

GeoValue: Valuing Geodiversity for the Community

Final Project Report

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Project undertaken in association with partners Camborne School of Mines, University of Exeter, British Geological Survey, Health & Safety Executive, English Nature, Cornwall Wildlife Trust, Cornwall RIGS Group, Somerset Geology Group and Mineral Industry Research Organisation

Front Cover Photographs:

St Michael's Mount, Cornwall - Granite in contact with metamorphosed, tectonised Mylor Slate, Devonian. Beam Quarry, North Devon - Bude Formation sandstones and shales, Upper Carboniferous.

Blackhill Quarry, East Devon - Budleigh Salterton Pebble Beds, Triassic. Other exposures of similar high quality geodiversity are found in the cliffs at nearby Budleigh Salterton.

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GeoValue: Valuing Geodiversity for the Community

Final Project Report

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The Geodiversity Profile Handbook – in separate book (Appendix 4)

Access and Safety at Geological Sites – in separate book (Appendix 5)

1. Introduction

There are innumerable geological sites in the United Kingdom where features of interest (i.e. geodiversity) can be seen. They include active, abandoned and historic quarries as well as natural and other man-made exposures of rock. In much of lowland England away from the coast, active and other quarries are of major importance in illustrating geodiversity, natural rock exposures being virtually absent. Sites are visited by the geological community as part of scientific, professional, educational or recreational activities. Some have protected status as Sites of Special Scientific Interest (SSSI). Some others are designated locally as Regionally Important Geological or Geomorphological Sites (RIGS), also sometimes known as County Geology Sites. Most geological sites have no designation, yet may have significant geodiversity, as illustrated by the development of Local Geodiversity Action Plans (LGAPS) at a county level in recent years (English Nature, 2004; Burek and Potter, 2004; 2006).

Quarry operators see community involvement by the geological visitor as an important part of public relations, and for developing a wider understanding of the role of the industry in modern society. In general, visits to quarries to observe the geology are encouraged by the industry. Geodiversity is regarded as an important component of our natural heritage. This is now recognised in a Memorandum of Understanding between English Nature (now Natural England) and the Quarry Products Association (2005) (see also English Nature et al., 2003) and the development of company Geodiversity Action Plans (cGAPS) (Thompson et al., 2006).

The GeoValue research project has two components. A new procedure for describing and valuing geodiversity at geological sites, known as the Geodiversity Profile, has been developed and tested. The basis of the procedure and its applications are described along with examples in a separate publication, 'The Geodiversity Profile Handbook' (Scott, et al., 2007a). The second component has examined the legal and safety issues in accessing geological sites, particularly active quarries. The results are presented separately in 'Access and safety at geological sites: a manual for landowners, quarry operators and the geological visitor' (Scott et al., 2007b).

This report summarises the activities through the project (from 1 August 2005 to 31 January 2007). It also contains a report on feedback from a Discussion Seminar held in Exeter in December 2005 (in Appendix 1), and the programme from a conference held in Nottingham in January 2007 to disseminate the results of GeoValue (in Appendix 2). Further examples of the Geodiversity Profile made by the project team and others during the course of the project are presented in an accompanying separate report Volume 2 (Appendix 3).

2. The GeoValue Project Partners

The partners in GeoValue are: David Roche GeoConsulting, Camborne School of Mines (University of Exeter), Cornwall Wildlife Trust, British Geological Survey, English Nature (now Natural England) and the Health & Safety Executive. Others with significant involvement have been MIRO, the Cornwall RIGS Group, Somerset Geology Group and University of Plymouth. Personnel are as follows:

David Roche GeoConsulting:	Peter Scott, David Roche, Clive Nicholas
Camborne School of Mines, University of Exeter:	Robin Shail, Peter Scott
Cornwall Wildlife Trust	Victoria Whitehouse, Sue Hocking
British Geological Survey	Andrew Bloodworth, David Harrison
English Nature	Jonathan Larwood
Health and Safety Executive	Helen Turner
MIRO	Abbie Richards
Cornwall RIGS Group	Peter Ealey
Somerset Geology Group	Hugh Prudden
University of Plymouth	Jim Griffiths

Several RIGS Groups / County Geology Trusts aided the project by testing the Geodiversity Profile at sites in their local areas and providing feedback on the procedure. They are listed below:

Oxfordshire Geology Trust
Warwickshire Geological Conservation Group
East Yorkshire RIGS Group
Cornwall RIGS Group
Bedfordshire RIGS Group
Buckinghamshire RIGS Group
Lothian & Borders RIGS Group
North East Yorkshire Geology Trust
Somerset Geology Group

Other staff from the British Geological Survey also made some determination of the Geodiversity Profile at sites in Derbyshire, Leicestershire and Nottinghamshire

3. Development of the Geodiversity Profile

The Geodiversity Profile is an independent, standardised, quantitative procedure for describing and valuing geodiversity at geological sites. It is particularly designed for use in active and other quarries. It contains the essential information about the geological features of a site (the Geodiversity Measure), and provides a set of values which record the scientific, educational and collectively, historical, cultural and aesthetics importances arising from the geodiversity (the Geodiversity Values). Determination of the profile requires a knowledge of the geology and surrounding area gathered through a desk study followed by fieldwork at the site. Any observed links with biodiversity (the Ecological Component) are also reported. The Geodiversity Profile is recorded on a two-page form, with written statements justifying each component.

The purpose of the Geodiversity Profile is to inform discussion on the value of geodiversity at a site and, when necessary to aid any decision-making process on a site's future management. It is relevant to all stakeholders. It is not intended to be designatory or replace existing statutory or other designations.

A draft version of the Geodiversity Profile was developed during a scoping study (David Roche Geo Consulting, 2005). This study reviewed the current practices, both within the UK and internationally, for valuing geodiversity, and presented a preliminary structure for the Geodiversity Profile, along with examples taken from four active quarry sites in Devon. Following a further review, the basis for the profile was presented at a discussion seminar on 15 December 2005 in Exeter, attended by 50 people. A report from this seminar was distributed to the participants (see Appendix 1, below) and the procedure refined. It was further refined during the testing phase on an on-going basis. Active discussions were held within the project partners and between the project partners and RIGS Groups / County Geology Trusts in the field during the determination of profiles. The Ecological Component was developed through discussions with ecologists at the Cornwall Wildlife Trust. It is recognised that a full appreciation of the relationship between the geodiversity and ecology may require a professional ecologist to be involved.

Testing of the Geodiversity Profile was made by the project team on a number of sites, mainly in South-west England. The RIGS Groups / County Geology Trusts and British Geological Survey staff undertook the testing independently following an introduction to the procedure at a few sites from a member of the project team. Feedback on the use of the procedure were given. This resulted in minor modifications being made and a better understanding of its applications. Independent determination of the Geodiversity Profile by different personnel on the same site showed that the procedure is reproduceable with only minor differences in interpretation, as long as the criteria explained in 'The Geodiversity Profile Handbook' are followed.

The procedure for the Geodiversity Profile was presented in draft form to the IV International Symposium ProGEO on the Conservation of Geological Heritage in Braga, Portugal, 13-16 September, 2005 (Scott et al., 2005), to the Ussher Society Annual Conference, Bideford, Devon 3-6 January, 2006, to Hull Geological Society on 16 May, 2006 and to the Extractive Industry Geology Conference, Edinburgh, 14-17 June, 2006.

The Geodiversity Profile was tested at a wide range of sites in England, mostly active quarries, and a few in Scotland to represent different geological settings. In total 62 sites were included. Fourteen sites were chosen for inclusion in 'The Geodiversity Profile Handbook' to cover sites of different geological ages and variety of geodiversity. The Geodiversity Profiles of all sites are presented in Appendix 3. These determinations were made by the project team and others whilst testing the procedure. Full statements of justification for the determination using the designated criteria are sometimes lacking, and these profiles should not be used for any decision-making without further verification.

4. Access and safety at geological sites

This component of GeoValue examines the law relating to access by the visitor to geological sites, safety and responsibilities for safety of the visitor, and current practices by landowners and quarry operators for allowing visits. The data were compiled through a desk study, using primary and interpretative legal and health and safety literature, information available on the internet, and fieldwork by the project team supported by discussions with legal experts. Topics covered are land ownership in England, the law relating to access to land, occupiers liability, health and safety legislation, responsibilities for health and safety, the quarries regulations and associated codes of practice.

The issues were presented at the Discussion Seminar held in Exeter on 15 December 2005, and views from the participants were sought (see Appendix 1). The work progressed through 2006.

A selection of major landowners from private and public companies, public bodies, establishment bodies and charities were contacted and discussions held through Email, telephone or personal meetings. They were asked about their policies and procedures for granting requests for visits to geological sites in their ownership. During visits to active quarries for the determination of the Geodiversity Profile, the policies and procedures of the operator were discussed with the quarry manager, and observations of the implementation of these and the practices for allowing the visits to take place were made by the project team. Independent meetings were held with senior personnel in several of the major aggregates companies operating in England to establish formally their policies and procedures for allowing visitor access to observe the geology in their quarries, and to gain their observations on visitor requirements and behaviour.

An important component of the study has been an examination of the Quarries Regulations, 1999 and Code of Practice and their impact on the needs of the geological visitor to gain access to observe the geology to best advantage in active quarries. Suggestions have been made of the facilities the quarry operator could provide so that the access to view the geology can be improved without compromising safety or the quarrying activity, and the objectives of a geological visit can be achieved. These are: provision of external or internal viewing areas and refuges, accepting visitors when there are no mobile plant movements, provision of pedestrian routes within the quarry, identifying faces which can be accessed safely and away from mobile plant movements, development of internal or external boulder parks, providing a rock collection or fossil hunting zone, making up samples boxes of rocks etc from the quarry to give to visitors, and having a geological literature resource of information relating to the quarry.

Recommendations from the access and safety component of the GeoValue Project include:

- the need for the visitor to obtain permission from the landowner where a right of access does not exist
- advice to the visitor to undertake an assessment of the risk from hazards at a site and put in place precautions to minimise them
- advice to site owners of abandoned or historic quarries to erect boards explaining the access arrangements and safety hazards
- the need for geological visitors to active quarries to acquaint themselves with the requirements of the Quarries Regulations 1999
- the most suitable time for visits to active quarries to see the geology is when there are minimal or no mobile plant movements
- quarry operators should design an information sheet on safety and procedures specifically for the geological visitor
- published guidelines and codes of practice for geological fieldwork are in need of comprehensive revision and updating
- a certificate of competence scheme developed for geological visits to active quarries, especially for group leaders, would enable less resource to be given by the quarry operator in supervising a visit.

5. Summary of project output

The major output from the GeoValue Project is the publication of two books in January 2007:

1. **'The Geodiversity Profile Handbook'**
by Peter W. Scott, Robin Shail, Clive Nicholas and David Roche, 60pp.
2. **'Access and safety at geological sites: a manual for landowners, quarry operators and the geological visitor'**
by Peter W. Scott, Clive Nicholas, Helen Turner, David Roche and Robin Shail, 52pp.

The books were launched at a conference entitled 'Geodiversity Geoconservation & GeoValue' at the British Geological Survey, Nottingham on 24 January 2007. The conference programme was developed to include other presentations by members of the project team and others. It was attended by 90 delegates including representatives from all of the major quarry operators, several RIGS / County Geology Trusts, geological and environmental consultants, local authority staff, the British Geological Survey, English Heritage, academics, and others. The full programme is given in Appendix 2.

