DEPARTMENT FOR ECONOMY

INFORMATION ON MINERALS, GEOTHERMAL ENERGY, GROUNDWATER and GEOHAZARDS

TO INFORM LOCAL COUNCIL PLANNING OPTIONS PAPERS

The Mineral Development Act (Northern Ireland) 1969 ("the MDA") vested the ownership of minerals in the Department for the Economy (through its predecessor departments) and gave the Department the power to grant licences for the exploration and mining of these minerals. The MDA does not apply to all minerals – common rock types (e.g. basalt, sandstone, shale, sand and gravel) are excluded from its provisions, and the precious metals gold and silver belong to the Crown. The department also has statutory responsibility for abandoned mines of the minerals covered by the MDA. The Petroleum Production Act (Northern Ireland) 1964 vested ownership of petroleum (oil and gas) in Northern Ireland in the department and gave it the power to grant licences 'to search for and bore for and get petroleum'. In planning policy hard rock aggregates, sand & gravel, metalliferous minerals and petroleum are all usually covered under the general heading of Minerals although the methods, location and scale of development may be very different for these different groups of 'mineral' as explained below. In addition to this the Geological Survey of Northern Ireland (GSNI) also has knowledge and experience in other fields of geology that are relevant to the formulation of different areas of planning policy covered by regional strategy and Local Development Plans. Subjects such as groundwater, geothermal energy, underground energy storage, subsurface geology, contaminated land, geohazards and geotourism naturally feed into planning policies for water assets and flood risk, energy including renewables, development zoning and tourism. These topics are considered briefly below in the context of Northern Ireland as a whole. More detailed information will be provided in individual responses to the Planning Options Papers of individual Councils.

Minerals

The following information is supplied to help the planning authorities better understand the types of mineral that may be found in their Council area, their likely distribution, and the techniques used in the exploration and development of the main different mineral types.

Definition of Mineral for Planning Purposes

A mineral in geological terms is defined as 'a naturally occurring crystalline inorganic solid substance with a defined chemical composition which may vary within known limits.' Copper, lead, zinc, gold and silver are all minerals. Non-metalliferous materials such as halite (commonly known as rock salt), potash and barytes are known as industrial minerals.

However, for planning purposes the term mineral is used much more broadly and includes common rock types such as basalt, granite, sandstone, greywacke, shale and limestone as they are usually extracted by quarrying of the land surface. Hard rock quarries may produce building stone but in most quarries in Northern Ireland the rock is mechanically broken into small pieces to be used as aggregates in the construction industry.

Sand and gravel are neither rock nor mineral but are also treated as minerals for planning purposes.

A further category of raw materials often included as minerals for planning purposes are the so-called 'energy minerals' which include coal, lignite and peat. Hydrocarbons – which include oil and gas – are not strictly minerals because they are not crystalline solids but are often included with minerals in planning policy documents.

The Need for Minerals

Minerals are essential to support sustainable economic growth and quality of life. It is vital that there is a sufficient supply of raw materials for manufacturing, construction, power generation, transportation and agriculture. In the UK trade in minerals and minerals-based products makes up over 20% of total trade, with exports of £66 billion and imports of £85 billion in 2014 (Source: UK Minerals Yearbook, 2015).

Minerals are a finite natural resource and can only be worked where they are found. It is important to make the best use of the mineral resources and to secure their long-term availability through the mechanism of mineral safeguarding.

This is endorsed in the Strategic Planning Policy Statement:

> **6.148** Minerals, including valuable minerals, are an important natural resource and their responsible exploitation is supported by Government. The minerals industry makes an essential contribution to the economy and to our quality of life, providing primary minerals for construction, such as sand, gravel and crushed rock, and other uses, and is also a valued provider of jobs and employment, particularly in rural areas.
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> **6.149** The Sustainable Development Strategy recognises that while it is important that we respect the limits of our natural resources and ensure a high level of protection and improvement of the quality of our environment, 'sustainable development' does not prevent us from using and capitalising on such resources. An enduring successful economy will effectively use natural resources and contribute towards the protection of the environment

DfE recognises the need to protect the environment and preserve and protect the natural beauty of the LDP area. Notwithstanding this, DfE would ask that careful consideration be given to the policies and positions to be adopted in any LDP in respect of minerals development in order to ensure that this valuable economic activity is not unduly restricted in the future by decisions taken now. Restrictive options suggested by some Councils have the potential to constrain the economic viability of mineral development in the Council area and impact broader economic benefits to Northern Ireland as a whole.

For example there will be NI councils that do not have all the natural resources they need for their micro-economies and so will be dependent on other NI councils for security of supply. This means that mineral planning policies and options cannot be considered exclusively from the local council perspective. In some cases, there is the potential to be a net exporter of minerals to the Great Britain, Republic of Ireland and beyond; e.g. salt, sand, gravel, chalk, gold, lead, and zinc.

