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**VOLUME 11 SECTION 3 PART 11  
GEOLOGY AND SOILS**

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# 1. INTRODUCTION

1.1 For its size, the UK has the most varied geology in the world. Soils and geology play an important part in determining the environmental character of an area. The nature and alignment of the rocks has a major influence on the landform. Rocks provide the parent material from which the soils are created and, through their constitution and chemistry, they influence the rate at which soils are formed. Soil chemistry and structure strongly influence the type of vegetation which occurs naturally in an area. The soil will also have a considerable influence on the types of agricultural and horticultural practices an area can support.

1.2 Road schemes can have an impact on both the geology and the soils of an area. It is therefore important that the potential impacts of development on both the soil and the underlying rocks are fully considered. The converse also applies in that existing soil conditions of a site can impose constraints on a proposed development for example, where land which has been contaminated by wastes from some previous industrial use.

## 2. THE STATUTORY BODIES

2.1 One source of information on the geology of a site is the British Geological Survey (BGS). Geological features which are considered to be of national importance are designated as Sites of Special Scientific Interest (SSSI). Information on such sites is available from the appropriate statutory body.

### The Statutory Bodies

#### ENGLAND

2.2 English Nature (EN) is the Government funded body whose responsibilities include identification and notification of geological and geomorphological Sites of Special Scientific Interest (SSSIs). Many of these sites also have some wildlife conservation value, and some have archaeological interest. EN is responsible for considering applications and issuing licences to regulate activities which may affect SSSIs. The wider role of EN is described in PART 4, CHAPTER 2.

#### SCOTLAND

2.3 Scottish Natural Heritage (SNH) has a similar but wider role to EN, which is to secure the conservation and enhancement of Scotland's natural heritage of wildlife and landscape. SNH provides advice to Government on landscape and recreation issues in Scotland and has a duty to ensure that anything done in relation to natural heritage is in a manner which is sustainable.

#### WALES

2.4 The Countryside Council for Wales (CCW) is the government's statutory advisor on wildlife and countryside conservation matters in Wales. It is the executive authority for the conservation of habitats and wildlife. Through partners it promotes the protection of landscape, opportunities for enjoyment, and the support of those who live and work in, and manage, the countryside. It enables these partners, including local authorities, voluntary organisations and interested individuals to pursue countryside management projects through grant-aid. The Countryside Council is accountable to the Secretary of State for Wales who appoints it and provides its annual grant in aid.

#### NORTHERN IRELAND

2.5 In Northern Ireland the Environment

Service: Countryside and Wildlife, of the Department of the Environment for Northern Ireland (ES : CW) is responsible for promoting nature conservation. It has broadly similar functions to that of English Nature in that it establishes and manages National Nature Reserves (NNRs) and declares Areas of Special Scientific Interest (ASSIs). Furthermore it has an advisory function to other branches of Government on matters related to nature conservation and holds extensive data on sites and species on which such advice is based.

2.6 The statutory bodies have two main roles in relation to trunk road schemes, those of advisor and consultee.

2.7 Consulting the statutory bodies in the early stages of a scheme's development, may help to avoid or minimise potential conservation problems and assist in choice of alignment. Consultation should continue throughout the design phase through to construction and management, where relevant. Advice should be sought from the statutory bodies on a wide range of issues including scoping of surveys, possible impacts and mitigation measures.

2.8 In England and Wales section 105A of the Highways Act 1980, and in Scotland sections 20A and 55A of the Roads (Scotland) Act 1984, stipulate that, for any scheme passing through or within 100m of an SSSI, the statutory bodies must be given the opportunity to express an opinion, (ie comment on the published Environmental Statement before the project is initiated).

2.9 Statutory bodies are also required to give information to the Overseeing Department or its Design Organisation during the preparation of the Environmental Statement. In England, in recognition of EN's wider role as the Government's advisor, it has been agreed that copies of the relevant sections of all Environmental Statements should be sent to EN, who will comment where appropriate. Similar procedures should apply in Wales, where CCW should comment on relevant sections of all Environmental Statements, where appropriate. In Northern Ireland Article 39B of the Roads (Northern Ireland) Order 1980 requires the Environmental Assessment of certain road projects. Copies of all Environmental Statements should be sent to ES : CW who will comment where appropriate.

