European Federation of Geologists (EFG)

Advice Document

to the

European Commission

on

Environmental Impact Assessment

Implementation and Practice

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SUMMARY

The requirement for the carrying out of an Environmental Impact Assessment (EIA) is set out in European Directives 85/337/EC and 97/11/EC; and is further defined in various national implementing legislation and regulations. The legislation and regulation identify the type and scale of development requiring an EIA as well as the minimum requirements in relation to the content of the associated Environmental Impact Statement (EIS).

The EFG considers that the current EU legislation does not satisfactorily address geological issues. As a result, in many cases, EISs do not deal satisfactorily with geological aspects of developments.

Geology is important for most types of development, in that they are either built on, or have foundations in geological deposits, utilise (natural) geological materials, or have the potential to pollute or sterilise other natural resources, which includes the groundwater.

The EFG believes that there are two major reasons why comprehensive geological reporting is required in any properly prepared and comprehensive EIS.

1. Environmental protection can only be achieved if all the aspects and possible impacts of a proposed development are comprehensively defined in the EIA stage of a planning proposal. The EIS for a project must examine the possible short term and long-term impacts of any development, if negative long-term residual environmental impacts are to be avoided.

2. Budget overruns are generally due to inadequately completed regional and site investigation studies in the initial site selection stage for a project and in inadequate site investigation work on the chosen site. A proper geological appraisal is a crucial component in site selection and investigation studies.

To improve the quality of the EISs the EFG recommends:

- The current EU Legislation needs to be amended to specifically include geology in the list of issues to be addressed in an EIS and not to have it inferred as it is currently presented.

- The geology section of the EIS must be completed by a "competent person" i.e. a professional geologist.

- The review / appraisal of EISs needs to be undertaken by suitably qualified and experienced professionals. To achieve this each agency responsible for reviewing EISs should either employ a professional geologist, or have access to professional geological advice.

INTRODUCTION

This submission is being made by the European Federation of Geologists. It is a response to the European Commission consultation invitation for the expression of views on the functioning of the European Council Directives on the assessment of the effects of certain public and private projects on the environment. Council Directive 85/337/Eec of 27 June 1985, amended by Council Directive 97/11/EC of 3 March 1997.

The European Federation of Geologists (EFG) was first established in 1980. The nations at present represented in the Federation as Full Members are; Belgium, Czech Republic, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Luxembourg, The Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom. In addition to these Full Members, Bulgaria, Norway, Romania, Turkey and Canada are present as Observer Members, while the American association is an Associate Member. Its mission is to promote the profession and practice of Geology and its relevance.

As part of the consultation process the EFG has surveyed the experience of its member associations.

IRELAND – A CASE STUDY

Introduction

Rather than review practice in each of the member countries this submission focuses on the situation in one country – Ireland – and uses this as an example to illustrate the general situation throughout the European Union.

The Institute of Geologists of Ireland ("IGI") was formed in 1999 to promote the science and profession of geology in Ireland and, *inter alia*, to raise the awareness of the importance of geology to society. The Institute has strict professional membership requirements, which entitle its members to use the title PGeo. It requires and assists its members to uphold, develop and maintain the highest professional standards in the practice of their profession. It has been recognised as the self-regulating body for professional geologists practising in Ireland.

As part of its remit the IGI reviewed the geological content of reports made within the EIA process. It concluded that in many cases the standard of reporting was very inadequate. It further concluded that cost over runs and failure to meet project schedules could be directly related to the inadequacy of the geological content. These had, and have, major implications for public finances and the health and safety of civil society now and in the future.

In response to this the IGI formed a Working Group with a remit to produce guidelines on the geological content of EISs. These guidelines were published in

September 2002[1] and were distributed to practitioners, regulators, and government departments. The objective of the guidelines is to improve professional practice in this area. As part of this education process the IGI, in association with the Irish Environmental Protection Agency, is organising a workshop on the subject. This workshop is being directed not just at the practitioners, but also to the local authority officials, planners and other government officials active in the area.

Geology is important for most types of development, in that they are either built on, or have foundations in geological deposits, utilise (natural) geological materials, or have the potential to pollute or sterilise other natural resources. The IGI considers that, in most cases, Environmental Impact Statements ("EISs") do not address in a comprehensive manner, all the geological aspects of that should be appraised to evaluate the impact of a proposed development on the existing natural environment. It is also the IGI's experience that in many of the EISs submitted in Ireland in the past decade, that a professional geologist did not prepare the section on soils/geology.

Legislative Basis for EIA's in Ireland

The requirement for the carrying out of an Environmental Impact Assessment (EIA) is set out in European (EU Directive 85/337/EC) and national legislation EC (EIA) Regulations (SI No. 93 of 1999).

The legislation identifies the type and scale of development requiring an EIA as well as the minimum requirements in relation to the content of the associated EIS.

The apparent poor description of the geological aspects of a development in many EISs is due to the fact that 'geology' is not listed as an issue to be dealt with in the existing legislation (Second Schedule of the 1999 EC (EIA) Regulations (SI No. 93 of 1999) which lists the issues to be addressed as:

Human Beings; Flora; Fauna; Soil; Water; Air; Climate; Landscape; Material Assets; and Cultural Heritage; and the interaction of the foregoing.

The limitations with current EISs

The initial EISs that were prepared in Ireland in the late 1980s - early 1990s were short documents, which only addressed selective aspects of the environment and the proposed project. In many cases the contents of the EIS reflected the professional background of the project manager rather than the requirements of the project.

By the early 2000s, the overall standard of the EISs has significantly improved, they are significantly longer and they address most issues. However, there is still a high degree of variability in the quality and content.

[1] Appendix One: Geology in Environmental Impact Statements – A Guide. Published by The Institute of Geologists of Ireland. Available for download on the IGI website at www.igi.ie

In Ireland, it is envisaged that the variability in the contents and quality of the EISs will be improved by the publication in March 2002 by the EPA of revised guidelines for the preparation of EISs, *("Guidelines on the Information to be contained in Environmental Impact Statement")*. These guidelines provide a framework for the preparation of an EIS and they should, if adhered to, help to standardise the structure and content of EISs. One of the limitations with the guidelines is the fact that they are only designed to be a guideline and they do not provide the detail of what is required to adequately address each subject in an EIS.

A limitation with the geology content on current EISs is the lack of site specific work to determine in a comprehensive manner the true geological characteristics of a site. In many EISs, regional geological bedrock and hydrogeological maps are used with no appropriate site investigation work undertaken to define the existing environment. If the existing environment is not comprehensively defined, it is not possible to properly evaluate the impact of the proposed development on that environment, or to propose adequate mitigation measures.

