Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements

INSTITUTE of GEOLOGISTS of IRELAND

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CONTENTS

Figures

Appendices

Foreword

President of the Institute of Geologists of Ireland (2011-13)
EurGeol Dr. Deirdre Lewis PGeo

The Institute of Geologists of Ireland ("IGI") was formed in 1999 to promote the science and profession of geology in Ireland and to raise the awareness of the importance of geology and related geosciences to society.

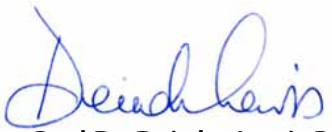
The Institute has strict professional membership requirements, which entitle its members to use the title Professional Geologist (PGeo). It requires and assists its members to uphold, develop and maintain the highest professional and ethical standards in the practice of their profession. It has been recognised as the self-regulating body for professional geologists and geoscientists practising in Ireland. See **www.igi.ie** for more details on becoming a professional geologist, membership, continuous professional development and upcoming events.

In 2012, the IGI Board commissioned a Working Group of IGI members to review and, where appropriate, update the earlier 2002 guidelines, *Geology in Environmental Impact Statements, A Guide* (IGI, 2002). These updated guidelines reflect the significant legislative changes in both Ireland and Europe in the interim, as well as the profound operational experience developed in the production of Environmental Impact Statement (EIS) chapters by geoscientists, since the original guidelines were produced.

The revised Guidelines reflect the multi-disciplinary nature of much of the work of a professional geologist and provide a practical framework within which to address all aspects of geological endeavour within an EIS.

It is with great pleasure that I commend these revised Guidelines to our membership and the wider public with an interest in the sustainable development of our natural resources and other developments requiring consideration of soil, geological and hydrogeological aspects of the environment.

I am also delighted to acknowledge the enormous voluntary effort contributed by the Working Group; many thanks to you all.



EurGeol Dr. Deirdre Lewis PGeo

April 2013

1 INTRODUCTION

The Environmental Impact Assessment Directive (Council Directive 85/337/EEC as amended by Directive 97/11/EC) requires member States of the EU to carry out assessments of the environmental impact of certain projects before they are allowed to proceed. The aim of the Environmental Impact Assessment (EIA) process is to ensure that projects which are likely to have a significant effect on the environment are assessed in advance and it is the responsibility of the Competent State Authority to undertake this process (e.g. a planning authority, EPA etc).

As part of the EIA process, some projects may require the developer to assess the likely effects (good and bad), of a proposed development on the environment and to submit a document detailing these effects. In the Republic of Ireland (RoI), this document is referred to as the Environmental Impact Statement (EIS). In the RoI, the Competent Authority (e.g. the Planning Authority, An Bórd Pleanala etc) carries out an EIA. An EIS is prepared by (or on behalf of) the proposed project Developer (the Client).

This publication provides guidance and a methodology for the assessment of the likely impacts, which a proposed development may have on soils, geological and hydrogeological environments, for the inclusion in an EIS. These guidelines should be applied to projects for which an EIS specifically is required to be produced. They do not deal with the alternative site assessment stage or route selection reports, although the main principles of this document may be applied in some cases.

Some developments may also require the consideration of other environmental legislation to be taken into account e.g. an Appropriate Assessment (AA) or a Strategic Environmental Assessment (SEA) may be required. When considering the environmental impacts of a development, all relevant legislation should be considered and the appropriate level of assessment undertaken.

A 13-step methodology, which is divided into four distinct elements, is outlined in this guidance document as follows:

- **Element 1:** Initial Assessment (Steps 1 to 5)
- **Element 2:** Direct and Indirect Site Investigation and Studies (Steps 6 to 9)
- **Element 3:** Mitigation Measures, Residual Impacts and Final Impact Assessment (Steps 10 to 12)
- **Element 4:** Completion of the Soils, Geological & Hydrogeological Sections of the EIS (Step 13)

The methodology matches the scale of studies and works carried out during each stage of the preparation of the EIS with the sensitivity of the receiving soils, geological and hydrogeological environment and the activities associated with the proposed development. The recommended procedure also provides for the development of a conceptual site model (CSM) with revisions to the CSM required as additional information becomes available throughout the preparation of the EIS.

The recommended methodology also requires that the level of work undertaken should reflect the scale and nature of the proposed development. A matrix is provided which clearly outlines the minimum level of information which should be gathered during the EIS. This is based on the range of activities which will take place during the construction, operation and, where relevant, the aftercare of the proposed development and aligns the type of investigations with the nature and sensitivity of the receiving environment.

These guidelines, however, do not remove the need for professional judgement when considering the information to be gathered and the level of assessment to be undertaken and it is highly

recommended that a Competent Person[1] be appointed to undertake the assessment.
This publication is designed to complement other relevant guidelines to ensure a consistent approach for the preparation of impact assessments for soils, geology and hydrogeology. The consideration of interactions with other relevant disciplines is an important aspect of preparing an EIS and is included in the recommended methodology described in Section 3.2 below.

It is recognised that both national and EU legislation and guidelines relating to environmental impact assessments will be continually reviewed and updated in light of experience and the stresses placed on the natural environment. The primary EU Directive relating to EIA is currently in a review and update process. The practitioner is encouraged to keep up to date with any changes to environmental legislation and to apply these guidelines in the context of the legislative position pertaining at the time.

The recommended procedure and methodology outlined in these guidelines are generic in nature and could be applied or implemented in any Member State. This specific document draws upon experience, guidance and legislation in the RoI and these guidelines are commended by the IGI for use on projects in the RoI. The Practitioner should acquaint themselves with its applicability in other Member States.

[1] A Competent Person in the area of soils, geology and hydrogeology 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.

2 LEGISLATION AND GUIDANCE

2.1 General Context

A wealth of relevant legislation and guidelines exists with respect to both the legislative requirements for the preparation of EIS chapters and assessments related to soils, geology and hydrogeology. These are listed in **Appendix A** of this publication, including those related to disciplines which may interact with geology and hydrogeology.

The catalogue of legislative and guideline references given in **Appendix A** is current at the time of going to print. The reader should refer to Government and to other organisations producing the guidelines listed for changes to the legislative position and for updated versions of the various guidelines that may have been published since the date of this publication. In particular, the primary EU Directive relating to EIA[2] is currently in a review and update process.

The current legislative requirement to include an assessment of the soil, geological and hydrogeological environments in an EIS is discussed briefly below.

Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA) are considered to be very significant instruments in the implementation of EU environmental policy. A comprehensive assessment of potential impacts is required to be undertaken for projects which are likely to have a significant effect on the environment under the EIA Directive (Council Directive 85/337/EEC of 27th June 1985 as amended by Directive 97/11/EC of 3rd March 1997, Directive 2003/35/EC of 26th May 2003 and Directive 2009/31/EC of 23rd April 2009).

The above EU legislation has been transposed into national legislation of Member States. The Practitioner is strongly advised to be aware of how the Directive has been transposed in the Member State they are working in.