2.10 The statutory bodies also hold extensive data

on the location and nature of designated sites, the existence of specialist studies and surveys (including those carried out by other organisations), and many other subjects. Any queries on geological nature conservation issues should therefore be directed to them in the first instance.

### **Other Sources of Advice and Information**

2.11 It should be noted that information on the geology of sites is also required for Ground Investigation Studies (see HA 34/87). The Design Organisation should ensure that requests for information from the BGS and others are co-ordinated wherever possible and that unnecessary duplication is avoided.

2.12 For contaminated land information may be available from the local planning authority.

2.13 For greenfield sites information on the agricultural quality of land can be obtained from MAFF who supply Agricultural Land Classification Maps. In Scotland SOAFD should be consulted and the MLURI will supply ALC maps of Scotland.

2.14 In the stages of scheme development prior to Stage 3, the statutory bodies should be able to provide the requisite levels of advice on geomorphological and geological conservation issues, on an 'in confidence' basis. However, it should be noted that they are not required to carry out research in connection with an environmental assessment, simply to provide information in their possession.

### **3. DESIGNATED SITES**

3.1 Geological and geomorphological features which are considered to be of national importance are designated as Sites of Special Scientific Interest.

3.2 Sites of Special Scientific Interest (SSSIs) have some legal protection under the Wildlife and Countryside Act 1981 (see ANNEXES III and IV), against operations which might damage their interest (details are set out in the English Nature publication 'What you should know about Sites of Special Scientific Interest' 1992). In some cases the proscribed operations (potentially damaging operations) may be carried out under certain conditions. Failure to adhere to these conditions can result in the landowner or occupier facing prosecution. The protection afforded to sites by local authority designations, by comparison, is normally minimal. Such designations are mostly for planning purposes only, and while a local authority may have a stated policy of avoiding development in these areas, there is no statutory protection process.

3.3 The designation SSSI (or ASSI in Northern Ireland) covers areas considered by the statutory bodies to be of national or international importance. It is the Government's policy, wherever possible, to keep roads away from protected areas such as SSSIs (1987 Roads White Paper, paragraph 5.1).

3.4 It is important to remember that the network of designated sites is not necessarily comprehensive. The list of SSSIs, for example, is constantly being reviewed to assess the state of sites in relation to the overall resource. This can lead to denotification of damaged sites and notification of new sites if appropriate.

## **4. NON-STATUTORY DESIGNATED SITES**

4.1 Other sites of geological importance may be designated as Regionally Important Geological Sites (RIGS). RIGS are any geological or geomorphological sites, excluding SSSIs, in a county (or region in Scotland) that are considered worthy of protection for their educational, research, historical or aesthetic importance. RIGS are broadly analogous to non-statutory wildlife sites and are often referred to locally by the same name. They can include important teaching sites, wildlife trust reserves, Local Nature Reserves and a wide range of other sites. RIGS are not regarded as 'understudy' SSSIs, but as sites of regional importance in their own right. This scheme operates on a local basis. Where it operates information will be available from the appropriate RIGS group. It should be noted that it cannot be assumed that all important geological sites will have been identified and designated.

## 5. POTENTIAL IMPACTS OF ROAD SCHEMES ON GEOLOGY AND SOILS

### Impacts on Geology and Geomorphology

5.1 Road schemes are capable of having a direct impact on geology. For example, surcharging of ground may accelerate the natural rate of collapse of underground mine workings or a new road may bury important deposits. A new road may also affect geological strata indirectly through altering the hydrogeology of an area, diverting underground stream flows, or preventing aquifer recharge. Consideration needs to be given to such factors in the assessment and design.

