 1977) and reviewed in an unpublished report by McQuhae and Sargeant in 1978 (see Gordon 1992). During this period as part of the Nature Conservancy Council's process of identifying SSSIs, the Geological Survey was consulted. The exercise benefited from the fact that the contemporary Land Survey Units were geographically defined and staffed by experienced field geologists who 'knew their patch'.

Today, as part of its routine enquiry service BGS is often asked to comment on planning applications whether they are for biodiversity, minerals or for some other development. It is BGS's policy to offer impartial advice, neither condoning nor criticising a particular development but making factual statements about the geology, hydrogeology, geotechnical information and geomorphology. If certain features are, in the opinion of the geologist, unique or unusual this may be stated.

Safeguarding resources

Both after the 1st World War and during the 2nd the Geological Survey undertook systematic strategic surveys of Britain's mineral resources. The value of these surveys was that they not only quantified mineral extent and workability but also provided a background for land-use planning and the safeguarding of resources. Reports published at the time have relevance today as renewed consideration is given to sustainable development of indigenous materials so far as this is possible.

Built Heritage

To assist in the identification of materials for built heritage stone repair and conservation work, reference economic memoirs provide details on sources of a wide range of natural resources including slate (Richey & Anderson 1940), mineral resources (including building and road stone) of the Lothians (MacGregor 1945) and limestone (Robertson *et al.* 1949). These provide an invaluable historical record for sourcing of materials. Together with UK-wide information and statistics on current quarrying, materials and products, published regularly by BGS through the *Directory of Mines and Quarries* (Cameron *et al.* 2005, and online via www.mineralsuk.com) these publications inform more recent resource assessment studies such as the recently published BGS *Building Stone Resources Map of Britain* (British Geological Survey 2001) or index volumes such as *Stone in Scotland* (Hyslop *et al.* 2006). In recent decades there has been a resurgence of interest in the use of indigenous natural materials, in particular building stone both for conservation of historic buildings and for new build. The town and city environment in which the majority of the population lives offers many opportunities to develop links between geology and the built heritage (Bennett *et al.* 1996). The opening of new quarries and the re-opening of long-abandoned workings highlight scope for built heritage geoconservation and provides a catalyst to involve the public and professionals in issues such as the use of appropriate indigenous stone in streetscapes and town and urban developments (McMillan *et al.* 2006). BGS has contributed in a variety of ways to promoting this interest through organisations such as the Scottish Stone Liaison Group (Historic Scotland 1997; McMillan & McKinney 2005), the Welsh Stone Forum (Coulson 2005) and the English Stone Forum (Doyle *et al.* 2007 in press).

Geological societies and RIGS

Officers of the Geological Survey have maintained strong links with geological societies and associations across Britain. From the early days, surveyors contributed to the activities of geological societies whose objectives have been the public understanding of geology. Mainly through voluntary effort, but often with the ready support of their managers, survey staff have contributed to the promotion of geoconservation through local activities including public lectures, field excursions and the publication of geological findings in proceedings or transactions.

Development of Geodiversity in the 21st century - networking links and partnerships

UKRIGS

The 'public good' role of the BGS also translates today into the input BGS geologists have made to the activities of many groups developing Regionally Important Geological and Geomorphological Sites (RIGS) within the UKRIGS Network. Since the 1980s BGS geologists have offered their professional advice or volunteer their own time to the development of new RIGS sites, preparing posters and leaflets and leading associated tours or excursions. To recognise the mutual benefit of this a close working relationship there is in place a Memorandum of Agreement between UKRIGS and BGS, the objectives of which are shown in Table 1.

Work with statutory bodies and NGOs

In recent years BGS has worked closely with statutory agencies including Scottish Natural Heritage (SNH), Natural England (formerly English Nature), Historic Scotland, CADW and English Heritage. The links have been strengthened as the relevance of earth science as the underpinning science for biodiversity has been recognised. Another form of link is by representation on external committees such as the Geoconservation Commission under the auspices of the Geological Society (London) (website www.geoconservation.com). This body aims to promote the conservation of our Earth heritage and to ensure that we pass it on in good order to future generations for investigation, education and enjoyment.

BGS has supported the Earth Science Forum for England and Wales (ESEF) and also the Scottish Earth Science Education Forum (SESEF). Both organisations are promoting earth science in education and provide resources for teachers, schools and colleges. BGS also collaborates with science centres (e.g. Our Dynamic Earth, website www.dynamicearth.co.uk and the National Stone Centre www.nationalstonecentre.org.uk) and museums. BGS also supports and funds a wide range of collaborative research with universities.

In terms of scientific geoconservation publications, a major input by BGS geologists has been to the Geological Conservation Review (GCR) series. The GCR is led by the Joint Nature Conservation Committee (JNCC), and aims to identify and describe the most important earth science sites in Britain (Ellis *et al.* 1996). At the heart of the government agencies' objectives has been the challenge to promote the care of Britain's natural environment, its responsible enjoyment and its greater understanding and its sustainable use. An example of joint publications aimed at increasing the general public's understating of the environment is the SNH/BGS series 'Landscape Fashioned by Geology' Series (McKirdy & Crofts 1999). These books, written with the minimum of jargon, tell the story of the evolving geological and recent history of Scotland through its rocks and landscapes. BGS also supports a range of visitor attractions such as mining visitor centres and heritage centres. It also participates in 'rock and fossil' events (e.g. the Vogrie Environment Fair) and hosts Open Days for the general public.

