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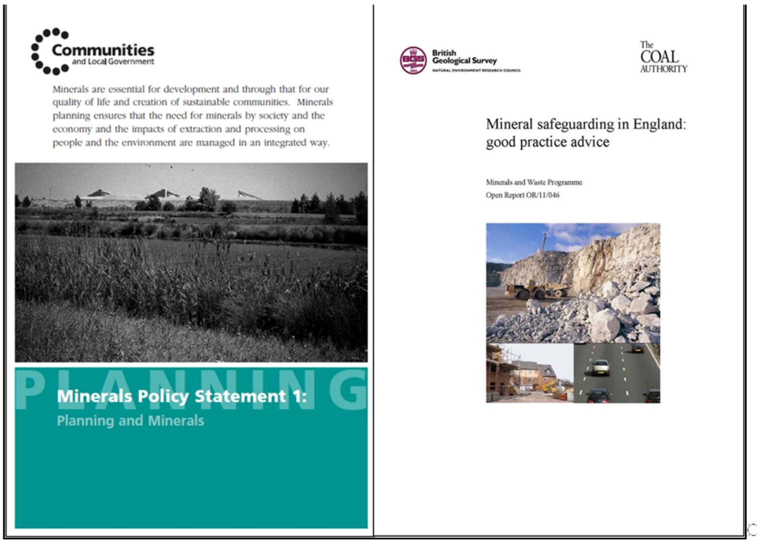
Mineral Safeguarding Areas for North Yorkshire County Council

Minerals and Waste Programme

Commissioned Report CR/11/132



BRITISH GEOLOGICAL SURVEY

MINERALS AND WASTE PROGRAMME

COMMISSIONED REPORT CR/11/132

Mineral Safeguarding Areas for North Yorkshire County Council

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List of abbreviations

BGS	British Geological Survey
BRITPITS	BGS’s database of mines and quarries
DCLG	Department for Communities and Local Government
DIGMAP	BGS’s digital onshore geology maps
DPD	Development Plan Documents
ESRI	Environmental Systems Research Institute (company which supplies the GIS software used in this project)
GIS	Geographical Information System
LDD	Local Development Documents
LDF	Local Development Framework
MPA	Mineral Planning Authority
MPS	Mineral Policy Statement (replaces some MPGs)
MSA	Mineral Safeguarding Area
MWDF	Minerals and Waste Development Framework
NERC	Natural Environmental Research Council
NPPF	National Planning Policy Framework
NYCC	North Yorkshire County Council
PPS	Planning Policy Statement

Foreword

This British Geological Survey (BGS) report presents the results of an assessment to define Mineral Safeguarding Areas for North Yorkshire County Council.

The assessment is based on published BGS Mineral Resource Maps, a consultation held with stakeholders from the minerals industry and local government organisations, and expert geological knowledge. To accompany this report is information detailing an exercise to define sand and gravel resources in North Yorkshire; this is contained in a separate report *North Yorkshire Sand and Gravel Assessment* (Bide *et al*., 2011).

The report (provided as hardcopy and in digital format) is supported by digital spatial information formatted for the MapInfo Professional version 9.5, Geographical Information System used by North Yorkshire County Council.

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Summary

This report describes work carried out by the British Geological Survey on behalf of North Yorkshire County Council to delineate Mineral Safeguarding Areas (MSAs), the results of which will be used to inform its Minerals and Waste Development Framework. The approach taken is in accordance with the methodology outlined in '*Mineral safeguarding in England: good practice advice*' (Wrighton *et al*., 2011). This report has been published during a period of change in national planning policy. The Government has committed to radically streamline and consolidate existing national planning policy. In July 2011 the Department for Communities and Local Government (DCLG) published the draft National Planning Policy Framework (NPPF) which has undergone a period of consultation. Whilst the draft NPPF retains the obligation for Local Planning Authorities to define MSAs, it is important to recognise that this report should be read in the context of a changing framework for planning. National policy for minerals safeguarding, at the time of the study, is contained within Minerals Policy Statement 1: *Planning and Minerals*, which was published in November 2006.

The work involved in this study involved the provision of maps showing the extent of mineral resources in North Yorkshire (excluding the national parks) and creating MSAs for each mineral resource. Data depicted on the maps have been provided in digital form to the council for use within a Geographical Information System.

1 Introduction

With increased pressure on land-use in the UK, there is a need to ensure that access to mineral resources are not needlessly restricted (sterilised) by other forms of development, leaving insufficient supplies for future generations. 'Mineral safeguarding' is the term that encompasses the process necessary to ensure that outcome.

There are two stages to the safeguarding process: (i) the identification of mineral resources and the definition of Mineral Safeguarding Areas (MSAs) where mineral sterilisation should be considered in the planning process; and (ii) the development of associated policies that guide the management of development proposals that are submitted in these areas. North Yorkshire County Council (NYCC) appointed the British Geological Survey (BGS) to delineate MSAs for inclusion in their Minerals and Waste Development Framework. This work does not include the development of suitable policies that will guide development decisions in these areas (stage ii). This will be undertaken by NYCC at a later stage, during their plan making process. To this end BGS has produced paper maps as well as Geographical Information System (GIS) files of MSAs. These maps are based on BGS geological linework, and amended where appropriate based on information obtained from expert geological knowledge and consultation with industry and other stakeholders including NYCC.

1.1 PLANNING CONTEXT

This report has been published during a period of change in national planning legislation and policy. The Government has committed to radically streamline and consolidate existing national planning policy. In July 2011 the Department for Communities and Local Government (DCLG) published the draft National Planning Policy Framework (NPPF) which is currently undergoing a period of consultation. Whilst the draft NPPF retains the obligation for Local Planning Authorities to define MSAs, it is important to recognise that this report should be read in the context of a changing framework for planning. National policy for minerals safeguarding, at the time of the study, is contained within Minerals Policy Statement 1: *Planning and Minerals*, which was published in November 2006. Box 1 outlines the general policies for the safeguarding of minerals.

Box 1 Key instructions in planning policy and available advice
National policy Minerals Policy Statement 1: *Planning for Minerals* (DCLG, 2006) outlines the national policy for safeguarding minerals resources. It requires Mineral Planning Authorities in England to define MSAs in their local development documents. Planning Policy Statement 12: *Local Spatial Planning* (DCLG, 2008) states that proposals maps should show areas where specific policies apply, and that minerals matters, including safeguarding areas, should be shown on the adopted proposal maps at the district level.
Key documents Minerals Policy Statement 1: *Planning and Minerals*, and annexes (DCLG, 2006) Minerals Policy Statement 1: *Practice guide* (DCLG, 2006) Planning Policy Statement 12: *Local Spatial Planning* (DCLG, 2008) *Mineral safeguarding in England: good practice advice* (Wrighton *et al*., 2011)

1.2 KEY DEFINITIONS

Box 2 provides some background to the terms used in the report. A list of abbreviations can be found at the beginning of this report.