There are a number of publications which are relevant to the assessment of economic value of minerals to the economy and should be considered;

- Under Article 18(1) of the Quarries (Northern Ireland) Order 1983 a return is required each year to the DfE in respect of quarries operating in Northern Ireland. From 2001-2010, DfE published the annual minerals statement for Northern Ireland which summarises the mineral production and employment figures, whilst there was a hiatus to date, this data gathering exercise will resume this FY.

- In 2004, the British Geological Survey (BGS) was commissioned by government to report on The Economic Importance of Minerals to the UK.

- In 2013, the Department of Communications, Energy and Natural Resources in the Republic of Ireland commissioned a report on the Assessment of Economic Contribution of Mineral Exploration and Mining in Ireland which found the value to the Irish economy to be '*considerable and far-reaching'*.
- The BGS also publishes the United Kingdom Minerals Yearbook which provides comprehensive statistical data on minerals production, consumption and trade, and includes commentary on the UK's minerals industry in 2015.
- The Minerals Group of the CBI published a report on the Importance of the UK Minerals Extraction Industry in February this year.

Context of Minerals Licensing Regime

The Mineral Development Act (Northern Ireland) 1969 ("the 1969 Act") vested most minerals in the Department and enables it to grant prospecting licences and mining licences for exploration and development of minerals. This licensing system is based on the provisions of the 1969 Act and on subsequent subordinate legislation. The provisions relating to prospecting for minerals are quite separate and distinct from those relating to the development of minerals. There is no automatic continuity between exploration and development work.

The legislation covers all minerals with three main exceptions (the scheduled substances):

(i) Gold and Silver belong to the Crown Estates and were not vested in the Department,
(ii) the few mineral deposits (mainly salt) which were being worked at the time of the 1969 Act were not vested in the Department, and,
(iii) 'common' substances including crushed rock, sand and gravel and brick clays are excluded.

It should be noted that exploration for most minerals (excluding common rock types and gold and silver) requires a company to hold a Mineral Prospecting Licence (MPL) issued by DfE. An MPL places certain conditions on the Licensee and approval from DfE is required before a Licensee can carry out exploration drilling. The approval process involves liaison with NIEA and provides additional regulatory protection for the environment, including designated areas, through the assessment of potential risks arising from the proposed operations including methodology, location and timing. Exploration for gold and silver are carried out under a Mines Royal Option from the Crown Estate but the company may also hold an MPL over the same area if it is also exploring for base metals and DfE will exercise a regulatory function for those exploration activities.

The Petroleum (Production) Act (Northern Ireland) 1964 ("the1964 Act") vested petroleum in its natural state (hydrocarbons – oil and gas) in the Department and enables it to grant petroleum licences to "search and bore for and get petroleum". This licensing system is based on the provisions of the 1964 Act and on subsequent subordinate legislation. Although a petroleum licence contains terms covering the exploration, appraisal and development (or production) of petroleum the transition from exploration to production requires the Licensee to meet the requirements of the legislation as set out in Model Clauses that apply to the licence. Certain operations within the specified work programme, such as drilling, require approval from DfE and are further regulated by health and safety, environmental and planning legislation.

Three Categories of Mineral to consider for Planning Purposes

Minerals are non-renewable natural resources that are vital for the construction, manufacturing and energy industries.

1. **Aggregates** - aggregates are examples of minerals which are relatively low-value (e.g. £10 - £20 per tonne weight) but used in bulk throughout the construction industry (e.g. for the manufacture of cement, concrete or tarmac). Because aggregates are bulky and low value, minimising the distance

between the source of the aggregate (quarry, sand pit) and the final destination (e.g. road or construction project) brings benefits in terms of cost and reduced impacts from road haulage. These are products which can be extracted in bulk from surface quarries and pits and sold with little or no additional processing. The material is sold as is, with screening (size reduction) and washing commonly the only additional mechanical processes. Fortunately sand and gravel deposits and occurrences of common rock types such as basalt, granite, limestone and greywacke are widely distributed throughout Northern Ireland, although they are not evenly distributed across all the council areas. There are over 200 quarries and pits in Northern Ireland where these materials are extracted and, in terms of mineral planning, these have by far the greatest impact in terms of number and area of operation. There is also one underground salt mine at Kilroot, County Antrim, which produces road salt for the domestic and export market.

2. **Valuable Minerals** - other minerals may be classified as **'valuable minerals'** and these include metalliferous minerals such as lead, copper and zinc (£1000 - £2000 per tonne) and precious metals such as gold, silver and platinum (£400 - £30,000 per kg). These minerals are essential for a wide range of manufacturing industries and, because of their relatively high value, are often mined in one country and exported to global destinations. In the Republic of Ireland zinc-lead mines at Navan, Lisheen and Galmoy have made the country the largest zinc producer and second largest producer of lead in Europe. The mines produce metal concentrates on site which are then exported for smelting. Historically, there has been small-scale mining of lead and silver in South Armagh and lead in the Newtownards district and, more recently, there has been one opencast gold operation at Cavanacaw, near Omagh.