Published abstracts from presentations made at conferences and short articles on GeoValue include the following:

Scott, P., Roche, D., Nicholas, C and Shail, R. 2005. The Geovalue project: Development of the Geodiversity Profile. IV International Symposium ProGEO on the Conservation of Geological Heritage in Braga, Portugal, 13-16 September, 2005, Abstracts, p16.

Scott, P., Roche, D, Nicholas, C., Shail, R., Prudden, H. and Ealey, P. 2006. The GeoValue Project: testing the Geodiversity Profile in Cornwall, Devon and Somerset. Geoscience in south-west England, 11, Abstract p.260.

Scott, P.W., Roche, D., Nicholas, C and Shail, R. 2006. The MIST GeoValue Project: Valuing geodiversity and gaining access for the community. Abstract, Extractive Industry Geology Conference, Edinburgh. Abstract.

Scott, P.W., Shail, R., Nicholas, C and Roche, D. 2006 Geodiversity, Geoconservation and GeoValue. Teaching Earth Sciences, 31, No. 4, 19-21.

Scott, P.W. and Roche, D.P. 2006. GeoValue: Valuing Geodiversity for the community. MIRO News, Vol. 19, Issue 2, 8-9.

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Burek, C and Potter, J. 2004. Local geodiversity action plans: sharing good practice workshop, Peterborough, 3 December 2003. English Nature Research Report, No 601, 38pp.

Burek, C and Potter, J. 2006. Local geodiversity plans: setting the context for geological conservation. English Nature Research Report, No. 560, 58pp.

David Roche GeoConsulting, 2005. GeoValue: Valuing Geodiversity for Conservation: Initial Scoping Study: Development of the Geodiversity Profile. Report 2432/1 to Minerals Industry Research Organisation, 105pp.

www.mi-st.org.uk/research_projects/final_reports/final_report_ma_4_2_016a.pdf.

English Nature, 2004. Local geodiversity action plans: sharing good practice. 3pp.

English Nature, Quarry Products Association and Silica and Moulding Sands Association, 2003. Geodiversity and the minerals industry – Conserving our geological heritage. Entec UK Ltd., 17pp.

English Nature and Quarry Products Association, 2005. Overarching Memorandum of Understanding. 1p.

Scott, P.W., Shail, R.K., Roche, D.P. and Nicholas, C. 2007a. The Geodiversity Profile Handbook. David Roche Geo Consulting, Exeter, UK, 60pp.

Scott, P.W., Nicholas, C., Turner, H., Roche, D.P. and Shail, R.K., 2007b. Access and safety at geological sites: a manual for landowners, quarry operators and the geological visitor. David Roche Geo Consulting, Exeter, UK, 52pp.

Thompson, A., Poole, J., Carroll, L., Foweraker, M., Harris, K., & Cox, P. 2006. Geodiversity Action Plans for Aggregate Companies: A Guide to Good Practice. Report to the Mineral Industry Research Organisation. Capita Symonds Ltd, East Grinstead.

Appendix 1. Report on GeoValue Discussion Seminar and Feedback and list of delegates attending discussion seminar on 15 December 2005 at Exeter

This report was produced following the Discussion Seminar. It contains the major points of discussion and a commentary.

GeoValue: Valuing Geodiversity for the Community

Report on GeoValue Project Discussion Seminar and Feedback

**The Discussion Seminar was held at Crossmead Conference Centre, Exeter,
15th December, 2005**

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Report from GeoValue Project Discussion Seminar and Feedback

The GeoValue Project provides a framework for evaluating geodiversity at geological sites (the Geodiversity Profile) and is developing procedures for managing safe access to sites, especially working and disused quarries. A Discussion Seminar was held at Crossmead, Exeter, on 15th December, 2005. This report summarises the seminar and the issues raised in discussion and written feedback, along with responses from the Project Team.

Attendance at the seminar was 50, including members of the Project Team and Partners. A wide range of organisations was represented including the quarrying industry, academia, amateur and professional geological societies, British Geological Survey, environmental organisations, mining and geological consultants, RIGS Groups, UKRIGS and geology trusts. A few RIGS groups and geology trusts provided displays of their work. Each delegate received a document with draft Guidance Notes and worked examples of the Geodiversity Profile.

The Seminar generated a lot of discussion especially regarding the purpose and use of the Geodiversity Profile as a procedure for evaluating geodiversity. As requested, further written comments and informal feedback have been received from many delegates. The discussion and comments from delegates have helped considerably in the further development of the project.

Guidance Notes for the Geodiversity Profile require modification and the scope of the work for the community access component of GeoValue is undergoing minor amendments to take account of the comments. The next stage for the project is to test the procedure for the determination of the Geodiversity Profile independently and several RIGS Groups and Geology Trusts have indicated a keenness to be involved. They are being contacted so that the work can be undertaken in the spring/summer 2006. Work on the community access part is in its initial data-gathering stages. It will progress through the year. The GeoValue Project completion date is 31st January 2007.

1. Summary of presentations

Following an introduction by David Roche, Project Director, six presentations on the various aspects of the GeoValue project were made. These are summarised below:

The Geodiversity Profile: development and testing.

Peter Scott, David Roche GeoConsulting and Camborne School of Mines.

The Geodiversity Profile has been developed as a standardised procedure for the assessment and comparison of the geodiversity value at geological and geomorphological sites. It summarises the geodiversity elements of the site, and places a value on the (a) scientific, (b) educational and (c) historical, cultural and aesthetic importance by making comparison with other sites in the local area with a similar geological setting. Any observed link with the ecology of the site is reported. It is intended that the Geodiversity Profile should be transparent, objective and reproducible. It is a standardised, fully justified statement of the geodiversity value that can form the basis for discussion between stakeholders and be challenged. Examples of the Geodiversity Profile of several sites were given.

Geodiversity in quarries.

Andrew Bloodworth, British Geological Survey.

A review of the benefits and problems associated with rock exposures in working quarries was presented, along with examples of active quarries in diverse geological settings, especially limestones and other aggregates. Challenges for the future for community access to quarries were explained as safety, development of ongoing good relationships between the extractive industry and conservation bodies, the preservation of key geological sections and sympathetic restoration.

Geomorphology in geodiversity

Jim Griffiths, Plymouth University.

The importance of including geomorphology within the Geodiversity Profile was emphasised and two examples of the determination of the Geodiversity Value of geomorphological sites (active landslides in Dorset and Dartmoor Tors) were given. A checklist for recognising geomorphological landforms and processes will need to be developed for use by non-specialists

GeoValue, the ecological component

Victoria Whitehouse, Cornwall Wildlife Trust.

The presentation reviewed the link between biodiversity and geodiversity and explained that both direct and indirect links can be made. The geodiversity contributes to an understanding of the ecology. Examples were given of the detailed level of understanding of ecology that may be required to be able to establish a link. It was concluded that a professional ecologist needs to work with a geoscientist if a full understanding of the ecological component is to be achieved. Understanding the landscape context with its biodiversity is also important. Including an ecological component adds value to the Geodiversity Profile.

'Access all areas?'

Helen Turner, Health and Safety Executive

Some of the problems that have to be addressed by the extractive industry in allowing visitors to gain access to quarry sites were explained. Some of these are practical, related to the day to day operation of the quarry, other are driven by legal requirements, such as the Health and Safety at Work Act (1974) and the Quarries Regulations (1999). Safety issues arising from visits to disused quarries are covered by separate legislation (Mines and Quarries Act 1954, Section 151 and Environmental Protection Act 1990). The 'right to roam' arising from the Countryside and Rights of Way Act (2005) exempts land used for quarrying, so access can be denied, but maps do not show such land.

Community access to geodiversity.

Peter Scott, David Roche GeoConsulting and Camborne School of Mines.

The community was explained as visitors to geological sites (includes societies, educational groups, and researchers), custodians (landowners and quarry operators) and others (regulators and conservation bodies). Issues for community access are legal, safety and practical. Solutions involve development of a protocol after examining existing policies, then developing procedures for access, with practical designs. Examples of possible solutions were given along with a suggestion for a leader passport scheme.

2. The Discussion and Feedback

The many issues raised in discussion and subsequent feedback fall into five main groups:

1. The purpose and need for the Geodiversity Profile;
2. The procedure for the determination of the Geodiversity Profile;
3. The personnel making the determination of the Geodiversity Profile;
4. The definition of the community to whom the project relates; and,
5. The development of safe procedures for arranging visits to working quarries.

Each is addressed below:

2.1 The purpose and need for the Geodiversity Profile

i. The purpose of the Geodiversity Profile

Information about the purpose of the Geodiversity Profile was provided to all delegates in literature at the Discussion Seminar. It is further clarified below:

The Geodiversity Profile is proposed as a standardised national framework for the evaluation and comparison of the geodiversity of geological and geomorphological sites. It is specifically designed for use in active, disused or abandoned quarries, although it can be applied to any site. It is intended for use by stakeholders, who may be landowners, quarrying companies, planning authorities, conservation bodies or others.

The Geodiversity Profile can be used as a basis to inform discussion and the decision-making process. It is not intended to be designatory nor replace existing statutory (GCR/SSSI) or quasi-statutory (RIGS/County Geology Site) designations. As a scheme for use in assessing geodiversity it is intended for general use, not to be 'owned' or administered by any single stakeholder. The procedure will be published as a handbook with illustrative examples at the end of the GeoValue Project.

Most GCR/SSSI and RIGS/County Geology Sites will score highly in one or more of the profile categories. However, there are a large number of geological and geomorphological sites that have no such designation(s) but whose geodiversity significance nevertheless requires evaluation within a comparable framework.

The Geodiversity Profile has a broad aim as an assessment tool and there is no preconception or presumption for conservation. The procedure is straightforward, and draws upon and standardises many elements of practice that are commonly used for the evaluation of potential RIGS / County Geology Sites. It requires knowing or gaining a thorough geological knowledge of the site and related literature as well as fieldwork. It relies solely on the geological (including geomorphological) characteristics of the site and ignores practical issues such as physical accessibility, and availability of access.

The Geodiversity Profile is being tested at a large number of sites having a variety of geological settings as a way of refining the procedure, checking reproducibility and to give illustrations of its application. The GeoValue Project is not re-assessing the quality of previously designated sites for either the purpose of conservation or de-designation. However, by having independent testing by others, especially RIGS / Geology Trusts, it is hoped that the methodology and data they gather will be of use to them.

Having clearly defined evidence-based criteria, supported by transparency of information, is increasingly important for decision-making in Britain's society. For example, British Standard and ISO procedures and specifications, along with formalised Codes of Practice are essential tools in many areas of activity, many having legal status. The quarrying industry, planning authorities and even educational establishments teaching geology have to work within a framework (e.g. in meeting the requirements of the Quarry Regulations (1999), Health and Safety at Work Act (1974), determining Rock Mass Ratings using a standardised procedure, or adhering to the numerous environmental and planning regulations and reporting procedures). There are advantages in adopting standardised national assessment criteria *and* procedures for the evaluation of any geological or geomorphological site. The Geodiversity Profile offers stakeholders a procedure for making an assessment of the value of a site and to have available all of the evidence on which the assessment is based, so that it can be used in decision-making within and outside its organisation.

