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## Chapter 5 Practical Geological Conservation Review selection methods

### Site selection criteria

The three essential components of the Geological Conservation Review are explained in Chapter 4. Practical guidelines were also developed so that Geological Conservation Review sites can be selected from the range of candidate sites.

First, two operational criteria are employed.

- there should be a *minimum of duplication* of interest between sites
- it should be *possible to conserve* any proposed site in a practical sense.

All scientific factors being equal, sites that cannot be conserved, or which entirely or largely duplicate the interest of another, are excluded. Sites that are least vulnerable to potential threat, are more accessible and are not duplicated by other sites are preferred.

Preference is given to sites that:

- demonstrate an assemblage of geological features or scientific interests
- show an extended, or relatively complete, record of the feature of interest. In the case of geomorphological sites, this often equates to sites that contain features which have been least altered after formation (e.g. Kildrummie Kames, Inverness District; (Figure 57)). For Quaternary networks, this might relate to sites containing an extended fossil record, including pollen, insects and molluscs. This can be used to infer vegetation history or environmental change
- have been studied in detail and which have a long history of research and re-interpretation;
- have potential for future study
- have played a significant part in the development of the Earth sciences, including former reference sites, sites where particular British geological phenomena were first recognised, and sites which were the focus of studies that led to the development of new theories or concepts.

Application of these criteria ensures that sites chosen for a particular network in the Geological Conservation Review have the greatest collective scientific value and can be conserved.

### Minimum number and minimum area of sites

In order to ensure that Geological Conservation Review site status is confined to sites of national importance, the number of sites selected is restricted to a reasonable minimum. Only those that are necessary to characterise the network in question, that is to demonstrate the current understanding of the range of Earth science features in Britain for the network, are selected. These factors are important in the justification of the scientific value of a Geological Conservation Review site if it is to be subsequently designated a Site of Special Scientific Interest. For example, the scientific case for conserving a given site is stronger if it is the only one of its kind, or if it is demonstrably the best of a set of similar examples (Figure 58).

The area of a Geological Conservation Review site is always kept to a minimum. For example, in tracing the form of a major structure over a distance of several kilometres, a small number of dispersed, representative 'sample' sites might be selected — the minimum number and size required to describe and interpret the feature adequately. There are, however, exceptions to this general rule: for example, large sites will be required to represent the range of large-scale glacial landforms in the uplands of Wales or Scotland. In contrast, mine spoil heaps, typically of limited size, normally form relatively small sites.

### Methods and working practice

## **Site selection procedures within the Geological Conservation Review**

The process of site assessment and selection for the Geological Conservation Review was led by Nature Conservancy Council staff supported by several hundred Earth scientists contracted to assess sites within their particular area of expertise.

The starting point for this process was to devise a comprehensive classification of blocks (see (Figure 56)) to subdivide the geology and geomorphology of Britain into a series of subject areas. Work on particular blocks typically followed four stages.

### **Stage 1: Building and briefing the block team**

For the larger blocks, a co-ordinator (a specialist member of the Nature Conservancy Council or an external expert Earth scientist) was appointed to oversee the task of assessing and selecting the sites. The co-ordinator's role was to advise on site selection criteria and collate the work of a number of contributors who dealt with networks of sites within the block. For the smaller blocks, a single Geological Conservation Review contributor often undertook the work, in consultation with other experts within the field.

### **Stage 2: Literature review and site shortlisting**

The block co-ordinator or contributor then undertook an extensive literature search of both published and unpublished sources to create a list of all known Earth science sites of potentially national or international importance, relevant to the subject of the block. Where appropriate, early historical references to specific sites were researched so that potential sites from the earliest days of British Earth science could be considered for inclusion in the review.

Each of the sites on the draft list was given standard basic documentation (e.g. site location, brief summary of scientific interest, possible justification for inclusion within a network).

Draft lists were circulated among the appropriate experts for critical assessment and comment. Sites with significant research potential were considered. Following this peer review, a shortlist of candidate sites was drawn up. In the case of the Jurassic–Cretaceous Reptilia Block, 380 potential Geological Conservation Review sites were identified from the literature as potentially special; this number was reduced to about 150 after first-stage sifting.