   There is considerable potential for the discovery and development of particularly valuable mineral deposits in various parts of Northern Ireland and the metamorphic rocks of the Sperrin Mountains are known to contain significant gold mineralisation such as that at Curraghinalt, near Gortin, County Tyrone. However, the metalliferous minerals attract higher prices because they are much more restricted in their distribution, occurring only in certain geological settings, and more expensive to find and extract when compared to aggregate minerals. The more limited occurrence of these valuable minerals, as well as their potentially greater positive impact associated with their development, is often taken into account when planning policy is formulated. In Northern Ireland valuable minerals are specified in Policy MIN 4 of A Planning Strategy for Rural Northern Ireland and this policy has been carried forward into the Strategic Planning Policy Statement for Northern Ireland (SPPS) 2015 which establishes the framework for planning in Northern Ireland and provides the basis for the operational policies within each Local Development Plan. Relevant Extracts are attached at Annex A.

3. **Energy Minerals & Hydrocarbons** - Oil, gas, coal, lignite and peat may be grouped together as 'energy minerals' and, as this term implies their main use has been to produce energy. In addition oil and gas are, of course, essential components in the petrochemical industry which produces the raw materials such as plastics, synthetic fibres, dyes and detergents that are used in a wide range of manufacturing industries. Decarbonisation forms an integral part of national energy policy, and in the future there may be a need to accelerate this process in response to climate change. However, fossil fuels are still expected to play a part in the energy mix in Northern Ireland over the term of the LDPs. For example, there are targets of 40% of electricity and 10% of heat from renewable energy sources, as part of a UK commitment to get 20% of total energy use from renewable energy by 2020. There is potential for any indigenous oil and gas resources to meet some of Northern Ireland's future energy needs and this could displace imports and increase security of supply.

   There has been a limited amount of exploration for hydrocarbons since the 1960s but drilling results indicate that there may be significant, as yet undiscovered, oil or gas fields in suitable geological settings in Northern Ireland. The main target areas are the Rathlin, Lough Neagh and Larne sedimentary

basins which cover large areas of counties Antrim and Armagh and extend into counties Tyrone and Londonderry. The geology of these basins has many similarities to that of the East Irish Sea (where the giant South Morecambe gas field and several smaller producing oilfields are located), in particular, extensive good quality conventional sandstone reservoirs and thick effective caprocks. The thick basalt rocks that overlie the hydrocarbon targets make exploration more difficult but small amounts of oil and gas found in wells suggest that larger accumulations may be trapped within these basins.

The Carboniferous rocks in County Fermanagh and neighbouring counties in the Republic of Ireland (in the Northwest Carboniferous Basin or NWCB) are also known to contain gas but the sandstone reservoirs here have very low permeabilities so the gas would not flow readily to surface. These tight gas sandstones, together with gas-bearing shales, are known as unconventional reservoirs and would require the use of high volume hydraulic fracturing (commonly known as 'fracking') to extract the gas. In relation to unconventional hydrocarbons (e.g. shale gas) the SPPS states that "there should be a presumption against their exploitation until there is sufficient and robust evidence on all environmental impacts." There may be potential for conventional production from some sandstone units in the NWCB but this is likely to be very limited.

Hard coal deposits were mined in the Dungannon, Coalisland and Ballycastle districts until the middle of the twentieth century but the remaining resources in these areas are small and there is no prospect for the resumption of mining in these coalfields. Coal deposits may extend below the Lough Neagh and Rathlin sedimentary basins but at depths too great for conventional mining.

The extensive lignite deposits near Ballymoney, Crumlin and Coagh were evaluated in the 1980s and, together, the Ballymoney and Crumlin deposits have a lignite resource of approximately 1 billion tonnes. A moratorium was placed on lignite extraction in Northern Ireland but there is a case for safeguarding these strategic mineral deposits for possible future use with CCS technology.

The Nature of Exploration for the Three Categories of Mineral

Exploration for raw materials for use as aggregates.

The distribution of common bedrock types and surface sand and gravel deposits has been mapped extensively by the Geological Survey of Northern Ireland (GSNI) and the British Geological Survey (BGS) was commissioned by the then Department of the Environment to evaluate the mineral resource of Northern Ireland based on the GSNI mapping. The BGS produced a series of mineral resource maps for each county and a Geographic Information System with digital minerals map information. These maps show the broad distribution of the bedrock types suitable for aggregates as well as the main areas containing sand and gravel deposits. Within these broad areas there are a range of criteria which will help to define the localities most suitable for extraction to take place. In terms of exploration there will be a need to ascertain the depth of overburden, the extent of the deposit (including the thickness of sand and gravel deposits), the quality of the resource and the hydrogeological characteristics of the proposed extraction site. Such exploration often involves drilling relatively shallow boreholes to retrieve samples for testing and sometimes non-intrusive surface geophysical surveys to map the extent of the deposits and is carried out by the company wanting to develop the quarry or pit. Such exploration is of short duration and the physical impact is temporary and very limited, with well-established mitigation measures to prevent pollution and other adverse effects.