The Geodiversity Profile has applications in the following areas (updated from David Roche GeoConsulting, Scoping Study Report, 2005):

- providing local, regional and national government with a standardised procedure for assessing geodiversity value as part of the planning process.
- aiding the drawing up of Geodiversity Action Plans (GAPs) and Company GAPs by highlighting those rock exposures that make a significant contribution to geodiversity. It contributes towards achieving the aims embodied in the memorandum of understanding between the Quarry Products Association and English Nature (June 2005).
- acting as an aid in resolving conflicts by providing a tool for expert witnesses to use in arguing the relative merits of the geodiversity at an inquiry.
- informing discussions between quarry owners and mineral planning authorities over quarry developments (e.g. by showing relative merits of geodiversity at different sites).
- informing discussions between quarry operators and conservation groups.
- giving quarry operators and others knowledge to propose suitable alternative sites for visiting educational groups and researchers, if appropriate.
- for quarry operators to prioritise rock faces for conservation, such as in planning restoration.
- enabling planning authorities to understand the relative quality of geodiversity at sites, so that geodiversity and geoconservation can be considered in developing or re-appraising mineral or other consultation areas.

ii. The need for the Geodiversity profile

The need for the development of a procedure for the determination of geodiversity value at geological sites was questioned, given that already there exists other procedures for the recognition of sites for geoconservation. The need for the Geodiversity Profile appeared to be unclear, and especially its relationship to the procedure used for the Geological Conservation Review (GCR), which provided a basis for recognition of geological Sites of Special Scientific Interest (SSSIs), and those procedures used for the determination of Regionally Important Geological and Geomorphological Sites (RIGS) / County Geology Sites.

The GCR and RIGS / County Geology Sites procedures are reviewed and discussed below. Procedures for the assessment of geodiversity value were more fully discussed as part of the earlier Scoping Study phase of the GeoValue Project (David Roche GeoConsulting, 2005). This is reproduced as Appendix A below. The study indicated a need for a standardised procedure.

The Geological Conservation Review was designed to identify those sites of national and international importance needed to show all the key scientific elements of the Earth heritage of Britain. It is ongoing. Sites recognised in the GCR are [at localities already notified or being considered for notification as 'Sites of Special Scientific Interest' \(www.jncc.gov.uk/page-2947\)](http://www.jncc.gov.uk/page-2947). Sites selected for the GCR form the basis for statutory conservation of geology in Britain. Work at county level by RIGS Groups and Geology Trusts has enabled the identification of additional sites that make an important contribution to local and regional geodiversity. These are designated as RIGS or County Geology Sites. They are recorded and reported to the local planning authority, but do not have statutory recognition.

GCR sites were/are selected because of their international importance to Earth science, because they contain exceptional features that are nationally important, or because they represent an Earth science feature which is fundamental to Britain's Earth history (Ellis et al., 1996; see also www.jncc.gov.uk/page-1). They are designated on the basis of their scientific importance alone, as are all SSSIs. Other criteria, including educational value, are not included. Their designation involves peer review, although the value judgements made in the selection process (e.g. to show that one site is unique or of higher value than any other) are not published in the information provided about the selection process (see Ellis et al., 1996).

RIGS Groups / Geology Trusts have developed in the last 15 years or so. These groups cover most parts of Britain. Each is autonomous and is made up largely of volunteers with a common interest in geological conservation, although Geology Trusts now employ some geoscientists. Geological locations are designated as RIGS or County Geology sites broadly using the four criteria published by UKRIGS. These are:

- The value of a site for educational purposes in life-long learning.
- The value of a site for study by both professional and amateur Earth scientists.
- The historical value of a site in terms of important advances in Earth science knowledge, events or human exploitation.
- The aesthetic value of a site in the landscape, particularly in relation to promoting public awareness and appreciation of Earth sciences.

The selection process aims to choose / has chosen sites representative of the geology of the county or area in which the group operates. Up to 70 or more sites are designated in some counties. The distribution is not uniform through Britain. The RIGS Groups / Geology Trusts have made a major contribution to the conservation of Earth Heritage in Britain through the designation of sites.

The basic criteria of education, study (i.e. broadly, but not exactly the same as science), history and aesthetics have some similarity with those adopted for the Geodiversity Profile, except that applied geology generally receives little recognition. A reference to 'human exploitation' in assessing the historical value is the one minor aspect of applied geology included. One strength of the RIGS / Geology Trusts is that local geological knowledge is usually available.

As part of the development of the Geodiversity Profile, a study was made of the internet sites of most RIGS groups / Geology Trusts along with other relevant published literature (e.g. proceedings of UKRIGS conferences). This shows that the methods used in applying the four criteria recommended by UKRIGS (and generally used by RIGS Groups / Geology Trusts) are variable and the process of decision-making commonly lacks clarity to the outsider. Some groups publicise that they use a scoring process in the assessment of sites. Most groups do not state their procedure for making judgements. No group publicises clearly and unambiguously how the decision is made for a rock exposure or landscape feature to be designated as a RIGS / County Geology site.

The published criteria for the assessment of sites (www.ukrigs.org.uk/public/assessment.doc), which may or may not be used by individual groups, involves assessed ratings from 0-10 with subjective descriptions such as poor, acceptable / useful, very good / excellent. These are partly explained in notes (www.ukrigs.org.uk/public/assessinfo.pdf), but still use subjective wording. For example, a site with an exposure of clay could be considered 'poor' by one geologist as it lacks macropalaeontology or interesting sedimentology, yet excellent by another who has used it as a resource for the microfauna it contains, or its unique clay mineralogy.

It has to be concluded that information about the value judgements and any thresholds that need to be exceeded in the decision-making process for designating GCR/SSSIs and RIGS / County Geology Sites is lacking. This information may exist, but is not in the public domain and it is not possible to determine whether there is any consistency of application between different sites or areas. Site owners, therefore, do not have a clear basis for understanding why they have such designated sites on their property, when perhaps a nearby site with similar geological features is not similarly designated. This leads to confusion and sometimes conflict between landowners or quarry operators and the community who wish to visit SSSIs and RIGS / County Geology sites. RIGS / Geology Trusts may be missing some high value sites which would be eliminated from their procedure because of access difficulties, or because they fall just over the boundary of their geographical area.

The Geodiversity Profile seeks to be objective by providing a consistent framework in which the geodiversity value of all geological sites, specifically those in working, disused or abandoned quarries can be assessed. The criteria are clearly defined. Each part has to be fully justified by the presentation of the supporting data. The Profile is an 'open-book' (i.e. transparent) statement of the geodiversity at the site, placing a value on it relative to other sites with a similar geological setting. It can be challenged. It is a statement of the geodiversity value made at the time of assessment, with knowledge of the geological literature that refers to the site, and done using the knowledge and experience of the geoscientist(s) making the assessment.

2.2 The procedure for the determination of the Geodiversity Profile

i. The individual components of the Geodiversity Profile

The three components for determining the Geodiversity Profile (i.e. Geodiversity Measure, Geodiversity Value and Ecological Component) and the criteria used for their determination appear appropriate as they received little discussion. The Geodiversity Measure is a simplified audit of the geodiversity. It is noted that the terminology is perhaps cumbersome. A glossary of terms will be added to the Guidance Notes to aid understanding.

ii. The Geodiversity Value

In discussion it was recognised that the Geodiversity Value uses criteria, namely the scientific, educational and historical, cultural and aesthetic importances, that are similar to those adopted for the assessment of RIGS / County geology sites,. This is a strength. However, there are differences in the criteria (see above). The application of these criteria is different, the Geodiversity Value establishing the relative importance or uniqueness of a site by comparing it numerically with others of a similar geological setting in the same area.

Although important for visitors, ease of access to a site is not considered part of the Geodiversity Profile. It is unrelated and independent of a site's contribution to geodiversity. The geological characteristics of a rock exposure or feature are present even though access may not be possible or safe. If a site is recognised as having high value through its Geodiversity Profile, engineering works could enable access as part of any agreed management plan. If ease of access became part of the Geodiversity Profile, potentially high geodiversity value sites could remain unrecognised.

There was little criticism of using numerical values, a scoring system being part of the assessment process recommended by UKRIGS (see www.ukrigs.org.uk/public/assessinfo.pdf and www.ukrigs.org.uk/handbook/rhb10.pdf). It is recognised that addition of numbers could mask the uniqueness of a site which has a high value on only one of the criteria. The Guidance Notes will stress that individual values for each criteria should be considered along with the total value. Equal weighting of each of the three criteria (scientific, educational and historical, cultural and aesthetic) is used. Using differential weighting, as suggested in some discussion, would create a further complication and potential distortion.

iii. The Ecological Component

The incorporation of an ecological component received little discussion and thus appears to be appropriate and acceptable.

It is recognised that a professional ecologist needs to work with a geoscientist if a full understanding of the ecological component is to be achieved. This is stated in the Guidance Notes.

iv. Incorporation of geomorphology into the Geodiversity Profile

As geomorphology is a constituent part of geodiversity, it is included within the Geodiversity Profile. Geomorphological features and processes can be studied in, and be seen at some working, abandoned or disused quarry sites.

v. Inclusion of other components within a quarry as part of the Geodiversity Profile

It has been suggested that archaeological remains, historic buildings, tips and stockpiles within a quarry site could or should be incorporated into the Geodiversity Profile within the historical, cultural and aesthetic value or elsewhere. This has been considered.

Archaeological remains and historic buildings at a site mostly have only an indirect relationship to the geodiversity. Thus, it is not appropriate to include them as part of the Geodiversity Value and Profile. There may be a link between the extraction of a rock or mineral at a quarry site and a structure of historical or archaeological significance. The existence of the structure may be dependent on a specific feature of geodiversity, which gave rise to the extraction of the rock or mineral, but the structure is not part of the geodiversity. A reference to the presence of historic buildings or archaeological remains could be made within the Geodiversity Profile to alert the reader to any potential relationship. This will be incorporated into the Guidance Notes.

The geologist does not usually have the competence to make a judgement on the heritage or other value of any archaeological or historic structure. However, a quarry site, which provided material used on a large scale in historic buildings (e.g. Portland Stone quarries), clearly has an historical, cultural and/or aesthetic value at a local, county, national or international level, and would be valued as such in the Geodiversity Profile.

Modern quarry tips (including waste lagoons), many tips at abandoned quarry / mine sites, and stockpiles of rock are major safety hazards. Direct access may be impossible, and should not be attempted in many cases. As features of geodiversity in themselves, tips may have an applied geology science or educational value for their engineering design, hydrogeology or environmental geology significance, which is reported in the applied geology scientific importance in the Geodiversity Value. This reflects the relationship between the quarry or mined product and the waste, and the need to contain the waste safely. Old tips may have a geological process or applied geology science and/or educational value for their mineralogical or mineralisation interest, especially in areas of former mine workings (e.g. in the metalliferous mining region of Devon and Cornwall). Occasionally, old tips may have palaeontological or other geological process interest and hence value.

Stockpiles of crushed rock or washed sand have no direct geodiversity value in themselves, although they may indirectly illustrate some features of applied geomorphology (e.g. rotational slipping; natural angle of rest). This does not contribute to the geodiversity of the site. Stockpiles of blocks of armourstone illustrate applied geology science or educational value arising from knowledge of the spacing of discontinuities. Blocks of armourstone often contain geodiversity features of geological history or processes value representative of the site.

vi. Taking account of prior designation of the site

It has been proposed that prior designation as GCR/SSSI or RIGS / County Geology site should be recognised in the determination of the Geodiversity Value.

Prior designation does not form part of the assessment procedure for the Geodiversity Profile. It would bias the result against other sites, which may have equal value to those with existing designations. It would also remove the independence of the Geodiversity Profile procedure.