Box 2 Mineral Safeguarding Areas
'Mineral resources are natural concentrations of minerals in or on the Earth's crust that are or may become of economic interest because they are present in such form, quality and quantity that there is the potential for eventual economic extraction. Mineral resources are thus defined by economic as well as physical parameters' [para 2.1.1].
'The definition of MSA boundaries requires up-to-date, factual information on the physical location of mineral resources and should be based principally on the best available mineral resource information at the time MSAs are defined. In the context of the plan making process, geology, unlike many other factors that influence planning, does not change with time' [para 4.1.1].
'There is no presumption that areas within a MSA will ultimately be allocated for extraction. If an application is submitted for mineral extraction within a MSA, the MSA designation itself does not provide any support for a grant of consent. If a MPA wishes to define future allocations for extraction then such areas must be identified as Areas of Search, Preferred Areas, and Specific Site allocations. Equally, there is no presumption that non-mineral development within a MSA is automatically precluded. MSAs alert those proposing sites for future development to the presence of valuable mineral resources which they otherwise might not have considered' [para 2.3.3].
'The MSAs indicate where local mineral safeguarding policies, formulated specifically to suit local circumstances, may apply. The process should ensure that minerals are not unnecessarily sterilised whilst allowing competing development to proceed if there is an overriding need for it. In those circumstances extraction of the mineral ahead of the development (prior extraction) should always be considered' [para 2.3.3].
Source: *Mineral safeguarding in England: good practice advice* (Wrighton *et al*., 2011)

1.3 LIMITATIONS

The identification and delineation of mineral resources (the first step in the mineral safeguarding process) is imprecise as it is limited by the quantity and quality of data currently available and involves predicting what might or might not become economic to work in the future. The pattern of demand for minerals is continually evolving due to changing economic, technical and environmental factors. The economic potential of mineral resources is not static, but it changes with time.

The mineral resource maps which informed the current work are derived from geological linework forming part of the national 1:50 000 scale digital geology coverage, DiGMapGB-50, from the BGS. This dataset is based on surveys carried at 6-inch or 1:10 000 scales, and acquired at different times. Whilst every effort has been made to ensure consistency of approach across the county, the level of detail reflects in part the variation in the age of the mapping.

2 Methodology

MSAs have been defined in the NYCC area in accordance with the methodology outlined in *Mineral safeguarding in England: good practice advice* (Wrighton *et al.*, 2011). The document outlines a seven-step approach to creating an effective system for mineral safeguarding. The scope of work undertaken by BGS for NYCC is limited to steps 1-3. Steps 4-7, which include drafting of the associated policies, was beyond the scope of this study.

Box 3 Step by step approach to creating an effective safeguarding system for minerals		
Stage i	Step 1	Identify the best geological and mineral resource information
	Step 2	Decide which mineral resources to safeguard and the physical extent of MSAs
	Step 3	Undertake consultation on draft MSAs
Stage ii	Step 4	Decide on the approach to safeguarding in the Core Strategy
	Step 5	Include development management policies in a DPD
	Step 6	Include safeguarding in district level DPDs
	Step 7	Include mineral assessments in the local list of information requirements

Source: *Mineral safeguarding in England: good practice advice* (Wrighton *et al*., 2011).

2.1 STEP 1: IDENTIFY THE BEST GEOLOGICAL AND MINERAL RESOURCE INFORMATION

The first step in the MSA process is to identify the most recent geological and mineral resource information. The mineral resources that are present in North Yorkshire are shown in Figure A1 whilst an overview of the geology of North Yorkshire is provided in Appendix 2.

As part of a preceding study, NYCC commissioned BGS to update the sand and gravel linework that they held for the area (Bide *et al.*, 2011). The information contained within this dataset also covered silica sand resources. A recent national update undertaken by BGS to the crushed rock and non-aggregate resource linework provided the most recent data for limestone and chalk (both crushed rock and industrial), together with sandstone and brick clay. Coal data was obtained from data produced by a joint BGS and Coal Authority project (Jones *et al.*, 2006). Data on building stone resources were extracted from the BGS DiGMapGB-50 dataset. The BGS mines and quarries database 'Britpits' was used to provide information on the location and current activity of quarries in North Yorkshire. All of the data were integrated within a GIS in order to undertake the process of defining MSAs. Table 1 summarises all of the data utilised during the study.

Table 1: **Available mineral resource information**

Resource	Data provider	Date of publication of dataset	Any more recent geological resource information	Comments
Sand and gravel	BGS	2011	No	Updated for NYCC as a precursor to this study.
Limestone (crushed rock)	BGS	2011	No	
Limestone (industrial)	BGS	2011	No	
Sandstone (crushed rock)	BGS	2011	No	
Igneous (crushed rock)	None present in study area			
Chalk (crushed rock)	BGS	2011	No	
Silica sand	BGS	2011	No	Updated for NYCC as a precursor to this study.
Building Stone	BGS	2011	No	Britpits database and DiGMap
Coal	BGS on behalf of the Coal Authority	2006 (shallow coal) 1999 (deep coal)	None highlighted in consultation	
Brick Clay	BGS	2011	No	

2.2 STEP 2: DECIDE WHICH MINERAL RESOURCES TO SAFEGUARD AND THE PHYSICAL EXTENT OF MSAs

As stated in Section 1.3, the pattern of demand for minerals is continually evolving due to changing economic, technical and environmental factors. Consequently areas that are of potential economic interest as sources of minerals may change with time. Using the best available data identified in Step 1, and the BGS mineral planning factsheets that have been prepared to inform the land use planning process, these can be downloaded from www.bgs.ac.uk/mineralsuk/planning/mineralPlanningFactsheets.html, a list of mineral resources that were to be excluded from or included in the safeguarding process was made. Where mineral resources were identified for exclusion, a justification was prepared for consultation. This list and justification can be seen in Appendix 1.

In order to define the physical extent of MSAs, it was decided that the mineral resource information identified in Step 1, and selected as part of Step 2, should be depicted on maps created of each mineral resource and used as a basis for consultation.

In the first instance, the full extent of each resource was included within the respective MSA. This included mineral resources in urban areas and in environmental designations in line with the mineral safeguarding good practice advice (Wrighton *et al.*, 2011). In urban areas, the definition of MSAs will identify opportunities for prior extraction beneath large regeneration projects and brownfield sites. It was felt that justification for any other approach would be weak at this stage as it would diverge from the best practise advice. Policies can be used to control the amount of applications which would be considered on mineral safeguarding grounds – for example householder development applications may be excluded from the need to assess mineral sterilisation, by inclusion in an exemption policy. Many of these considerations are likely to be picked up through the consultation on policy and on the adoption of detailed safeguarding boundaries that NYCC will undertake in the course of their plan preparation. Development is more limited in environmental designations, and so in these instances the mineral resource should be considered alongside all of the other planning factors.