One of the other limitations with the geology content of EISs in Ireland is the lack of suitably qualified and experienced professional staff in the regulatory authorities that review and appraise the EIS as part of the planning process. In Ireland, most of the EISs are submitted to Local Authorities as part of the planning application process for the development of a project. The vast majority on the Local Authorities do not employ a professional geologist as a member of their staff. For large projects, local authorities retain consultant engineering and environmental firms to review and evaluate the EISs but for smaller projects they do not have any in-house professional geological advice.

The IGI EIS Guidelines

The IGI believes that the development of specific geological guidelines will serve to clarify and improve the content and quality of EISs as well as enhancing public confidence in them. To this end, the IGI established a Working Group in 2001 to review the geological content of EISs and develop Guidelines to assist practitioners in how geological issues should be addressed in the context of a proposed development.

The IGI EIS Guidelines were published in 2002. They are intended to complement the 2002 EPA's EIS Guidelines. The IGI Guidelines provide a checklist on the geological issues for each topic (Human Beings, Soils, Water, etc) under the headings:

- Existing Environment
- Likely Significant Impacts
- Mitigation Measures

Under the section on Existing Environment in the IGI Guidelines, the document lists all the issues relating to geology that may be required to be addressed in the EIS. However, the Guidelines acknowledge that the level of geological detail required is dependent on the nature of the development, its potential impact and associated mitigation measures. Thus, the Guidelines highlight the importance in the EIA process of the Scoping Study to determine the specific geological issues that a relevant to each individual project.

The guidelines are intended to provide practical advice in relation to the geological aspects only and do not replace any of the legislative requirements. The IGI produced the guidelines to assist those involved in the preparation and assessment of EISs and to assist in having the subject of geology dealt with adequately and in an appropriate manner.

Competence and Responsibility

The roles and expertise of the geologist are many and varied. Geologists are the experts in the discovery of raw materials that underpin and sustain modern life, such as oil and gas, base and precious metal ores and construction materials. Engineering geologists evaluate the natural conditions necessary for the safe construction and operation of roads, railways, high rise buildings, industrial complexes, dams and earthworks generally. Hydrogeologists and environmental geologists are responsible for finding, and advising on the protection of, water supplies, the evaluation and remediation of contaminated sites, for environmental protection measures and for locating sites for the safe containment of wastes, be they hazardous or non-hazardous.

Given the increasing stress on the Earth's ecosystems it is essential that the data, interpretations and advice provided by the profession, be of the highest technical standard. Too often there are examples where this is not the case, where unqualified or inexperienced personnel are contracted to complete the studies, where unqualified personnel 'sign off' on the studies, and indeed examples where the necessary studies have not even been commissioned.

Geologists, whatever their specialisations, are frequently asked to provide information that will enable plans and decisions to be made that directly affect the future economic success and safety of a specific project. It is essential in fulfilling this role that the professional work of the geologist is always of the highest technical standard.

In addition to producing these guidelines, the IGI considers that there should be an emphasis on the quality of the investigation, interpretation and assessment of the geological data submitted as part of an EIS. To achieve high standards in geological reporting (as well as in other specialised areas) the IGI believes that there should be a requirement that a 'Competent Person' sign off each specialised report. In the area of geology, the IGI believes that a "Competent Person" should be a professional member of a professional association with a code of conduct and disciplinary procedures.

In many instances preparation of an EIS is a team effort. Where there is a clear division of responsibilities within a team, each member should accept responsibility for his or her particular contribution. It is also important that:

- The person with overall responsibility for an EIS, which has been prepared in whole or in part by others, should be satisfied that the work of the other contributors is acceptable.

- The professional geologist should be satisfied that the information in the geological report(s) is faithfully reflected in the final composite EIS (i.e. after any editing), including the Non-technical Summary.

- The compiler of the final report(s) should ensure that each contributor has read and approved his/her contribution as reproduced in its final edited form.

The Environmental Protection Agency in Ireland has accepted these principles and are recommending to their staff that all technical reporting be signed off in this way.

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APPENDIX ONE

GEOLOGY IN ENVIRONMENTAL IMPACT STATEMENTS

A GUIDE

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MISSION STATEMENT

To promote and advance the science of geology and its professional application in all disciplines, especially the geosciences, and to facilitate the exchange of information and ideas in relation to geology.

To require its members to uphold, develop and maintain the highest professional standards in the practice of their profession, as described in the Institute's Code of Ethics and Conduct.

TABLE OF CONTENTS

INTRODUCTION

The Institute of Geologists of Ireland ("IGI") was formed in 1999 to promote the science and profession of geology in Ireland and, *inter alia*, to raise the awareness of the importance of geology to society. The Institute has strict professional membership requirements, which entitle its members to use the title PGeo. It requires and assists its members to uphold, develop and maintain the highest professional standards in the practice of their profession. It has been recognised as the self-regulating body for professional geologists practising in Ireland.

The IGI considers that, in many cases, Environmental Impact Statements ("EISs") do not deal satisfactorily with geological aspects of developments, and usually do not involve a professional geologist. This may, in part, be due to the fact that 'geology' is not listed as an issue to be dealt with in the existing legislation (Second Schedule of the 1999 EC (EIA) Regulations (S.I. No. 93 of 1999) which identifies 'Human Beings; Flora; Fauna; Soil; Water; Air; Climate; Landscape; Interaction of the foregoing; Material Assets; and Cultural Heritage' as issues to be addressed. Guidance produced by the EPA attempts to remedy this deficiency by including 'geology' and 'aquifers' under 'soils', while groundwater issues are to be discussed under 'Water' (*Guidelines on the information to be contained in Environmental Impact Statements*, March 2002).

The IGI is promulgating these guidelines to assist those involved in the preparation and assessment of EISs and to assist in having the subject of geology dealt with adequately and in an appropriate manner.

Geology is important for most types of development, in that they are either built on, or have foundations in geological deposits, utilise (natural) geological materials, or have the potential to pollute or sterilise other natural resources.

The IGI believes that the development of specific geological guidelines will serve to clarify and improve the content and quality of EISs as well as enhancing public confidence in them. To this end an IGI Working Group has reviewed the geological content of EISs and developed Guidelines to assist practitioners in how geological issues should be addressed in the context of a proposed development.

This document is intended to complement the Environmental Protection Agency's guidance (*Guidelines on the information to be contained in Environmental Impact Statements, March 2002*). It elaborates on the geological issues for each topic (Human Beings, Soils, etc.) under the headings:

- Existing Environment
- Likely Significant Impacts
- Mitigation Measures

The geological details listed in this document cover a variety of projects, covering a range of complexity. Projects of lesser complexity will require less information. The amount of detail provided should reflect the circumstances of each project.

Under the 'Significance of Geology in the context of Development' the importance of geology to EISs is described. It is stressed that geological aspects of EIS's need to be addressed professionally. 'Geological Content of EIS's' and the 'Geology in the Context of Project types' are checklists to ensure that relevant aspects of geology are addressed.