2.2 Republic of Ireland Legislation

The EIA Directive has been transposed into Irish legislation by S.I. 349 of 1989, S.I. 84 of 1994 and S.I. 93 of 1999 and subsequent amendments. The requirements of the legislation have also been incorporated into the Irish planning system, under the Planning and Development Act, 2000. Part X of the 2000 Act contains the relevant provisions in relation to the requirements of the EU Environmental Impact Assessment Directive in so far as the planning consent system is concerned. Part 10 of the Planning and Development Regulations, 2001, as amended, contains more detailed provisions in relation to Part X of the 2000 Act.

Section 171A was inserted into the Planning and Development Act, 2000 (as amended) by section 53 of the Planning and Development (Amendment) Act 2010 and so defines "environmental impact assessment" for the purposes of Part X of the 2000 Act as an assessment:

'that shall identify, describe and assess in an appropriate manner, in light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and

indirect effects of a proposed development on the following:

(a) human beings, flora and fauna,

(b) ***soil***, ***water***, *air, climate and the landscape*

(c) material assets and the cultural heritage, and

[2] In Ireland, the Competent Authority (e.g. the Planning Authority, An Bórd Pleanala etc) carries out an EIA. An EIS is prepared by (or on behalf of) the proposed project Developer.

(d) the interaction between the factors mentioned in paragraphs (a), (b) and (c).'

In these guidelines, the requirement to assess the potential impact of a development on ***soil and water*** is interpreted as an assessment of the soils, geological and hydrogeological environments.

The term **geological/hydrogeological environment** used in these guidelines should be interpreted as including all aspects of the soils, geological and hydrogeological environments found on the island of Ireland.

These guidelines consider the hydrogeological aspects of the water element of an EIS. However, it is recognised that groundwater and surface waters are intrinsically linked and where appropriate the inter relationship between these related water environments should be addressed by the relevant competent person.

Geological heritage is not specifically mentioned in the EIA Directive 85/337/EEC nor in the Directive amendments 97/11/EC and 2003/35/EC. In the RoI geological heritage is considered in the Directive's transposition into Irish Law through S.I. 600 of 2001, Part X. Articles 103, 109 and 120 cover geological heritage described as a geological feature and/or geomorphological feature, if it benefits of the following protection status: European site (Special Area of Conservation (SAC) under the Habitats Directive 92/43/EEC), proposed or designated Natural Heritage Area, nature reserve and/or refuge (all under the Wildlife (Amendment) Act, 2000). Finally, Article 121 covers the prescribed bodies to consult on the matter.

With regards to legislative objectives for the protection of geological heritage in RoI, geology is now recognised as an intrinsic component of natural heritage in separate pieces of legislation or regulations, which empower and require various branches of Government and statutory agencies, to consult and take due regard for the conservation of geological heritage features as follows:

- Planning and Development Act 2000 [e.g. Sections 212 (1) f; Part IV, 6; First Schedule Condition 21];
- Planning and Development Regulations 2001;
- Wildlife (Amendment) Act 2000;
- The Heritage Act 1995.

3 EIS FOR SOILS, GEOLOGY AND HYDROGEOLOGY

The legislative requirements with respect to the EIA process / preparation of EIS chapters have been outlined in **Section 2** and are detailed in the legislation in **Appendix A**. This section describes the principal considerations which should be addressed during the preparation of the geological/ hydrogeological elements of an EIS.

3.1 Consultation

A process of consultation with interested relevant parties is advised during or in advance of the preparation of EIS chapters. A non-exhaustive list of many of the recommended consultees is included in **Appendix B** of this publication.

3.2 Interaction with Other Disciplines

Soils, geology and hydrogeology chapters of EIS may typically be prepared as separate or joint chapters or with another inter-related discipline subject to the project requirements. Depending on the nature of the development and the receiving environment, the following disciplines may interact with soils, geology and hydrogeology to a greater or lesser extent. Some examples of potential interactions are:

- **Hydrology:** consideration of groundwater and surface water interactions may be required or consideration of discharges of groundwater to surface waters;
- **Ecology:** the inter-relationship of groundwater and any ecological features to be protected should be considered e.g. Groundwater Dependent Terrestrial Eco-systems or surface water ecosystems dependent on groundwater baseflows;
- **Waste:** contaminated land and volumes of waste to be excavated based on ground conditions may need to be considered;
- **Traffic:** the volume of material to be imported and exported from the site may relate heavily to the geological conditions;
- **Material Assets:** the removal, destruction or derogation of material assets e.g. the exploitation of natural resources, the potential of a planned project to sterilise natural resources or the impact of a project on water supply wells should be considered;
- **Noise, vibration and air quality:** the interactions that construction / operational activities related to geology (e.g. rock blasting / breaking) may have with noise, vibration and air quality will require an understanding of both aspects (i.e. geology and noise / vibration / air).

The level of assessment regarding the inter-relationship with these other disciplines and the decision of whether to prepare the chapter jointly or separately should be made based on professional assessment of the project requirements by a Competent Person.

3.3 Relevant EIS Definitions

It is widely recognised that the description of potential impacts relating to a proposed development varies greatly and can lead to misunderstandings between the developer, the regulatory agencies and most importantly to those potentially impacted by the development.

In an effort to minimise such misunderstandings a generic list of standard definitions has been produced by the Irish Environmental Protection Agency (EPA, 2002)[3]. Each term has been clearly defined to describe the type, quality, significance and duration of a potential and/or residual impact. It is recommended that these terms are used across all disciplines and applied to soils, geology and hydrogeology in the RoI. These terms are highlighted and summarised below and the definitions are presented in **Appendix C** of this publication.

Each potential impact for a proposed development should be described in terms of its **Quality**, **Significance**, **Duration** and **Type**. Each of these criteria have sub-descriptors associated with them, one of which should be chosen to describe that impact. These terms and their sub-descriptors are outlined below and full definitions are provided in **Appendix C**.

The **Quality** of an impact should be described as being a **Positive**, **Neutral** or **Negative** impact.

The **Significance** of an impact should be described in terms of whether it is **Imperceptible**, **Slight**, **Moderate**, **Significant** or **Profound**. The Irish National Roads Authority (NRA) have provided useful matrices outlining how these terms can be applied based on the **Importance** of the feature to be protected and the **Magnitude** of the potential impact. This process is also described in **Appendix C**.

The Duration of an impact should be described in terms of whether it is **Short-term**, **Medium-term**, **Long-term**, **Permanent** or **Temporary**.

The impact assessment should also consider the **Type** of the impact. This may be described as **Cumulative**, **'Do Nothing'**, **Indeterminable**, **Irreversible**, **Residual**, **Synergistic** or **'Worst Case'**.

Once mitigation measures are designed and incorporated, the Significance and Quality of the **residual impacts** should be described again using the above terms, clearly identifying a reduction where possible.

[3] Environmental Protection Agency, 2002. Guidelines on the information to be contained in Environmental Impact Statements.

4 RECOMMENDED PROCEDURE

Introduction

Many developments which require an EIS to be completed will have no significant impact on the geological/hydrogeological environment, such as developments which are distant from areas of geological heritage and which are connected to municipal services. On the other hand, developments such as mines, quarries, significant groundwater abstractions and discharges to groundwater would naturally impact on subsurface resources.