### **Stage 3: Field visits and detailed site investigation**

Shortlisted sites were usually visited by the block co-ordinator or relevant expert to assess and validate the scientific interest.

Following the initial field visits, the list of potential sites was refined further by the co-ordinator, in liaison with the specialist advisers for the block. At this stage, sites where significant deterioration of the features of interest had taken place were usually dropped from the list. In some cases it proved necessary to clear exposures of vegetation and soil, or to sample them remotely, for example by augering, before an assessment of potential could be made. This was particularly true of some historically important Quaternary localities.

### **Stage 4: Final assessment and preparation of Geological Conservation Review site documents**

The draft list of potential sites was then reviewed and the sites were once again scrutinised against the selection and operational criteria. A final list of sites meriting inclusion within the particular Geological Conservation Review block was then prepared. From the list of 150 shortlisted potential Jurassic–Cretaceous Reptilia sites, a final list of 28 actual Geological Conservation Review sites was produced.

For each proposed Geological Conservation Review site the following documents were prepared:

- a site boundary enclosing the important features of the site, drawn on 1:10,000

- Ordnance Survey maps
- a concise statement of the scientific interest, typically between 100 and 200 words in length, an example of which is given in (Figure 59)
- a longer statement describing the scientific importance of the site and citing key references from the literature.

The statement and map form the basis of a key part of the documentation required to notify the Geological Conservation Review sites as components of the SSSI system under the *Wildlife and Countryside Act 1981*. The process of work stages applied in selecting sites for a Geological Conservation Review block is shown schematically in (Figure 60). SSSIs may contain more than one Geological Conservation Review site; an example is Durlston Bay, South Dorset, SSSI which contains six Geological Conservation Review sites (see information box on page 79).

## **The study of the Earth — continuing developments**

The final concept to be considered is 'current understanding'. It is unlikely that the entire geological and geomorphological record will ever be fully understood. Given the speed of scientific change within geology, there is a continual need to re-survey to ensure that the Geological Conservation Review networks and sites reflect the current state of knowledge. The

Geological Conservation Review is, therefore, an ongoing process of refinement and update to ensure that conservation keeps pace with current understanding.

The physical character of sites is constantly being changed by weathering and vegetation growth. Some sites are lost to development, while other new exposures are created by quarrying and engineering works (Figure 61). Thus a site series is inherently dynamic and should be reviewed periodically. In practice, such reviews have resulted in only modest changes since 1990.

## **Geological Conservation Review sites within Sites of Special Scientific Interest**

Geological Conservation Review sites within Sites of Special Scientific Interest

The 3002 Geological Conservation Review sites identified will be considered for notification as approximately 2300 SSSIs. The difference in numbers reflects the fact that Geological Conservation Review sites chosen as parts of different blocks may partly or entirely overlap geographically. A single SSSI may encompass several Geological Conservation Review sites, as well as one or more features of special biological value. The diagram below shows GCR site overlaps within a single hypothetical SSSI.

Durlston Bay SSSI, South Dorset, is a good example of a large composite site which incorporates separate and overlapping Geological Conservation Review sites. (Figure unnumbered 2) Photo: J.G. Larwood.