In the good practice advice, the issue of sterilisation by development that is permitted on or close to the edges of the identified resource boundaries is raised, as access to mineral resources is affected by consideration of the amenities of, and nuisance to, those that live and work close to the operation. For this reason, a 'buffer' distance, i.e. the extension that should be applied to the mineral resource boundary in order to create an MSA and protect the identified 'edges' of the resource from sterilisation, was also subject to consultation. The resource maps were not changed, as there were no other spatial changes to make for the purposes of consultation. In the accompanying letter, however, an initial distance of 100m for resources that did not require extraction by blasting, and 200m for those that did, were proposed for comment. These values were based on previous work undertaken on mineral safeguarding in Wales, and were seen as a starting point for discussions.

Box 4 Buffering of MSA boundaries
'The boundaries of MSAs may be extended beyond the lateral extent of a mineral resource to avoid sterilisation by adjacent development.' [Case study 3, page 20] Source: *Mineral safeguarding in England: good practice advice* (Wrighton *et al*., 2011)

2.3 STEP 3: UNDERTAKE CONSULTATION ON DRAFT MSAS

Members of the minerals industry are likely to hold the most up-to-date and detailed mineral resource information in relation to their operational areas, specifically their former and current sites and also any prospective future sites. Neighbouring MPAs may also have views and policies on the safeguarding of minerals and a joined up approach to safeguarding should prevent the unnecessary sterilisation of minerals close to the borders of each MPA boundary.

Box 5 Consultation with neighbouring MPAs
'Consultation should be undertaken with neighbouring MPAs where mineral resources cross or are in close proximity to administrative boundaries. A 'joined-up' approach to the definition of MSAs is essential to ensure that development in one MPA does not needlessly sterilise mineral resources in an adjacent MPA area.' [para 4.3.4]. Source: *Mineral safeguarding in England: good practice advice* (Wrighton *et al*., 2011)

The mineral resource maps, together with the list of minerals proposed for safeguarding and justifications for minerals that were not proposed for safeguarding, were sent out to members of industry in North Yorkshire that were identified by NYCC and the BGS mines and quarries inventory. The consultation information was also sent to all neighbouring MPAs. The consultation maps produced were extended by 1km to ensure that resources that were outside the NYCC boundary would be considered, and consultation with neighbouring MPAs would be made easier. Consultees were requested to provide any additional information that might affect the delineation of MSAs, either geologically or operationally. It was anticipated that certain issues might be identified to inform the delineation of MSA boundaries. These included:

- mineral resource beneath overburden;
- new data proving that mineral resource is not present in an area
- new data proving that mineral resource is present; and

- suitability of suggested MSA buffer distances (see Section 2.2).

Onsite meetings were held where possible and a consultation event was held in October 2011 to disseminate the results as they stood at the time and provide opportunity for additional comments / data to be gathered.

A copy of the letters sent out to consultation is included in Appendix 4 and the responses to the consultation are summarised in Appendix 5.

The results of the consultation (as summarised in Appendix 3) were used to modify the mineral resource linework and it is this modified linework that was used as a basis for defining MSAs. Safeguarding decisions and justifications were based on the information provided through consultation and are explained in Section 3. The buffer distances that were decided as a result of consultation are shown in Table 2, and the final maps produced are shown in Appendix 1.

Table 2: Buffer distances as a result of consultation

Category	**Buffer**
Sand and Gravel	250m
Brick Clay	250m
Building Stone	250m
Coal: shallow	250m
deep	700m
Limestone and chalk	500m
Sandstone	500m
Silica Sand	500m
Potash	0m

3 Mineral Resources

This section provides a summary of the geological mineral resources in North Yorkshire from an economic perspective. It provides a geological description of the resource, information regarding extraction activity and a rationale for delineation of MSAs.

3.1 SAND AND GRAVEL[1]

Sand and gravel are defined on the basis of particle size as opposed to composition. Currently the term 'gravel' (or more correctly coarse aggregate) is used to describe material coarser than 4mm, with a maximum size of 80mm. 'Sand' (or fine aggregate) is described as material that is finer than 4mm, but coarser than 0.063mm. Material with a particle size of less than 0.063mm (i.e. clay and silt) is classed as 'fines'. Most sand and gravel is composed of particles that are rich in silica (quartz, quartzite and flint). A brief overview of the superficial geology of North Yorkshire is outlined in Appendix 2.

The superficial or 'drift' sand and gravel deposits accumulated in a variety of geological environments but are broadly divided into

- River terrace deposits

[1] North Yorkshire Sand and Gravel Assessment (Bide *et al.*, 2011).

- Sub-alluvial river terrace deposits
- Glacial sand and gravel

3.1.1 Geological description

RIVER TERRACE DEPOSITS (INCLUDING SUB-ALLUVIAL)

Resources in these deposits take the form of extensive spreads of sand and gravel that occur in both raised river terrace sequences, flanking the modern floodplains, and underlying alluvium (‘sub-alluvial terrace deposits’). River sand and gravel resources are reasonably consistent over considerable distances, their composition reflecting, in general, the geology of the river catchment from which they were reworked. Generally, they are ‘clean’ deposits, with low fines content.

Only exposed river terraces are depicted on the 1:50 000 scale geological maps, although inferred resources in sub-alluvial sand and gravel deposits occurring beneath river floodplains may be extensive in some places and have been identified from the Mineral Resources map data used for this project. Where they underlie alluvium, these deposits will be water saturated and require wet-working, potentially making them less desirable as a resource. These deposits occur in all of the major river valleys in North Yorkshire but the largest deposits are located in the valleys of the Rivers Swale and Ure.

The extensive terraces associated with the River Ure are the result of reworking of the glaciofluvial deposits in the area. The terraces are mainly composed of sandy gravel but with thin layers of silt and clay in the lower terraces, representing overbank deposits.

The terrace deposits associated with the River Swale are worked at several localities, including Catterick, and Scorton quarries. These deposits have 60-70 per cent gravel with the remainder mostly sand but with up to 15 per cent silt and clay in places. The deposit is up to 15m thick with the upper 5m worked dry and the remainder wet worked. The composition of the gravel fraction of the river terrace deposits varies greatly reflecting the varied glacial and bedrock deposits from which they are derived.

Sub-alluvial deposits tend to be thicker and have thicker overburden than river terrace deposits. Both show significant variability in thickness as would be expected for an extensive area containing several river systems.

GLACIAL SAND AND GRAVEL

For convenience and simplicity the term Glacial Sand and Gravel is used in this report to encompass a range of sand and gravel-bearing glacial deposits such as glaciofluvial deposits, glaciolacustrine deposits and blown sand.