Prior designation as GCR/SSSI or RIGS / County Geology Site may be relevant to any decisions made for the site. Thus, it should be recorded as part of the Geodiversity Profile. The profiling

sheets will be modified to take this into account. Many GCR/SSSIs encompass large areas of landscape or multiple rock exposures. In these circumstances it is important to state that the area to which the Geodiversity Profile applies is within the prior designated site, but does not include it all.

vii. Geographical limits

Determining the scientific value part of the Geodiversity Profile involves considering exposures with similar attributes in a geographical area. Uncertainty was expressed regarding the interpretation of the area. This is referred to in the Guidance Notes, but clarification is necessary.

Valuing is made by considering all exposures with similar attributes in the same area which may or may not be within a single county or other political boundary. The value is awarded on the basis of sites with similar attributes being common (>10 sites), uncommon (5-10 sites), rare (<5 sites) or unique. The areal extent for consideration will vary with the availability of sites and the scale of change of the geodiversity. It could be several 100s of km², where geological units show little change over a wide area and there are many similar sites, or much smaller where there is complex geology. 500km², for example, is an area only 25km by 20km. In considering the areal extent, the emphasis is on there being similar attributes, and as the areal extent is widened, the frequency of sites having similar attributes (e.g. the same stratigraphical unit with the same geodiversity) will diminish. It would be inappropriate to group together exposures of similar attributes at opposite ends of the country in making the determination. The areal extent being considered in justifying the Geodiversity Value for a site needs to be stated in reporting the Profile so that any ambiguity is avoided.

viii. Stratigraphical limits

There appeared to be some confusion about the procedure for making comparisons between sites with similar attributes.

In general, sites with similar attributes are considered at the level of the formal lithostratigraphical Formation name, rather than between those with a more widespread Group status. However, where the Formation is sub-divided into Members, it may be appropriate to consider sites with similar attributes at this level. This has been done in determining the Geodiversity Profile of the Oxford Clay in the Peterborough area. Elsewhere, subdivision below Group level may not have been achieved, and it may be necessary to consider similarities between lithologies at different sites within the Group in making the assessment (e.g. in metamorphic terrains).

Intrusive igneous rocks are not usually named using lithostratigraphical Group, Formation or Member designations. In comparing sites with similar attributes in these rocks and where metamorphic rocks similarly lack formal designation, the key on the 1:50,000 Geological Survey map can be used to provide a guide to the separation of rocks at different sites. However, igneous and metamorphic rocks at sites with the same designation on the map can have very different geodiversity. Clarity is achieved by providing the relevant information in the justification statements.

ix. Educational importance

In discussion it was stated that the suitability of sites for their educational value varies between different educational groups, some sites being more suitable for younger age groups, others for visits by people at advanced educational levels. It was suggested that the Geodiversity Profile should take this into account and determine a site for its educational value at different levels.

This has been considered, but would increase the complexity of the Geodiversity Profile. Many sites can be experienced at all levels of education, the leader of a group changing the terminology, activities and nature of interpretation of the site according to the audience. The justification for the educational value of the site along with the details provided in the Geodiversity Measure should provide sufficient information to enable an understanding of the suitability of a site for visits by different educational groups.

In determining the educational importance, the highest value is given where there is 'An opportunity to demonstrate clearly multiple geological interest categories in pure and/or applied geology and 'hands-on' data collection is possible'. The term 'hands-on' is unclear, and could be taken to imply solely the collection of samples. It also implies that it is safe to collect data at the site. This statement will be changed to:

'An opportunity to demonstrate clearly multiple geological interest categories in pure and/or applied geology and practical data collection is possible assuming safe access can be achieved'. Practical data collection includes measurement, direct observation using a hand lens, and close-up photography, as well as sample collection where the owner of the site has granted permission.

2.3 The personnel making the determination of the Geodiversity Profile

i. Definition of suitable person

There was considerable discussion and additional written feedback regarding the suggestion that an appropriate person to determine the Geodiversity Profile would be a Chartered Geologist.

It is understood that not all geoscientists are, or want to become, Chartered Geologists, and that an important contribution to geoconservation is made by those with considerable experience of geology gained over a long period of time rather than formal geological qualifications. Thus, it is more appropriate that a suitable person for determining the Geodiversity Profile has competence to do the work, and the term 'Competent Person', rather than Chartered Geologist is more appropriate.

A 'Competent Person' through training, qualification, experience or a combination of these, has the knowledge and skills necessary to perform the task required. A suitable definition of competence is:

The ability to perform activities within an occupation or function in such a manner as to engender the confidence of the individual, the employer, the end user and the community at large." (Engineering Council).

ii. Differences in the Geodiversity Profile determined by different personnel

It was suggested that only those with specific experience of the site should make an assessment of its value.

Although major discrepancies are unlikely as the criteria are carefully defined, minor differences in the Geodiversity Profile may result from differences between people making the assessment. There may be small differences in interpretation of some of the criteria.

Differences between personnel determining the Geodiversity Profile of a site may arise as a consequence of one or more of the following:

- inadequate literature search;
- missed key references in obscure journals or books;
- failure to acquire sufficient local knowledge;
- lack of experience or training in the type of the geology exposed at the site, or applied geology or geomorphological features exhibited at the site;
- inexperience in recognising or understanding key features within the specific geological setting.

However, as each component of the Geodiversity Profile has a written justification, the evidence used for the determination is known. Any omission can be rectified in the light of additional information. Any differences between profiles of the same site made by different personnel can be used as a basis for discussion, resolution of conflict, or open disagreement should the need arise.

An important part of the GeoValue Project is to test the Geodiversity Profile in different geological settings using different personnel so that differences in interpretation can be understood and problems addressed before finalising and formally publishing the procedure and guidance notes at the end of the project.

2.4 The community to whom the GeoValue project relates

The community can be divided into three categories with differing needs. These are:

Visitors to geological sites –

- Geological groups and societies
- Educational organisations
- Geological researchers
- Companies and consultants providing professional training / CPD

Custodians -

- Landowners
- Quarrying companies

Others

- Local government, and other planning authorities
- Conservation bodies

The list of visitors to geological sites was considered too narrow. It will be broadened to include community groups who have an interest in observing geodiversity as part of recreational or social activity. This category is partly but not wholly embodied within geological groups and societies. Such groups (e.g. Woman's Institute; heritage groups; village societies) make requests to visit quarries in their local community. This is generally welcomed by quarry operators as a way of improving community liaison. However, the GeoValue Project is not designed to encompass procedures to enable unrestricted access to rock exposures in quarries or elsewhere on private land by the general public.

2.5 The development of safe procedures for arranging visits to working quarries

The community access part of GeoValue was only in its preliminary stages of work at the time of the Seminar. Some initial proposals for enabling access appeared to be welcomed. These include the provision of suitable viewing points at safe areas inside or outside a quarry, and placing boulders in safe locations so that the geodiversity could be examined. A suggestion of a passport scheme for leaders was much criticised by some delegates.

It is recognised that informal arrangements often exist between one or more local geologists and the quarry manager, so that access can be made to examine the geodiversity. In effect, the local geologist is empowered to have access to the quarry for his/her own purposes and often to lead groups on visits. The group is sometimes accompanied by company personnel but not always. This arrangement works well in some situations, and engenders good community relations. However, it is informal and operates only at a local, and often very local, level.

The potential for further development, and possibly formalisation, of such arrangements will be investigated as part of the GeoValue Project. However, there are essential issues that need to be addressed even within present informal arrangements. These include legal responsibilities for safety, and training / competence of the leader. Clarification of these will be of benefit to the leader as well as the quarry operator or land owner. These issues also need to be addressed for community access to disused and abandoned quarry sites on private land. Another safety issue is the responsibilities of leaders of groups and landowners in areas where there is a 'right to roam'. Quarry company policies and protocol on visitors, and land owners' policies for access to sites will be researched during the project.

3. References

David Roche GeoConsulting, 2005. GeoValue: Valuing Geodiversity for Conservation: Initial Scoping Study: Development of the Geodiversity Profile. Report 2432/1 to Minerals Industry Research Organisation, 105pp.

Ellis, N.V., Bowen, D.Q., Campbell, S., Knill, J.L., McKirdy, A.P., Prosser, C.D., Vincent, M.A. and Wilson, R.C.L. 1996. An introduction to the Geological Conservation Review. GCR Series, No. 1. Joint Nature Conservation Committee, Peterborough.

Appendix A

Extract from:

GeoValue: Valuing Geodiversity for Conservation: Initial Scoping Study
Development of the Geodiversity Profile

David Roche GeoConsulting 2005, Chapter 3, pp 15-24.

3. Procedures for the assessment of geodiversity and current practice in the United Kingdom

3.1. Introduction

There are many procedures reported in published literature directed towards establishing the nature and importance of the geology or geomorphology of a rock exposure or site. They have been developed by several individuals and organisations in several countries. In effect, these procedures are assessing the quality of the geodiversity. They are discussed below as they are useful in indicating the types of criteria that need to be considered in the development of the Geodiversity Profile. Current practices in the United Kingdom for the designation of Sites of Special Scientific Interest (SSSIs) and Regionally Important Geological and Geomorphological Sites (RIGS), which include a component of assessment of the quality of the geodiversity, are also presented.

3.2. A review of procedures for the assessment of geodiversity

The procedures for the assessment of geodiversity are discussed in several publications, mostly connected with assessing the importance of geological and geomorphological sites for conservation. Much further literature may exist in unpublished reports.

Important concepts on geodiversity and geoconservation are discussed in Sharples (2002). He defines three key values as intrinsic (it is of value because it exists!), ecological (or natural process) and human-centred (anthropocentric or geoheritage). In this context, ecological includes geological, geomorphological and soil processes. Human centred values include science, education, aesthetic, recreational, 'sense of place' (i.e. features that form the basis of landscape), and cultural or spiritual. He discusses the choice of criteria for judging the significance of geodiversity for conservation, which he considers is the first stage in any assessment, by subdividing his three key values into aesthetic, scientific/research/educational, recreational, social/historical, 'sense of place' and spiritual/religious. This is to be followed by assessing their importance (levels of significance). Terms used here are qualitative and subjective, such as world, national, state, regional, local significance, and high, medium and low.

Grandgirard (undated, accessed February 2005) ([L'évaluation des géotopes: http://perso.wanadoo.fr/geotop/article/arti/Grandgd.htm](http://perso.wanadoo.fr/geotop/article/arti/Grandgd.htm)) discusses the evaluation of geotopes and uses a complex scoring system for assessing the quality of landforms. The system involves addition and multiplication of numerical values placed on criteria such as intrinsic scientific value, degree of preservation, rarity and local, regional, national or international importance. This and other European literature appears to relate largely to the designation of geotopes and their geoconservation.

Alcala and Morales (1994) present criteria for assessing Spanish palaeontological heritage. They recognise three classes of criteria: scientific, socio-cultural and socio-economic. The scientific criteria incorporate a full description of the geological setting, taphonomy, bio- and chronostratigraphic interest, fossil diversity, and level of knowledge. The socio-cultural criteria are fragility (i.e. lateral extent and potential of the fossil-bearing layer), geographic situation, vulnerability to damage by collecting, historic value, educational interest, touristic interest, and complementary value (i.e. in respect of other sites nearby). Socio-economic criteria include urban value (e.g. threat from development), mineral value (i.e. threat from quarrying), public works, and economic value (i.e. to fossil collectors).