LEGISLATIVE BASIS

The requirement for the carrying out of an Environmental Impact Assessment (EIA) is set out in European (EU Directive 85/337/EC) and has been adopted in national legislation under S.I. 349 of 1989, S.I. 84 of 1994 and S.I. 93 of 1999.

The legislation identifies the type and scale of development requiring an EIA as well as the minimum requirements in relation to the content of the associated EIS.

These IGI Guidelines acknowledge that the level of geological detail required is dependent on the nature of the development, its potential impact and associated mitigation measures. The guidelines are intended to provide practical advice in relation to the geological aspects only and do not replace any of the legislative requirements.

A listing of the current relevant legislation is given in the Appendix.

COMPETENCE AND RESPONSIBILITY

In addition to the guidelines on the drafting and assessment of EISs the IGI considers that there should be an emphasis on the quality of the investigation, interpretation and assessment of the geological data submitted as part of an EIS. To achieve high standards in geological reporting (as well as in other specialised areas) the IGI considers that there should be a requirement that a 'Competent Person' sign off each specialised report.

In many instances preparation of an EIS is a team effort. Where there is a clear division of responsibilities within a team, each member should accept responsibility for his or her particular contribution. It is also important that:

- The person with overall responsibility for an EIS, which has been prepared in whole or in part by others, should be satisfied that the work of the other contributors is acceptable.

- The professional geologist should be satisfied that the information in the geological report(s) is faithfully reflected in the final composite EIS (i.e. after any editing), including the Non-technical Summary.

- The compiler of the final report(s) should ensure that each contributor has read and approved his/her contribution as reproduced in its final edited form. [2]

[2] A Competent Person in the area of geology should be a professional member of the Institute of Geologists of Ireland, i.e. PGeo (Ireland), or an equivalent professional organisation e.g. EurGeol (Europe), CGeol (UK), CPG (USA), PGeo (Canada), etc. This will ensure that the work is carried out by a Competent Person with a minimum of five years experience relevant to the issues which are being reported.

SIGNIFICANCE OF GEOLOGY IN THE CONTEXT OF DEVELOPMENT

THE PROFESSIONAL PROFILE OF A GEOLOGIST

Much of today's geological practice affects the health, safety and welfare of the public, the environment, the economy and the feasibility of engineered works.
The roles and expertise of the geologist are many and varied. Geologists are the experts in the discovery of raw materials that underpin and sustain modern life, such as oil and gas, base and precious metal ores and construction materials. Engineering geologists evaluate the natural conditions necessary for the safe construction and operation of roads, railways, high rise buildings, industrial complexes, dams and earthworks generally. Hydrogeologists and environmental geologists are responsible for finding, and advising on the protection of, water supplies, and for locating sites for the safe containment of wastes, be they hazardous or non-hazardous.

Geologists, whatever their specialisations, are frequently asked to provide information that will enable plans and decisions to be made that directly affect the future economic success and safety of a specific project. Commonly geologists work in conjunction with engineers to ensure the safety of structures. Most activities that require geological advice are closely connected directly, or indirectly, to the environment. Mining, quarrying, construction, development of water resources and waste disposal are just a few examples of activities that may significantly change the landscape and the quality and way of life of local inhabitants and in which the geologist has an important role. It is essential in fulfilling this role that the professional work of the geologist is always of the highest technical standard.
As well as the general fields of activity listed above geologists are likely to be experienced in specific fields of activity:

The exploration for, and utilisation, of natural resources including metalliferous minerals, non-metalliferous minerals, water supply and water management, energy and other natural resources.

Environmental management, environmental risk assessments, preparation of environmental impact statements and assessment, soil conservation and protection of natural environments.

Examination of past and present geological processes related to the development of earth history.

Management and prediction of geological hazards and avoidance of environmental problems in the future.

Evaluation of human activity directly affecting and necessarily modifying the natural habitat through the construction of buildings, communication links, dams, underground excavations etc. Such activities can have a profound and irreversible effect on the use of indigenous natural resources, on the environment in general and on geology in particular for example dewatering, polluting discharges, underground storage, and land-use.

IMPORTANCE OF QUALITY GEOLOGICAL DATA

Given the increasing stress on the Earth's ecosystems it is essential that the data, interpretations and advice provided by the profession be of the highest technical standard. Too often there are examples where this is not the case, where unqualified or inexperienced personnel are contracted to complete the studies, where unqualified personnel 'sign off' on the studies, and indeed examples where the necessary studies have not even been commissioned.

There are many examples of hazards where quality geological input would minimise risks to life, property and environment. Examples include:

> **Water Supply and Quality**: Groundwater is an important natural resource in the State and accounts for 20 to 25 per cent of drinking water supplies, with the proportion rising to 90 per cent in rural areas (DELG/EPA/GSI 1999). A very large number of groundwater supply sources exist, with at least 100,000 in use (DELG/EPA/GSI 1999). However, only a small proportion of the available groundwater resource is currently being used. In general, in Ireland the majority of private groundwater supplies are untreated. This heightens the need for aquifer and source protection and the treatment of groundwater to ensure that the quality of drinking water conforms to the requirements of the Drinking Water Regulations (SI No. 81 of 1988). Additionally, as groundwater may ultimately discharge from an aquifer as base or spring flow to rivers, wetlands, estuaries, quarries or springs, the latter may be affected adversely if such discharge is polluted (*McGarrigle et al. 2002 Water Quality in Ireland 1998 - 2000. Environmental Protection Agency, Wexford*).
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> **Waste Disposal**: Ireland currently produces approximately 7 million tonnes of solid waste plus in excess of 65 million tonnes of varied agriculture wastes and sewage sludges. The solid waste is generally disposed off in landfill sites and most of the agriculture wastes and sewage sludges are disposed off by spreading on landbanks. All waste disposal has the potential to pollute elements of the environment, particularly surface and groundwaters. Thus to protect the environment it is imperative that comprehensive geoscientific and engineering investigations are carried out during the appraisal and selection of areas for the construction of waste disposal facilities or landbanks for waste spreading.
>
> **Land Use**: Economic and social pressures dominate the planning of land use, although environmental factors are increasingly important. Decision-makers have tended to ignore geological factors, partly because the relevant information is either not readily available, or is presented in such a manner that it is poorly understood. In reality land-use issues are a complex inter-play of factors relating to resources and building materials, changing water tables, pollution, waste disposal, and over-exploitation of the coastal zone. If our planning system is to be effective we have to consider the total picture, and not just individual component parts. Thus it is essential that geological expertise be involved in the planning process.