Some of the thickest deposits in the county are water-lain sands and gravels deposited in close proximity to the ice-sheet. These deposits mainly occur on top of the sheet of till or, in valleys initiated as meltwater channels during glacial times. In some areas, for example around Thirsk, the deposits occur in well developed linear esker systems trending south-southeast. The main component of the eskers is moderately well-sorted, fine-grained sand although a broad range of grain sizes, from silt to boulders may also be present in places. The gravel fraction is composed mainly of Carboniferous sandstones with minor amounts of Carboniferous and Permian limestones. South of Newby Wiske the deposits are characterised by red to red-brown, fine- to medium-grained sand, with beds of coarse-grained sand and fine to coarse gravel. The gravel fraction is again mainly Carboniferous sandstones with 10 to 50 per cent Carboniferous limestone. Elsewhere landforms associated with the deposits are less distinct and occur as irregular spreads and ridges of red-brown clayey sand with gravel, cobbles and sparse boulders of quartzite, sandstone, mudstone, chert and both Jurassic and Carboniferous limestones. These deposits are typically up to 6m thick in places, although deposits in the Thirsk area as, for example, between Topcliffe and Brafferton, reach 22m in thickness.

The most commonly worked glacial sand and gravel are glaciofluval deposits, the products of deposition by glacial meltwaters. They often display intricate relationships with adjacent deposits. Bodies of sand and gravel may occur as sheet- or fan-like layers above till deposits or as elongate, irregular lenses within the till sequence. Areas of wholly concealed, and thus possibly unknown, bodies of sand and gravel may occur under spreads of till and other drift deposits.

In North Yorkshire, extensive spreads of these deposits occur in the mid and lower reaches of the Esk, Ure, Swale, Ouse, Wharfe, Nidd and Aire valleys. Some of these deposits form broadly rounded and elongate ridges and overlie and clearly postdate the till and older glacial sand and gravels. They are composed of yellow to reddish-brown, fine-grained sands with varying proportions of gravel, cobbles and occasional boulders. In the Hambleton Hills, these deposits have a sloping, steep sided, terrace-like form and are composed of red-brown gravels with thin lenses of medium- to coarse-grained sand. The gravel fraction includes local Jurassic sandstone, ironstone, limestone and siltstone with a few pebbles of Carboniferous limestones. North of Thirsk, these deposits form broad ridges of red-brown sandy gravel associated with underlying glaciolacustrine sediments. Glaciofluvial sediments also occur in ‘terrace’ deposits where drainage from the glaciers in the Pennine valleys entered the west side of the Vale of York, depositing spreads of sand and gravel in front of the ice sheets. The deposits are generally gravelly, with Carboniferous limestones and sandstones the main gravel components, and form the highest, flat-topped terraces along the valleys. This type of deposit is typified in the workings at Marfield Quarry near Masham, where up to 15m of coarse-grained sand and gravel is dry worked for concreting aggregate. The deposit is typically 60 per cent gravel and 40 per cent sand with a significant proportion of oversized material reflecting the coarse grained nature of many of these deposits.

Large areas of blown sand have also been mapped in North Yorkshire In general these are too thin and fine grained to constitute economic resources for sand and gravel (although they may have applications for silica sand or mortar sand). Where borehole evidence has shown a resource within blown sand deposits they have been included in glacial sands and gravels as these deposits are believed to be largely of late Quaternary age resulting from aeolian reworking of fluvial and glaciofluvial sands. The sand is red-brown-yellow in colour and well-sorted, although the deposits are generally less than 2m thick.

3.1.2 Extraction activity

There are 11 active quarries working sand and gravel within North Yorkshire, the majority work glacial sands and gravels but river terrace deposits are worked as well (this includes one site, Hensall, in the south of the county that works sand from the Sherwood Sandstone formation). Coarse aggregate for use primarily for concrete applications is in most demand. Fine aggregate for use in concrete, mortar and asphalt are less sought after. There is a shortage of concreting aggregate in the Yorkshire and Humber region, which is reflected in the North Yorkshire exportation figures of 60% of the sand and gravel produced (NYCC, 2011).

3.1.3 Rationale for MSA delineation

The resource linework (Figure A2) has been amended through consultation, which has allowed specific areas of the boundary to be refined. These changes have been incorporated into the Mineral Safeguarding Area map (Figure A9), and are reported in Appendix 5.

MSA buffer

The suggested buffer of 100m for minerals not extracted by blasting was amended through consultation for sand and gravel as there were several responses that suggested that 250m would be more appropriate. This figure reflects the fact that 100m may not be enough to ensure the effective safeguarding of the identified boundaries of the resource area from development permitted nearby.

3.2 SILICA SAND

3.2.1 Geological description

Silica (industrial) sands contain a high proportion of silica in the form of quartz and are marketed for purposes other than for direct application in the construction industry. They are essential raw materials for the glass and foundry casting industries, but also have a wide range of other industrial uses (including ceramics and chemicals manufacture) for water filtration media, and in sports and horticultural applications. Silica sands are valued for both their chemical and physical properties. These include a high quartz content and, more importantly, low levels of deleterious impurities such as clay, iron oxides and chromite, and typically a narrow grain-size distribution (generally in the range 0.5 to 0.1 mm). For most applications silica sands have to conform to very closely defined specifications with alternative end uses demanding different combinations of properties.

Within the UK, deposits of silica sand occur in only limited areas and quantities, and the special characteristics of silica sand extraction, in particular the cost of processing, means that the industry has a restricted distribution.

North Yorkshire has only limited resources of silica sand from the Jurassic Osgodby Formation and from Carboniferous sandstones within the Millstone Grit Group (Hall Moor Sandstone) at Blubberhouses, near Harrogate. The resource map (Figure A2) shows the outcrop of the Osgodby Formation only in the Burythorpe area and the Millstone Grit Group around the Blubberhouses area.

3.2.2 Extraction activity

There are two occurrences of silica sand resource in the NYCC area, one at has been historically worked from a site at Blubberhouses and one is actively worked at Burythorpe.

The site at Blubberhouses has been mothballed since 1991 after operating for three years due, in part, to difficulties processing the silica sand. The site formerly produced glass sand, mainly for the colourless glass container market (Harrison *et al,* 2006 and NYCC, 2011). The planning permission was due to expire at the end of 2011, but a planning application for an extension of the time on this permission is currently in preparation. Production, therefore, is confined to a relatively small site at Burythorpe, near Malton. Here, fine-grained, pale-coloured sands from the Jurassic Osgodby Formation are quarried, predominantly for the production of resin-coated foundry sand. The planning permission at Burythorpe Quarry expires in 2042 (NYCC, 2011).

3.2.3 Rationale for MSA delineation

The original resource linework (Figure A2) was not changed as a result of consultation and so has been used as the basis for defining MSAs (Figure A9).

MSA Buffers

The original buffer of 100m that was proposed for silica sand has been amended to reflect the fact that some mineral is hard enough to require blasting. As the buffer distance for minerals that are extracted by blasting was amended through consultation from 200m to 500m, this is the buffer that has been included in the safeguarding map to ensure the effective safeguarding of the identified boundaries of the resource area from development permitted nearby.

3.3 SANDSTONE

Sandstones are sedimentary rocks consisting of sand-sized particles composed predominantly of quartz but with variable amounts of feldspar and rock fragments set in a fine-grained matrix or cement. Sandstones are common rocks with a widespread occurrence, but most sandstones are too weak and porous to make good quality aggregate for roadstone and concrete.