5.2 In addition physical works may have direct impacts on geological or geomorphological features which are, in themselves, of scientific interest and importance. These sites may be important because of their rarity; the educational value of the exposures; or due to the active processes of erosion and deposition which are in train.

5.3 Approximately one third of geological SSSIs are man-made, many as a result of quarrying activity. Thus quarrying is often beneficial, revealing new strata. A new road through a rock cutting may have a similar effect. The value of many geological sites relies upon their exposures being kept fresh by weathering and in allowing access to study such exposures. If access is restricted or if an engineering solution involving drainage or retaining walls is imposed upon a rock cutting slope this may reduce the geological interest.

### Impacts on Soils

5.4 The total loss and destruction of agricultural soils has a self-evident impact but where soils are excavated and stored for reuse the level of damage and deterioration in soil quality will depend upon the types of earthmoving machinery employed, method of handling, weather conditions, and provision of storage. In addition to any deterioration in soil quality there may be a loss of valuable seed banks, for example, when soil is taken from a site of nature conservation interest together with a loss of palaeo environmental remains.

5.5 Soils adjacent to existing roads may be affected by spray or air borne pollutions. Most spray is deposited near to the carriageway. Information on possible pollutants is given in PART 10, CHAPTER 4.

### Contaminated Land

5.6 Where land has been contaminated by waste and residues from former industrial process, the presence of toxic or other hazardous material may pose threats to human health or impose other constraints. Local authorities should be asked for information on contaminated sites. In Scotland Planning Advice Note 33 DEVELOPMENT OF CONTAMINATED LAND (SDD) gives advice to Local Authorities and developers. Careful analysis of historic plans, maps and survey data may provide limited information about the way a site has been used and suggest the nature and type of chemicals likely to be present. However, in the absence of exhaustive surveys, it will usually only be feasible to quantify the approximate order of risk that hazardous materials are present. Estimating the quantities of waste, and the extent to which leachates may have travelled into the surrounding soils and rock is notoriously difficult. In such circumstances the main emphasis will need to be placed on methods of isolating or treating the waste prior to development.

## 6. MITIGATION

6.1 The assessment of the effects on geology and soil quality at each key stage should be based on the likely impacts of scheme taking account of mitigation measures agreed by the Overseeing Department's Project Manager.

6.2 Examples of possible mitigation techniques are described below.

### **Geology**

6.3 Where 'hard rock' geological sites are affected there may be scope to mitigate such effects by providing new exposure for study.

6.4 Where active geological processes are taking place, such as bank erosion, careful attention to the siting and design of new roads is the most effective way of anticipating future problems and minimising the initial impact. In circumstances where some disturbance of existing processes is inevitable, appropriate engineering techniques may be used to ameliorate or mitigate the effects, including use of rock anchors and stone-filled gabions, or "bioengineering" using the roots of fast-growing trees and shrubs or reed mats.

### **Contaminated Land**

6.5 It may be possible to treat contaminated land 'in-situ' if there is sufficient land available to create a permanent disposal site. A void is excavated and lined with puddled clay or an impermeable liner. The resulting 'cell' is then backfilled with the waste and capped over with clay or other impervious seal to exclude water. Underdrainage is usually provided beneath the cell so that, should any leakage occur, the presence of leachate can be detected. Careful consideration will need to be given to the possible hazards of gaseous emissions such as methane.

6.6 Reducing the impact of a road on geology and soils is just one of the factors to be considered in route choice and design. In addition to fulfilling the intended purpose any mitigation measure must perform to an acceptable level in engineering, traffic, road safety and economic terms.

## 7. STAGES OF ASSESSMENT

7.1 Assessments should become increasingly detailed as a scheme develops, and in accordance with the importance of the features affected by the scheme. It is also particularly important that, as the assessment becomes more detailed, it both informs and takes account of the development of mitigation measures. Assessment and design are part of an iterative process.

7.2 The physical scope of the assessment will vary according to the nature of each individual scheme. Consultation with the statutory bodies, and other relevant environmental organisations, from an early stage, is therefore most important to ensure that the scope of the assessment is appropriate. Proposals must be agreed with the Overseeing Department's Project Manager before the scope of the assessment is finalised.

