The Earth in our hands

- how geoscientists serve and protect the public

11 AGGREGATES

Landfill Tax and Aggregates Levy

The main aim of the Landfill Tax is to reduce waste tipping and that of the Aggregates Levy is to reduce the use of green field sites for aggregates supply and to encourage the use of secondary and alternative materials. The Landfill Tax was an implementation of EU directives on environmental sustainability. The Aggregates Levy is a UK initiative.

Some of the cash netted is redistributed via the Aggregates Levy Sustainability Fund (ALSF), reserved specifically for projects connected with aggregates' environmental impact. The Aggregates Levy, currently £1.60/tonne, has so far raised c. £340m, of which £35m is returned for use across England, Scotland and Wales via the ALSF.

The funds have increased partnership and collaboration with the mineral aggregates extraction industry, increasing opportunities for geotourism and promoting more widely the importance of geological sites within the UK via education and greater involvement by all groups in geoconservation.

Lafarge Aggregates

The future

The aggregates industry manages large areas of land. Careful planning, operating, restoring and management are needed to allay concerns and meet the expectations of government, planning authorities and public.

With continued emphasis on the importance of site restoration, the long-term impact of the aggregates industry can remain positive. In our increasingly leisure-orientated society, the development of recreational parks, woodlands and conservation areas is essential and will be appreciated by generations to come.

The aggregates industry can also contribute to increased biodiversity. Environmental disturbance associated with quarrying increases habitat diversity. For example, a gravel pit turned into a lake vastly increases the ecological niches available, while quarries create fresh cliff habitats in landscapes where they did not exist before.

In the future, we may see the development of a few "superquarries" in isolated or coastal areas, which do not impinge on communities. Already, where the right rocks occur, technology now exists to allow quarries to be opened and operated almost directly onto waiting ships (minimising road and rail traffic) (e.g., Dean Quarry (RMC) or Glensanda Quarry (Foster Yeoman) Scotland). Modern technologies are beginning to make it possible to consider "underground aggregate quarries" that are both economic to work and have minimal environmental impact.

Further information

- Quarry Products Association (QPA), 156 Buckingham Palace Road, London SW1W 9TR (tel 020 7730 8194) **www.qpa.org**
- The British Geological Survey's dedicated minerals website **www.mineralsuk.com**
- English Nature **www.english-nature.org.uk**
- Office of the Deputy Prime Minister, Eland House, Bressenden Place, London SW1E 5DU **www.odpm.gov.uk**
- The Environment Agency **www.environment-agency.gov.uk/gwcl**
- The Campaign to Protect Rural England (CPRE) **www.cpre.org.uk**
- English Heritage **www.english-heritage.org.uk**
- Scottish Natural Heritage **www.snh.gov.uk**
- Environment and Heritage Service for Northern Ireland **www.ehsni.gov.uk**
- *Aggregates – sand, gravel and crushed rock aggregates for construction purposes* Geological Society Engineering Geology Special Publication No 17. (3rd edition, 2001) Edited by M R Smith and L Collis, revised by P G Fookes, J Lay, I Sims, M R Smith and G West. (ISBN 1 86239 079 7)

The Earth in our hands

Published by:
The Geological Society of London
Burlington House
Piccadilly
LONDON W1J 0BG
Tel: +44 (0)20 7434 9944
Fax: +44 (0)20 7439 8975
Email: enquiries@geolsoc.org.uk
Web site: www.geolsoc.org.uk

Further copies are available on request (preferably by email). Individual copies are free, and will be posted anywhere without charge. Multiple copies attract both charge and postage. Please contact the Society if you wish to order more than one copy. All leaflets in this series can now be downloaded free as colour PDFs from www.geolsoc.org.uk.

Series Editor: Ted Nield
Written by: Cally Oldershaw

The Geological Society gratefully acknowledges the assistance of its External Relations Committee (Chair, Dr Hazel Rymer) and the following scientists, who (in a personal capacity) read and commented on earlier drafts of this briefing.

Richard Fox
Edward Bailey
Susan Brown (ERC)
Elizabeth Clements
David Highley
Jean-Paul Latham
Clive Nicholas
Mike Petterson
Duncan Pollack
Ian Sims

Acknowledgement: All line diagrams are taken from *Collation of the Results of the 2001 Aggregates Minerals Survey*, by permission of the British Geological Survey. The Geological Society gratefully acknowledges the assistance of Lafarge Aggregates (http://www.lafarge-aggregates.co.uk) who kindly provided the photographs for this publication.