Popular events and publications

BGS geologists have contributed to exhibitions, display boards (e.g. at National Trust properties) or in partnership with others (National Museums of Scotland, Our Dynamic Earth, BGS and the Hunterian Museum in Glasgow), involved with raising an awareness of the Earth heritage through geology festivals leading to joint ventures, such as the organisation of 'Rock On' the biennial Scottish Geology Festival (formerly Scottish Geology Week). Over the last 15 years the BGS and the Geological Survey of Northern Ireland have published a wide range of popular publications. These include landscape books of Ireland and the Isle of Man (e.g. McKeever 1999; Pickett 2001), popular applied geology 'Whisky on the Rocks' (Cribb & Cribb 1998), Holiday Geology Guides (e.g. Gallois 2001), Falklands Island guides (e.g. Stone & Aldiss 2000), Discovering Geology Fossil Focus Guides (e.g. Wilkinson 2000), building stones leaflets (e.g. Lott & Barclay 2002), and GeoTourism maps (e.g. British Geological Survey 2000).

European Geopark Network

A European Geopark is a clearly defined area with important geological heritage in terms of scientific quality, rarity, aesthetic appeal and educational value. The key functions of a European Geopark are to protect geological heritage, promote geology to the public, and to use geology and other aspects of its natural and cultural heritage to promote sustainable economic development, normally through responsible tourism. All European Geoparks work together in the European Geoparks Network, established in 2000. The network consists of some 25 Geoparks in 11 countries. The European Geopark Network ensures quality of geological heritage, interpretation and education and conservation and also shares expertise. All European Geoparks are also endorsed by UNESCO as a Global Geopark.

BGS has played a valuable advisory role in the establishment of European and UNESCO Geoparks. The first in Britain was the North Pennines AONB in 2003 (Table 2) with the Brecon Beacons National Park being accorded European Geopark status in 2005. The latter's mountains and hidden valleys are the result of nearly 500 million years of earth history, and the area contains evidence of ancient seas, mountain building and sea level and climate change scattered across a landscape that was shaped by the last ice age. The first European Geopark in Scotland, the North West Highlands Geopark was launched in 2005 at the SNH-owned Knockan Crag National Nature Reserve Visitor Centre (Barron *et al.* 2005). This outstanding area contains some of the most important and diverse geological and geomorphological features and stunning landscapes in Britain and the rocks in the Geopark record the last 3000 million years of history for the landmass that we now know as Scotland. The Geopark also recognises the diverse natural heritage of the area, local culture and the rich array of historic and archaeological sites. Geologically, the area is dominated by the internationally important Moine Thrust Zone, which runs from north to south. In the 19th century, this zone puzzled geologists who recognized that packages of rocks were 'thrust' over long distances on top of younger rocks. The Northwest Highlands Memoir celebrating its centenary (Peach *et al.* 1907) has stood the test of time as a classic ground-breaking publication. Thrusts are now recognized in rocks around the world, including those in the Himalayas and the Alps – but are rarely as accessible as the Moine thrust at Knockan Crag. As part of recent mapping in the

Northwest Highlands, the BGS has published a Walkers' Map (British Geological Survey 2004) which offers an excellent template for future popular publications.

Geodiversity audits and action plans – shaping planning policy

With the expertise and records described previously the BGS has been well placed to provide advice on geodiversity throughout the UK. Generations of BGS geologists have walked over much of the UK recording information on the geology and, based upon their local knowledge have compiled geodiversity audits and contributed to Geodiversity Action Plans, examples of which are shown in Table 2. One of the earliest examples to which BGS contributed was the Inventory of Earth Science sites in the Dundee District (Hardie 1995). The minerals industry is also playing a key role in the conservation of geological heritage. From the creation of geological sections, through to the restoration and management of sites, the industry is uniquely placed to contribute to the conservation, management, scientific, educational and recreational use of geological sites.

There is now an increased emphasis on planning for geodiversity. This is reflected in the recently published PPS9 for England 'Biodiversity and geological conservation', in which Government clearly places geodiversity at the heart of planning policy, and in the number of local and company level geodiversity action plans being produced and implemented. In Scotland, geodiversity has also been recognized in updated Biodiversity Action Plans (e.g. City of Edinburgh Council 2004) and in county natural heritage designations (e.g. Scot 2005).

Concluding remark

The Geological Survey has travelled far in its 172 years. Throughout its history, it has changed course many times to reflect the needs of the nation and to make its geoscience research relevant to the people. It now employs specialists in a wide range of disciplines from physics to chemistry, from information technologists to graphic designers. Yet we can reflect that the Survey's underpinning core activities, its archive and databases and its staff have played and continue to play a significant role in the development of geoconservation to ensure that development in the century ahead is truly sustainable. Charles Lyell would be pleased.