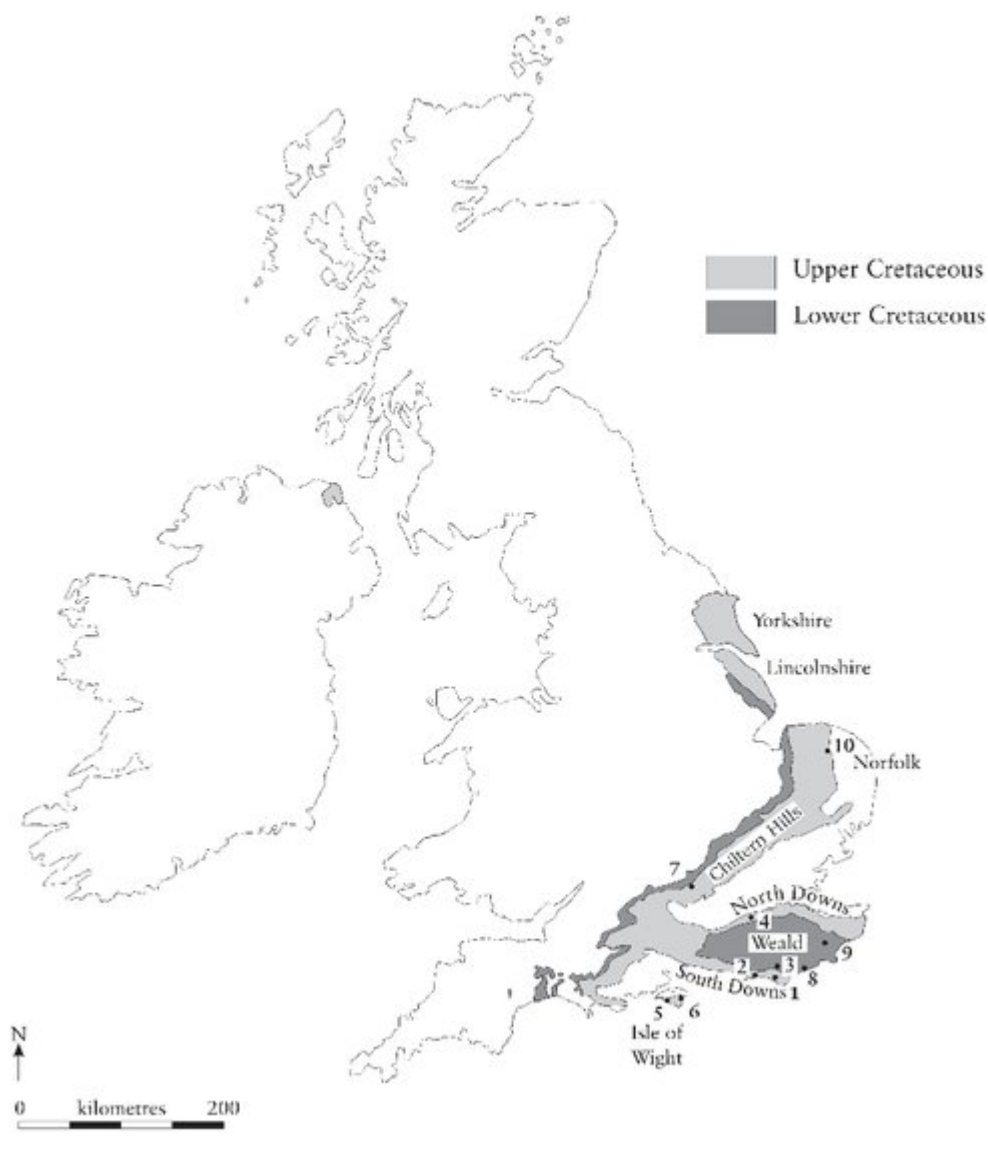
Special features of interest found at Durlston Bay have led to the sites' inclusion in six Geological Conservation Review blocks, as follows:

- Portlandian–Berriasian Stratigraphy
- Mesozoic Mammalia
- Palaeoentomology
- Mesozoic–Tertiary Fish/Amphibia
- Jurassic–Cretaceous Reptilia
- Coastal Geomorphology of England.

Each of the six Geological Conservation Review sites within the single Durlston Bay SSSI was assessed independently for inclusion within its respective network, and judged worthy of Geological Conservation Review status in its own right.