Exploration for valuable minerals (metalliferous and non-metalliferous)

Mineral exploration begins with low-impact techniques designed to identify areas where the target minerals may be present. These may involve geological and geochemical surveys where small samples of soil or stream sediment are collected and analysed for anomalously high concentrations of specific elements, or samples of mineralised rocks may be found. These exploration techniques are considered to be extremely low impact in

that samples are retrieved from shallow soil depths (up to 50 cms), they involve the use of hand tools, access by foot beyond the road network, and little or no visible sign of disturbance. Under current legislation any proposed surveys are assessed to ensure that they would not have a significant detrimental effect on environmentally designated sites such as ASSIs or Natura 2000 sites. DfE does not consider that there is any need for further restrictions to be placed on such activities through the LDPs.

A single Mineral Prospecting Licence (MPL) can be up to 250 square kilometres in area but the results from early regional exploration often leads to the Licensee focussing their subsequent exploration effort on smaller areas within the MPL which show the greatest potential for a mineral deposit to be located. Because of the nature of the geology in Northern Ireland very low traces of minerals (measured in parts per million) are used to guide more detailed investigation. This more detailed exploration may involve geophysical surveys, the excavation of shallow trenches, deep overburden sampling using hand and mechanical augers and the drilling of narrow diameter boreholes to retrieve rock cores. In all cases these activities require approval from DfE and they are assessed to ensure that they would not have a significant detrimental effect on environmentally designated sites such as ASSIs or Natura 2000 sites. In the case of drilling, an abstraction licence or a discharge licence from NIEA is needed if a company wishes to abstract water or discharge water to surface or groundwater bodies. In most cases drilling contractors use a zero discharge water system where drilling water is returned to surface via an enclosed system and recycled for subsequent use. Any residual liquid and solid waste is tankered away to be disposed of in licensed waste facilities. Most minerals drilling operations use small rigs that can be towed behind a 4x4 vehicle and drilling sites are selected to be close to access roads and tracks to minimise damage to the ground surface. Specialised tyres may be used where ground conditions require this. Drilling at a single site is normally completed within a few days or at most a couple of weeks. Currently these drilling operations are carried out under Permitted Development Rights (PDR) and DfE believe that PDR is appropriate for minerals exploration drilling in most circumstances. On rare occasions, due to their location and nature, the planning authorities may determine the proposed drilling operations to be an EIA development that would require a planning application with an accompanying Environmental Statement.

Some Councils are proposing to place a time limit on exploration and development. DfE would consider this to be both arbitrary and unnecessary. Individual MPLs currently last for six years and Mines Royal options for six years plus an optional four year extension period. At the end of the MPL term a Licensee can apply for a new MPL over the same or different area and DfE will assess the new MPL application in the light of the Licensee's performance and progress to date, and this process provides an adequate regulatory control on the exploration in a particular area. A statutory consultation, involving a range of regulatory authorities including planning, NGOs, industry and the public, is an integral part of the licensing process. However, given the nature of mineral exploration, it is not uncommon for an area to be explored by different companies over a period of several decades, although this exploration may be for different minerals and have breaks between licences. Any imposition of a time limit on exploration activities does not take this practice into account and could result in valuable economic mineral deposits remaining undiscovered. Furthermore, the time required to develop a metalliferous mine can vary considerably but it is not uncommon for the time between the start of exploration and the submission of a planning application for an underground mine to be as long as 20 years . A time limit would have a negative effect on mineral exploration and, thus, would significantly reduce the inward investment and employment opportunities that the development of mineral resources could bring to Northern Ireland as well as perpetuating the reliance on imports of raw materials.

Exploration for Energy Minerals & Hydrocarbons

A petroleum licence may comprise three terms, namely, the initial term, the second term and the production period which normally last 5 years, 5 years and 20 years respectively. None of the 33 petroleum licences issued to date in Northern Ireland has progressed into a production period and many of them have ended at or before the end of the initial term. During the initial term a Licensee is expected to carry out exploration with the aim of identifying a drilling target and drilling an exploration well before the end of the fifth year, although the Licensee has the option of deciding not to drill and 'dropping' or relinquishing the licence. There is no maximum

limit to the area of a licence but the Licensee is expected to fully evaluate the exploration potential of the whole licence area. Any exploration on the ground requires the Licensee to obtain the permission of the landowner.