Coastal Erosion: The natural balance between sea and land is not static, but is constantly changing with net accretion or retreat of land. Because these coastal zones are of such great socio-economic importance they have been traditionally protected by so-called “hard defences”. Increasingly however it is being realised that more integrated scientific approach is required, and that “soft defences” may be more environmentally sensitive and more sustainable in the longer term. Design of such systems will be feasible only when there is a sound basic knowledge of geological and ecological factors.

Flooding: Floods are one of the most common natural hazards that impact on human activity and the environment, with possible resultant loss of life and extensive damage to property. The geology of a river’s catchment area is an important factor in assessing the risk of flooding, and in designing systems to minimise that risk. As an example, the flooding of recent years in east Co. Galway is intimately related to the karstic nature of the limestone bedrock.

Land Subsidence: This is a well-documented problem in many European states, particularly those with significant limestone or evaporite bedrock, where groundwater dissolves the rock, leading to cavities, and eventual collapse. Modern geophysical techniques and geological mapping can provide timely information for remediation, planning and investment decisions affecting infrastructure.

Radon: Radon is a radioactive gas produced in the decay of the U^{238} present in a range of rock types. In some buildings this gas can accumulate to concentrations that pose significant risk to health. For example, long term exposure can result in lung and other cancers.

Mining and Quarrying: Ireland has a long history of mining going back to the bronze age. In the last few decades Ireland has been the largest zinc producer in Europe. As well as our zinc mining industry, which is worth approximately €200m, there is a thriving aggregate industry. Detailed geological examination is required for these projects to assess the resource, ground stability and safety, long term restoration and impact on groundwater.

GEOLOGICAL CONTENT OF ENVIRONMENTAL IMPACT STATEMENTS

OPENING STATEMENT

All projects and developments that require an EIS are likely to have an impact on the environment. It is therefore necessary to determine all details of the nature of the existing environment at the proposed site and the surrounding area that would be affected by the development. An appropriate geological investigation of the site and the surrounding area is a fundamental part of any determination of the existing environment in an EIS.

A comprehensive geological study requires and comprises:

- The use of regional geology maps.
- A site investigation to include the appropriate use of mapping, sampling, trenching/pitting, drilling, geophysics, geotechnical appraisal of soil and rock properties and laboratory analysis of soil, rock and water samples.
- The preparation of a geological report including appropriate maps and sections.

The issues to be addressed in an EIS are defined in Article 3 of the EU Directive 85/337/EC and S.I. 93 of 1999. This lists 10 topics that an EIS should consider to assess the direct and indirect effects that a project might have . These topics are:

- Human beings,
- Fauna and flora,
- Soil,
- Water,
- Air,
- Climate
- Landscape,
- Material assets,
- Cultural heritage,
- and the inter-action between the factors mentioned above.

There are a range of issues under most of these 10 topics that are directly relevant to geology, but some issues that are not generally directly related to geology. The Scoping Phase of the EIS process should determine the relevance of geology to these issues and the appropriate level of the required geological investigation and reporting.

The following pages are set out in tabular form and divided into three main sections: 'Existing Environment', 'Likely Significant Impact' and 'Mitigation Measures'. In each section the importance of geology to relevant topics is outlined.

The first column shows those topics, as listed in the EIA regulations, which are relevant to geology. (Topics such as Flora and Fauna will not normally require a significant input from geology, although there may be exceptions, e.g. where a particular flora may be dependent on the underlying geology.)

The second column ('Issues') deals with the scope of the topics as described by the EPA (March 2002). Again the issues listed are those of significance to geology.

The third column gives more detail to help identify the types of geological issues that need to be assessed. For example, under 'Human Beings', geology should be addressed under the issue of Health & Safety, which is relevant where there is potential for concentrations of radon gas emanating from the subsoil or bedrock beneath a proposed development.

The geological issues listed in each of the three main areas ('Existing Environment', 'Likely Significant Impacts' and 'Mitigation Measures') are by no means exhaustive. In particular, examples for mitigation will have to be addressed on a site-specific basis and best practice should apply. Many of the issues outlined below may not be relevant to particular developments. This chart should be used as a guide for identifying areas where geological input may be necessary.

Professional Geologists, Regulatory Authorities, consultants and authors of EISs should use the table as a checklist to ensure all relevant aspects of geology are addressed.

EXISTING ENVIRONMENT		
Topic	***Issues***	***Geology issues***
Human Beings	Health & Safety	• *Trace element levels:* Possible public safety issues relating to contaminated soil or groundwater containing potentially harmful levels of trace elements. • *Radon Gas:* The potential for the concentration of radon gas emanating from the subsoil or bedrock beneath the proposed development. • *Ground stability:* Potential public safety issues relating to ground stability conditions during all phases of the proposed project.
	Land use	• *Land use and geology:* The influence of geology on the current land-use.
Soils	Mineral Soils	• The *soil descriptions* should include: - Soil texture and structure. - Regional setting. - The extent and thickness of the different soils. - Discontinuities/Preferential flow paths. - Colour. - Soil name and type. - Geochemistry. • *Geomorphology* • *Surface water* on the site and direction of flow.
	Geology (surficial and bedrock deposits)	• *Regional geological setting* should include a description and geological maps, of bedrock and Quaternary geology (at appropriate scale). • *Local geological setting*: including depth to bedrock, rock types, and surficial deposits and alteration, weathering and structures, with appropriate maps and cross-sections. • Details of *site investigation data*: including all trial pits, borehole logs/locations, and tests (e.g. physical properties, geochemistry), with appropriate scale maps. • *Geophysical investigations*: results of any geophysical investigations with interpretative report.
	Peat/fens	• *Peatland*: Type of peatland, i.e. raised bog, blanket bog, fen, cutover areas. For raised bog, presence and role of acrotelm and catotelm. • *Geometry* of the peatland, including boundaries and thickness. • *Bedrock and subsoil* types surrounding and beneath the peatland. • *Hydrology and hydrogeology* • *Position* of the peatland in the landscape. • *Peat Stratigraphy* if relevant. • *Conceptual Model:* Details of conceptual model of the peatland, integrating the geological, hydrological and hydrogeological aspects should be given. In some cases numerical modelling may be required.
	Estuarine sediments	• *Description of the sediments* should include: - Type of sediment.