The preparation of an EIS sets out to determine whether the proposed development could have a significant impact on the receiving environment. A determination of whether a significant impact on the geological/hydrogeological environment will result from a proposed development requires an understanding of the hazards associated with an activity that might result in an impact as well as the type, interaction with and sensitivity of the receiving subsurface environment.

It is important therefore to identify at the outset the:

- Relative Scale of the Development;
- Range of Activities associated with the Development;
- Type of the receiving Geological/Hydrogeological Environment;
- Sensitivity of the receiving Geological/Hydrogeological Environment;
- Interaction/ relationship between the development site and nearby protected environments.

By compiling the above information, and where necessary carrying out appropriate site investigations and studies, on a phased basis and with iterative reviews taking place as more information becomes available, it should then be possible to determine:

- Whether the development has the potential to impact on the receiving Geological/ Hydrogeological Environment;
- The significance, type, duration and quality of any potential impacts;
- Mitigation measures;
- The significance, type, duration and quality of any residual Impact.

This determination will then inform the EIS as to the impact, if any, of the proposed development on the geological/hydrogeological environment and so allow for a fuller evaluation of the proposed project in the context of the planning, regulatory and wider environmental setting.

The preparation of an EIS involves an assessment of potential impacts to other aspects of the natural and man-made environments. It is important at the outset that the inter relationships between the geological/hydrogeological environment and other aspects of the EIS are established. Where such inter relationships are identified it is important that they continue to be recognised throughout the recommended procedure and addressed in the EIS.

It is recommended that the preparation of an EIS relating to the Soils/Geology and Hydrogeology sections of the EIS be carried out in four discreet Elements involving data collection and iterative reviews as shown in the flow chart presented in **Figure 1** *(see page 22)*.

Each Element of the process can be further broken down into a series of Steps depending on the scale of the proposed development, the nature of the associated activity and the type and sensitivity of the receiving geological / hydrogeological environment.

The flow chart should not be taken as prescriptive to each and every project but rather as a guideline of how the process might usefully evolve from an initial desktop exercise to the information provided in the Soils, Geology and Hydrogeology Sections of an EIS.

An initial Conceptual Site Model (CSM) should be developed at the start of the project and the use of the accepted Source-Pathway-Receptor model for assessing impacts is encouraged.

Regular iterative reviews of the Conceptual Site Model (CSM) are a key part of the recommended procedure. Such reviews and updating of the CSM, where relevant and possible, demonstrate how the information which was available at the outset of a project has been supplemented by the collection of site specific data giving confidence in the various components of the CSM.

Where professional judgement concludes that certain Elements and /or Steps of the recommended procedure are not appropriate to a particular project then an explanation as to the reason for the omission of these Elements and / or Steps should be documented in the EIS.

1st Element - Initial Assessment

This Element of the recommended procedure is broken down into 5 Steps as follows.

Step 1 – Establish the Location, Type and Scale of the Proposed Development:

The objective of **Step 1** of the recommended procedure is to compile the available and relevant information which, together with a site visit, would allow for the determination of the type and scale of the proposed development, the range of related activities and the type and sensitivity of the receiving geological / hydrogeological environment.

It is important to establish at the outset the type and scale of the project. This information should be requested from the Client and/or the project team. The information provided should be sufficiently detailed to allow for an initial assessment of how the proposed development might impact on the wider geological / hydrogeological environment.

At a minimum, maps identifying the site boundary and any related discharge points should be provided together with a plan outline and levels of any proposed earth works or deep excavations. Information should be provided on the nature, location and volume of any groundwater development for dewatering, water supply or on-site energy production.

Of particular importance will be the scale of the proposed development. Reference should be made to S.I. No. 600/2001 — Planning and Development Regulations, 2001 in relation to the type of projects for which an EIS is required and also for the thresholds relating to certain aspects of such projects.

Professional judgement will be required to adjust the amount of studies to be undertaken in line with the type and scale of the proposed development and related activities in the context of the local environmental baseline conditions. Clearly, the works and studies required for a proposed aggregate quarry covering 40 hectares will be much greater than those required for a similar excavation covering 5 hectares. Similarly, the details required for a basic on-site groundwater supply normally would be significantly fewer than those required for the development of a regional groundwater supply.

Step 2 – Establish Baseline Conditions

The objective of establishing the baseline conditions is to place the proposed development site within the context of the local or regional geological / hydrogeological regimes and allow for an initial assessment of how the development and/or related activities might impact on the existing subsurface environment.

The compilation of the available geological and hydrogeological information into a preliminary CSM for the development site and its environs is central to establishing baseline conditions.

The CSM will consist of a series of maps centred on the development site together with interpretative cross sections passing through the development site and a textual description.

Sources of Information

The information required to construct the initial CSM should be obtained from a combination of:

- Published reports and maps (a partial list of sources of geological and hydrogeological informationcan be found in **Appendix D**).
- A site visit and walk over survey.

Extent and Scale of Data

In the first instance, maps should be sourced to allow for the review of the geological and hydrogeological conditions that exist within a minimum of 2 km of the site boundary (from the outer limit of the planning and/or licence area) and presented at a scale of 1:25,000. The recommended minimum distance of 2 km should be reviewed in the context of the geological / hydrogeological environment as well as the scale of development and increased to reflect the sensitivity of the subsurface, for example where karst systems are present.

Maps to a scale of 1:50,000 are adequate to present the regional geological and hydrogeological information. Where the information is published or available only to a lower level of detail, say to a scale of 1:100,000, then this information should be reproduced at the published scale only, so as not to misrepresent the degree of certainty associated with the information.

Required Information

The output from the Baseline Review should contain maps and information including, but not restricted to:

- Ordnance Survey topographic base mapping and, where possible, aerial photography;
- Designated Sites, including Geological Heritage Sites, County Geological Sites (as available), Natura 2000 Sites and proposed and candidate Special Areas of Conservation (SACs), Special Protection Areas (SPA) and National Heritage Areas (NHAs);
- Bedrock Geology, including all known outcrops, karst features, quarries and identified faults and formation boundaries;
- Overburden Geology, thicknesses and overburden types with depositional descriptions such as glacial, fluvial, marine etc. where this information is available;
- Soils, both natural and man-made;
- Groundwater Bodies and Surface Water Bodies, including current qualitative and quantitative status and related objectives and measures;
- Aquifers, showing groundwater abstractions and any related protection zones and discharges to groundwater;
- Groundwater Vulnerability;
- Surface Water Drainage, including areas at risk of flooding;
- Sites with waste licences and permits, both current and historical;
- Sites where illegal dumping has been recorded/reported;
- Sites with recorded/reported contaminated land;
- Sites with recognised aggregate potential and/or which contain economic minerals.

The maps should clearly show the outline of the site and demonstrate how the proposed development relates spatially to conservation sites, aquifers (both bedrock and overburden), groundwater abstractions and discharges areas, surface watercourses, groundwater vulnerability and areas prone to flooding. The known or assumed direction of groundwater flow in the vicinity of the site should be indicated.

A minimum of two interpretative cross sections through the proposed development site should be constructed, at right angles to one another and at a vertical scale that places the proposed development site in the context of the local geological and hydrogeological regimes.