### Stage 1

7.3 The objective at this stage is to undertake sufficient assessment to identify the possible geological/soil constraints associated with particular broadly defined routes or corridors as defined by the Design Organisation and agreed with the Overseeing Department's Project Manager;

7.4 The steps to take are:

- (i) obtain details of the location and nature of any designated sites in the corridor. This can be done by contacting the relevant statutory body and the local planning authorities;
- (ii) obtain information on the geology of the area from the British Geological Survey;
- (iii) obtain information on the agricultural quality of land (ALC) from MAFF or SOAFD/MLURI in Scotland (see PART 6, CHAPTER 7);
- (iv) obtain information from the local planning authority about contaminated land.

7.5 The result of the Stage 1 assessment to be included in the Stage 1 Report should consist of:

- (a) a map of the overall study area (1/25,000 or 1/10,000 scale, or as

appropriate), with any route corridors indicated, showing the geology of the area and any designated sites;

- (b) a statement setting out the characteristic geology of the study area, designated sites and areas of contaminated land, including any areas or sites within the study area which should be regarded as a constraint;

- (c) a map showing the agriculture land quality (see PART 6, CHAPTER 7).

### Stage 2

7.6 The objective at this stage is to undertake sufficient assessment to identify the factors, and the significance of effects upon them, to be taken into account by the Design Organisation in developing and refining route options in agreement with the Overseeing Department's Project Manager.

7.7 The steps to be taken are:

- (i) check with the relevant statutory body and the local planning authorities that no new sites have been designated in the study corridor or further areas of contaminated land identified, and whether any new survey work has been carried out, since Stage 1, which might have a bearing on the route options;
- (ii) where the Stage 1 study, and subsequent verification of results, show that there is no evidence that any of the proposed routes will have significant impacts for geological or geomorphological conservation, the appropriate statutory body should be contacted to confirm that no further work is required;
- (iii) where an area of contaminated land may be affected, consideration should be given to the need for site investigation work at this stage. Any survey work should be agreed with the Overseeing Department's Project Manager.

The levels of any soil contaminants which are

detected will need to be assessed in accordance with the current guidelines of the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL).

site and the method of treatment. Where removal to off-site is proposed the availability of suitable sites should be discussed.

7.8 The results of the Stage 2 assessment to be included in the Stage 2 Report should consist of:

- (i) a statement describing the geological/ geomorphological interest of the area and an assessment impact of the route options. The assessment should take account of any mitigation measures agreed with the Overseeing Department's Project Manager;
- (ii) a statement of the likely impact of the route options on soils and on contaminated land.

### Stage 3

7.9 The objectives at this stage is to undertake sufficient assessment of the preferred route to identify any significant impact on geology and soil and where appropriate any particular environmental issues associated with contaminated land.

7.10 The steps to be taken are:-

- (i) confirm information gathered from the relevant statutory body and the local planning authority;
- (ii) where a site of geological/geomorphological interest will be affected the views of the relevant statutory body should be obtained;
- (iii) undertake a site investigation of any contaminated land to establish the contaminants present and identify the method of treatment.

7.11 The results of the assessment to be included in the Environmental Statement should consist of:-

- (i) where a site of geological/geomorphological interest would be affected, a statement describing the site, its significance and the significance of the impacts on it. Account should be taken of any mitigation measures agreed with the Overseeing Department's Project Manager;
- (ii) when contaminated land would be affected, a report detailing the nature of the

## 8. FURTHER READING

8.1 Earth Science Conservation in Great Britain - A Strategy. (Nature Conservancy Council).

8.2 Planning Policy Guidance No 14 (PPG 14). Development on Unstable Land. DOE.

8.3 Planning Advice Note 33 Development of Contaminated Land. SDD.

8.4 DMRB 4, HS 34/87 Ground Investigation Procedures (Department of Transport, 1987)