August 2003

The Geological Society of London is a Registered Charity, No. 210161

The Geological Society

Designed & Produced by Witherbys 020 7253 5413 Website: www.witherbysonline.com

The Earth in our hands

- how geoscientists serve and protect the public

11 AGGREGATES

What are aggregates?

Aggregates are granular materials used in construction. They may be as small as sand grains (in mortar) or as large as blocks weighing many tonnes (in sea defences). Sand and gravel, or solid rock crushed for use, or sand and gravel dredged from the seabed (see *EIOH 12*) are all aggregates.

Definitions

Aggregates may be natural, manufactured or recycled.

- **Natural aggregates** have been subjected to no more than mechanical processing e.g. sand and gravel or crushed rock. *Primary aggregates* come from deposits of sand & gravel or rock extracted from the ground (or sea-bed). *Secondary aggregates* arise as waste during the extraction of other geological materials such as coal, slate or china clay.
- **Manufactured aggregates** originate from by-products of industrial processes involving thermal or other modification and include the remains of pulverised fuel from coal-fired power stations (PFA), slag from steelmaking etc.
- **Recycled aggregates** result from processing inorganic material previously used in construction: e.g., demolition waste, concrete, asphalt from roads and even bottle glass and tyre chippings.

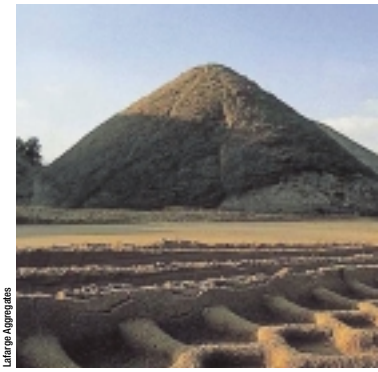
Why do we need aggregates?

Aggregates are an important resource. It takes 50–60 tonnes of aggregate to build an average house.

- Every home, factory, school and hospital is built using quarry products
- Aggregates provide the basis for our transport network, water and sewerage systems
- They are the essential raw materials for the construction industry (including concrete and asphalt) which accounts for 10% of the country's GDP and provides jobs for 1.4 million people
- Quarrying employs 20,000 people and a further 20,000 depend upon the industry for their livelihood
- About 15-20% of the aggregates market is met from recycled aggregates. Recycled plus secondary natural aggregates (see Box) comprise 20%-25%.
- Primary aggregates are the main category, and will continue to predominate for quality products where long life and durability are important
- Over 700 Sites of Special Scientific Interest (SSSIs) were formerly quarries
- There are over 1200 working quarries, sand and gravel pits in the UK

Lafarge Aggregates

Lafarge Aggregates



Lafarge Aggregates

Lafarge Aggregates

The Geological Society

Where, and why?

Primary aggregates are either deposits of unconsolidated sand and gravel, or are created by blasting and crushing suitable rock.

- River gravels – deposited by rivers in lowland valleys
- Glacial gravels – deposited by glaciers and associated rivers after the last Ice Age
- Hard rock of many types and ages

Getting permission

Extraction is carried out mostly by private companies who have received planning permission from the Mineral Planning Authority (MPA). The MPA is the authority with planning control over mineral working in its area – e.g., the County Council. Aggregate resources with planning permission are termed "reserves".

Planning permission is granted where applications fall within the framework of government guidance, taking into account the need and the best location. Bodies such as the Environment Agency, English Nature, Forest Enterprise, the Department of the Environment, Food and Rural Affairs (DEFRA), and utility (gas and electricity) companies are consulted, among others.

Lafarge Aggregates

The Government's *Minerals Planning Guidance for Aggregate Minerals* (MPG6) with the *National and Regional Guidelines for Aggregates Provision in England: 2001 – 2016* (June 2003), apply the principles of sustainable development to minerals planning. These include "supply and demand issues, the use of recycled, secondary (and marine) sources, and the more efficient use of minerals of different grades".

MPAs monitor all sites and impose controls by attaching conditions to the planning permission to ensure that work is carried out in the most environmentally acceptable way and with minimum impact. Examples of controls include:

- noise and dust control
- blast vibration control
- method of working
- hours of working (e.g. restrictions on blasting times)
- traffic controlling measures
- protection of water courses (rivers, streams and groundwater)
- protection of archaeological and heritage sites
- site screening, including tree and shrub planting
- restoration and aftercare.