The constructed cross sections will describe the bedrock and overburden geology and indicate the position of the water table and/or the potentiometric surface (where this is known) at the proposed development site. The cross sections will include any available borehole information. Where a conservation site or a groundwater abstraction or a groundwater discharge location is located within 2 km of the proposed development site at least one cross section will pass through these features.

The maps and sections should be brought together to inform the initial Conceptual Site Model (CSM). Likely impacts should be discussed in terms of Source – Pathway – Receptor linkages.

A brief textual description (with appropriate references) of the geological / hydrogeological information presented in the maps and cross sections and a description of the Initial CSM will be prepared. The objective of this summary text is to identify and describe the range of, and relationships between, important geological / hydrogeological features and surface waters and conservation sites that are located within a minimum of 2 km of the proposed development site boundary. Of particular importance will be the description of the susceptibility of the identified features and sites to potential activities that may be associated with the proposed development.

Step 3 - Establish the Type of Soil / Geological / Hydrogeological Environment:

From the CSM completed in **Step 2**, now determine the generic Type of Geological/Hydrogeological Environment into which the proposed development will be placed.

A range of generic geological / hydrogeological Environments is described below and has been assembled in the accompanying Matrix presented in **Figure 2** *(see page 23)* to describe and encompass the variety of subsurface environments likely to be found in Ireland.

The list of possible environments should not be considered as comprehensive and the practitioner must use his / her professional judgement to define the geological / hydrogeological environment present and where there is any doubt, he/she should adopt the precautionary principle.
The generic Types of geological / hydrogeological environments classified in the Matrix are:

- **Type A** – Passive geological / hydrogeological environments e.g. areas of thick low permeability subsoil, areas underlain by poor aquifers, recharge areas, historically stable geological environments;
- **Type B** – Naturally dynamic hydrogeological environments e.g. groundwater discharge areas, areas underlain by regionally important aquifers, nearby spring rises, areas underlain by permeable subsoils;
- **Type C** – Man-Made dynamic hydrogeological environments e.g. nearby groundwater abstractions, nearby quarrying or mining activities below the water table, nearby waste water discharges to ground, nearby geothermal systems;
- **Type D** – Sensitive geological / hydrogeological environments e.g. potentially unstable geological environments, groundwater source protection zones, karst;
- **Type E** – Groundwater dependent eco systems e.g. wetlands, nearby rivers with a high groundwater component of base flow.

Step 4 – Establish the Activities Associated with the Proposed Development

Activities associated with the construction, operation and, where relevant, the aftercare of a development can impact on the geological / hydrogeological environment. A range of generic Activities is described below and has been assembled in the accompanying Matrix in **Figure 2**

to encompass the wide series of operations that occur during the construction and operation of projects requiring the completion of an EIS. The list of possible activities should not be considered as comprehensive and the practitioner must use his / her professional judgement to identify other hazards associated with the activities present and where there is any doubt, he/she should adopt the precautionary principle.

The generic Activities identified are outlined below and further information on work which may be included under these headings is provided in **Appendix E**:

- **Earthworks;**
- **Storage / Transmission of leachable or hazardous materials;**
- **Lowering of groundwater levels by pumping or drainage;**
- **Discharges to ground;**
- **Excavations of materials above the water table;**
- **Excavations of materials below the water table;**
- **Landspreading;**
- **Abstraction / Discharge of energy (heat) from/to the ground.**

Step 5 – Undertake an Initial Assessment and Impact Determination

An Initial Assessment and Impact Determination should now be prepared that summarises the information compiled so far and then reviewed to determine whether the proposed development would result in any impact on the receiving geological / hydrogeological environment.

The Significance of any impact should be determined based on:

- the Importance of the feature to be protected and
- the Magnitude of the impact on the receiving geological / hydrogeological environment

with particular reference to the definitions in **Appendix C**.

Where there is a determination that:

- None of Activities identified in **Step 4** above will take place at the development site, **or**
- Where the determined level of impact is capable of measurement but without noticeable consequences (EPA, 2002)[3],

an Initial Assessment and Impact Determination should then be prepared. This will result in the assessment proceeding directly to the **4th Element** to inform the preparation of the geological / hydrogeological sections of the EIS as detailed in **Figure 1**.

In all other cases additional site specific studies will be required and these form the **2nd Element** of the recommended procedure as shown in **Figure 1**.

Industry specific checklists / matrices are useful tools in identifying potential environmental impacts e.g. IGI Quarry Guidelines[4], EPA Discharge to groundwater guidance[5].

Appropriate consultees should be identified and consultation initiated at this stage if it has not already been undertaken prior to the start of the EIS preparation e.g. during a scoping phase. A non-exhaustive list of potential consultees is included in **Appendix B**.

Consideration should be given in the Initial Assessment and Impact Determination to any previously identified inter relationship between the geological / hydrogeological environment and other areas of the natural and/or man-made environments. Where such inter relationships are determined to be significant then they should also be carried forward into the **2nd Element** of the recommended procedure and ultimately addressed in the EIS.

2nd Element – Direct and Indirect Site Investigations & Studies

The **2nd Element** of the recommended procedure builds on the Initial Assessment and consists of four steps as detailed below.

Step 6 – Select appropriate Site Investigations and Studies

Professional judgement will be required to select the necessary range of direct and indirect site investigations and studies required to further inform the CSM and to categorise the impact of the proposed development on the receiving geological / hydrogeological environment. However, the range and scope of the planned investigations must reflect the scale of the proposed development, the range of activities likely to occur during the construction, operation and, where relevant, the

[4] Institute of Geologists of Ireland, 2007. Recommended collection, presentation and interpretation of geological and hydrogeological information for quarry developments.
[5] Environmental Protection Agency, 2011. Guidance on the Authorisation of Discharges to Groundwater.

aftercare of the development and most critically the type and sensitivity of the receiving geological / hydrogeological environment.

Critically, they must be sufficient to categorise the impacts associated with each relevant activity associated with the development.

The Matrix presented in **Figure 2** provides a useful basis on which to select a suitable range of direct and indirect site investigations and hydrogeological studies that could be carried out to further develop the CSM. The scope of the recommended works and studies increase both in variety and complexity as the receiving environment becomes more vulnerable to potential impacts.

Where possible, the Competent Person should interact with other EIS specialists and the project design team to ensure that the field data requirements of all parties are considered.

Step 7 – Carry out Site Investigations and Studies

It is recognised that site and other conditions may preclude the completion of the full range of the recommended works and studies. However, every effort should be made to undertake as many of the recommended works and studies as is necessary to establish the geological / hydrogeological conditions existing at the development site and in its environs. Critically, they must be sufficient to categorise the impacts related to each relevant activity associated with the development.

Step 8 – Refine the Conceptual Site Model

As shown on **Figure 1**, the continuous updating of the CSM is an integral aspect of the recommended procedure. The updating of the CSM is an iterative process with each new piece of information adding to the previous version of the CSM.

The CSM is fundamental to assessing the potential impact of a development on the receiving geological / hydrogeological environment. Every effort should be made in establishing a robust CSM so that the significance of a potential impact resulting from a proposed activity can be categorised and assessed.