Rosengren (1994) awarded a significance rating to sites of volcanics in Victoria, Australia, which are and have been significant sites for extraction of rock, scoria and ash from many small pits and quarries. His criteria for the significance rating can be summarised as:

- a. The contribution the site makes to the understanding of volcanic or related geological and geomorphological features;
- b. The extent to which it represents a type of volcanics or landform;
- c. Its frequency of replication;
- d. The quality of exposure;
- e. Its value for teaching or research
- f. Its importance for displaying or determining volcanic chronology and sequence; and,
- g. The environment of the site as an example of the range of terrain in which the volcanics were erupted.

Using these criteria, the sites are categorised as national, state, regional, local, unknown or unassigned significance.

Joyce (1994) discusses the assessment of sites. He states that significance is assessed after the feature or site has been identified as of possible interest and documented as fully as possible. The documentation includes a description of the site, such as its size, physical type, geological type and age. The physical type may be a natural section, quarry, landform, landscape or view point. Twelve geological types are recognised: palaeontological, geomorphic, palaeoenvironmental, igneous, sedimentary, metamorphic, stratigraphic, structural, mineralogical, relationship, economic and other (including historical). Its use, as either scientific or educational, is one of its attributes. Management and accessibility are considered to be related to the assessment of significance, and include condition of the site, ownership, proximity to population centres, and availability of alternative sites for teaching or research. Joyce (1994) regards the significance of a geological feature or site lies in its value in research, reference or education at the local, national, international or world level. He introduces the concepts of 'outstanding', 'representative' and 'rarity', the former term being preferred to 'unique'.

Joyce (1994) discusses the techniques for assessment used by the various Australian states. Outstanding or representative sites are sometimes called geological monuments. Practice varies from two subdivisions (larger more scenic features, and smaller more scientific or educational features – Queensland), four classes (international, national, state, local), plus information (research, reference, education) and landscape value (Western Australia), to representation or outstanding (Victoria, and South Australia which refers to geological monuments as outstanding). He concludes by stating that the best method for assessing geological significance is to use a group of experienced geologists, who make their decisions as a group (made up from different specialists), using a well defined set of criteria, and in the knowledge that they may later need to justify their assessment. The problems are in assembling the group and ensuring it has a suitably defined set of criteria within which to work.

The designation of SSSIs for their geological significance and RIGS involve an evaluation of some of the components of geodiversity. Therefore, they have a bearing on the Geodiversity Profile and require discussion here, although their procedures are not directly comparable. They relate to ensuring that the most important geological sites (including individual rock exposures, more extensive areas where rocks crop out, and landforms) in the United Kingdom are recognised and have statutory protection (SSSIs), and that there are sites at county level which have regional geological significance and are suitable sites for visiting groups to visit (RIGS) respectively. The procedures for the designation of SSSIs and RIGS are discussed below.

3.3. Designation of geological Sites of Special Scientific Interest (SSSIs)

There are over 4,000 SSSIs in England of which approximately 1,400 have a notified geological interest (www.english-nature.org.uk). SSSIs have legal protection as the best sites for wildlife, ecology or geology (including geomorphology) in England. The first SSSIs were identified in 1949, when the then Nature Conservancy (a predecessor of English Nature) was given a duty to notify local planning authorities of sites of special scientific interest so that wildlife and geology could be taken into account during the planning process. SSSIs continue to have protection in England under the Wildlife and Countryside Act, 1981 (as amended). The process of notification of SSSIs is an ongoing one. New sites can be identified by an English Nature survey or contact by other parties. The Council of English Nature confirms the site or otherwise following assessment against published guidelines (English Nature, 2002).

The Geological Conservation Review (GCR), launched in 1977 (Ellis et al., 1996), provided a more systematic approach to the selection of sites, and from 1977-1990 the review process identified those sites needed to show all of the key scientific elements of British geology and geomorphology. Sites selected for the GCR form the basis for statutory conservation of geology in Britain. They were selected because of their international importance to Earth science, because they contain exceptional features that are nationally important, or because they represent an Earth science feature which is fundamental to Britain's Earth history (Ellis et al., 1996; see also Joint Nature Conservation Committee (JNCC), accessed Feb 2005, for a more recent statement). The emphasis is on the scientific attributes of the site and that it has at least national importance, although historically important type localities where great advances in geological theory were first made, or phenomena first described, are also included.

Two types of sites are recognised for the GCR. These are Exposure Sites that expose strata which are extensive and continue at depth (i.e. it is replaceable, such a limestone in a quarry), and Integrity Sites that contain finite and limited deposits or landforms, which are irreplaceable if destroyed (e.g. a cave in limestone).

To ensure representativeness in the GCR, Britain has been divided into a series of blocks based on its geology and geomorphology, and sites have been selected within each block. New sites continue to be proposed for the GCR lists and are accepted or rejected following consideration of conservation value, and detailed assessment and independent refereeing (www.jncc.gov.uk/page-2949). The assessment of sites for the GCR process (Ellis et al., 1996) involved a literature search of published and unpublished sources to create a list of all known Earth science sites of potentially national or international importance relevant to each block. This list was followed by peer review to draw up a short list of candidate sites which was further reduced in number following fieldwork and re-assessment against the criteria. Sites where the geological feature of interest had deteriorated were usually eliminated. The logistics for selection appears to continue to be based on reaching a consensus of the widest possible range of available expert opinion (JNCC, accessed Feb 2005). The vast majority of this opinion is sought from outside the conservation agencies.

The JNCC internet site (accessed Feb 2005) states that in choosing between otherwise identical sites, preference should be given to sites:

- with an assemblage of several different geological interests, or representation of different sub-disciplines.
- that show an extended, or relatively complete record of the feature of interest. In the case of landforms they should be intact.

- that have been studied in detail and that have a long history of research and re-interpretation.
- that have potential for future study and interpretation should be preferred. Such potential might be manifested by, for example, extensive *in situ* deposits with continuing interest or sites which otherwise lend themselves to further work.
- that have yielded results that assist placing them in a wider context (e.g. radiometric dates, palaeomagnetic or geochemical data, pollen dating).

3.4. Selection of Regionally Important Geological and Geomorphological Sites (RIGS)

Regionally Important Geological and Geomorphological Sites (RIGS) were established in 1990 by the Nature Conservancy Council (NCC) (a predecessor of English Nature) (Nature Conservancy Council, 1990). They have support from English Nature and other agencies, and are gaining recognition by local planning authorities. RIGS complement the SSSI coverage. Sites are selected by voluntary groups (known as RIGS groups, County Geology Groups or similar title), which are generally formed by county or by unitary authority area in England. There are more than 50 local groups in the UK. RIGS are selected on a local or regional basis according to the following nationally agreed criteria:

- The value of a site for educational purposes in life-long learning;
- The value of a site for study by both amateur and professional Earth scientists;
- The historical value of a site from an Earth science perspective;
- The aesthetic value of a site from an Earth science perspective.

(www.english-nature.org.uk/special/geological/rigs.htm and RIGS Handbook, 2000)

That is, sites are chosen on the basis of one or more of scientific importance, historical importance, educational value, and aesthetic value. Although each RIGS group established its own procedure for selection of sites, it invariably involves a peer review process, and consensus by a 'committee'.

RIGS do not have formal statutory protection in the same way as SSSIs. However, the RIGS groups notify the local planning authorities of the RIGS that have been declared in their area and encourage the local authority to protect the RIGS through the planning process. For example, RIGS can be listed on local authorities' development plans (see: www.english-nature.org.uk/special/geological/rigs.htm).

Information for assessing a RIGS site is available in the RIGS Handbook (RIGS, 2000). Suggestions for assessing a site are provided (Chapter 6, RIGS Handbook), although it points out that RIGS groups might decide not to use the approach given, choosing a different process by preference. The assessment proposed includes general criteria, such as access (practical and legal), safety and condition of exposure, and scientific criteria, the latter showing the type of geological feature(s) exposed. Assessment of the value of a site is proposed as follows:

- Geodiversity value, which refers to the uniqueness of the site as an example of the geodiversity of the area.
- Educational value, and its relevance to different levels of education.
- Cultural value, which is its association with history, history of geology, economic activity, landscape/aesthetics, amenity/recreation, and wildlife.
- Conservation value; an existing status by an organisation, such as English Nature, AONB, National Parks, local authority etc.

It is suggested that one way to bring objectivity to the assessment process is to initiate a points scoring system for potential RIGS. A 0-10 scale with 0 as the worst and 10 as the best is given, but only detailed as follows:

0	useless / no good
1-2	very poor
3-4	poor
5-6	acceptable / useful
7-8	quite good
9-10	excellent / very good

without explaining what constitutes poor, good or excellent for each criterion.

Factors, such as conflicting activities on the site, which presumably could include quarrying (although it is not stated), and restrictions (e.g. sensitive areas to avoid) are considerations to be included.

A selection panel is proposed for making recommendations for a RIGS site, the panel composition including representatives from a wide variety of local and other interest groups in earth science. Those listed are: local geology group/society, Wildlife Trust, local planning authority, conservation agencies, Environment Agency, British Geological Survey, minerals industry, university, school, colleges and amenity groups, advisors on health and safety, landowners.

A seven page RIGS site assessment form (UKRIGS 2001) to accompany the RIGS Handbook (2000) has been developed. Considerable details of the site are required, including sketches, photos, location map, case for site designation, etc. Four individual sections for assessment of the value of the site are given. These are access and safety; education and science; culture, heritage and economic; and geodiversity. Except for the latter, each section contains sub-sections, and for most of these a score can be given in the range 1-10, using the system detailed above. For access and safety the sub-sections are: road access and parking; safety of access; safety of exposure; permission to visit; current conditions; current conflicting activities; restricting conditions, nature of exposure; multiple exposure / prospect for trail. For education and science the sub-sections are the disciplines within geology (surface processes, geomorphology, sedimentary, fossils, igneous, metamorphic, tectonic (structural), minerals, and historical geology (stratigraphy)). For culture, heritage and tourism the sub-sections are: historic, archaeological and literary associations; aesthetic landscape; history of Earth science; and economic geology. The geodiversity value refers to key features of specific interest. Notes to accompany the form provide more details of the scoring procedure, with specific descriptive statements given for the 0, 5 and 10 scores.

It is difficult to reconcile the 1-10 categories with the descriptive statements for 0, 5 and 10 for many of the sub-sections. For example, giving a score between 1-10 (i.e. very poor to excellent) is inappropriate for the 'permission to visit' sub-section. Scoring 0 (permission refused), 5 (permission usually granted on written request) and 10 (open public access) is attempting to quantify different parameters within the same scoring system. Likewise for current condition of exposure, 0 (overgrown and severely weathered), 5 (sufficient useful exposure for use by group of 10 students), 10 (clean fresh exposure, open to large party) is mixing up more than a single parameter, as a small exposure can be in good condition, and/or the weathering of an exposure may be the feature of interest. The same confusion can result in the science and education criteria. For example, under sedimentary rocks, 0 (no sedimentary rocks exposed), 5 (limited range of useful evidence in relation to one or two rock types), 10 (wide range of good evidence in relation to two or more rock types), does not take into account an excellent exposure of a single sedimentary rock containing many sedimentary structures.