The initial phase of exploration starts with desk studies, including the reprocessing and re-interpretation of existing exploration data, before the Licensee carries out geochemical or geophysical surveys. These surveys are low-impact, occupying a small footprint and the physical signs, if any, tend to be minor and temporary. The most noticeable activities are seismic reflection surveys which use trucks which move slowly along roads, stopping to lower heavy pads onto the road surface and send vibrations into the ground. Occasionally seismic surveys may be carried out across open ground and the seismic signal is generated by the use of small explosive charges placed in boreholes several metres deep. The seismic signals returning from the rock layers deep in the earth are recorded by a series of geophones laid out on the surface, and the recorded data are processed to produce an image of the subsurface geological structure. The routes for the seismic lines are surveyed beforehand and sensitive locations may be omitted from the vibration programme. The seismic contractors will assess the proposed programme for any potential environmental impact and this information is incorporated into the Habitats Regulation Assessment carried out by DfE to ensure that the survey will not have a significant adverse effect on any nearby Natura 2000 sites. Seismic surveys are usually carried out under Permitted Development Rights (PDR) although the planning authorities may screen them for the purposes of EIA determination. The Department for Infrastructure is consulting on the remit of Permitted Development Rights.

If the Licensee identifies a subsurface geological structure that they believe may contain oil or gas they may decide that they wish to drill an exploration well. Drilling an oil or gas exploration well usually involves the construction of a wellsite and the use of a large rig which operates 24/7 for a period of one to two months. Such drilling has been carried out in Northern Ireland under PDR in the past but it is possible that the legislation could be amended to exclude such drilling from PDR depending on the outcome of the Department for Infrastructure's public consultation on PDR . If this is the case, the operator will require planning permission as well as a range of other permits and regulatory oversight from DfE, NIEA and HSENI. The Licensee will negotiate a contractual arrangement with the landowner for use of the site. When drilling operations have been completed the well will be permanently plugged and abandoned in compliance with the petroleum and H & S legislation and in accordance with the Oil & Gas UK guidelines. The wellsite will be restored, as required by planning conditions, and the agreement of the landowner.

Testing of any hydrocarbons found in an exploration well may require additional permission from DfE and the planning authorities. Further drilling would require new applications to DfE and planning, as would any development plans. Onshore production facilities can be relatively small-scale and unobtrusive, occupying a few hectares at most.

The Need to Safeguard Minerals

As mineral resources are finite and are not distributed evenly, knowledge about their whereabouts is essential for making effective and sustainable planning decisions that consider the needs of future generations.

Access to mineral resources can be prevented or restricted (sterilised) by non-mineral development and the process of 'mineral safeguarding' ensures that this does not occur unnecessarily when planning applications are determined.

An effective safeguarding system requires the adoption of 'mineral safeguarding areas' and the adoption of suitable policies through which development is managed in these areas.

When considering Minerals Development, the Council should make use of the Mineral Resource Map of Northern Ireland which was produced by the British Geological Survey Minerals UK Centre for Sustainable Minerals Development and published in 2012. This Northern Ireland wide Geographical Information System (GIS) dataset and map outputs was compiled in close consultation with DoE central planning and key stakeholders and using DoE funding.

The Mineral Resource Map of Northern Ireland is intended to assist strategic decision-making in respect of mineral extraction and the protection of important mineral resources against sterilisation.

The Mineral Resources Map of Northern Ireland comprises six sheets, one for each county at a scale of 1:100,000. The mineral resource data depicted on these maps are also available in a digital format for use within a GIS much of which can be downloaded from Spatial NI, whilst pdfs of the county maps can be downloaded from the following site: https://www.bgs.ac.uk/mineralsuk/planning/resource.html#NI

The map has been produced through the collation and interpretation of mineral resource data principally held by the Geological Survey of Northern Ireland. The major elements of information presented on the map are:

- The geological distribution of all onshore (above low water mark) mineral resources
- The extent of mineral planning permission and their current planning status (extant or expired)
- The recorded occurrences of metallic minerals
- The recorded location of building stone quarries
- The extent of selected landscape and nature–conservation designations (SACs, SPAs, RAMSAR sites, AONBs, ASSIs, NNR and scheduled monuments) and planning designations (Area of Constraint on Mineral Developments)

In support of Local Councils, Geological Survey of Northern Ireland (GSNI) has begun to draw together the data necessary to enable an approach to be developed in relation to safeguarding in Northern Ireland. This work will be taken forward in conjunction with Councils looking at each of the areas of most relevance in each Council. The work will build on the information included in the Mineral Resource maps and look in more detail at specific localities within individual council areas. A brief summary of the mineral resource potential within each District Council area will be provided in response to each separate POP consultation. This summary will give an indication of the mineral wealth there may be in the District Council area but should not be taken as a definitive assessment of mineral prospectivity which may become apparent as a result of future exploration.

In **England**, the key national planning policies for minerals are set out in the National Planning Policy Framework (NPPF), published in 2012. The NPPF also recognises that, since minerals are a finite natural resource, and can only be worked where they are found, it is important to make the best use of them and to secure their long-term conservation through the mechanism of mineral safeguarding.