Step 9 - Undertake Detailed Assessment and Impact Determination

A Detailed Assessment and Impact Determination should now be prepared that describes: the full range of site investigations and studies carried out, the revised CSM, and a full assessment of any potential impacts.

The significance of any potential impact should be determined based on the importance of the feature to be protected and the magnitude of the impact on the receiving geological / hydrogeological environment and with particular reference to the definitions listed in **Appendix C** .

Each potential impact for a proposed development should be described in terms of its **Quality**, **Significance**, **Duration** and **Type** as discussed in **Section 3.3**. The definitions for these terms and their sub-descriptors are provided in **Appendix C** .

Where the impact determination now concludes that the level of potential impact is capable of measurement but without noticeable consequences then the Detailed Assessment and Impact Determination should be prepared and the assessment will proceed directly to the **4th Element** so as to inform the preparation of the geological / hydrogeological sections of the EIS as detailed in **Figure 1**.

In all other cases the Detailed Assessment and Impact Determination should be carried forward into the **3rd Element** of the recommended procedure where mitigation measures are designed and the

significance of any residual impact is assessed.

The Detailed Assessment and Impact Determination should include a description of the range and scale of the potential impacts that could be associated with the Activities that will take place on the development site.

3rd Element – Mitigation Measures, Residual Impacts and Final Impact Assessment

The **3rd Element** of the recommended procedure builds on the outcome of the preceding two elements, by identifying mitigation measures to address potential impacts and then assessing the significance of any residual impacts. Mitigation measures which have been built into the development design should also be considered in this section.

The **3rd Element** of the recommended procedure consists of 3 Steps as detailed below.

Step 10 – Identification of Mitigation Measures

Appropriate mitigation measures should be identified that would avoid, reduce or remedy the potential impacts identified in the Detailed Assessment and Impact Determination. This process is likely to be iterative with **Step 11**.

Step 11- Residual Impact Determination

The development, with proposed mitigation measures assumed implemented, is then subject to impact assessment, to identify any residual impacts.

Step 12 – Final Impact Assessment

The output from the Detailed Assessment and Impact Determination from **Step 9**, a description of the proposed mitigation measures from **Step 10** and the Residual Impact Determination from **Step 11** will then be included in a Final Impact Assessment.

The Final Impact Assessment should include a description of any residual impacts. The significance of any residual impact should be determined based on the importance of the feature to be protected and the magnitude of the impact on the receiving geological/hydrogeological environment. The determination of the significance of any residual impact should be made with particular reference to the definitions listed in **Appendix C** .

The Final Impact Assessment will inform the preparation of the geological / hydrogeological sections of the EIS.

4th Element – Completion of the Soils, Geological and Hydrogeological Sections of the EIS

Step 13 – Complete the Soils, Geological and Hydrogeological Sections of the EIS

The final element of the recommended procedure is the completion of the Soils, Geology and Hydrogeological Sections of the EIS with the outcomes of the relevant preceding elements.

At a minimum the information gathered for the completion of the Initial Assessment and Impact Determination (**Step 5**) including the CSM should be described in the body of the EIS and where appropriate the maps and cross sections should be included in appendices to the EIS.

Where site investigations and hydrogeological studies have been carried out then the conclusions outlined in the Detailed Assessment and Impact Determination (**Step 9**) should be included in the EIS with the relevant field data included in appendices to the EIS.

In the case where potential impacts which will require mitigation are identified, then the conclusions outlined in the Final Impact Assessment (**Step 12**) should be documented in the EIS.

Where it is determined that no significant impacts will result from Activities at the proposed development site, with or without mitigation measures employed then the rational for such a determination should be clearly set out in the body of the EIS.

Where a residual impact is identified in the Final Assessment then the significance of the residual impact on the receiving geological / hydrogeological environment should be described in the body of the EIS.

The significance of any residual impact should be determined based on the importance of the feature to be protected and the magnitude of the impact on the receiving geological / hydrogeological environment and with particular reference to the definitions listed in **Appendix C**.

Where it is determined in either **Steps 9 or 12** that the level of impact which will result from the proposed development is: capable of measurement but without noticeable consequences, unless mitigation is employed, or that there is no residual impact with mitigation measures employed, then the rationale for such a determination should be clearly set out in the body of the EIS.

5 CONCLUSION

Following the recommended procedure outlined above will result in a considerable amount of information about the geological and hydrogeological setting of the development site and surrounding lands being contained within the EIS and supporting appendices and documents. This very technical data, together with details of activities associated with the proposed development likely to impact on the geological and hydrogeological environments should allow for an EIA to be carried out on the proposal by the regulatory authorities.

The Non Technical Summary (NTS) accompanying the EIS should include, in layman's language, a brief summary of the geological and hydrogeological environments present and the activities associated with the proposed development that could impact on these environments.

The NTS should describe the sensitivity and vulnerability of the geological and hydrogeological environments to the range and scale of the activities associated with the construction, operation and, where relavant, the aftercare of the proposed development. A brief description of the works and studies carried out to determine the likely impact of these activities on the geological and hydrogeological environment should be included in the NTS, together with proposed mitigation measures.

Finally, the NTS should include a description of the residual impacts, if any, of the proposed development on the geological and hydrogeological environments present including an assessment of the capacity of the geological and hydrogeological environments to absorb the predicted residual impacts.

Figures

Figure 1 Flow Chart

*Matrix: See Figure 2 in Guidelines for the Preparation of the Soils, Geology and Hydrogeological Chapters of Environmental Impact Statements - Issued by the Institute of Geologists of Ireland (2013)