An earlier set of guidelines for evaluating RIGS is given in Harley (1994). They were produced by English Nature working with a small group of 'experienced practitioners in this field'. Scientific

importance, educational value, historic association and aesthetic characteristics are given as the four parameters. The former is divided into petrology, stratigraphy, palaeontology, mineralogy structure, geomorphology and other scientific interest (wildlife significance / protected site). Educational value incorporates access and safety. Historical associations are advances in geological / geomorphological knowledge, association with culture folklore or religion, and archaeological significance. Aesthetic characteristics ask the questions 'is the site an essential component of an attractive or evocative local landscape' and 'could the site be used to promote public awareness and appreciation of geology or geomorphology. Harley (1994) states that groups may wish to consider developing a scoring system with thresholds to assist in the selection.

Brown (1998) in discussing RIGS and geological conservation in Scotland shows the criteria that have been used in Dundee for the evaluation of RIGS using a scoring system. The system is complex, partly using an addition process. The criteria are: research and education (a score of 0.1 for each university lecturer who used the site for education) , references (0.1 for every paper (i.e. presumably published article) including a reference to the site / feature), accessibility (a score between 0.1-1.0 from highly inaccessible to highly accessible), visibility (0.1-1.0 from, badly weathered and overgrown, to easily seen and fresh surface for geological sites; 0.1-1.0 from, obscured and hardly identifiable, to the site is seen from a number of vantage points, for geomorphological sites), part of a landform suite (0.1-1.0, with 0.1 being poor, 0.4 reasonably good example, 0.6 being very good example of a particular type / stratigraphic Group / stratigraphic Formation for geological sites; 0.1-1.0 for geomorphological landforms with 0.1 being an isolated and unconnected feature and 0.5 bring an important element of a nationally important series), and uniqueness (0.1-1.0 for national and regional importance, with 0.1 being a common and widespread feature within the District, 0.3 being a regionally important feature, 0.5 being a nationally important feature and 1.0 being a type locality.

The assessment procedure used by Cornwall RIGS is discussed by Macadam (1998). It involves discussion of the completed proposal by an executive committee comprised (in 1998) of 18 people including a local authority mineral planner, teachers and lecturers at all levels of education, consultants, museum staff, Wildlife Trust Conservation Officers and English Nature staff, with input by outside expertise as required. Criteria used are scientific, educational, historic and aesthetic. Macadam (1998) refers to a recent questionnaire in which it appears that RIGS groups (30 in number) were asked to list the criteria used in the assessment of sites. As well as scientific, educational, historic and aesthetic, the following criteria were included in different Groups' responses: access, safe access, accessibility (landowner's consent), good parking, rarity (of exposure), community value, intrinsic geological importance, local heritage, social, cultural, wildlife, recreation, vulnerability, and conservability. He reports that 7 out of 30 groups did use a scoring system to assess the proposed sites, arguing that it gives a rational basis for decision making and will strengthen the validity of a RIGS designation. In contrast he also states that the weighting given to each criterion will be subjective, may vary from one group to the next and that sites proposed for the Geological Conservation Review sites were not scored.

The current practice by RIGS groups varies. Some details are provided in published information (from a web based search, February 2005) from many of the groups including some varying practice in criteria used for assessment. Most groups who publish the criteria include the value of a site for educational purposes, for scientific study, for its history and for its aesthetics (e.g. Lancashire, Shropshire, Peterborough, Gloucestershire, Hereford and Worcester, Essex, Cheshire, North East Wales, East Yorkshire, Cornwall). West Yorkshire does not appear to include scientific importance. Regional importance (Gloucestershire), access and safety (Peterborough, Cheshire, Dorset), vulnerability (Gloucestershire), and promoting public awareness (Essex) are stated as additional criteria occasionally, although it is likely that these are considered indirectly by most RIGS groups. Most groups emphasise that the criteria are locally developed (including Lothian and Borders). Only

two groups (Shropshire and Peterborough) refer to a scoring process as part of the assessment, and only Cornwall and East Yorkshire publicise the forms used for the assessment and nomination of a site. The decision-making process of designating a RIGS is not referred to in any detail by any of the groups, statements such as ‘A period of consultation ensues, fully involving the landowner’ (Cornwall) or ‘The group has selected RIGS based on a set of criteria which identified them for their research, educational, historical or geomorphological importance’ (East Yorkshire), ‘each potential RIGS is assessed by the Panel of Assessors, a group of 10 professional geologists and geomorphologists advised by Professor David Dineley’ (Hereford and Worcester) being typical.

3.5. Strengths and weaknesses of procedures for assessing geodiversity, including SSSIs and RIGS.

The large amount of information given above has provided the basis for the development of the Geodiversity Profile. Many criteria require addressing in the assessment of sites. A number of general points and specific points regarding SSSIs and RIGS assessments are relevant. These are presented and discussed below.

3.5.1. General points

1. The procedures that have been proposed for the assessment of sites mostly adopt a two stage approach. The first is descriptive, and the second involves a defined set of criteria on which the assessment is based.

The descriptive part includes a statement of the location of the site, its extent, and establishing the nature of the geology exposed (e.g. igneous, sedimentary, metamorphic, structures, mineralisation, stratigraphy, stratigraphic relations), landforms or soils.

A compilation of the criteria for assessment shows that they can be grouped as follows:

Criteria related to the geology:

scientific importance; value for research; rarity; significance for the history of geology; diversity of geology; importance as an example of a geological process; economic geology importance; association with wildlife.

Criteria related to mankind’s social interaction with geology:

value for education; aesthetic importance; value for recreation; ‘sense of place’; cultural importance; spiritual importance; historical significance outside geology; archaeological or literary associations; present conservation value or designation.

Criteria related to the practicalities of conserving the site:

degree of preservation; fragility; vulnerability; quality of exposure.

Criteria related to access:

accessibility; ownership; safety.

2. Criteria related to the practicalities of conserving the site and those relating to access are usually included in the assessment of a site for its geodiversity. This prevents an objective assessment of the site to be made based solely on its geodiversity quality. There needs to be a clear distinction made between geodiversity quality and practical aspects for gaining access and the assessment of a site for its geoconservation. However, it also has to be recognised that mode of access, safety and ownership are critical in any decision-making process where access to observe geodiversity is to be gained and/or a site is to be conserved.

3. A close relationship between the assessment of geological sites (i.e. its geodiversity) and the need and processes for achieving geoconservation is evident in much of the literature. This implies that, following the assessment of the geodiversity, there are sites that require to be preserved and/or conserved (i.e. there is a presumption of the need for geoconservation). Under these circumstances, an objective assessment of geodiversity may not always be possible, the process of assessment being disposed towards the need for geoconservation.
4. The opinion of experts is often part of the assessment of sites, prior to recommending conservation. The experts are chosen because of their knowledge and expertise in the relevant area. This is likely to include a detailed knowledge of the geodiversity of the sites, their relationships and representation. The expert may already make use of the sites for teaching, research or other purpose, and his/her opinion is a valuable contribution to an understanding of the importance of the geodiversity. However, the expert does have a vested interest in these sites and may not always be able to place the overall geodiversity in a wider context. Thus, his/her opinion has to be questioned for its objectivity.
5. The scoring of criteria in the assessment of sites is referred to in several publications. Nowhere is a full scoring process published with cited examples.
6. Although ideally a site should be assessed for its geodiversity independently of any other site, in practice this is not possible. This is recognised indirectly in some assessment criteria, such as the relative importance a site makes to the understanding of a geological process, and categorising a site as of local, regional, national or international importance.

3.5.2. *SSSIs and RIGS assessments*

Designating a site as an SSSI or RIGS ensures that a large number of geological exposures in the United Kingdom are recognised as containing important geology. The purpose of SSSIs and RIGS are different. A number of points can be made which are relevant to the development of the Geodiversity Profile.

1. SSSIs are designated on the basis of their scientific importance alone, which may include its importance for the history of science. This ensures that the most important sites where geological research in UK has been focussed, where some of the best examples of geological processes can be observed, and sites where advances in science have been made, are designated as SSSIs. Criteria such as access, educational value and aesthetics are not included.
2. The designation of SSSIs for the GCR involved a process of peer review, using experts within and without English Nature who had a specialism relevant to the site. The current procedures for geological SSSI designation are closely similar. Final confirmation of sites is by the Council of English Nature. The procedure appears to be robust, although the details of the value judgements made for sites based on their scientific importance (i.e. to show that one site is of higher value than another) is not apparent.
3. The term ‘confirmation’ is used in the publicity of English Nature in designating sites, although the literature (English Nature, 2002) does state “The Council of English Nature does decide whether or not to confirm the notification”, after a notification has been made by the Executive Committee. There is an implied link between the assessment of a site based on its scientific importance and the need to conserve it.

4. The designation of some SSSIs is for a single exposure of rock exhibiting specific geological features. Other SSSIs are more extensive with multiple exposures showing the same, or a range of different types of geodiversity, or they are extensive areas of a landform. Although the criteria of scientific importance can show that all of these types of sites are relevant for the designation as SSSIs, using a wider range of criteria would enable the quality of individual exposures to be distinguished.
5. RIGS groups do not have a coordinated approach to site assessment. This is a strength in that local criteria are used, but also a weakness that relative values of sites across county or area boundaries cannot be established.
6. The four criteria for the assessment of RIGS, as recognised by most Groups (i.e. scientific importance, historical importance, educational value, and aesthetic value), are independent of practical considerations for gaining access, safety etc. However, in the final selection of sites for designation as RIGS, most Groups include practical considerations. This is understandable as visiting sites to observe the geology is an important educational and recreational activity at a local level.
7. The importance of a site for its applied geology, whether for research or education, apart from the presence of mineralisation, is ignored in both SSSI and RIGS designations.
8. Informal feedback at the Focus Group meeting indicated that there is some dissatisfaction with some of the published information on the criteria for the assessment of RIGS sites, notably the RIGS Handbook (2000). The criticisms relate to the lack of robustness in the assessment process, and subjectivity.

In summary, the procedures used for the assessment of sites as SSSIs or RIGS address some, but not all aspects of geodiversity. Although the procedures for SSSIs are well established and adopted nationally giving some consistency in application, they address adequately only the scientific part of geodiversity. This is not a negative criticism, as SSSIs by definition have this role. Also SSSIs encompass sites, which often cover a much wider area than a rock exposure. The site may have a range of exposures with different geodiversity quality. Although the processes for designating RIGS encompass a wider set of criteria relevant to quantifying geodiversity, the inclusion of criteria such as access, safety, and exposure condition do not enable an objective assessment of the geodiversity quality to be achieved. The considerable differences in the assessment criteria between different RIGS groups can result in a lack of comparability and varying assessments for similar sites in different parts of the country. In all publications giving information on the processes for assessing geological and geomorphological sites, there is a direct or implied link between geodiversity and geoconservation. The assessment of the geodiversity, therefore, is not usually independent of a desire for conservation. The Geodiversity Profile presented here does not have any presumption for geoconservation.