EXISTING ENVIRONMENT		
Topic	***Issues***	***Geology issues***
		- Geometry of the sediments, including boundaries and thickness. - Engineering characteristics.
	Engineering Characteristics	• *Soil/subsoil/bedrock description* and classification. • *Rock Mass Classification*. • *Strength.* • *Permeability.* • *Compressibility.* • *Chemical composition, pH.* • *Excavatability.* • Re-use potential of any *excavated soil/rock.*
	Vibration	• *Site Description*: Location of and distance to residence(s), structure(s) or animal(s) that are likely to be impacted by blasting activities. • *A site specific vibration survey*: - The response to blasting activity should be determined in all directions so as to ascertain whether there is any heterogeneous response. • A trial blast should be carried out to determine the blasting parameters.
	Aquifers	• *Type of aquifer(s):* - Aquifer geometry (extent, thickness, slope, etc.). - Annual recharge, and infiltration conditions in soil and subsoil. - Water table level, and type (perched, confined, unconfined). - Water table fluctuations (seasonal, extremes). - Groundwater flow direction and gradient (with evidence). - Aquifer properties (permeability, transmissivity, storage) and classification (regionally important, locally important, etc.). - Groundwater quality: details of sampling points (well construction, depth, water level), sampling dates, parameters measured, methods of sampling and analysis.
Water Water (continued)	Ground/surface Physical Chemical Ground/surface Physical Chemical (continued)	• *Surface watercourses* on and around the site, directions of flow, with appropriate data describing the quantity of flow (by season, and at extremes of flood/drought), and water quality parameters. • *Groundwater* conditions beneath and around the site. • *Groundwater quality:* details of sampling points (well construction, depth, water level) sampling dates, parameters measured, methods of sampling and analysis. • *Groundwater vulnerability*: based on thickness and permeability of subsoil. • *Groundwater usage*: locations of abstraction points (dug wells, boreholes, springs), quantities used.

EXISTING ENVIRONMENT		
Topic	***Issues***	***Geology issues***
		• *Karst features*: location and type. • *Wetland* sites of recognised and potential ecological value. • *Conceptual Models*: Interpretative report including a conceptual model of the hydrogeological regime and groundwater / surface water interaction.
Landscape	Character	The current landscape is a result of the geological and geomorphological history of an area. Issues include: • Landscape type e.g. hill or valley • *Influence of geology* and geomorphology on the current landscape. • *Character of the landscape* e.g. elevation, relief, slopes, etc.
Material Assets	Natural resources of economic value	**Extractive Industry** Site description as for bedrock but with a detailed description of the natural resource of economic value to be extracted. The "Code for Reporting of Mineral Exploration Results, Mineral Resources and Mineral Reserves", October 2001, should be used. • *Resource-reserve estimation* The mineral resource and reserve must be estimated in order to demonstrate that the project is feasible. The resource-reserve estimation should include: - Appropriate drilling, trenching/pitting, geophysics and sampling techniques should define the resource. - The drill density and distribution should be sufficient to establish the degree of geological and grade continuity that is required to define the appropriate Mineral Resource and Mineral Reserve category. - The drilling should define the composition and quantity of the economic minerals and waste material. - A map showing the location of all data points used in the resource-reserve estimation plus appropriate cross sections should be included. - Detailed site topographic map should be submitted. • *Non extractive industry developments* Appraise the potential of a planned project to sterilise natural resources.
Cultural Heritage	Natural Heritage	• *Natural Heritage Areas (NHA)/Special Areas of Conservation (SAC):* Any NHAs and SACs relevant to the development. • *New Sites*: Studies conducted for an EIS may identify new sites of geological/geomorphological importance, which may be classified as geological heritage sites.

LIKELY SIGNIFICANT IMPACTS		
Topic	**Issues**	**Geology issues**
Human Beings	Health and Safety	• *Trace element levels*: Impact of naturally occurring elevated levels of potentially harmful trace elements in soils/bedrock and groundwater should be evaluated. • *Radon:* Impact of radon on a proposed development and the affect of the development on radon. • *Ground stability* throughout all phases of the development.
	Land use	• *Land-use and geology*: Impact of development on land-use.
Soils	Mineral Soil	• *Contamination* of the soil by leakages or spillages. • *Compaction* of the soil during the construction phase or by the development of paved or built up areas. • *Instability* of the soil on site and within the immediate vicinity, usually as a result of excavation or underground development. • The *removal* of soil from the site.
	Geology (surficial and bedrock deposits)	The impact of a development on the geology and structure should be assessed in terms of: • The removal of surficial/bedrock deposits. • The surficial/bedrock deposits' stability.
	Peat/fens	• *Activities:* The impact of peat cutting, drainage, afforestation and agricultural activities on the peatland • *Groundwater abstraction*: Lowering of water levels, drying out, subsidence and damage to ecosystems. • *Contamination* of water.
	Estuarine sediments	• Impact of the proposed project on the erosion and deposition of estuarine sediments.
	Engineering Characteristics	• *Ground conditions:* Any impact, which may result from the development, e.g. subsidence, slope stability, compaction, failure.
	Vibration	• The impacts of vibration in terms of magnitude, frequency and consequences. • Nuisance and/or adverse effects to humans and animals. • Structural damage.
Water Water	Surface/ground water Chemical Physical Surface/ground	**Quantitative impacts:** • Effect of groundwater abstraction on yields of nearby wells, flows in nearby springs or streams, or water levels in wetlands (e.g. fens or turloughs). • Reduction of groundwater recharge, e.g. by the creation of large built-up or paved areas (buildings, car parks, roads, airfields, etc.) and disposal of runoff to surface water. • Increase of groundwater recharge, e.g. by disposal of storm-water from large paved areas directly into aquifers. **Qualitative impacts**: • Disposal of effluents or contaminated surface runoff to the ground or directly into aquifers. • Leakages or spillages into the ground of contaminating liquids or soluble or degradable solids. • Changes in groundwater flow due to abstraction may draw

LIKELY SIGNIFICANT IMPACTS		
Topic	**Issues**	**Geology issues**
(continued)	water Chemical Physical (continued)	poor quality groundwater into the aquifer, from another aquifer or from saline coastal water. Using an appropriate 'Source-Pathway-Target' model, examine in turn the potential contamination source ('hazard'), the potential pathway for contamination, and the aquifer(s) and groundwater sources ('targets') which might be contaminated. **Hazards which may result from the development:** • Effluent disposal. • Storage of potential contaminants (tanks, etc.). • Areas where spillages or leakages might occur (e.g. refuelling areas, loading bays). **Pathways:** • Direction and rate of travel of contaminants. • Attenuation and/or dilution likely to occur *en route*. • Time scale for arrival of contaminants at targets. • Appropriate monitoring to give timely warning of any contamination. • Evaluation of monitoring points, construction and types of monitoring facilities, frequency of monitoring and parameters to be measured. **Targets:** (described under 'Existing Environment') • Impact on aquifer and down-gradient groundwater sources.
Landscape	Character	• Impact of a development on the landscape.
Material Assets	Natural resources of economic value	Mineral extraction involves the physical removal of the mineral resource and waste material by either surface or underground operations. Issues include: • Extraction of the resource. • Extraction of waste material. • Lowering of the water table. • Spoil heaps – their size, composition, location. • Potential for Acid Rock Drainage (ARD) and Acid Mine Drainage (AMD). • Waste disposal – composition, quantity, disposal method and location. • Subsidence due to surface excavation or underground development. • Sterilisation of the site by the exploitation of the mineral resource. • Sterilisation of potential natural resources by other developments.
Cultural Heritage	Natural Heritage	• *NHA/SAC:* Development could result in damage or destruction of the site. • *New Sites*: The impact may need to be re-assessed in light of any newly identified natural heritage site.