Figure 2 Activities /Environments Matrix

Environments	Activities: Earthworks	Storage / transmission of leachable and/or hazardous materials	Lowering of groundwater levels by pumping or drainage	Discharges to ground	Excavation of materials above the water table	Excavation of materials below the water table	Land-spreading	Abstraction / Discharge of energy (heat) from/to the ground
Type A	Invasive site works to characterise nature[1] and thickness of soil and subsoil e.g. trial pits or augering.	Establish nature and quantity of leachable materials.	Establish details of borehole /spring construction or drainage system structure details (as appropriate).	Complete a Risk Assessment as per EPA (2011) Guidance on the Authorisation of Discharges to Groundwater[2]; Apply Tier 1, 2 or 3 Assessment as appropriate	Site works to characterise nature[1], thickness, permeability and stratification of soils and subsoils e.g. trial pits, augering.	Site works to characterise nature[1], thickness, permeability and stratification of soils and subsoils e.g. trial pits, augering.	Establish the type of waste to be landspread.	Provide details of type of system (open/closed, shallow/deep). The site works required and described below will reflect the design parameters of the system being installed.
		Site works to characterise nature[1], thickness, permeability and stratification of soils, subsoils and bedrock geology e.g. trial pits, boreholes.	Establish sustainable yield and proposed daily abstraction rate or drainage system invert levels (as appropriate).		Site works to fully characterise the bedrock geology and in order to to define the resource volume/weight according to The PERC Reporting Standard[3] e.g. trenching, drilling, geophysics.	Site works to fully characterise the bedrock geology and in order to to define the resource volume/weight according to The PERC Reporting Standard[3] e.g. trenching, drilling, geophysics.	Undertake a walkover survey of the site.	Site works to characterise nature[1], thickness, permeability and stratification of soils, subsoils and bedrock geology.
		Works to determine groundwater level, e.g.mapping, monitoring in stand pipes, piezom-eters, or boreholes.	Works to determine summer level of the water table, annual actual recharge and proposed maximum drawdown. Measurement of effects of change in water level on nearby abstractions.		Works to determine groundwater level, flow direction and gradient; e.g.monitoring in stand pipes, piezometers, or boreholes.	Works to determine groundwater level, flow direction and gradient; e.g.monitoring in stand pipes, piezometers, or boreholes.	Review Groundwater Protection Responses for Landspreading[4], and apply Departmental[5] and Regularory[6] guidelines and best practice.	Design parameters for the system will be required to be collected, however these are out of the remit of this document - although any information gathered for design purposes should be used in the EIS.
						Characterisation of groundwater chemistry and quality.	Assign a response category.	
						If lowering of groundwater levels is required, then proceed also as for activity Lowering of water levels by pumping of drainage.		
Type B	*In addition to all the above;*	*In addition to all the above;*	*In addition to all the above;*	*As above;*	*As above;*	*As above;*	*In addition to all the above;*	*In addition to all the above;*
	Works to determine groundwater level, flow direction and gradient; e.g. monitoring in stand pipes, piezometers, or boreholes.	Works to determine groundwater flow direction and gradient; e.g. monitoring in stand pipes, piezometers, or boreholes.	Works to determine aquifer properties, seasonal variations in water levels, extent of cone of depression or drawdown of surrounding water levels (as appropriate) and alterations in groundwater flow pattern.				Site works to characterise subsoil/soil characteristics e.g. trial pits or augering.	Characterise baseline temperature of soil / groundwater and groundwater hydrochemistry and quality.
	Works to determine groundwater - surface water interactions.	Works to determine groundwater - surface water interactions.	Works to determine groundwater - surface water interactions and measure effects of drawdown in water levels on hydraulically connected surface waters and springs.					Works to determine groundwater level e.g.monitoring in stand pipes, piezometers, or boreholes.
								If it is proposed to discharge to surface water, then characterisation surface water quality, baseline temperature and flow rates.
Type C	*In addition to all the above;*	*In addition to all the above;*	*In addition to all the above;*	*As above;*	*As above;*	*As above;*	*In addition to all the above;*	*In addition to all the above;*
	Identify location and abstraction rate of nearby groundwater abstractions.	Measure or determine rate of groundwater flow/travel time.	Installation of sufficient monitoring wells to provide groundwater flow direction, gradient, flow pattern and rate of flow/travel time.				Confirm subsoil permeability in laboratory. Delineate inner and outer source protection areas and source protection zones.	Works to determine thermal and hydraulic conductivity of soil, subsoil and bedrock.
			Identify nearby geothermal systems, and discharges to groundwater				Establish water quality of groundwater abstraction. Undertake risk assessment if appropriate.	Identify location and abstraction rate of nearby groundwater abstractions.
Type D	*In addition to all the above;*	*In addition to all the above;*	*In addition to all the above;*	*In addition to all the above;*	*In addition to all the above;*	*In addition to all the above;*	*As for Type C above*	*In addition to all the above;*
	Regional study of karst in an area, including identified karst features (both mapped and identified during site walkovers).	Full detailed hydrogeo-logical assessment required in this situation.	Geotechnical assessment of risk of landslide or subsidence.	Geotechnical assessment of risk of landslide or subsidence.	Full detailed hydrogeological assessment required in this situation.	Geotechnical assessment of risk of landslide or subsidence.		Geotechnical assessment of risk of landslide or subsidence.
	Map bedrock topography.	Geotechnical assessment of risk of landslide or subsidence.			Geotechnical assessment of risk of landslide or subsidence.			
	Geotechnical assessment of risk of landslide or subsidence.							
Type E	Full detailed hydrogeological assessment required in this situation.	Full detailed hydrogeological assessment required in this situation.	Full detailed hydrogeo-logical assessment required in this situation.	Complete a Risk Assessment as per EPA (2011); Apply Tier 1, 2 or 3 Assessment as appropriate.	Full detailed hydrogeological assessment required in this situation.	Full detailed hydrogeological assessment required in this situation.	*As for Type C above*	Full thermogeological and/or hydrogeological assessment required in this situation.

Type A	Passive geological / hydrogeological environments
Type B	Natural dynamic hydrogeological environments
Type C	Man-made dynamic hydrogeological environments
Type D	Sensitive geological / hydrogeological environments
Type E	Groundwater dependent eco systems

Where works are required to characterise, establish, measure, determine or otherwise provide information, the level of activity and detail required will be informed by a combination of a) the potential impact of the proposed development , b) the scale of the proposed development and c) the professional judgement of the project geoscientist. In addition, the works are likely to be iterative, with new works required in reponse to information acquired during any phase of works.

1 Characterisation of soil and sub-soils to be carried out in accordance with a recognised standard or nomenclature system e.g. BS5930:1990 for subsoils or EPA Code of practice for Environmental Risk Assessment for Unregulated Waste Disposal sites where relevant
2 EPA, 2011. Guidance on the Authorisation of Discharges to Groundwater - Version 1 December 2011. www.epa.ie
3 The PERC Reporting Standard
4 Groundwater Protection Schemes (DoELG/EPA/GSI, 1999)
5 Control of Farm Pollution (DAFF, 1992) and the Code of Good Agricultural Practice to Protect Waters from Pollution by Nitrates (DoE and DAFF, 1996)
6 Landspreading of Organic Waste - Guidance on Groundwater Vulnerability Assessment of Land (EPA 2004)

Appendix A

Legislation and Guidelines

A LEGISLATION AND GUIDELINES

This section contains a non-exhaustive list of legislation and guidelines which may be considered during the preparation of soils, geology and hydrogeology EIS chapters. It should be noted that both legislation and guidelines may update frequently and as such, consultants should be cognisant of any future changes in legislation.

A.1 EU Legislation:

- Environmental Impact Assessment Directive (2011/92/EU);
- Integrated Pollution and Prevention Control Directive (2008/1/EC);
- Industrial Emissions Directive (2010/21/EU);
- The management of waste from extractive industries (2006/21/EC);
- Environmental Liability Directive (2004/35/EC);
- Waste Framework Directive (2008/98/EC);
- Water Framework Directive (2000/60/EC);
- Groundwater Directive (2006/118/EC);
- Habitats Directive (1992/43/EEC);
- Birds Directive (2009/147/EC);
- REACH (Regulation 1907/2006/EC);
- Biocidal Products Directive (98/8/EC);
- Authorization (for the prospection, exploration and production) of hydrocarbons Directive (94/22/EC);
- Seveso II Directive (96/82/EC) and Seveso III Directive (2012/18/EU);
- Urban Wastewater Directive (97/271/EEC);
- Flooding Directive (2007/60/EC);

as transposed into the national legislation of Member States.