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Fig. 1. Laying the foundations for geoconservation. A group of geologists from the Survey mapping near Braemar, in 1903. From left to right the group comprises John Flett?, Robert Lunn (with camera), E. H. Cunningham-Craig (in kilt) and JohnHorne. (Reproduced with the permission of the British Geological Survey © NERC. All rights reserved.)

Table 1. Objectives of the Memorandum of Understanding between UKRIGS and BGS

Communicating

- Seeking closer understanding of each other's work, and exploring means by which greater collaboration may be established.
- Undertaking regular national level meetings to discuss and share information regarding strategic direction, potential work programmes, joint working, and issues impacting on the objectives, work and running of the respective organisations.
- Providing support to encourage increased contact between BGS Programmes and RIGS groups.
- Promoting each other's existence and remit in appropriate literature, relevant presentations, and when meeting influential or key players in the field of geological conservation, both in the United Kingdom and abroad.

Supporting and sharing

- Providing each other with support information, and facilities, as long as this is within reason and is in keeping with the capacities of the respective organisations.
- Working together to facilitate the sharing of information, exchange of ideas, expertise and general learning opportunities. For example through training events, workshops, publications and web-based media and Geodiversity Action Plans.
- BGS will continue to support The Association of UKRIGS Groups throughout the period of this agreement. The Association of UKRIGS Groups will continue to encourage member groups to support BGS in its strategic mapping and scientific programmes.

Working together in partnership

The intention of the MoU is to define the guidelines for the two parties to co-operate in the field of geoscientific data exchange, particularly where mutual interests exist. The intellectual property rights, third party data ownership interests, aspects of commercial sensitivity, societal concerns, and confidentiality, will be paid due regard, protected, and not knowingly infringed.

- BGS and the Association of UK RIGS Groups will meet at least annually to explore and develop areas for joint working. This may result in time and/or financial resources being pooled to develop projects that address issues of mutual concern, in particular Geodiversity Action Plans, geoconservation and related topics.
- Whilst working nationally on strategic issues, BGS and The Association of UKRIGS Groups will encourage cooperation and joint working at a local level between specific BGS projects and individual RIGS groups on more site-specific issues.
- Both parties intend to produce inventories that will cover digital and non-digital data holdings including basic metadata information. When complete, the inventories will be shared between the parties by appropriate electronic means.
- Both will publicise internally what data services are available from the other party, and how to make use of them. They will also publish internally the organisational e-mail addresses of the nominated contacts of each party, to facilitate the effective exchange of data and information by this medium
- It is agreed that neither party to this MoU will seek to profit from the inputs of the other party or undermine their position.
- For Geodiversity Action Plans and related topics that have been funded from external sources, BGS and the relevant RIGS group(s) should work in close cooperation to achieve the agreed output both at the planning and working stages. If the funding levels are insufficient for the full deployment of BGS staff, then BGS will make up any difference or make full funding available to contribute to the success of the project.

Table 2 Examples of Geodiversity audits and action plans to which BGS has contributed

Project	Duration	Description
Dundee District Inventory	1995	Inventory of Earth Science Sites in the Dundee District. BGS contributed to this early audit prepared for SNH which set out methodology and site details for quarries, road cuttings, river sections and for geomorphological features
County Durham Geodiversity Audit	2003 – 2004	Conserving geodiversity required a combination of statutory protection for nationally important sites. The protection of both non-statutory sites and geodiversity interests in general impacts the development, and active management of sites and features of importance to geodiversity.
North Pennines AONB Geodiversity Audit and Action Plan	2003 – 2004	The AONB was awarded the UNESCO-endorsed Global Geopark status in 2003, partly in recognition of the importance of its geology, but also in recognition of local efforts to conserve, interpret and revitalize the area through its Earth heritage. In order to guide understanding and management of the area's unique geological heritage and to support the development of sustainable 'geotourism', the North Pennine AONB Partnership commissioned BGS to advise on the framing of a Geodiversity Action Plan for the AONB. This is the first such study of a protected landscape in this country.
Leicestershire and Rutland LGAP	2003 – 2007	The principal aims were centred around education, the provision of a detailed audit of all known geological sites in the two counties and the gathering together of data sets of geological information on the counties.
West Lothian Geodiversity Audit	2005 – 2006	The first to be conducted in Scotland, the audit was undertaken as a means of informing the framing of recommendations and action points designed to guide the sustainable management, planning, conservation and interpretation of all aspects of the Earth heritage of West Lothian. A draft West Lothian Geodiversity Action Plan (WLGAP) was prepared. See Barron & Arkley, 2006
Yorkshire Dales and Craven Lowlands Draft LGAP	2005 – 06	The draft Action Plan 'Your Dales Rocks' sets out a framework of actions for auditing, recording and monitoring the geodiversity. It is currently a draft and subject to change
Northumberland National Park Sustainable Geodiversity Framework	2005 – 2007	Evaluating the resource and identifying ways of exploiting it within the co-ordinated framework of the National Park strategy. Emphasis is placed on identifying ways by which geodiversity and, in particular, opportunities arising from past and present aggregate extraction might contribute to sustainable tourism and provide opportunities for learning and employment.