3.3.1 Geological description

Carboniferous sandstone outcrops extensively in the west of the county; these rocks may be suitable for lower specification aggregates applications such as fill and road sub-base. Only units that are considered most prospective for aggregate use have been included on the map (Figure A3)

3.3.2 Extraction activity

In the NYCC area, only minor amounts of sandstone, resulting as a by-product of building stone extraction and processing, are sold for aggregate use.

3.3.3 Rationale for MSA delineation

The resource linework (Figure A3) has not been amended through consultation, as there was no information that was presented to refine the boundaries further. For this reason, all of the sandstone resources identified on the mineral resources map have been safeguarded (Figure A10).

MSA buffers

Buffers for minerals that are extracted through blasting techniques were originally set as 200m. Through consultation, this was changed to 500m as it was felt that 500m would be more appropriate to ensure that the identified boundaries of the resource are not sterilised by development permitted nearby.

3.4 LIMESTONE AND CHALK

Limestone is a sedimentary rock consisting primarily of calcium carbonate (the calcified remains of marine organisms). If limestone has high magnesium carbonate contents, limestone grades into dolomite or dolostone. Limestone has a variety of uses – it can be crushed, ground or calcined (burnt to make lime) for a variety of constructional and industrial applications. As most limestones are hard and durable the rock is useful for aggregate, but it also has a variety of non-aggregate industrial uses which utilise its chemical properties. Chalk is a relatively soft, fine-grained, white limestone consisting mostly of the debris from planktonic algae (Harrison *et al.*, 2006).

3.4.1 Geological description[2]

LIMESTONE CRUSHED ROCK AGGREGATE

North Yorkshire Carboniferous limestones are a major source of limestone aggregate minerals. These limestones are commonly thick-bedded, pale grey or grey, consistent deposits which are structurally simple and can be quarried extensively and economically. Other limestones being worked for aggregates are the Permian 'Magnesian Limestone' and certain of the more indurated Jurassic limestones. Small amounts of Cretaceous Chalk are also quarried at the margins of the Yorkshire Wolds, for less demanding aggregate applications.

Carboniferous Limestone

Large areas of the northern Pennines are underlain by Carboniferous limestones which, in the more northern areas (Wensleydale northwards), are thinner and associated with units of mudstone and sandstone. The most consistent limestones are found within the thick (>150 m) Malham Formation and equivalent beds which crop out widely between Ingleton, Settle and Grassington.

Permian Limestone

Dolomitic limestones of Permian age occupy a narrow outcrop of easterly dipping strata from Knottingley to the River Tees. These Permian limestones and dolomites – commonly known as the 'Magnesian Limestone' – are highly variable lithologically and in their rock properties. They are much softer than typical Carboniferous limestones, with higher porosity and frequently are too weak and friable to make high quality aggregate. Nevertheless, they are extensively quarried for low-grade applications, such as sub-base roadstone and fill, and some of the rocks are sufficiently sound, strong and durable to be used as concreting aggregate or roadstone. In Yorkshire, the Permian sequence is made up of two carbonate units, separated by a calcareous mudstone.

Jurassic Limestone

Jurassic rocks occur in the areas adjacent to the North York Moors. Limestones only form part of the sequence which also contains clays, siltstones and sandstones. The limestones, which are generally soft, friable and porous, occur in units which are usually relatively thin and may be laterally impersistent. Certain limestone units, however, such as the Upper Jurassic Malton Oolite Member of the Coralline Oolite Formation, which flanks the Vale of Pickering, are sufficiently indurated to produce good quality aggregates. The Malton Oolite is an impure limestone with high and variable silica contents and is quarried at several sites for general-purpose crushed rock aggregate.

Chalk

In North Yorkshire, the Chalk occurs where the Yorkshire Wolds flank the broad Vale of Pickering. Five distinct formations are defined in the chalk, the Hunstanton Formation, Ferriby Chalk, Welton Chalk, Burnham Chalk and Flamborough Chalk, some of which may have potential for industrial applications due to high $CaCO_3$ contents.

[2] Source: Harrison *et al.*, 2006.

3.4.2 Extraction activity

LIMESTONE

Carboniferous limestone, magnesian limestone and Jurassic limestone are all used as sources for crushed rock in the NYCC area (NYCC, 2011). There are 20 sites that operate in North Yorkshire, the largest of these being in limestones of Carboniferous age. Limestone for industrial use has been produced from several limestone quarries in the past but currently all limestone is used as aggregate or for the production of agricultural lime (Harrison *et al.*, 2006).

CHALK

The Chalk is suitable for low-grade aggregate applications such as fill and sub-base roadstone. It is currently extracted at two sites, at Knapton and Flixton, although there are numerous small, disused quarries where the Chalk has been dug for local use as agricultural lime and hard core (Harrison *et al.,* 2006).

3.4.3 Rationale for MSA delineation

All limestone and chalk resources were included on the resource maps for consultation (Figures A4 and A5). The limestone resources map was refined through consultation and the mineral safeguarding maps (Figures A11 and A12) incorporate this information.

MSA buffers

Buffers for minerals that are extracted through blasting techniques were originally set as 200m. Through consultation, this was changed to 500m as it was felt that 500m would be more appropriate to ensure that the identified boundaries of the resource are not sterilised by development permitted nearby. Although chalk in England is generally fine grained, soft and porous, in regions such as Yorkshire and the Humber, it is older and harder so is a potential source of aggregate (Mankelow *et al.,* 2008). As the material is described as being harder than chalk in most other areas of England, the chalk resource has been buffered by the same amount as other crushed rock resources for consistency.

3.5 BRICK CLAY

'Brick clay' is the term used to describe clay in the manufacture of bricks, roof tiles, clay pipes and decorative pottery. These clays may sometimes be used in construction, such as in cement manufacture, as a source of fill and for lining and sealing landfill sites. The behaviour of a clay during shaping, drying and firing dictates its suitability for the manufacture of bricks as it affects the properties of the fired brick such as strength and frost resistance and architectural appearance (Harrison *et al,* 2006).

3.5.1 Geological description

The laminated clays that formed in glacial lakes in the Vale of York are a widely utilised source of brick clay in the county. These deposits, which are widespread throughout the Vale of York, were deposited in a glaciolacustrine environment during the last major ice age.

3.5.2 Extraction activity

There are small clay pits at Alne, which make handmade bricks and drainage pipes, and at Littlethorpe, near Ripon, which make pottery and gardenware. Both pits work the laminated glacial clays. Historically these clays have also been extensively worked for bricks at York and more recently for pipe manufacture at Escrick. They are also used in the manufacture of lightweight expanded clay aggregate for block production and are worked at Hemingborough. (Harrison *et al*, 2006).

3.5.3 Rationale for MSA delineation

The advice in *'mineral safeguarding in England: good practice advice'* (Wrighton *et al*, 2011) suggests that where more geologically mapped subdivisions exist for geology in an area, it may be possible to reduce the extent of safeguarding areas for Brick Clay based on those formations that are actively worked. In the case study provided in the good practice advice, specific formations are identified that are worked by industry and Nottinghamshire County Council are consulting on the options for safeguarding. As no further subdivisions of the Brick Clay resource are available for the NYCC area, this approach cannot be taken and so all resources of Brick Clay were shown on the resources map for consultation purposes (Figure A6). Only minor changes to the mineral resources linework were identified through consultation, which comprised the addition of resource in the Riccal Airfield area (Figure A13).