A.2 Republic of Ireland National Legislation

EIA, SEA and/or AA is/are carried out primarily in the ROI in accordance with the following national legislation:

- S.I. No. 349 of 1989, European Communities (Environmental Impact Assessment) Regulations, and subsequent amendments (S.I. No. 84 of 1994, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001).
- S.I. No. 473 of 2011, European Union (Environmental Impact Assessment and Habitats) Regulations 2011.
- S.I. No. 584 of 2011, European Union (Environmental Impact Assessment and Habitats) (No. 2) Regulations 2011.
- The Planning and Development Acts, 2000 to 2009, The Planning and Development (Amendment) Act 2010, S.I. 600 of 2001 Planning and Development Regulations and subsequent amendments including, S.I. No. 364 of 2005 and S.I. 685 of 2006.

National legislation on the protection of the water environment

Since 2000 water management in EU member states has primarily been directed by the Water Framework Directive (2000/60/EC) and the associate 'daughter' Groundwater Directive (2006/118/EC). Irish legislation implementing these and other relevant directives currently includes:

- S.I. No. 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations 2010 and amendments (S.I. 389 of 2011 and S.I. 149 of 2012).
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations 2009 and amendment (S.I. 327 of 2012).
- S.I. No. 684 of 2007 Waste Water Discharge (Authorisation) Regulations, 2007, as amended (S.I 231 of 2010).
- S.I. No. 278 of 2007 European Communities (Drinking Water) (No.2) Regulations.
- Water Services Acts 2007 and 2012.
- S.I. No. 722 of 2003 European Communities (Water Policy) Regulations.
- S.I. No. 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations 2010.
- S.I. No. 457 of 2008 European Communities (Environmental Liability) Regulations which bring into force the Environmental Liability Directive (2004/35/EC).
- **Note** that with effect from the 22nd December 2013 that S.I. No. 41 of 1999 Protection of Groundwater Regulations, 1999 is revoked by Article 47 of SI 684 of 2007 Waste Water Discharge (Authorisation) Regulations, 2007.
- **Note** that with effect from 22nd December 2013 that SI No. 42 of 1999 Local Government (Water Pollution) (Amendment) Regulations, 1999 is revoked under Article 61 of S.I. No. 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations 2010.

National legislation on the protection of flora and fauna

- SI No. 477 of 2011, European Communities (Birds and Natural Habitats) Regulations, 2011.S.I. No. 33 of 2000, The Wildlife Amendment Act, 2000.
- S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life.
- S.I. No. 296 of 2009 European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009.

A.3 Republic of Ireland Guidelines

- DoEHLG, 2010. Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities.
- Environmental Protection Agency, 2002. Guidelines on the information to be contained in Environmental Impact Statements.
- Environmental Protection Agency, 2003. Advice Notes on current practice (in the preparation of Environmental Impact Statements).
- Environmental Protection Agency, 2011. Guidance on the Authorisation of Discharges to Groundwater.

- European Communities 2001. Assessment of plans and projects significantly affecting Natura 2000 sites - Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.
- European Communities, 2000. Managing Natura 2000 Sites.
- Geological Survey of Ireland, Irish Concrete Federation, 2008. Geological Heritage Guidelines for the Extractive Industry.
- Institute of Geologists of Ireland, 2002. Geology in Environmental Impact Statements, A Guide.
- Institute of Geologists of Ireland, 2007. Recommended collection, presentation and interpretation of geological and hydrogeological information for quarry developments.
- National Roads Authority, 2008. Environmental Impact Assessment of National Road Schemes – A Practical Guide.
- National Roads Authority, 2008. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

Appendix B

Potential consultees

B POTENTIAL CONSULTEES

Consultation with the relevant bodies is recommended prior to or during the preparation of an EIS. The following is a non-exhaustive list of potential consultees which practitioners in the Republic of Ireland may consider consulting with:

- The Minister for the Environment, Heritage and Local Government;
- The National Tourism Development Authority – Fáilte Ireland;
- An Taisce – The National Trust for Ireland;
- An Chomhairle Ealaíon (Arts Council) and the Heritage Council;
- The Minister for Communications, Energy and Natural Resources must be sent a copy of the EIS in the case of a mine or quarry developement;
- The Regional Fisheries Board, where the development:

  (i) might cause the significant abstraction or addition of water either to or from surface or groundwaters, whether naturally occurring or artificial,

  (ii) might give rise to significant discharges of polluting matters or other materials to such waters or be likely to cause serious water pollution or the danger of such pollution, or

  (iii) would involve the carrying out of works in, over, along or adjacent to the banks of such waters, or to any structure in, over or along the banks of such waters, which might materially affect the waters;
- Waterways Ireland, in any case where the waters concerned are listed in Part 1 of Annex 1 of the Schedule to the British-Irish Agreement Act, 1999 (No. 1 of 1999);
- The relevant Local Authority;
- Geological Survey of Ireland;
- Teagasc - the Irish Agriculture and Food Development Authority;
- Planning authorities;
- Exploration and Mining Division of the Department of Communications, Energy and Natural Resources;
- The Irish Peatland Conservation Council;
- Environmental Protection Agency;
- River Basin District Project Offices;
- Met Eireann;
- Local authorities;
- Group Water Schemes;
- Local Angling Associations;
- Irish Aviation Authority;
- Radiological Protection Institute of Ireland;
- An Bord Gais;
- Iris Water;
- Irish Rail;
- National Roads Authority;
- National Parks and Wildlife Service;
- Office of Public Works;
- National Monument Service;
- Heritage Ireland;

Appendix C

EIS Definitions

C EIS DEFINITIONS

C1 EPA Guidance

The classification of impacts in a EIS should follow the definitions provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003).

Table C1 below reproduces the glossary of impacts as published in the EPA guidance documents referred to above.

Table C1 Impact Classification Terminology (EPA, 2002/3)

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	A change which does not affect the quality of the environment
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An impact capable of measurement but without noticeable consequences
	Slight	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends
	Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Profound	An impact which obliterates sensitive characteristics
Duration	Short-term	Impact lasting one to seven years
	Medium-term	Impact lasting seven to fifteen years
	Long-term	Impact lasting fifteen to sixty years
	Permanent	Impact lasting over sixty years
	Temporary	Impact lasing for one year or less
Type	Cumulative	The addition of many small impacts to create one larger, more significant impact
	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out
	Indeterminable	When the full consequences of a change in the environment cannot be described
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant impact is of greater significance than the sum of its constituents
	'Worst Case'	The impacts arising from a development in the case where the mitigation measures may substantially fail

C2 NRA Guidance

NRA rating criteria uses the same significance terminology as the EPA, however it has intermediate steps to justify using that terminology:

Step 1: Quantify the Importance of a feature for geology (**Table C2**) and hydrogeology (**Table C3**);

Step 2: Estimate the Magnitude of the impact on the feature from the proposed development (**Table C4**: Geology, **Table C5**: Hydrogeology);

Step 3: Determine the Significance of the impact on the feature from the matrix (**Table C6**) based on the Importance of the feature and the Magnitude of the impact.