*(Figure 57) Kildrummie Kames esker system, Inverness District, viewed towards the east. Two areas of braided ridges (right foreground and centre distance) are linked by a single ridge. These striking features were produced by glacial meltwater rivers at the end of the last ice age. Photo: Cambridge University Collection. Reproduced by permission of the Curator of Aerial Photography.*



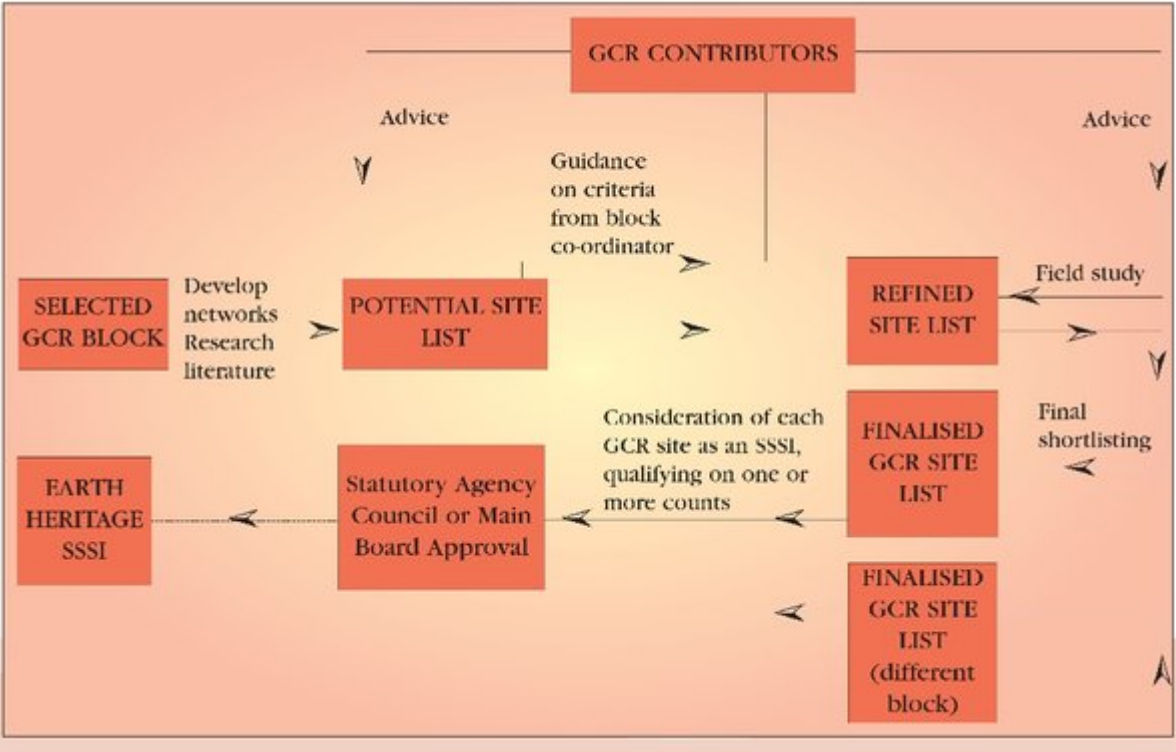
(Figure 58) Ten sites were selected for the fossil reptiles Cretaceous network in Britain to illustrate the range and diversity of reptiles of this period. Some 150 sites were considered as potential sites for this network. The sites not included as SSSIs may be conserved by other means, such as RIGS or local nature reserves.