MSA buffers

The suggested buffer of 100m for minerals that are not extracted by blasting was amended through consultation on other mineral safeguarding maps. To keep the methodology consistent as far as possible, and prevent the unnecessary sterilisation of the identified boundaries of the resource, a buffer of 250m has now been included in the final safeguarding maps.

3.6 COAL

Coal is a combustible rock that is formed through the alteration of dead plant material under the increasing temperatures and pressures experienced during burial. As a result of geological processes such as faulting and folding, coal seams can occur at varying depths from the surface, and be of varying thicknesses.

Depending on its quality (physical and chemical properties), coal can be used as power station fuel to generate electricity, or if it is high enough quality, it can be used to fire blast furnaces for the metallurgical industries. Its quality is ranked by its Calorific Value (CV), which is the heat energy given off by the combustion of a unit quantity of fuel. This can vary from 15 MJ/kg for peat (low rank) to 35 MJ/kg for anthracite (high rank). Impurities such as chlorine and sulphur are detrimental in coal as it causes corrosion and pollution (BGS, 2011a).

Coal is extracted by surface or underground mining, depending on its proximity to the surface. However, where conditions and quality allow it may also be suitable for Coal Bed Methane (CBM) extraction or Underground Coal Gasification (UCG). CBM extraction exploits the gas that is adsorbed onto the coal surface during coal formation, usually via boreholes. UCG is the initiation of partial combustion of the coal seams in situ in order to drive off gases and produce heat (BGS, 2011a, BGS, 2011b).

Fireclays are often worked as a by-product of surface coal mining. They are mudstones that usually underlie a coal seam, and would have once been the soils on which the coal-forming plants and vegetation grew. Beds are primarily used for buff-coloured facing bricks and pavers (BGS, 2011a).

3.6.1 Geological description and coal resource areas

The county includes the concealed East Pennine Coalfield. Coal-bearing strata are principally confined to the Pennine Lower and Middle Coal Measures (Upper Carboniferous). In general the coal-bearing horizons dip from west to east under the south and southeast of the county. These horizons generally occur at depths of between 50 to 1200m beneath the surface. There is some shallow coal in the extreme southwest of the county. Coal seams are widespread and many are developed on a regional scale. However, there are lateral variations in thickness, composition and the number of 'dirt' partings they contain. The seams are mainly bituminous and the calorific value and rank of the coals broadly increases eastward. Sulphur is an impurity associated with all Yorkshire coals, with the more easterly parts of the coalfield containing higher sulphur contents (Harrison *et al.*, 2006).

For the purpose of this study, the spatial geological information for the coal measures formations is shown as coal resource areas in order to give a more relevant indication of their suitability as a coal resource. These resources were delineated in the 2006 study carried out by BGS for the Coal Authority (CR/06/159N). They are based on a detailed examination of the stratigraphy to determine the vertical spacing, lateral continuity and thickness of coals. Although the North Yorkshire County Council area does not contain all of the categories:

- Primary opencast coal resource areas are the main target for opencast coal extraction and comprise a relatively closely spaced succession of variable but generally thick coals. There are no primary opencast coal resources within NYCC.
- The secondary resource area represents the area which contain opencast coal resources, but in which the coals are generally thinner and less concentrated in vertical and areal distribution.
- Tertiary opencast resource areas are locally present and typically inter-bedded with thick sandstones. They do form a resource but are not generally attractive for opencast mining. They often have high overburden ratios.
- Buried coals overlain by up to 50m overburden are usually down-dip of the main areas of mapped resource. They are covered by younger strata and are not ranked as primary, secondary or tertiary.

3.6.2 Extraction activity

Kellingley Colliery, near Knottingley, is now the only remaining deep mine in the county. With regard to shallow coal, although small areas of shallow coal are shown on the resources map, there has been no commercial interest in working these resources (NYCC, 2011).

3.6.3 Rationale for MSA delineation

SHALLOW COAL RESOURCES

Although not currently worked, the shallow coal resource areas shown on Figure A7 are considered to be a resource that should be safeguarded. Through consultation it was identified that the Coal Authority supported the proposal to safeguard shallow coal resources and are actively seeking the inclusion of all surface coal resources within MSAs. These resources, therefore, are shown in the safeguarding map (Figure A14).

DEEP COAL RESOURCES

During the consultation phase, the issue of subsidence was raised for minerals worked underground. Although subsidence from deep coal workings does not generally affect normal development, as pillars can be left to support the surface, sensitive surface development can affect the viability of deep workings. The example of a glass factory in Selby District was provided as support for this view, where risks to the operator from working underneath such sensitive development, even if pillars were left to support the surface, were considered too great to work the mineral. Therefore, although the effects of subsidence are not necessarily an issue for all surface development, it should be recognised that some sensitive surface developments will have the potential to sterilise mineral resources at depth. Deep coal resources, therefore, are shown on the mineral safeguarding map (Figure A14).

MSA buffers

The suggested buffer of 100m for minerals that are not extracted by blasting, and therefore applied to shallow coal resources, was amended through consultation on other mineral safeguarding maps. To keep the methodology consistent as far as possible, and prevent the unnecessary sterilisation of the identified boundaries of the resource, a buffer of 250m has now been included for shallow coal resources in the final safeguarding maps.

It was identified in consultation that a suitable buffer distance for deep coal would be 700m. Subsidence effects on sensitive development (such as high precision factories) is negligible (using current extraction techniques) at a horizontal distance of 0.7 multiplied by the depth of working. As current depths of working do not generally exceed 1000m, a buffer of 700m should ensure that the safeguarding mechanism is robust.

3.7 POTASH

Potash is a term used to encapsulate a variety of potassium-bearing mineral and refined products. Potassium bearing minerals that are of commercial interest are water-soluble. Sylvanite, which is mined in the UK, is a mixture of sylvine (potassium chloride, KCl) and halite (salt). Sylvine is a relatively scarce mineral, which occurs in beds up to a few metres thick. It is found in deposits that are formed by the extreme evaporation of seawater.

Approximately 90% of UK potash production in the UK is used for fertilisers. Small quantities are also used by the chemical and pharmaceutical industries in goods such as soaps, the production of glass for television screens, drilling fluid additives, and as a flux in secondary aluminium smelting (BGS 2011c).

3.7.1 Geological description

Potash resources occur in rocks of late Permian age that underlie the eastern part of North Yorkshire. The resource comprises the Boulby Potash, which occurs at the top of the Boulby Halite Formation. The bed underlies extensive parts of east Yorkshire but is currently only worked at the Boulby Mine in the North Yorkshire Moors National Park. The Boulby Potash averages 7m in thickness but ranges from nil to over 20m. The bed consists of sylvinite (a mixture of sylvine and halite) with minor clay minerals and anhydrite, and traces of other minerals. The material mined is of high-grade by international standards with a mean KCl content of 34 per cent. However, grade varies both vertically and laterally (Harrison *et al*, 2006).