GeoValue Project : Discussion Seminar
List of Delegates at Discussion Seminar Meeting
at Crossmead, Exeter on 15 December 2005

John	Lewis	Aggregate Industries
Jill	Eyers	Bedfordshire RIGS Group
Andrew	Bloodworth	British Geological Survey
Max	Foweraker	Capita Symonds
Richard	Small	Cemex
Peter	Ealey	Cornwall RIGS Group
Victoria	Whitehouse	Cornwall Wildlife Trust
Kevin	Page	Devon RIGS Group
Roger	Taylor	Devon RIGS Group
John	Dangerfield	Devonshire Association
Chris	Pamplin	Dorset County Council
Geoffrey	Walton	Dustscan
John	Macadam	Earthwords
Annie	Horne	East Yorkshire RIGS Group and University of Hull
Mike	Horne	East Yorkshire RIGS Group and University of Hull
Jonathan	Larwood	English Nature
Pauline	Johnston	Environment Agency
Dee	Edwards	GeoEd Ltd
Dave	Williams	GeoEd Ltd
Malcolm	Keeble	Hanson
Roger	Griffiths	Hanson Aggregates
John	Sedman	Hanson Aggregates
Helen	Turner	Health & Safety Executive
Mark	Stephenson	Mineral Valuer Services
John	Cowley	Minerals & Resource Planning Associates
Abbie	Richards	MIRO
Phil	Brierley	North East Yorkshire Geology Trust
Mike	Windle	North East Yorkshire Geology Trust
Stephen	Lawson	Offwell Woodland & Wildlife Trust
Mike	Hermolle	Open University Geological Society
Jane	Worrall	Oxfordshire Geology Trust
Paul	Brewer	Paul Brewer Geological Services
Gerard	Edwards	Peter Brett Associates
Vicky	Munn	Somerset County Council
Hugh	Prudden	Somerset Geology Group
Eddie	Bailey	Tarmac
Peter	Jones	UK RIGS
Thomas	Hose	UKRIGS and Buckingham & Chiltern University College
John	Reynolds	UKRIGS and Staffordshire RIGS Group
Cynthia	Burek	UKRIGS, Cheshire RIGS Group and University of Chester
Anthony	Ryall-Harvey	University of Leeds
Jim	Griffiths	University of Plymouth
Martin	Bradley	Warwickshire Geological Conservation Group

Peter	Scott	Camborne School of Mines and David Roche GeoConsulting
Robin	Shail	Camborne School of Mines
Clive	Nicholas	David Roche GeoConsulting and Devon Stone Federation
David	Roche	David Roche GeoConsulting
David	Allen	David Roche GeoConsulting
Karen	Leslie	David Roche GeoConsulting
Phillip	Stephenson	David Roche GeoConsulting

Individuals unable to attend but wishing to maintain involvement in GeoValue Project:

Brian	Simpson	Aggregate Industries
Ben	Vivian	Aggregate Industries
David	Harrison	British Geological Survey
Richard	Scrivener	British Geological Survey
Colin	Bristow	Camborne School of Mines
Jane	Poole	Capita Symonds
Bill	Barrett	Consultant
Paul	Wheeler	Consultant
Carol	Foster	Cornwall County Council
Sue	Hocking	Cornwall Wildlife Trust
Peter	Chamberlain	Devon County Council
Stewart	Redding	Devon County Council
Bob	Symes	Devonshire Association
Alan	Holiday	Dorset RIGS Group
Margaret	Thornley	Environment Agency
John	Howe	Imerys
Diana	Franks	Kent RIGS Group
Gordon	Riddler	MIRO
Ian	Thomas	National Stone Centre
Brian	Marker	ODPM
Sarah	Baldry	Quarry Products Association
Margaret	Hargrave	Surrey RIGS Group
Peter	Grainger	Sustrans and University of Exeter
Jenny	Bennett	University of Exeter, Department of Geography
Tony	Brown	University of Exeter, Department of Geography
John	Merefield	University of Exeter, Department of Lifelong Learning
Roger	Trend	University of Exeter, School of Education
Malcolm	Hart	University of Plymouth, English Nature, and Geological Society
Brian	Leveridge	Ussher Society

GeoValue: Valuing Geodiversity for the Community

Discussion Seminar

Thursday 15th December, 2005

Crossmead Conference Centre, Barley Lane, Exeter EX4 1TF

The Discussion Seminar will provide an overview of the GeoValue Project, its components and achievements so far, and the future research programme. An important objective is for the Project Team and Partners to gain the views and comments from delegates who represent wide interests within the geological community. A lot of time during the Seminar has been set aside to enable discussion to take place. We also ask that, having learned of the Geodiversity Profile, delegates with interests in RIGS will apply the parameters and determine the Geodiversity Profile at some quarries and other sites in their local area. Feedback on the experience of determining the Geodiversity Profile will be welcomed and incorporated into the GeoValue project. Profile sheets and guidance notes will be provided at the Seminar.

Programme

Chair: David Roche, *David Roche GeoConsulting*

10.00 – 10.30 Arrival and coffee.

10.30 – 10.40 David Roche. Welcome and Introduction.

10.40 – 11.15 Professor Peter Scott, *Camborne School of Mines and David Roche GeoConsulting*.
The Geodiversity Profile: development and testing.

11.15 – 11.30 Discussion.

11.30 – 11.45 Andrew Bloodworth, *British Geological Survey*. **Geodiversity in quarries.**

11.45 – 12.00 Discussion.

12.00 – 12.15 Professor Jim Griffiths, *Plymouth University*. **Geomorphology in geodiversity.**

12.15 – 12.30 Discussion.

12.30 – 12.45 Victoria Whitehouse, *Cornwall Wildlife Trust*. **Biodiversity links.**

12.45 – 13.00 Discussion.

13.00 – 14.15 Lunch.

Chair: Dr Robin Shail, *Camborne School of Mines*

14.15 – 14.45 Helen Turner, *Health and Safety Executive*. **'Access all areas?'**

14.45 – 15.00 Professor Peter Scott. **Community access to geodiversity.**

15.00 – 15.30 Discussion and review.

15.30 Tea and departure.

There is no charge for attendance at the meeting. Lunch and refreshments are provided.

**Appendix 2. Project Dissemination Conference, 'Geodiversity Geoconservation & GeoValue' held on 24 January 2007 at Nottingham
- programme and list of delegates**

**List of Delegates for GeoValue Conference held at
British Geological Survey, Keyworth, Nottingham on 24 January 2007**

Delegates Registered in Advance

Wayne	Allum	Nottinghamshire County Council
John	Aram	E.S.S.E. (Earth Science Services & Education)
John	Bailey	Norfolk County Council
Eddie	Bailey	Tarmac
Hugh	Barron	British Geological Survey
Dr Jenny	Bennett	Devon RIGS
Richard	Boak	Water Management Consultants
Peter	Bond	Leicestershire County Council
Martyn	Bradley	Warwickshire Geological Conservation Group
Paul	Brewer	PBGSL
Gareth	Burdell	Lafarge Aggregates
Don	Cameron	BGS
Alan	Clarke	WBB Minerals
Thomas	Cliffard	Aggregate Industries
Tom	Cooke	CEMEX UK
Oliver	Craven	Halletc Associates
John	Darlington	Edge Hill University
Lesley	Dunlop	Berkshire RIGS / TVERC
Dr DW	Edwards	GeoEd Ltd
Scott	Engering	South Yorkshire RIGS Group
Phil	Feeney	Edge Hill University
Dr Bob	Fletcher	NSGGA / U3A
Tom	French	Nottinghamshire County Council
Helen	Gamble	Lincolnshire Wolds Countryside Services
Dr Sarah	Gately	Geological Survey of Ireland
Kirsten	Hannaford-Hill	Leicestershire County Council
Barrie	Heaton	East Yorkshire RIGS
Charlotte	Herbert	British Geological Survey
Dr Peter	Hodgson	Corus RD&T
Nick	Horsley	WBB Minerals
Dr Tom	Hose	UKRIGS
John	Humble	English Heritage
Dr Neil	Humphries	White Young Green Environmental
John	Hunter	Peak District National Park
Paul	Inman	Water Management Consultants
Kip	Jeffrey	University of Leicester
Peter	Jones	University of Derby
Adrian	Kidd	North Yorkshire Geodiversity Partnership
Carole	Lawson	Edge Hill University
Gerry	Lucas	Edge Hill University
John	Mather	Devon RIGS
Simon	McCurdy	Tarmac
Jessica	Morgan	The Mineral Planning Group
Ian	Mundy	Lafarge UK Aggregates
Will	Nattrass	Edge Hill University

Patrick	O'Reilly	Quarry Products Association
John	Peate	Hanson
Jane	Poole	Capita Symonds
Mark	Pritchard	PGW&A
Dr Jon	Radley	Warwickshire Museum
Ben	Ramsay	Edge Hill University
Sarah	Reay	Edge Hill University
Stan	Salmon	University of Derby
Rob	Simmons	Tarmac
Richard	Small	CEMEX UK Materials Limited
Dr Mark	Stephens	National Ice Age Network / University of Leicester
Derek	Sudlow	Edge Hill University
Jane	Tebbatt	Lafarge Aggregates
Neil	Turner	Nottingham Natural History Museum
Jim	Watts	Warwickshire Geological Conservation Group
Martin	Whitely	Earth Science Teachers Association
Dr DJ	Williams	GeoEd Ltd
John	Williams	The Natural History Museum

Delegates Registered on Day

Steve	Booth	British Geological Survey
Adam	Caton	Edge Hill University
Robert	Donnelly	Hanson Building Products
Shirley	Everett	Hanson
Ian	Fenwick	Warwickshire Geological Conservation Group
Anthony	Gerrard	Edge Hill University
David	Harris	Edge Hill University
Catherine	Murray	Edge Hill University
Hazel	Salkeld	Edge Hill University
Mick	Smith	Ibstock Bricks UK Ltd
Poul	Strange	British Geological Survey

Project Team Members, Project Partners and Conference Speakers

David	Roche	David Roche GeoConsulting
Maureen	Roche	David Roche GeoConsulting
Phil	Stephenson	David Roche GeoConsulting
Clive	Nicholas	David Roche GeoConsulting
Peter	Scott	David Roche GeoConsulting and Camborne School of Mines (University of Exeter)
Robin	Shail	Camborne School of Mines (University of Exeter)
Helen	Turner	Health and Safety Executive
Abbie	Richards	MIRO
Peter	Ealey	Cornwall RIGS
Andrew	Bloodworth	British Geological Survey
Keith	Ambrose	British Geological Survey
John	Ludden	British Geological Survey
Christina	Edwards	British Geological Survey
Jonathan	Larwood	Natural England
Colin	Prosser	Natural England

Delegates Registered in Advance - Failed to Attend

Helen	Andrews	National Stone Centre
Alun Jeffrey	Ashton	University of Leeds
Isobel	Brown	GWP Consultants
Sarah	Cole	English Heritage
Jo	Davies	ATH Resources
Paul	Ensom	Independent museum consultant
Kate	Harris	Capita Symonds
Jenny	Higgs	Capita Symonds
Mike	Horne	East Yorkshire RIGS
Mike	Hurley	WBB Minerals
Vernon	Marks	South London RIGS
Linda	McArdell	OUGS
Phil	Pye	Edge Hill University
Philip	Rayson	Scottish Resources Group
David	Roberts	CEMEX UK Operations Ltd
Ian	Thomas	National Stone Centre
Mike	Windle	North East Yorkshire Geology Trust
Jane	Worrall	North East Yorkshire Geology Trust

Delegates Registered/Cancelled in Advance

Sarah	Baldry	Quarry Products Association
Kirk	Blackburn	Lafarge Aggregates
Phil	Brierly	North East Yorkshire Geology Trust
Prof Cynthia	Burek	University of Chester / UKRIGS
Michelle	Lewis	North East Yorkshire Geology Trust
Robert	Palmer	Tarmac
Sue	Smith	Peak District National Park Authority
Stuart	Swann	North East Yorkshire Geology Trust
Alan	Thompson	Capita Symonds
Elaine	Tilson	CrLGAP, UKRIGS
Benedicte	Windle	North East Yorkshire Geology Trust