Geographical area	ICR Number	Number of sites			ICR Number	ICR Name	Number of sites			ICR Number	ICR Name	Number of sites		
		England	Scotland	Wales			England	Scotland	Wales					
<b>ICR Group 1</b>														
England	ICR001	5			ICR002	ICR002 Name	5	9	2	ICR003	ICR003 Name	5	9	2
Wales	ICR004	5	2		ICR005	ICR005 Name	5	9	2	ICR006	ICR006 Name	5	9	2
Scotland	ICR007	5			ICR008	ICR008 Name	5	9	2	ICR009	ICR009 Name	5	9	2
<b>ICR Group 2</b>														
England	ICR010	5			ICR011	ICR011 Name	5	9	2	ICR012	ICR012 Name	5	9	2
Wales	ICR013	5	2		ICR014	ICR014 Name	5	9	2	ICR015	ICR015 Name	5	9	2
Scotland	ICR016	5			ICR017	ICR017 Name	5	9	2	ICR018	ICR018 Name	5	9	2
<b>ICR Group 3</b>														
England	ICR019	5			ICR020	ICR020 Name	5	9	2	ICR021	ICR021 Name	5	9	2
Wales	ICR022	5	2		ICR023	ICR023 Name	5	9	2	ICR024	ICR024 Name	5	9	2
Scotland	ICR025	5			ICR026	ICR026 Name	5	9	2	ICR027	ICR027 Name	5	9	2
<b>ICR Group 4</b>														
England	ICR028	5			ICR029	ICR029 Name	5	9	2	ICR030	ICR030 Name	5	9	2
Wales	ICR031	5	2		ICR032	ICR032 Name	5	9	2	ICR033	ICR033 Name	5	9	2
Scotland	ICR034	5			ICR035	ICR035 Name	5	9	2	ICR036	ICR036 Name	5	9	2
<b>ICR Group 5</b>														
England	ICR037	5			ICR038	ICR038 Name	5	9	2	ICR039	ICR039 Name	5	9	2
Wales	ICR040	5	2		ICR041	ICR041 Name	5	9	2	ICR042	ICR042 Name	5	9	2
Scotland	ICR043	5			ICR044	ICR044 Name	5	9	2	ICR045	ICR045 Name	5	9	2
<b>ICR Group 6</b>														
England	ICR046	5			ICR047	ICR047 Name	5	9	2	ICR048	ICR048 Name	5	9	2
Wales	ICR049	5	2		ICR050	ICR050 Name	5	9	2	ICR051	ICR051 Name	5	9	2
Scotland	ICR052	5			ICR053	ICR053 Name	5	9	2	ICR054	ICR054 Name	5	9	2
<b>ICR Group 7</b>														
England	ICR055	5			ICR056	ICR056 Name	5	9	2	ICR057	ICR057 Name	5	9	2
Wales	ICR058	5	2		ICR059	ICR059 Name	5	9	2	ICR060	ICR060 Name	5	9	2
Scotland	ICR061	5			ICR062	ICR062 Name	5	9	2	ICR063	ICR063 Name	5	9	2
<b>ICR Group 8</b>														
England	ICR064	5			ICR065	ICR065 Name	5	9	2	ICR066	ICR066 Name	5	9	2
Wales	ICR067	5	2		ICR068	ICR068 Name	5	9	2	ICR069	ICR069 Name	5	9	2
Scotland	ICR070	5			ICR071	ICR071 Name	5	9	2	ICR072	ICR072 Name	5	9	2
<b>ICR Group 9</b>														
England	ICR073	5			ICR074	ICR074 Name	5	9	2	ICR075	ICR075 Name	5	9	2
Wales	ICR076	5	2		ICR077	ICR077 Name	5	9	2	ICR078	ICR078 Name	5	9	2
Scotland	ICR079	5			ICR080	ICR080 Name	5	9	2	ICR081	ICR081 Name	5	9	2
<b>ICR Group 10</b>														
England	ICR082	5			ICR083	ICR083 Name	5	9	2	ICR084	ICR084 Name	5	9	2
Wales	ICR085	5	2		ICR086	ICR086 Name	5	9	2	ICR087	ICR087 Name	5	9	2
Scotland	ICR088	5			ICR089	ICR089 Name	5	9	2	ICR090	ICR090 Name	5	9	2
<b>ICR Group 11</b>														
England	ICR091	5			ICR092	ICR092 Name	5	9	2	ICR093	ICR093 Name	5	9	2
Wales	ICR094	5	2		ICR095	ICR095 Name	5	9	2	ICR096	ICR096 Name	5	9	2