In **Wales**, the land use planning policies for minerals are contained in Planning Policy Wales updated in November 2016, Chapter 14 of which focuses on Minerals. This policy is supported by two *Minerals Technical Advice Notes* (MTANs) on aggregates and coal.

For **Scotland**, the planning framework is centred round the National Planning Framework for Scotland 3. Published in 2014, it details the long term planning strategy for Scotland for next 20-30 years. Mineral policies for Scotland are contained in Scottish Planning Policy (SPP), published in 2014.

Mineral safeguarding in England: good practice advice (BGS, 2011) provides information on how current national mineral safeguarding policies in England can be implemented whilst the Aggregates Safeguarding Map of Wales depicts mineral safeguarding areas defined on a national basis and an accompanying report describes the process.

There are a number of exploration and development projects for metallic minerals currently active in the UK. Whilst there is no specific planning guidance for metalliferous mining developments in GB; the BGS Metals Mineral Planning Factsheet provides information on the land–use planning process with specific reference to metalliferous deposits.

Sustainability of Minerals

Aggregates, industrial minerals and high value metallic minerals can, by their nature, only be extracted where they occur and, once used they are not renewed on a human timescale. The concept of sustainability for minerals is therefore different to many other types of development although the circular economy principles of reduce, reuse and recycle apply to the sustainable development of minerals.

In terms of Sustainability Objectives the sustainable development of minerals in Northern Ireland can contribute positively to improving health and well-being and sustainable economic growth through the creation of jobs directly and indirectly related to quarrying. Quarrying operations can have conflicting impacts on other sustainability objectives – for example, the quarry operations may have some local detrimental effects on air quality but this may be offset by reduced HGV movements that result from local production rather than importing aggregates from outside council areas. In many cases potential negative impacts from quarrying on sustainability objectives such as protecting the environment, landscape character and water resources can be the use of mitigation measures or proper consideration of these sustainability objectives in individual planning decisions.

The demand for and supply of raw materials such as hard rock aggregates, limestone, sand and gravel are not evenly distributed across Northern Ireland. Demand will be greatest in urban areas where major construction projects are commonly located whereas the mineral resources can only be extracted where they are found which is in various areas throughout Northern Ireland. It will be important to plan how to identify resources to meet future demands across Northern Ireland and neighbouring councils may wish to consider developing joint Mineral Plans for the sustainable development of mineral resources in their areas.

Groundwater

Introduction to Groundwater

Groundwater is water that is underground in both the loose material above bedrock and in bedrock itself. Contrary to popular ideas, groundwater is not like surface water in that, typically, it is not found in underground streams and lakes. Groundwater fills the tiny void space between grains of material or in the cracks in the ground. The proportion of voids in the ground affects how much water can infiltrate down through the ground to form what are known as aquifers. The greater the proportion of voids, the larger and more productive the aquifer will be.

As an example, the Sherwood Sandstone Aquifer in the Lagan Valley contains 20 times more water than the Silent Valley reservoir can hold. Groundwater can range in age from being only a few hours old to a few thousand years old. The natural attenuation processes that go on in the ground serve to remove harmful chemicals and bacteria out of groundwater. The water itself dissolves out minerals in the ground so that it takes on similar chemical characteristics. Although groundwater quality is variable across Northern Ireland, in general, groundwater is naturally found in a condition that may be suitable for drinking without the need for any treatment.

In regards to Local Development Plans, groundwater can be viewed as a natural resource that requires careful protection and as a water source that can be used for growth and economic development. It is important that both aspects are given consideration so as to look after the valuable resource and to use it sustainably to enhance and support future development needs. When zoning land for industrial and commercial development it may be useful for Councils to assess the availability of local groundwater resources.

Distribution and use of groundwater in Northern Ireland

Northern Ireland has a wide range of different rock types and superficial sediment deposits that may overlie the bedrock and these may range from highly productive groundwater aquifers to low permeability aquifers that have limited prospects for groundwater supplies. Historically groundwater has been used quite extensively for public, commercial and private water supplies although the use of groundwater for public supplies stopped in the 1980s when these supplies were centralised in a small number of large surface water bodies. Currently many farms have boreholes for agricultural use and groundwater is used in commercial (e.g. Coca Cola Hellenic Bottlers, poultry industry), public sector premises (e.g. Queen's University, Belfast Hospitals) and leisure facilities (e.g. golf courses, water-based artificial sports pitches).

Groundwater may also be used in open loop shallow geothermal systems for space heating and cooling in a range of buildings (e.g. the Lyric Theatre, Royal Victoria Hospital). The extraction of shallow geothermal energy using Ground Source Heat Pump systems is an example of a low carbon sustainable energy resource that can help reduce greenhouse gas emissions.