How much material is extracted from a site varies. MPAs have to plan for an adequate and steady supply of aggregate, but must balance this against the impact on the environment and local communities. This is sometimes referred to as the "Plan, Monitor and Manage" (PMM) approach.

What is "sustainable"?

The objectives of sustainable development for aggregates planning in England are:

- to conserve aggregate minerals in the ground as far as possible, without switching to imports or to other primary building materials
- to give priority to secondary and recycled materials so that primary aggregates are only worked as a last resort
- to use aggregate minerals for highest grade applications for which they are technically suited
- to ensure the efficient use of aggregate minerals (as part of the Government's *Sustainable construction* programme)
- to encourage sensitive working practices and to see the best practicable environmental option (BPEO) for satisfying aggregate needs.

The role of the geologist

Geologists are able to apply their knowledge of where and how aggregates occur and have a key role in finding sources of aggregates (exploration) and assessing their suitability for particular purposes (assessment) and also analysing geotechnical and structural geology of the source – ensuring safe extraction.

Many geologists working in developing countries will be asked to find aggregates for large infrastructure projects such as harbours, breakwaters, or highways in desert or tropical landscapes where locating suitable materials is a great skill. The aggregates geologist has a varied job; every quarry is different, geology ranges from the oldest rocks to the youngest and includes practically every rock type.

Exploration

Preliminary investigation and geological evaluation of sites to assess whether they will satisfy a particular need includes using:

- geological maps
- resource reports
- borehole data
- aerial photographs.

Detailed investigations may then include:

- indirect investigation by geophysical survey
- direct methods such as geological mapping, trial pits and borings.

Typical reasons for exploration and investigation include:

- searching for the *continuation* of a source, or one to match an existing source
- searching for a particular type of aggregate, or aggregates to be used for a specific purpose, and to understand quality variations across a deposit

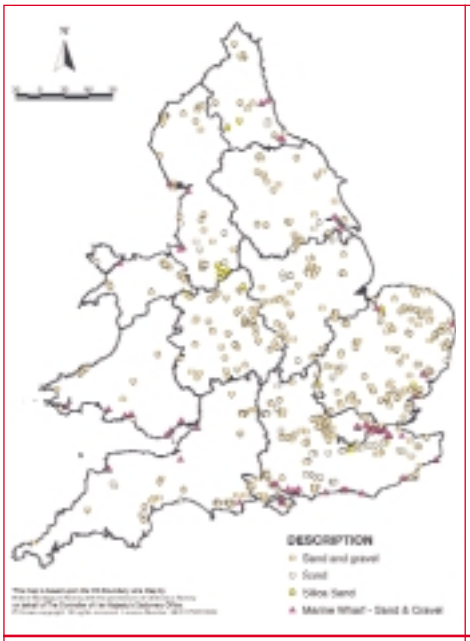


Fig 1: Location of active sand and gravel quarries in England and Wales.

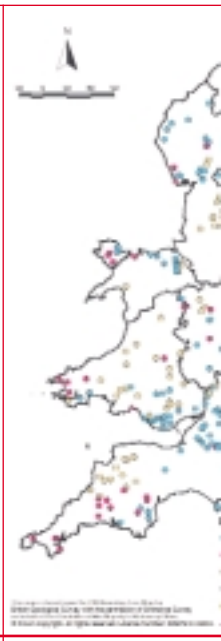


Fig 2: Location of active cru and Wales.

- evaluation of an undeveloped (or partly developed) site that a company may wish to buy
- valuation of a site for company reports and other commercial uses
- local, regional or national scale assessment to inform decisions on conservation and extraction
- searching for nearby temporary sources for large-scale infrastructure projects (more common overseas and in developing countries).

Assessment

The use of a rock, sand or gravel for a particular purpose depends on such characteristics as:

- how it was formed (mode of origin, occurrence)
- what it is made of (mineral content, chemical composition)
- strength and durability (petrofabric and weathering).

This will affect:

- physical properties (density, water content etc.)
- mechanical properties (strength and toughness)
- weathering durability
- wearing performance (abrasion and polishing resistance)
- chemical properties (chemical contamination, reactivity etc.).