Scotland	ICR097	5			ICR098	ICR098 Name	5	9	2	ICR099	ICR099 Name	5	9	2
<b>ICR Group 12</b>														
England	ICR100	5			ICR101	ICR101 Name	5	9	2	ICR102	ICR102 Name	5	9	2
Wales	ICR103	5	2		ICR104	ICR104 Name	5	9	2	ICR105	ICR105 Name	5	9	2
Scotland	ICR106	5			ICR107	ICR107 Name	5	9	2	ICR108	ICR108 Name	5	9	2
<b>ICR Group 13</b>														
England	ICR109	5			ICR110	ICR110 Name	5	9	2	ICR111	ICR111 Name	5	9	2
Wales	ICR112	5	2		ICR113	ICR113 Name	5	9	2	ICR114	ICR114 Name	5	9	2
Scotland	ICR115	5			ICR116	ICR116 Name	5	9	2	ICR117	ICR117 Name	5	9	2
<b>ICR Group 14</b>														
England	ICR118	5			ICR119	ICR119 Name	5	9	2	ICR120	ICR120 Name	5	9	2
Wales	ICR121	5	2		ICR122	ICR122 Name	5	9	2	ICR123	ICR123 Name	5	9	2
Scotland	ICR124	5			ICR125	ICR125 Name	5	9	2	ICR126	ICR126 Name	5	9	2
<b>ICR Group 15</b>														
England	ICR127	5			ICR128	ICR128 Name	5	9	2	ICR129	ICR129 Name	5	9	2
Wales	ICR130	5	2		ICR131	ICR131 Name	5	9	2	ICR132	ICR132 Name	5	9	2
Scotland	ICR133	5			ICR134	ICR134 Name	5	9	2	ICR135	ICR135 Name	5	9	2
<b>ICR Group 16</b>														
England	ICR136	5			ICR137	ICR137 Name	5	9	2	ICR138	ICR138 Name	5	9	2
Wales	ICR139	5	2		ICR140	ICR140 Name	5	9	2	ICR141	ICR141 Name	5	9	2
Scotland	ICR142	5			ICR143	ICR143 Name	5	9	2	ICR144	ICR144 Name	5	9	2
<b>ICR Group 17</b>														
England	ICR145	5			ICR146	ICR146 Name	5	9	2	ICR147	ICR147 Name	5	9	2
Wales	ICR148	5	2		ICR149	ICR149 Name	5	9	2	ICR150	ICR150 Name	5	9	2
Scotland	ICR151	5			ICR152	ICR152 Name	5	9	2	ICR153	ICR153 Name	5	9	2
<b>ICR Group 18</b>														
England	ICR154	5			ICR155	ICR155 Name	5	9	2	ICR156	ICR156 Name	5	9	2
Wales	ICR157	5	2		ICR158	ICR158 Name	5	9	2	ICR159	ICR159 Name	5	9	2
Scotland	ICR160	5			ICR161	ICR161 Name	5	9	2	ICR162	ICR162 Name	5	9	2
<b>ICR Group 19</b>														
England	ICR163	5			ICR164	ICR164 Name	5	9	2	ICR165	ICR165 Name	5	9	2
Wales	ICR166	5	2		ICR167	ICR167 Name	5	9	2	ICR168	ICR168 Name	5	9	2
Scotland	ICR169	5			ICR170	ICR170 Name	5	9	2	ICR171	ICR171 Name	5	9	2
<b>ICR Group 20</b>														
England	ICR172	5			ICR173	ICR173 Name	5	9	2	ICR174	ICR174 Name	5	9	2
Wales	ICR175	5	2		ICR176	ICR176 Name	5	9	2	ICR177	ICR177 Name	5	9	2
Scotland	ICR178	5			ICR179	ICR179 Name	5	9	2	ICR180	ICR180 Name	5	9	2
<b>ICR Group 21</b>														
England	ICR181	5			ICR182	ICR182 Name	5	9	2	ICR183	ICR183 Name	5	9	2
Wales	ICR184	5	2		ICR185	ICR185 Name	5	9	2	ICR186	ICR186 Name	5	9	2
Scotland	ICR187	5			ICR188	ICR188 Name	5	9	2	ICR189	ICR189 Name	5	9	2
<b>ICR Group 22</b>														
England	ICR190	5			ICR191	ICR191 Name	5	9	2	ICR192	ICR192 Name	5	9	2
Wales	ICR193	5	2		ICR194	ICR194 Name	5	9	2	ICR195	ICR195 Name	5	9	2
Scotland	ICR196	5			ICR197	ICR197 Name	5	9	2	ICR198	ICR198 Name	5	9	2
<b>ICR Group 23</b>														
England	ICR199	5			ICR200	ICR200 Name	5	9	2	ICR201	ICR201 Name	5	9	2