Table C2 Criteria for Rating Site Importance of Geological Features (NRA, 2008)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale Degree or extent of soil contamination is significant on a local scale Volume of peat and/or soft organic soil underlying route is significant on a local scale	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or high fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale Volume of peat and/or soft organic soil underlying route is small on a local scale	Large historical and/or recent site for construction and demolition wastes Small historical and/or recent landfill site for construction and demolition wastes Poorly drained and/or low fertility soils Uneconomically extractable mineral resource

Table C3 Criteria for Rating Site Importance of Hydrogeological Features (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – e.g. NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer. Potable water source supplying <50 homes.

Table C4 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Geology Attribute (NRA, 2008)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves Irreversible loss of high proportion of local high fertility soils Removal of entirety of geological heritage feature Requirement to excavate / remediate entire waste site Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves Removal of part of geological heritage feature Irreversible loss of moderate proportion of local high fertility soils Requirement to excavate / remediate significant proportion of waste site Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves Removal of small part of geological heritage feature Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils Requirement to excavate / remediate small proportion of waste site Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table C5 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrogeology Attribute (NRA, 2008)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off[1]. Calculated risk of serious pollution incident >2% annually[2].
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off[1]. Calculated risk of serious pollution incident >1% annually[2].
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off[1]. Calculated risk of serious pollution incident >0.5% annually[2].
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually[2].

[1] Refer to Annex 1, Method C, Annex 1 of HA216/06
[2] Refer to Appendix B3/Annex 1, Method D, Annex 1 of HA216/06

Table C6 Rating of Significant Environmental Impacts at EIS Stage (NRA, 2008)

Importance of Attribute	Magnitude of Impact			
	Negligible	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Profound/ Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

Appendix D

Sources of publicly available information

D1 SOURCES OF PUBLICLY AVAILABLE INFORMATION

The following is a non-exhaustive list of publicly available sources of information:

- 1:100,000 Scale Bedrock Mapping (Geological Survey of Ireland) & associated memoirs
- Karst Database (Geological Survey of Ireland)
- Quaternary Maps (Geological Survey of Ireland)
- Aquifer classification maps (Geological Survey of Ireland)
- Groundwater vulnerability maps (Geological Survey of Ireland)
- Groundwater well database (Geological Survey of Ireland)
- Groundwater Body Descriptions (Geological Survey of Ireland)
- Source Protection Zone reports (Geological Survey of Ireland)
- Water Framework Directive characterisation, status, trend and programme of measures data (WFD Dissemination agency at **http://watermaps.wfdireland.ie regional River Basin District managers and EPA)**
- Groundwater monitoring data (EPA)
- Teagasc Subsoil Mapping (2004)
- Teagasc Soils Mapping (2007)
- Corine Land Cover datasets, (European Environment Agency, 2006)
- General Soil Map of Ireland (An Foras Talúntais, 2nd Edition,1980)
- The Peatlands of Ireland (An Foras Talúntais, 1981)
- Directory of Active Quarries, Pits and Mines in Ireland (Geological Survey of Ireland, 3rd Edition, 2001)
- Planning Departments of Local Authorities (Section 261)
- Pits and Quarries Planning and Development Act 2000
- Historic Mine Sites - Inventory and Risk Classification (EPA & GSI)
- Concrete Products Directory (Irish Concrete Federation)
- Proposed / Designated NHA Sites (National Parks and Wildlife Service)
- County Geological Sites (Local Authority Planning Office/Heritage Officers) / County Geological reports (GSI)
- Mining Heritage Trust of Ireland (old mining sites)
- Office of Licensing and Guidance, Environmental Protection Agency
- Local Authorities (Waste Management Section)
- Historical Maps (Ordnance Survey of Ireland / National Library of Ireland)
- National Landslide Database (Geological Survey of Ireland)
- Aerial Photographs (Geological Survey of Ireland / Ordnance Survey of Ireland)
- Atlas of Ireland (Royal Irish Academy)
- Exploration and Mining Division of the Department of Communications, Energy and Natural Resources
- Soil Geochemical Atlas
- Tellus Border Geochemical Data

The following is a list of websites where spatial viewers are available and information can be downloaded directly. Many of these allow maps to be created and printed directly from the website or shapefiles can be downloaded to allow the user to create their own maps.

Developed By	Website	Description
Department of Communications, Energy and Natural Resources	http://www.dcenr.gov.ie/Spatial+Data/	Viewing and download in GIS formats of GSI, Petroleum Affairs, Exploration and Mining Division and links to most other government data sites.
Department of the Environment, Community and Local Government	www.myplan.ie	One stop shop for information about planning and information relevant to planning decision-making
Environmental Protection Agency	gis.epa.ie/	Site allows you to search, browse a map or to download data (Corine landcover, Soils, Water Framework Directive etc). ENVision is the main Map viewing tool. Includes data on historic mine sites, IPPC and Waste license facilities, surface and groundwater quality, WFD protected areas etc. Other EPA spatial veiwers include:- Pollutant Release and Transfer Register (PRTR) - Bathing water quality
	http://hydronet.epa.ie	On-line hydrometric data
Water Framework Directive Data Dissemination	http://watermaps.wfdireland.ie	Mapped data arising from Water Framework Directive characterisation and monitoring. Also additional background data.
Office of Public Works	http://www.opw.ie/en/FloodRiskManagement/	Visualisation and download of CFRAMS, past flood events and hydrometric data.
National Parks and Wildlife Service	www.npws.ie/mapsanddata/	Includes SPA's, NHA, pNHA, SAC's
Geological Survey Ireland	www.gsi.ie/Mapping.htm	Range of websites and services that enable you to view, download or connect live to GSI data.
Ordnance Survey Ireland	maps.osi.ie/publicviewer/	OSi public viewer which includes historical maps
Met Eireann	www.met.ie	Historic and recent weather data including rainfall, evapotranspiration etc.

Appendix E

Activities list

E1 ACTIVITY LIST

The following is a non-exhaustive list of projects or work types which may be considered to be included under the generic activities headings which were developed for these guidelines.

Activity	Example
Earthworks	Stripping / removal of soil, subsoil and shallow rock; land reclamation; peat extraction
Storage / transmission of leachable and hazardous materials	Landfill; waste disposal sites; leachate collection systems; sludges from on-site effluent treatment; waste management facilities; hydrocarbon storage tanks; tailings storage facilities; new sewers
Lowering of groundwater levels by pumping or drainage	Temporary dewatering; pumping of groundwater for water supplies/process waters; road cuttings; peatland drainage
Discharges to ground	Waste water treatment systems; storm waters and/or process waters; recharge structures; reinjection of dewatering waters or spent geothermal abstractions; road runoff
Excavation of materials above the water table	Shallow aggregate and rock quarries/mines; basements; cemeteries; diverse burial sites; pipeline routes; pumping structures; road cuttings
Excavation of materials below the water table	Deep aggregate and rock quarries/mines; basements; pumping structures; deep burial sites; road cuttings
Land-spreading	Disposal of waste sludges to agricultural lands; golf course management
Abstraction / Discharge of energy from/to the ground	Geothermal wells (heat); shallow geothermal pipe systems (heat); major drilling projects (kinetic)

63 Merrion Square, Dublin 2
Phone: 01-662 4914
Email: info@igi.ie

The IGI acknowledges the support
of the Environmental Protection Agency
in the publication of this guidance.