Individuals Not Registered for Conference but Requested/Sent Documentation:

Lesley	Dunlop	Berkshire RIGS
Richard	Edmonds	Dorset County Council
Jill	Eyers	Bedfordshire/Buckinghamshire RIGS Groups
Carol	Foster	Cornwall County Council
Zoë	Goffin	Bright & Associates
Jim	Griffiths	University of Plymouth
Roger	Griffiths	Hanson
Malcolm	Hart	University of Plymouth
Martin	Isles	Quarry Products Association
Andrew	Jenkins	Shropshire Geological Society
John	Lewis	Aggregate Industries
Jacqui	Malpas	Clwydian Range AONB Geodiversity Officer
Vicky	Munn	Somerset County Council
Ian	Newby	
Hugh	Prudden	Somerset Geology Group
Jeremy	Owen	
Stewart	Redding	Devon County Council
Brian	Simpson	Aggregate Industries
Mark	Stephenson	Inland Revenue Mineral Valuer
Geoffrey	Walton	PGW&A

Geodiversity Geoconservation and GeoValue

A one-day conference, including dissemination of the results of the completed ALSF/MIST /MIRO research project entitled *GeoValue: Valuing Geodiversity for the Community*

on Wednesday 24th January 2007, at 10.00am

at British Geological Survey, Keyworth, Nottingham

Conference Programme:

- 1000 Coffee and Registration
- 1030 **Welcome Address** by John Ludden, *Director, British Geological Survey*
Introduced by Andrew Bloodworth, British Geological Survey
- 1040 **Geodiversity in action: quarries in the UK.** Clive Nicholas, *David Roche GeoConsulting*
and Robin Shail, *Camborne School of Mines, University of Exeter*
- 1110 **BGS and Geodiversity: An example from Leicestershire and Rutland.**
Keith Ambrose, *British Geological Survey*
- 1135 **The Geodiversity Profile.** Peter W. Scott, *David Roche GeoConsulting and Camborne*
School of Mines, University of Exeter
- 1215 **Discussion.** *Chaired by David Roche, David Roche GeoConsulting*
- 1230 Lunch and viewing exhibits from RIGS Groups / County Geological Trusts and others
- 1345 **Delivering geological conservation through Natural England.**
Colin Prosser and Jonathan Larwood, *Natural England*
- 1415 **Visitors in quarries - obstacle or opportunity?** Helen Turner, *Health & Safety Executive*
- 1435 **Access and Safety at geological sites.** Peter W. Scott, *David Roche GeoConsulting*
and *Camborne School of Mines, University of Exeter*
- 1515 **Discussion.** *Chaired by Robin Shail, Camborne School of Mines, University of Exeter*
- 1530 Tea and departure



DAVID ROCHE
Geo Consulting



UNIVERSITY OF
EXETER



British
Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL



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Mineral Industry
Sustainable Technology

Appendix 3. Geodiversity Profiles

Appendix 3A. Geodiversity Profiles of quarries and other geological sites determined during the development and testing phase

The Geodiversity Profiles presented in this Appendix 3A were made by members of the Project Team, by staff from the British Geological Survey and by members from RIGS Groups / County Geology Trusts who assisted in the project. The profiles vary in content and completeness, and not all have been verified to the full extent of those used as examples in The Geodiversity Profile Handbook. Full statements of justification and literature sources for the determination using the designated criteria may be lacking in some cases, and these profiles should not be used for any comparison or decision-making without further verification. Their purpose was for the testing of the procedure.

The list of site profiles presented in this Appendix follows below in alphabetical order, with acknowledgements for principal input or assistance in the fieldwork and assessment.

Appendix 3A /cont

List of Sites:

Asthall Meander, nr Witney, Oxfordshire	<i>Oxfordshire Geology Trust</i>
Barns Ness RIGS, nr Dunbar, East Lothian	<i>Lothian & Borders RIGS Group</i>
Bestwood No 2 Quarry, Nottinghamshire	<i>British Geological Survey</i>
Binny Craig RIGS, Ecclesmachan, West Lothian	<i>Lothian & Borders RIGS Group</i>
Brown Hills Quarry, Leicestershire	<i>British Geological Survey</i>
Castle an Dinas Quarry, Cornwall	
Cleveland Dyke, North Yorkshire	<i>North East Yorkshire Geology Trust</i>
Cloud Hill Quarry, Leicestershire	<i>British Geological Survey</i>
Colemans Quarry, Holwell, Somerset	
Countybridge Quarry, Lizard, Cornwall	<i>Cornwall RIGS Group</i>
County Gate Screes, Malmshead, Somerset	<i>Somerset Geology Group</i>
Crousa Gravel, Lizard, Cornwall	<i>Cornwall RIGS Group</i>
Dean Quarry, St Keverne, Cornwall	<i>Cornwall RIGS Group</i>
Edge Hill Quarry, Warwickshire	<i>Warwickshire Geological Conservation Group</i>
Enys Head, Cornwall	<i>Cornwall RIGS Group</i>
Epwell Quarry, nr Banbury, Oxfordshire	<i>Oxfordshire Geology Trust</i>
Greenaleigh, nr Minehead, Somerset	<i>Somerset Geology Group</i>
Griff No 4 Quarry, Warwickshire	<i>Warwickshire Geological Conservation Group</i>
Ham Hill Stone Quarry Limekiln Trail, Somerset	<i>Somerset Geology Group</i>
Ham Hill War Memorial Quarry (NE face), Somerset	<i>Somerset Geology Group</i>
Hestercombe Charcoal Burners Quarry, Somerset	<i>Somerset Geology Group</i>
Hestercombe Gardens Car Park, Somerset	<i>Somerset Geology Group</i>
Hestercombe Gardens Whetstone Quarry, Somerset	<i>Somerset Geology Group</i>
Inchbonny RIGS, Jedburgh, Scottish Borders	<i>Lothian & Borders RIGS Group</i>
Ivinghoe Beacon, Buckinghamshire	<i>Bedfordshire / Buckinghamshire RIGS Group</i>
Ketton Quarry, Rutland	<i>English Nature</i>
Keyingham Gravel Pit, East Yorkshire	<i>East Yorkshire RIGS Group</i>
Kings Dyke RIGS, Whittlesey, Cambridgeshire	<i>English Nature</i>
Kirtlington Cement Works, Oxfordshire	<i>Oxfordshire Geology Trust</i>
Knapton Gravel Pit, North Yorkshire	<i>East Yorkshire RIGS Group</i>
Ledburn Lane Quarry, Leighton Buzzard, Bedfordshire	<i>Bedfordshire / Buckinghamshire RIGS Group</i>
Love Lane Quarries, North Yorkshire	<i>North East Yorkshire Geology Trust</i>
Mancetter Quarry (Purley South), Warwickshire	<i>Warwickshire Geological Conservation Group</i>
Mundays Hill Quarry, Bedfordshire	<i>Bedfordshire / Buckinghamshire RIGS Group</i>
National Stone Centre, Wirksworth, Derbyshire	<i>British Geological Survey</i>
New Downs Sand Pits, St Agnes, Cornwall	
Newtondale, North Yorkshire	<i>North East Yorkshire Geology Trust</i>
Nine Acre Pit, Leighton Buzzard, Bedfordshire	<i>Bedfordshire / Buckinghamshire RIGS Group</i>
North Grimston Quarry, North Yorkshire	<i>East Yorkshire RIGS Group</i>
Queensgate Quarry, Beverley, East Yorkshire	<i>East Yorkshire RIGS Group</i>
Rifle Butts Quarry, Goodmanham, East Yorkshire	<i>East Yorkshire RIGS Group</i>
Sands Top Quarry, North Newbald, East Yorkshire	<i>East Yorkshire RIGS Group</i>
Spikers Hill Quarry, North Yorkshire	<i>North East Yorkshire Geology Trust</i>
Tilton Railway Cutting, Leicestershire	<i>British Geological Survey</i>
Trevassack Quarry, Lizard, Cornwall	<i>Cornwall RIGS Group</i>
Tubney Woods Sand Pit, Oxfordshire	<i>Oxfordshire Geology Trust</i>
Withnoe Quarry, nr Torpoint, Cornwall	<i>Cornwall RIGS Group</i>
Wood Farm Quarry, Warwickshire	<i>Warwickshire Geological Conservation Group</i>
Wykeham Pit, North Yorkshire	<i>North East Yorkshire Geology Trust</i>

Appendix 3B. Geodiversity Profiles of quarries and other geological sites determined during the development and testing phase, and used as examples in The Geodiversity Profile Handbook.

The list of site profiles presented in this Appendix follows below in alphabetical order, with acknowledgements for principal input or assistance in the fieldwork and assessment.

List of Sites:

Balk Quarry, Church Cove, Lizard, Cornwall	<i>Cornwall RIGS Group</i>
Besthorpe Quarry, nr Newark, Nottinghamshire	<i>British Geological Survey</i>
Birch Quarry, nr Colchester, Essex	
Breedon Hill Quarry, Leicestershire	<i>British Geological Survey</i>
Buckingham Sand Pit, Buckinghamshire	<i>Bedfordshire / Buckinghamshire RIGS Group</i>
Craigeith Quarry, Edinburgh	<i>Lothian & Borders RIGS Group</i>
Dene Quarry, Wirksworth, Derbyshire	<i>British Geological Survey</i>
Hamdon Hill Quarry, nr Yeovil, Somerset	<i>Somerset Geology Group</i>
Humber Bridge Country Park, East Yorkshire	<i>East Yorkshire RIGS Group</i>
Kings Dyke Brick Pit, Whittlesey, Cambridgeshire	<i>English Nature</i>
Mancetter Quarry, Mawbournes site, Warwickshire	<i>Warwickshire Geological Conservation Group</i>
Tedbury Camp Quarry and adjacent valley, Somerset	<i>Somerset Geology Group</i>
Traprain Law, East Lothian	<i>Lothian & Borders RIGS Group</i>
Wicklesham Quarry, Farringdon, Oxfordshire	<i>Oxfordshire Geology Trust</i>

Appendix 3C. Geodiversity Profiles of quarries and other geological sites determined during the initial scoping study phase.

(Presented previously in Report 2432/1, March 2005)

List of Sites:

Moorcroft Quarry, Plymstock, Plymouth, Devon
Safeway car park, Plymstock, Devon
Mount Batten Point, Plymouth, Devon
Radford Quarry, Plymstock, Devon
Cattedown, beside Laira Bridge, Plymouth, Devon

Beam Quarry, nr Great Torrington, Devon
Beam House, disused quarry, nr Great Torrington, Devon
New Bridge, Great Torrington, Devon
Rosemore, disused quarry, nr Great Torrington, Devon
Langtree Common, nr Great Torrington, Devon

Blackhill Quarry, nr Woodbury, Devon
Budleigh Salterton Cliffs, Devon
Marsh Broadmoor, Street Raleigh, Devon
Rockbeare Hill, nr Rockbeare, Devon
Rockbeare Quarry, nr Rockbeare, Devon
Ven Ottery Quarry, nr Woodbury, Devon

Trusham Quarry, Teign Valley, Devon
Crockham Quarry, Teign Valley, Devon
Ryecroft Quarry, Teign Valley, Devon
Hill Copse, small disused quarry, Teign Valley, Devon
Doghole Bridge, nr Trusham, Teign Valley, Devon