Wales	ICR202	5	2		ICR203	ICR203 Name	5	9	2	ICR204	ICR204 Name	5	9	2
Scotland	ICR205	5			ICR206	ICR206 Name	5	9	2	ICR207	ICR207 Name	5	9	2
<b>ICR Group 24</b>														
England	ICR208	5			ICR209	ICR209 Name	5	9	2	ICR210	ICR210 Name	5	9	2
Wales	ICR211	5	2		ICR212	ICR212 Name	5	9	2	ICR213	ICR213 Name	5	9	2
Scotland	ICR214	5			ICR215	ICR215 Name	5	9	2	ICR216	ICR216 Name	5	9	2
<b>ICR Group 25</b>														
England	ICR217	5			ICR218	ICR218 Name	5	9	2	ICR219	ICR219 Name	5	9	2
Wales	ICR220	5	2		ICR221	ICR221 Name	5	9	2	ICR222	ICR222 Name	5	9	2
Scotland	ICR223	5			ICR224	ICR224 Name	5	9	2	ICR225	ICR225 Name	5	9	2
<b>ICR Group 26</b>														
England	ICR226	5			ICR227	ICR227 Name	5	9	2	ICR228	ICR228 Name	5	9	2
Wales	ICR229	5	2		ICR230	ICR230 Name	5	9	2	ICR231	ICR231 Name	5	9	2
Scotland	ICR232	5			ICR233	ICR233 Name	5	9	2	ICR234	ICR234 Name	5	9	2
<b>ICR Group 27</b>														
England	ICR235	5			ICR236	ICR236 Name	5	9	2	ICR237	ICR237 Name	5	9	2
Wales	ICR238	5	2		ICR239	ICR239 Name	5	9	2	ICR240	ICR240 Name	5	9	2
Scotland	ICR241	5			ICR242	ICR242 Name	5	9	2	ICR243	ICR243 Name	5	9	2
<b>ICR Group 28</b>														
England	ICR244	5			ICR245	ICR245 Name	5	9	2	ICR246	ICR246 Name	5	9	2
Wales	ICR247	5	2		ICR248	ICR248 Name	5	9	2	ICR249	ICR249 Name	5	9	2
Scotland	ICR250	5			ICR251	ICR251 Name	5	9	2	ICR252	ICR252 Name	5	9	2
<b>ICR Group 29</b>														
England	ICR253	5			ICR254	ICR254 Name	5	9	2	ICR255	ICR255 Name	5	9	2
Wales	ICR256	5	2		ICR257	ICR257 Name	5	9	2	ICR258	ICR258 Name	5	9	2
Scotland	ICR259	5			ICR260	ICR260 Name	5	9	2	ICR261	ICR261 Name	5	9	2
<b>ICR Group 30</b>														
England	ICR262	5			ICR263	ICR263 Name	5	9	2	ICR264	ICR264 Name	5	9	2
Wales	ICR265	5	2		ICR266	ICR266 Name	5	9	2	ICR267	ICR267 Name	5	9	2
Scotland	ICR268	5			ICR269	ICR269 Name	5	9	2	ICR270	ICR270 Name	5	9	2
<b>ICR Group 31</b>														
England	ICR271	5			ICR272	ICR272 Name	5	9	2	ICR273	ICR273 Name	5	9	2
Wales	ICR274	5	2		ICR275	ICR275 Name	5	9	2	ICR276	ICR276 Name	5	9	2
Scotland	ICR277	5			ICR278	ICR278 Name	5	9	2	ICR279	ICR279 Name	5	9	2
<b>ICR Group 32</b>														
England	ICR280	5			ICR281	ICR281 Name	5	9	2	ICR282	ICR282 Name	5	9	2
Wales	ICR283	5	2		ICR284	ICR284 Name	5	9	2	ICR285	ICR285 Name	5	9	2
Scotland	ICR286	5			ICR287	ICR287 Name	5	9	2	ICR288	ICR288 Name	5	9	2
<b>ICR Group 33</b>														
England	ICR289	5			ICR290	ICR290 Name	5	9	2	ICR291	ICR291 Name	5	9	2
Wales	ICR292	5	2		ICR293	ICR293 Name	5	9	2	ICR294	ICR294 Name	5	9	2
Scotland	ICR295	5			ICR296	ICR296 Name	5	9	2	ICR297	ICR297 Name	5	9	2
<b>ICR Group 34</b>														
England	ICR298	5			ICR299	ICR299 Name	5	9	2	ICR300	ICR300 Name	5	9	2
Wales	ICR301	5	2		ICR302	ICR302 Name	5	9	2	ICR303	ICR303 Name	5	9	2
Scotland	ICR304	5			ICR305	ICR305 Name								