MITIGATION MEASURES

Mitigation measures will depend on the development, location and issues of each individual case. Therefore there can be no comprehensive list of mitigation measures. The table below lists some examples of types of mitigation measures, which could be used in some circumstances. Best Practice should be applied in all cases. The table also highlights issues to be aware of in order to ensure that mitigation measures are in place to deal with the issues.

MITIGATION MEASURES		
Topic	Issues	Geology issues
Human Beings	Health & Safety	• *Trace element levels:* Where harmful levels of trace elements have been identified, mitigation measures could include removal of soil or some other mechanism which will ensure there is no risk to public health. • *Radon:* Compliance with 1997 Building Regulations for developments in high radon areas. • *Ground Stability:* Application of a design or support procedures, which will ensure that ground stability will not be a health issue.
Soils	Mineral Soils	Measures to reduce potential impacts on the soil should be defined. Such measures could include: • Protection of watercourses. • The storage and re-use of topsoil and subsoil for rehabilitation. • Geotechnical stabilisation within the area.
	Geology (surficial and bedrock deposits)	• Measures to ensure the stability of the bedrock during each phase of the life of the development. • Measures to reduce potential impacts from removal of surficial/bedrock deposits from the site.
	Peats/fens	• If water levels are affected, measures such as building dams to minimise the water loss should be considered.
	Engineering Characteristics	• Ensure that the planning, design and construction of the proposed development takes into account the engineering characteristics of the ground. • Mitigation measures for vibration fall into three categories: (i) Avoidance: Use of other methods to effect fragmentation of rock may be possible. (ii) Reduction: Reduction of the 'maximum instantaneous charge' so as to limit the impact to a specified level (peak particle velocity and air overpressure) at particular distances or sensitive receptors. There may also be different levels for specified times and frequency of blasting. (iii) Remedy: If damage to a third party occurs as a result of blasting activities, a remedy should be offered to the party, e.g. reinstating buildings or structures.
Water	Groundwater	• Measures to deal with potential raising and lowering of

MITIGATION MEASURES		
Topic	Issues	Geology issues
	Surface water Physical & Chemical Properties	the water table, or effects on springs or surface water. • Measures to prevent/avoid contamination e.g. bunding of refuelling areas, lining of ground around underground storage tanks. • Back-up plans to deal with the possibility of contamination, e.g. pumping of wells to collect contaminated groundwater for treatment. • If water supplies are affected, provision of new supply.
Landscape	Character	Proposed mitigation measures could include: • The use of local stone materials. • The re-use of excavated local soil and rock. • Design features to replicate or simulate local landscape character features, e.g. slope angles, stone walls, natural outcrops. • Avoidance or mitigation of specific single features such as inappropriate screening, which might impact on the landscape character.
Material Assets	Natural resources of economic value	• Measures to reduce the impacts caused by the mineral extraction during the preparation, operation and post-operation phases of the project. • Limitation and control of Acid Rock Drainage (ARD) from the worked-out areas and the spoil heaps. • Rehabilitation of waste dumps. • Geotechnical stability of the workings.
Cultural Heritage	Natural Heritage	• Measures to limit impacts on the specific sites. • Where a site is impacted, a full investigation of the site.

GEOLOGY IN THE CONTEXT OF PROJECT TYPES

A number of project types have been identified by the EPA (March 2002). The effects of these developments are described under topics including "soil (and geology)". Geology is significant for most of these project types and a full report on the existing environment, likely significant impacts and mitigation should be included.

The Table below lists the Project types, a brief description of the relevance of geology to that Project Type and the main topics under which geology should be taken into account. Many of the issues listed here are given in the EPA guidance (March 2002) although others have been added. Topics may vary depending on the specifics of the project and its location. For example, issues such as heritage or sterilisation of natural resources will depend on the existing environment of the development. These issues should be examined for all major projects.

The list of issues given here is not exhaustive. It highlights the main issues, which may require additional investigation for particular Project Types. All developments should assess the geology for many reasons such as rock stability for buildings/structures, water pollution, sustainable development (natural resources may be sterilised due to any development and this should be assessed for each project).

Project Type	Significance of Geology	Topics
Project Type 0 Crude oil refineries	• Soils obliteration • Soils acidification from atmospheric accretions • Effects of any shore works on sediment movement • Impact on groundwater • Removal of rock/soil • Rock Stability	Soils Water
Project Type 1 Installations for the gasification and liquefaction of coal or bituminous shale Coke ovens (dry coal distillation)	• Soils obliteration • Soils for waste disposal site coverings • Soils erosion by wind • Seepage of run-off of contaminants • Dissolution of airborne emissions • Surface/groundwater abstraction • Rock stability for the development	Soils Water
Project Type 2 Thermal power stations or other combustion installations Installations for hydroelectric energy production Industrial installations for the production of electricity, steam and hot water	• Soils acidification • Soils for bunding • Impact on groundwater - damming watercourses. • Rock stability • Removal of rock/soil	Soils Water
Project Type 3 Nuclear power stations or other nuclear reactors Installations for the production or enrichment of nuclear fuels Installations for the reprocessing of irradiated nuclear fuels Installations for the collection and processing of radioactive waste	• Sink of radioactivity • Rock stability • Removal of rock/soil • Impact on groundwater • Land use as a large amount of land is required • Impact on Natural Resources e.g. sterilisation	Soils Water Landscape Material Assets
Project Type 4 Installations designed solely for the permanent storage or final disposal of radioactive waste	• Nature of rock, rock stability, hydraulic conductivity • Impact on groundwater - Long-term and cumulative discharges to groundwater • Rock/soil removal • Impact on Natural Resources e.g. sterilisation • Land use	Soils Water Landscape Material Assets