Sustainable Use of Groundwater

It is important that groundwater is used sustainably. Groundwater is recharged from rainfall infiltrating in to the ground. It is important that the rate of abstraction from an aquifer does not exceed the rate of recharge minus the ecological flow requirements of terrestrial water bodies such as rivers and lakes. If it does exceed it, groundwater levels will decline resulting in mining of groundwater. On the other hand, high groundwater levels in unconfined aquifers may contribute to flood risk so that properly regulated groundwater abstraction could help to mitigate this risk.

It is possible to manage this using groundwater monitoring and modelling. Decisions on the capacity of any aquifer to sustain a level of abstraction should only be made following careful and extensive investigation, monitoring and modelling.

Groundwater Regulation

Groundwater is regulated by the Northern Ireland Environment Agency (NIEA). All abstractions of groundwater over 20 cubic metres per day require an abstraction license from the NIEA to operate. The licensing system operates on a 'first come first served' basis. Therefore once an operator has a license, their investment is protected from others who may wish to use groundwater also.

Groundwater quality is also regulated by measures brought in by the EU Water Framework Directive. These include Nitrate Action Plans to regulate mainly diffuse pollution by land spreading. The Pollution Prevention Control regulations require businesses to operate a license for the appropriate and careful management of all substances used during production processes. The principles upon which these regulations operate are the prevention of any hazardous substance being released in to the environment and the limiting of the release of non-hazardous substances.

Geothermal energy

There is potential for the use of both shallow and deep geothermal energy resources for the production of heat, and possibly electrical power, in Northern Ireland.

The earth is very hot at its core and the temperature decreases from the core to the earth's surface. In the earth's crust additional heat is produced from the decay of radioactive minerals within the crustal rocks. In volcanic areas of the world very hot temperatures are found at shallow depths of a few hundred metres, hot enough to produce electricity in countries such as Iceland, Italy and Indonesia. However, even in non-volcanic regions the rocks at a few kilometres depth may contain hot water that can be pumped to the surface and used to provide direct heating for district heat networks and, if hot enough, to generate electricity.

In the Lough Neagh and Larne sedimentary basins Permo-Triassic and possibly Carboniferous sandstones have sufficient water-filled pore space and are hot enough to form a viable deep geothermal resource for direct heating applications, in those areas where they are buried to depths of more than 1 kilometre. If these rocks are buried to depths of approaching 3km, temperatures of about 100^{o}C might be expected which would be hot enough for electricity generation. Some of the areas that have the best potential for deep geothermal energy resources include the area southwest (close to Dungannon) and northeast (Antrim) of Lough Neagh, the Ballymoney – Armoy - Ballycastle area, and southeast Antrim.

Most of Northern Ireland has widespread potential for the use of shallow geothermal energy. The temperature of the ground is similar to the air temperature but, at shallow depths of only a few metres, the temperatures are relatively stable and not significantly affected by seasonal fluctuations in air temperature – at temperatures of about 12^{o}C – 14^{o}C the ground is hotter than winter and cooler than summer air temperatures. Ground source heat pump (GSHP) technology uses the ground's heat energy provide heating for domestic and non-domestic buildings via horizontal closed loop systems buried at depths of 1 – 2 metres or vertical systems installed in boreholes up to 100 metres deep. In some locations vertical open loop systems can circulate water through aquifer rocks at depths of a few hundred metres to produce either heating or cooling for buildings according to their seasonal needs. The regional high quality Sherwood Sandstone aquifer could be used for geothermal heating and cooling systems in many parts of the northeastern parts of Northern Ireland, and particularly in the Greater Belfast area.

Sustainability of Geothermal energy resources

Geothermal energy, from both shallow and deep sources, could play a significant role in meeting part of the heat energy demand in Northern Ireland. Geothermal energy is a reliable low carbon, sustainable energy resource. Unlike other renewable energy resources such as wind, tidal or solar it is not subject to short term fluctuations – it is available 24/7 and 365 days a year. The other important property of shallow geothermal heat systems is that their heat output is 3 to 4 times the electricity input that the heat pumps use. The main thrust of government energy policy has been on the decarbonisation of electricity and GSHP systems can use electricity

generated from renewable sources to meet heat demand whilst only producing very small carbon emissions. The efficiency of deep geothermal energy systems is much greater than shallow GSHP systems but the capital investment involved is also many times higher. Geothermal energy systems – both shallow and deep – are much more widely deployed in many other European countries and there is potential to develop these resources in Northern Ireland as part of a future low carbon economy.

The role of the sub-surface in urban planning

The importance of the ground beneath cities and towns is under-recognised and often overlooked. For underground space to remain a societal asset there is a need to plan and manage its use. Consideration should be given to the challenges and opportunities presented by the sub-surface and planning for the use of the sub-surface should be considered in Local Development Plans.

Complex geology, particularly in an urban environment, poses engineering challenges and the underlying geology should be considered early in the planning process to make use of the opportunities that the sub-surface presents, and to avoid unexpected delays and increased costs.