(Figure 56) List of blocks.

GCR BLOCK	Quaternary of Wales
NAME OF SITE	Dinas Dinlle
COUNTY/DISTRICT	Gwynedd
GRID REFERENCE	SH 437562
GCR INTEREST	
<p>Dinas Dinlle is an important coastal exposure for interpreting late Pleistocene glaciation in North Wales. The sequence comprises a complex series of Irish Sea and Welsh tills with associated sands, silts and gravels. It is complicated by well-developed glaciotectionic structures including folds, faults and overthrows, and by cryoturbation features which occur in the uppermost horizons. The sections have been regarded as showing the northernmost occurrence of Irish Sea till belonging to the oldest-known glacial episode in the area (the Trevor Advance), while the glaciotectionic structures have been interpreted as evidence for a later readvance of ice. However, recent research suggests that the sediments and glaciotectionic structures need not be the product of different glacial advances, but can be adequately explained as a multiple drift sequence formed during one glaciation. The drift sequence, and particularly the glaciotectionic structures, make Dinas Dinlle a site of significant interest for reconstructing late Pleistocene processes and events in North Wales.</p>	

(Figure 59) Specimen citation.



(Figure 60) Flow diagram showing a typical site selection process within a GCR block.





*(Figure 61) Florence Mine, Cumbria. Mineralogy of the Lake District Block. The importance of this site lies in its excellent exposures within the Beckerment iron ore body, the largest remaining of the iron ore 'flats' (an ore body that has replaced a sediment layer) of the West Cumbria mining province, and its contribution to research into ore mineralisation in Britain. At the mine, the variety and form of the ore is displayed in situ. This site is one of seven chosen to represent the variety of iron ore deposits across Britain. It is the only one which shows iron ore replacement flats, a type of deposit unrecorded outside Britain. This site was recently added to the Geological Conservation Review. At the time of selection of Lake District mineralogy sites, no good in situ exposures were available at the surface, and a nearby mine dump site was the only available source of material for studying these unique deposits. Florence Mine now supersedes the mine dump site. The photograph shows the mine-roof of kidney ore. This part of the mine is to be conserved with the intention of using it as an educational/visitor resource, consequently no removal of in situ specimens is permitted by the mine management. Photo: T. Moat.*



*The photograph shows a fossil ammonite, *Asterooceras obtusum*, from Charmouth, Dorset. Although superficially like a snail shell, it is actually the remains of a cephalopod. Modern relatives include the squid, octopus and Nautilus. Because of the relative abundance of ammonite fossils, and the relatively rapid evolution of different species, they provide useful 'markers' for comparing ages of rocks at different places. Photo: K. N. Page.*



*(Figure unnumbered 2) Durlston Bay SSSI, South Dorset, is a good example of a large composite site which incorporates separate and overlapping Geological Conservation Review sites. Photo: J.G. Larwood.*