Project Type	Significance of Geology	Topics
Project Type 5 Integrated works for the initial melting of cast iron and steel Iron and steelworks, including foundries, forges, drawing plants and rolling mills Installations for production of non-ferrous metals Installations for pressing, drawing and stamping of large castings Installations for surface treatment and coating of metals Installations for the roasting and sintering of metallic ores Swaging by explosives Storage of scrap iron	• Nature of rock, rock stability • Rock/soil removal • Impact on groundwater.	Soils Water
Project Type 6 Installations for the extraction of asbestos or for the processing and transformation of asbestos or products containing asbestos	• Impact of rainwater/surface run-off management system to avoid contamination of groundwater	Water
Project Type 7 Processing and chemical industries Installations for manufacturing, packing, loading or placing in cartridges of gunpowder or explosives Installations for the manufacture of cement Installations for treatment of intermediate products and production of chemicals Installations for the production of pesticides and pharmaceutical products, paints and varnishes, elastomers, peroxides and elastomer based products Storage facilities for petrochemical and chemical products Installations for the manufacture of glass Installations for the manufacture of mineral fibres	• Rock/soil stability • Contamination of soil by discharges • Impact on groundwater - Abstraction and discharge - Leakage of effluent - Leakage of stored chemicals • Impact on Natural Resources e.g. sterilisation	Soils Water Material Assets
Project Type 8 Railway lines Tramways Elevated or underground railways	• Rock/Soil stability • Rail ballast sources • Induced erosion • Impact on groundwater - Use of herbicides • Land use • Impact on Natural Resources e.g. sterilisation	Soils Water Material Assets
Project Type 9 Aerodromes Runways	• Rock/soil contamination due to fuel spillage • Loss of soil profiles during construction • Rock/soil stability • Impact on groundwater - Reduced groundwater percolation due to introduction of large hard surfaced and compacted earth areas - Contamination due to spillages/leakages - Use of pesticides or fertilisers - Impact of de-icing agents, dumped fuels, and fire-fighting materials • Impact on Natural Resources e.g. sterilisation	Soils Water Material Assets
Project Type 10 Ports Sea-water marinas Fresh-water marinas	• Impact on rock/soils - Excavation - Stability - Erosion - Spoil deposition/removal - Erosion and siltation • Impact on groundwater - Spillages - Seepage from storage areas	Soils Water
Project Type 11 Use of cultivated lands or semi-natural areas for intensive agricultural purposes Initial afforestation Replacement of broadleaf high forests with conifers Land reclamation for the purpose of conversion to another type of landuse Reclamation of land from the sea	• Nature of rock/soil - Erosion - Stability/settlement - Drainage - Flooding - Removal of rock/soil - Alteration of soil structure/fertility • Impact on groundwater • Impact on Natural Resources e.g. sterilisation	Soils Water

Project Type	Significance of Geology	Topics
Project Type 12 Water management projects for agriculture Water impoundment (including hydroelectric generation) Canalisation Flood relief	• Nature of rock/soil - Erosion - Excavation/Stability - Deposition of soil - Loss of/changes to soil • Impact on groundwater - Changes to the physical, chemical and biotic characteristics of water bodies - Effects on flow regime - Changes to water table • Impact on geological heritage	Soils Water Heritage
Project Type 13 Intensive animal rearing Pig-rearing installations Poultry-rearing installations	• Nature of Rock/soil - Transmissivity and hydraulic conductivity of rock • Nutrient levels in soils • Assimilative capacity of soils • Impact on groundwater - Leakage from effluent (including during transportation) - Pollution by contaminated run-off/seepage - Dumping of carcasses - Location and timing of slurry spreading	Soils. Water.
Project Type 14 Salmonid breeding installations	• Impact on groundwater - Abstraction and discharges (land based only)	Water
Project Type 15 Peat extraction	• Nature of rock • Impact on groundwater - Susceptibility to water and wind erosion - Effects of drainage/lowered water table - Changes of soil texture, drainage, chemistry - Pollution of surface waters by peat silt. - Changes in bed and oxygen conditions - Changes in flowrates/downstream effects • Impact on geological heritage	Soils. Water. Material Assets. Heritage.
Project Type 16 Major drilling projects Geothermal drilling Drilling for storage of nuclear waste material Drilling for major water supplies	• Nature of rock/soil - Stability of rock - Extraction/deposition of drilled material - Capacity of existing regime to sustain extraction - Capacity of existing regime to sustain containment (of nuclear waste) - Contamination due to leakage/spillage - Subsidence potential • Impact on groundwater - Contamination potential with particular reference to the development of contaminated groundwater and migration over long time periods - Depletion of reserves - Effects on surface waters/wetlands • Impact on Natural Resources e.g. sterilisation	Soils. Water. Material Assets.
Project Type 17 Mining (opencast) Mineral extraction, by surface or underground methods of material other than sand, gravel, stone or clay, i.e., minerals as defined under the Minerals Development Acts, including metal ores, coal and a variety of industrial minerals Surface industrial installations for extraction of ores	• Nature of rock/soil - Stability of soil and rock - Potential for subsidence - .Effects of vibration from blasting - Transmissivity and hydraulic conductivity of rock • Impact on Groundwater - Contamination from surface or underground mine workings - Acid mine drainage - Lowering of water table - Contamination from tailings or waste rock - Potential for post-mining contamination due to effects of dewatering workings • Impact on Geological Heritage • Land-use change, effects on agriculture due to mining activities • Consumption of finite Natural Resources	Soils Water Heritage Material Assets

Project Type	Significance of Geology	Topics
Project Type 18 Quarrying of sand, gravel, stone or clay	• Nature of rock/unconsolidated sediments/soil - Stability of rock - Potential for erosion/subsidence - Effects of vibration from blasting - Transmissivity and hydraulic conductivity of rock • Impact on Groundwater - Contamination accidental spills - Lowering of water table • Impact on geological heritage • Land-use change, effects on agriculture due to quarrying activities • Consumption of finite Natural Resources	Soils Water Cultural Heritage Material Assets
Project Type 19 Fossil fuel extraction Extraction of petroleum Extraction of natural gas (on-shore and off-shore) Surface industrial installations	• Nature of rock/soil - Stability of rock - Potential for subsidence - Transmissivity and hydraulic conductivity of rock • Impact on groundwater - Potential of leakage/spillage - Impacts on groundwater chemistry/dynamics • Consumption of finite Natural Resources	Soils Water Material Assets
Project Type 20 Linear developments Installations for carrying, oil, gas, steam and hot water Installations for transmission of electrical energy by overhead cables Overground aqueducts Ski-lifts and cable-cars	• Nature of rock/soil - Removal/excavation of rock/soil (temporary/permanent) - Sourcing fill material - Soil contamination. - Potential for subsidence • Impact on groundwater - Interference with watercourses during construction - Ground/surface water quality impairment due to leakage • Impact on Geological Heritage • Impact on Natural Resources e.g. sterilisation	Soils. Water. Material Assets. Heritage.
Project Type 21 Storage facilities Installations for the surface storage of natural gas Installations for surface storage of fossil fuels Storage facilities for petroleum Installations for underground storage of combustible gases	• Nature of rock/soil - Stability of rock - Potential for subsidence - Transmissivity and hydraulic conductivity of rock - Disturbance during excavation - Seepage from storage of fossil fuel - Long term effects of soil contamination • Impact on groundwater - Surface run-off water - Leakage of hydrocarbons to ground or surface water	Soils Water
Project Type 22 Installations for industrial briquetting of coal and lignite	• Nature of rock/soil for construction - Stability of rock • Surface run-off and groundwater contamination	Soils Water
Project Type 23 Installations for metal fabrication, including production of boilers, reservoirs, tanks, other sheet metal containers, engines, vehicles, ships, aircraft or railway equipment Test benches for engines, turbines or reactors	• Nature of rock/soil for construction - Stability of rock • Impact on groundwater - Liquid waste (engine oil and kerosene solvents, etc)	Soils Water
Project Type 24 Food industry production facilities Installations for the manufacture of the following: Vegetable and animal oils and fats; Packing and canning of animal and vegetable products; Confectionery and syrup; Starch; Fish-meal and fish oil; Sugar; Dairy products Installations for commercial brewing, distilling and malting	• Nature of rock/soils - Transmissivity and hydraulic conductivity of rock - Effects of land-spreading of wastes (particularly in dairy sector) • Impact on groundwater - Pollution from discharges/effluent (addition of nutrients, organic materials). - Abstraction	Soils Water
Project Type 25 Installations for the slaughter of animals	• Nature of rock/soils - Transmissivity and conductivity of rock. • Impact on groundwater - Pollution due to high BOD content of waste - Contaminants such as feathers and fat (suspended solids impacts) - Temperature increase - Run-off	Soils Water