Sustainable Drainage Systems (SuDS)

The sub-surface is relevant to flood management through the use of Sustainable Drainage Systems (SuDS); by mimicking natural drainage systems SuDS can lower flow rates, increase water storage capacity and reduce the transport of pollution to the water environment. However care should be taken to understand the nature of the underlying geology in terms of its groundwater storage capacity and its susceptibility to ground stability hazards. Use of SuDS can improve water quality and enhance the amenity and biodiversity value of the environment.

Geohazards

Land Stability

Northern Ireland is generally composed of stable ground with some areas deemed to have variable degrees of land instability that are for example related to landslides, abandoned mines and compressible ground. Within areas of instability subsidence and surface movement events have occurred in the past and could take place in the future.

The majority of landslide events occur naturally but can be triggered by human activity, particularly new development in susceptible areas. The most common forms of landslide in Northern Ireland are mudflows, peat bog bursts, rock falls and debris flows.

Abandoned Mine Workings

Northern Ireland has a rich history of mining activity which has left the legacy of over 2,400 abandoned mine workings. These are predominately located in County Antrim and east County Tyrone with smaller concentrations in other locations throughout Northern Ireland. As with all underground cavities, the surface lands over abandoned mines are susceptible to subsidence as a result of mine collapse. All historic mine sites in Northern Ireland classified as abandoned are vested in the Department for the Economy and are managed by the Northern Ireland Mines Oversight Committee (NIMOC).

Compressible Ground

In Northern Ireland the most commonly occurring compressible materials include areas of peat, lacustrine and estuarine silts and clays. Subsidence of structures in areas underlain by such material can occur if the foundations are inadequate. In addition, differential movement of the ground has the capacity to cause disruption to the infrastructure network.

The hazard posed by areas susceptible to land instability can be incorporated into procedures for land use planning to help aid future resilience. It is important that land stability be given adaquate consideration for future planning of residential dwellings, commercial properties, infrastructure projects and recreational areas.

ANNEX A – EXTRACTS FROM STRATEGIC PLANNING POLICY STATEMENT

6.148 Minerals, including valuable minerals, are an important natural resource and their responsible exploitation is supported by Government. The minerals industry makes an essential contribution to the economy and to our quality of life, providing primary minerals for construction, such as sand, gravel and crushed rock, and other uses, and is also a valued provider of jobs and employment, particularly in rural areas.

6.149 The Sustainable Development Strategy recognises that while it is important that we respect the limits of our natural resources and ensure a high level of protection and improvement of the quality of our environment, 'sustainable development' does not prevent us from using and capitalising on such resources. An enduring successful economy will effectively use natural resources and contribute towards the protection of the environment

6.150 While minerals development delivers significant economic benefits, there are also a number of challenges arising from this form of development which fall to be addressed through the planning system. The effects of specific proposals can have significant adverse impacts on the environment and on the amenity and well-being of people living in proximity to operational sites. This presents a challenge because minerals can only be extracted from sites where they occur, and there may be limited opportunities for consideration of alternative sites. A further challenge is related to the restoration of sites upon completion of work associated with the extraction and processing of materials.

6.151 The planning system has a key role to play in facilitating a sustainable approach to minerals development, and ensuring the appropriate restoration of sites after working has ceased. However, as the impact of mineral working on the environment can never be entirely reversed the broader role and responsibilities of government, the industry, customers and key stakeholders also need to be recognised. For example, the Sustainable Development Strategy advocates the greater use of recycled building rubble in construction so as to reduce the depletion of natural resources and to limit transportation of such materials.

6.155 In preparing LDPs councils should bring forward appropriate policies and proposals that must reflect the policy approach of the SPPS, tailored to the specific circumstances of the plan area. In particular LDPs should:

- ensure that sufficient local supplies of construction aggregates can be made available for use within the local, and where appropriate, the regional market area and beyond, to meet likely future development needs over the plan period;

- safeguard mineral resources which are of economic or conservation value, and seek to ensure that workable mineral resources are not sterilised by other surface development which would prejudice future exploitation;

- identify areas which should be protected from minerals development because of their intrinsic landscape, amenity, scientific or heritage value (including natural, built and archaeological heritage). There should be a general presumption against minerals development in such areas. However, where a designated area such as an Area of Outstanding Natural Beauty (AONB) covers expansive tracts of land, the LDP should carefully consider the scope for some minerals development that avoids key sites and that would not unduly compromise the integrity of the area as a whole or threaten to undermine the rationale for the designation.

6.157 From time to time minerals may be discovered which are particularly valuable to the economy. Their exploitation may create environmental effects which are particular to the methods of extraction or treatment of that mineral. There will not be a presumption against their exploitation in any area, however in considering a proposal where the site is within a statutory policy area, due weight will be given to the reason for the statutory zoning. However, in relation to unconventional hydrocarbon extraction there should be a presumption against their exploitation until there is sufficient and robust evidence on all environmental impacts.