3.7.2 Extraction activity

Large scale extraction of potash and salt takes place at Boulby mine in the North Yorkshire Moors National Park. Mining operations extend some 12.5 km, reaching 5 km offshore to the north where they are approximately 800m below the seabed. Until recently, there has been no interest in the exploitation of these resources in the NYCC plan area. However, in 2011, there has been commercial interest in the area between Scarborough and Whitby (BGS 2011c).

3.7.3 Rationale for MSA delineation

Initially, potash was not included among the list of proposed minerals for safeguarding, due to the low risk of sterilisation of the mineral by surface development. It was felt that any surface infrastructure associated with any mine could be relatively flexible in terms of siting and so minimise any conflicting impacts. Similar to coal, however, the issue of subsidence was raised during the consultation for minerals worked underground. Subsidence at surface can be up to 0.5m as a result of underground potash workings (BGS 2011c), which occurs uniformly and over large areas. Although not a threat to normal development, the siting of sensitive developments over areas of mineral resource is likely to lead to sterilisation of the mineral due to the risk of cost and reputation associated with any detrimental impacts. Safeguarding areas for potash have, therefore, been defined (Figure A15).

MSA buffers

Potash has not been buffered due to the nature of the dataset, which is large in scale. The presence of the mineral resource linework as a safeguarding area should capture any sensitive development that has the potential to affect future access to the mineral.

3.8 BUILDING STONE

3.8.1 Context

Historically, building stone has been used extensively throughout the county and has been extracted from a wide range of geological units.

Competition from cheaper building materials such as brick, concrete, glass and steel, together with a reduction in building after wartime reconstruction efforts, has led to the closure of many stone quarries [BGS, 2007]. Nevertheless, the industry is still buoyant, and several types of stone are actively quarried in the county. There are now two principal markets that rely on the supply of building stones: new buildings and the repair of historic buildings.

The building stones industry is unique in many ways to the rest of the minerals industry:

- historically, many geological units were worked and used for local buildings, walling, roofing, flagstone or ornamental purposes (NYCC, 2011).
- the suitability of a stone for building purposes depends on factors such as strength and durability, the size of blocks or slabs that can be extracted, colour, texture, bed thickness, ability to polish and ease of carving or sawing for mouldings (BGS, 2007). Suitable sources can, therefore, be highly localised where subtle variations and lateral differences occur, despite apparently extensive resources being mapped.
- the supply of stone for some historic buildings should be like for like according to protective legislation. The physical and chemical properties of certain stones cannot always be 'matched' with those of other types of stone.
- the high value of natural building stones means that in some instances it may be economic to serve global markets.

For these reasons, MPS1 contains specific planning policy related to building stone, including specific guidelines for the safeguarding these resources, which are presented in Annex 3 to the policy document.

Box 6 Safeguarding building stone resources
'Safeguarding will be most appropriate where stone is believed to be of suitable quality, and is: • *scarce in terms of its technical properties and / or aesthetic characteristics; or* • *has been identified as having characteristics which match those required for repair and preservation purposes, including those related to individual, or groups of, culturally important buildings... [para 3.2]* *…Important historic quarries should be safeguarded, as far as practicable, where it can be shown:* • *that the quarry was the original source of stone used in the construction of a historic building or monument;*

or

- *that the stone is technically compatible with material in the structure to be repaired; and*
- *that stone from the quarry is, or will be, required for restoration or conservation purposes in the absence of viable alternatives.'* [para 3.3]

MPS1, Annex 3: Natural Building and roofing stone

3.8.2 Rationale for MSA delineation

MPS1 has very specific guidelines for safeguarding building stone, as identified above. When considering the policy, it became clear that specific expertise is necessary to identify those stones that match the criteria identified for safeguarding. As the policy term 'historic quarries' seems to be related to whether the stone was used for historic buildings or conservation areas, it did not relate to the 'historic quarries' identified in the BGS mines and quarries database 'BritPits' which shows 'historic sites' as 'historic building stone sites where not currently active and the location is not known for certain'. In view of the widespread use of local stone sources for building in the area, it is likely that many of the abandoned, inactive quarries identified in BritPits might have been used for the building of structures that are now recognised or conserved as heritage structures.

For initial consultation and discussion, therefore, a map was produced (Figure A8a) using a methodology that varied according to whether the stone was actively worked, or whether it was classed as 'closed, historic or inactive' in BritPits. This initial consultation map identified sites that are actively worked, so have a buoyant market and are currently economic to extract, and showed the boundary of the geological units from which they extract stone. For closed, inactive and historic sites, a precautionary approach was taken, as the evidence to identify 'important' quarries according to the criteria in MPS1 was not available. This was to ensure that consideration is given to the sterilisation of all currently unworked quarries if applications are submitted, providing the option of preserving access to them for future generations.

Box 7 Site status on the BGS mines and quarries database, 'Britpits' (as appears on the maps)

Active

Site which is actively extracting mineral, or in the case of wharfs and rail depots, is actively handing minerals

Yet to be worked

Sites which have been notified by operators or mineral planners but have not started extracting mineral at date of entry into the database. They will be considered as 'Active' by the Mineral Planning Authority.

Inactive

Sites which, at the date of entry into the database, are not extracting minerals but which still have valid planning permission to do so. They can restart at any time. They may be described as 'Mothballed' by the operator.

Closed

Sites which, at the date of entry into the database, have ceased to extract minerals. They may be considered as 'Closed' by the operator. They may be considered to have 'Active', 'Dormant' or 'Expired' planning permissions by the Mineral Planning Authority.

Historic

Historic building stone sites where not currently active and location is not known for certain.

As a result of consultation with building stone experts, the methodology for producing safeguarding areas was amended. For actively worked resources, building stones experts in BGS used their knowledge and expertise to identify the more scarce resources (in accordance with the wording of MPS1). This led to the removal from the map of some geological units that were originally proposed for safeguarding (Figure A8b). Table 3 summarises the changes and provides justification for the retention of the remaining geological units. Figure A16 shows the corresponding safeguarding map. Although this leads to a situation where some active quarries lie outside of safeguarding areas identified on the safeguarding map, this is a function of the methodology chosen according to the national policy wording. An alternative approach may be to safeguard the active quarries also, by defining a buffer around them where consultation would be necessary if development applications were submitted within these boundaries. If this option is chosen, full justification would be necessary and consistency of approach maintained with safeguarding methodologies used for other minerals.

For the inactive, closed and historic quarries, it was raised in consultation that the Strategic Stone Study[3], which is currently being undertaken by BGS on behalf of English Heritage, will eventually provide more evidence that can relate historic buildings and monuments to the specific quarries from which stone has been utilised. It is hoped that this will be able to assist in the identification of important historic quarries for the purposes of safeguarding, though not within the timescales of this project.