Project Type	Significance of Geology	Topics
Project Type 26 Textile and leather processing Installations for the following: Scouring, degreasing or bleaching wool; Leather tanning or dressing; Fell-mongering; Fibre-dying	• Nature of rock/soils - Transmissivity and hydraulic conductivity of rock. • Impact on groundwater - Abstraction (requirements for hot water are substantial) - Assimilative capacity of receiving water - Contamination of ground and surface waters - Effects of dyes - Effects of biocides and moth proofing agents	Soils Water
Project Type 27 Timber based products Installations for the production of the following: Fibre board, particle board or plywood; Pulp, paper or board; Cellulose (processing and production)	• Nature of rock/soils - Transmissivity and hydraulic conductivity of rock - Soil type • Impact on groundwater - Abstraction - Discharges of effluent - Chemical spillage - Leakage on disposal	Soils Water
Project Type 28 Development projects Industrial estates Urban development projects Holiday villages Stationary caravans or trailers Hotel complexes	• Nature of rock/soils - Transmissivity and hydraulic conductivity of rock - Stability of rock • Impact on groundwater - Supply capacity - Effluent disposal capacity - Water table effects • Impact on Natural Resources e.g. sterilisation	Soils Water Material Assets
Project Type 29 Motorways Other roads Bridges Permanent racing and test tracks for cars and motor cycles	• Nature of rock/soils - Transmissivity and hydraulic conductivity of rock - Stability of rock - Erosion • Impact on groundwater - Interference with drainage patterns - Run-off pollutants - Construction impacts to watercourse - Effects of de-icing chemicals and herbicides - Potential for accidental spills • Impact on Natural Resources e.g. sterilisation	Soils Water Material Assets
Project Type 30 Waste water treatment plants	• Nature of rock/soils - Transmissivity and hydraulic conductivity of rock - Rock stability • Impact on groundwater - Contamination by uncontrolled surface run-off - Pathogens released with water	Soils Water
Project Type 31 Installations for the disposal of industrial and domestic waste Sludge deposition sites Landfill operations	• Nature of rock/soils - Rock stability - Need for material capping. - Deterioration of capping soils due to upward migration of contaminants - Transmissivity and hydraulic conductivity of rock • Impact on groundwater - Contamination by uncontrolled surface run-off - Contamination of groundwater by leachates - Movements of contaminated groundwaters	Soils Water
Project Type 32 Hazardous waste Incinerators Chemical treatment plants	• Nature of rock/soils - Transmissivity and hydraulic conductivity of rock - Rock stability • Impact on groundwater - Contamination of surface and groundwater - Dissolved airborne contaminants	Soils Water

APPENDIX

INFORMATION BODIES

Environmental Protection Agency (EPA) (Web site: www.epa.ie)
Geological Survey of Ireland (GSI) (Web site: www.gsi.ie)
Teagasc
Met Eireann
Local Authorities
Radiological Protection Institute of Ireland
Dúchas
Bord na Mona
ENFO
The Heritage Council
Irish Aviation Authority
Department of Communication, Marine and Natural Resources
Department of Justice, Equality and Law Reform
Department of the Environment and Local Government
Institute of Geologists of Ireland (Web site: www.igi.ie)

LEGISLATION

EU Directives

1. Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment.
2. Council Directive 97/11/EC amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment.

Irish Legislation

1. European Communities (Environmental Impact Assessment) Regulations, 1989 (S.I. No. 349 of 1989).
2. European Communities (Environmental Impact Assessment) (Amendment) Regulations, 1994 (S.I. No. 84 of 1994).
3. European Communities (Environmental Impact Assessment) (Amendment) Regulations, 1996 (S.I. No. 101 of 1996).
4. European Communities (Environmental Impact Assessment) (Amendment) Regulations, 1998 (S.I. No. 351 of 1998).
5. European Communities (Environmental Impact Assessment) (Amendment) Regulations, 1999 (S.I. No. 93 of 1999).
6. European Communities (Environmental Impact Assessment) (Amendment) Regulations, 2000 (S.I. No. 450 of 2000).
7. European Communities (Environmental Impact Assessment) (Amendment) Regulations, 2001 (S.I. No. 538 of 2001).

Planning and Development Acts and Regulations

1. Planning and Development Act, 2000 (No. 30 of 2000).
2. Local Government (Planning and Development) Regulations, 1994 (S.I. No. 86 of 1994).

3. Local Government (Planning and Development) Regulations, 1999 (S.I. No. 92 of 1999).
4. Local Government (Planning and Development) (Amendment) Regulations, 2001 (S.I. No. 539 of 2001).

PUBLICATIONS

EPA Guidance
Guidelines on the Information to be contained in Environmental Impact Statements. Published by the Environmental Protection Agency, March 2002.

IGI GUIDELINES

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FURTHER READING

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Daly, D. and Johnston, P., 1994 The hydrodynamics of raised bogs: an issue for conservation. Proceedings of AGMET Group (Ireland) and Agricultural Group of the Royal Meteorological Society (UK) Conference 'The Balance of Water – Present and Future', TCD, September 7-9, 1994.

Streefkerk, J.G. and Casparie, W.A., 1989. The hydrology of bog ecosystems. Staatsbosbeheer, National Forest Service in the Netherlands, Utrecht.120pp.