MSA buffers

An extension to the defined boundary around the identified scarce, actively worked building stone resources was proposed in the initial consultation. This was changed from 100m to 250m as a result of consultations, as it was felt that 100m was not enough to ensure that the mineral would be protected from sterilisation at the identified boundaries of the resource. Although building stone quarries are worked by a variety of methods, the intermittent and typically less intensive way of working is reflected in this distance (BGS, 2007).

A buffer around all inactive, closed and historic sites was initially proposed to ensure that each quarry would not be unnecessarily sterilised if a development application were submitted close by. This was discussed with building stones experts at BGS and it was decided that the Strategic Stone Study mentioned above would provide additional evidence that would assist in justifying any decisions being made about the relative importance of the quarries that are not currently worked in line with the safeguarding guidelines in MPS1. At this stage, therefore, we are not proposing the safeguarding of any currently unworked sites, but propose to show them on the map so that the location of them is known and future work can be commissioned on safeguarding once the necessary evidence is available.

[3] English Heritage (EH), the BGS and local geological teams across the country are collating a catalogue of local building stones: their patterns of use, culturally significant buildings and villages in England, and their historic sources. The BGS is expanding its database of quarries, mines and other mineral workings in the UK (BRITPITS) to accommodate the first national repository of data on building stone resources and the stone built heritage of England through a freely available unique database called English Building Stone Pits (EBSPits) (http://www.bgs.ac.uk/mineralsuk/mines/stones/EH_safeguarding_stone.html).

Table 3: Information and safeguarding justification for actively worked units for building stone

Geological unit name	Description and use	Geographical extent	Safeguarded?	Justification
Four Fathom Limestone Member (Alston Formation)	Limestone, packstone, fine-grained, medium and dark grey, thick bedded and wavy-bedded, with few mudstone partings; somewhat argillaceous, particularly at the top. Typically contains layers of nodules and lenses of black chert.	Occurs throughout northern England and the Scottish borders (http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=FFL).	No	Local use as walling stone.
Richmond Chert (part of the Stainmore Formation, Yoredale Group)	Sequence of chert, cherty limestone, limestone and mudstone in very variable proportions.	Occurs in the north west of the NYCC area.	No	The limestone associated with the chert beds is the unit most often used as vernacular building material.
Lower Follifoot Grit (Part of Silsden Formation, Millstone Grit Group)	Sandstone; fine-, medium- and coarse-grained. Used in buildings that are now part of a conservation area. 'The buildings of Follifoot are constructed in local gritstone. All stonework is coursed and many houses are of tooled or dressed stone and have larger blocks called quoins at the corner's. (http://www.harrogate.gov.uk/Documents/DS-P-CAA_Follifoot_Appd_180309_B.pdf)	Present in the Harrogate, Leeds, Masham and Pateley Bridge areas (http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=LFG).	Yes	The stone has been widely used in buildings, many of which are now recognised for their architectural and historic importance through the planning system. Outcrops are restricted to a few areas.
Brotherton Formation (Part of Zechstein Group)	Limestone, dolomitic, grey with abundant Calcinema.	Crops out from north Nottinghamshire to north Yorkshire. Pinches out south-west of a line from Worksop to Newark. Equivalent to Seaham Formation of Co. Durham (http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=BTH).	No	Local use as walling stone.

Cadeby Formation (Part of the Zechstein Group)	Dolostone, grey to buff grey, commonly ooidal, bioclastic or finely crystalline, with subordinate mudstone, dolomitic siltstone and sandstone.	Crops out in parts of north Yorkshire, Nottinghamshire, south Yorkshire and west Yorkshire. Thickens in subsurface to east. Dies out south of line from Nottingham to Grantham. (http://www.bgs.ac.uk/Lexicon/lexicon.cfm?pub=CDF).	Yes	Used in Knaresborough, Ripon Cathedral.
Coralline Oolite Formation (including the Malton Oolite Member and its local variant the Hildenley Stone; Birdsall Calcareous Grit Member and Hambleton Oolite Member)	Mostly pale-grey to pale-yellow ooidal and shelly limestone together with calcareous sandstone, locally rich in sponge spicules. Hildenley Stone is a white to pale grey fine-grained limestone much prized as an architectural and monumental stone. The ooidal limestone and calcareous sandstone were used widely in the Hambleton, Tabular and Howardian hills, e.g. Malton, Helmsley, Pickering, Byland Abbey, Nunnington Hall, Duncombe Park, and as walling stone.	Crops out in the Tabular Hills from Scarborough westwards to Helmsley and the Hambleton Hills. It is also present in the Howardian Hills from Coxwold, south-eastwards to Malton and North Grimston.	Yes	The various limestones and calcareous sandstones have been widely used in town and village buildings, and in country houses and their estate buildings, many of which are now recognised for their architectural and historic importance through the planning system. Formerly quarried widely along the outcrop, giving a local character to vernacular buildings, dependant on the local variety of stone.

3.9 OIL AND GAS

Onshore oil and gas production makes a small but important contribution to UK energy supply (BGS, 2011d). For conventional onshore oil and gas insufficient data prevents the usual method of safeguarding resources from being applied. Safeguarding licence areas only would be taking a fairly short-term view, which is not consistent with the methodology used elsewhere and the definition that safeguarding should keep options of supply open for future generations.

For both conventional and unconventional sources of hydrocarbons such as Coal Bed Methane and Abandoned Mine Methane, the location of surface infrastructure is relatively flexible, so the sterilisation risks as a result of other surface development is relatively limited. However, deep coal resources are proposed for safeguarding in the North Yorkshire County Council area, in relation to sensitive surface developments only. This may automatically provide an opportunity for any comments about unconventional sources of hydrocarbons to also be included as part of the consultation.

The burning of coal seams underground by Underground Coal Gasification (a method of gas extraction) has the potential to cause subsidence at surface. There are currently no operations of this type in the UK. In addition, it was stated during consultation that the extent of the burn area underground is unpredictable and so boundaries for this type of development would be hard to define. The safeguarding of deep coal resources against sensitive development may provide the opportunity to discuss this form of gas extraction in the future, if / when the practice becomes economic in the UK.

4 Conclusions

This study has provided North Yorkshire County Council with a clearly defined and delineated set of Mineral Safeguarding Areas for most minerals. The project has followed recommendations and guidance, where possible, from '*Mineral Safeguarding in England: good practice advice*' (Wrighton *et al*., 2011) in support of MPS1.

As part of this work the first three steps involved in mineral safeguarding, namely: Step 1; Step 2 and Step 3, have been undertaken. The remaining steps (4-7), including the development of associated mineral safeguarding policies, will be undertaken by North Yorkshire County Council in the future.

Paper maps and Adobe PDF documents have been provided to North Yorkshire County Council showing the considered mineral resources and Mineral Safeguarding Areas within the Mineral Planning Authority. The digital data has been supplied in the form of ESRI shapefiles for integration in a Geographical Information System.