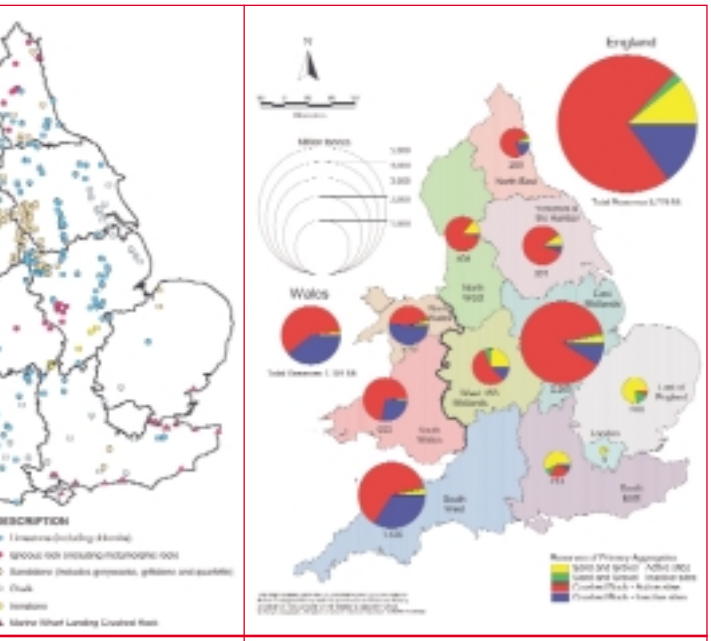
These can be assessed by:

- Examining the deposit and geological setting in outcrop
- Looking at the rock (hand specimen)
- Examining rock under the microscope (thin section).

Lafarge Aggregates

Other tests include:

- PSV (polished stone value) assessing the ease with which individual grains or crystals can be plucked from a rock fabric to leave a rough surface, which gives an idea of the rock's resistance to polishing (important in preventing skidding on road surfaces)
- MicroDeval Coefficient (M_{DE}) assesses aggregates resistance to abrasion (wear)
- Los Angeles Value (LAV) to assess the resistance to fragmentation
- Water absorption and porosity, to indicate possible damage from frost or salt crystallisation etc.
- Particle size distribution (grading analysis for sands and gravels).



shed rock quarries in England

Fig 3: Permitted reserves of primary aggregate minerals in England and Wales, active and inactive sites 2001

Environmental concerns

Aggregates are a necessary fact of life. They must be extracted somewhere, and can only be extracted from those places where they occur. They are mainly found in rural locations, but can also be found near towns. In any event, they then have to be transported to where they are needed, which also impacts on the environment.

In the past, some impacts of aggregate extraction have been irreversible; e.g., loss of ancient woodland, archaeological remains or change of landscape. The main concerns of people living near sites under consideration for quarrying include:

- possible visual damage to the landscape
- disruption to agriculture and forestry (loss of trees and hedgerows, disturbance to wildlife and loss of farmland)
- lorry traffic, noise, dust and vibration
- diversion of footpaths and bridleways
- use of the site after the work has finished.

Nowadays, however, these issues are most likely to be short-term or negligible. There will be some disruption or disturbance during extraction, but where codes of practice are adhered to and constraints are in place (e.g., through planning procedures) concerns can be kept to a minimum and impacts reduced. If unexpected archaeological or geological finds are made, site managers are made aware of their importance and of the need to preserve specimens for educational or research purposes. In order to allay concerns over the noise or sight of extraction, it is now common practice to plant shrubs or trees to provide a visual shield during extraction as well as in restoration. As a result, the quarrying industry is one of the major contributors to forestry in the UK – recently planting over 2 million trees in five years.

Extraction of minerals is a temporary land use. The time scales associated with extraction, restoration and regeneration vary depending on the aggregates and the landscape. Following sand and gravel extraction, restoration may be complete in 5–10 years – much shorter than for a rock quarry, which may last for c. 40 years. Deeper working within the same area often means that opportunities for progressive restoration are more limited for rock quarries than sand and gravel pits.

Environmental benefits

In addition to providing for essential building needs, aggregate extraction brings many environmental benefits including:

- increased biodiversity, with the establishment of new habitats for wildlife (sand martins, peregrines, orchids etc.) and restoration or improvement of habitats
- increased geodiversity, with provision of sites with geological exposures, accessible for education and recreation
- improved local or regional economy through increased tourism etc.
- restoration or improvement of agricultural lands (i.e., to higher grade).

In the past it was normal practice to leave a site to transform naturally or help it to revert back to land suitable for farming. Nowadays mineral companies are restoring sites and providing alternative benefits such as wildlife and recreational access, including:

- forestry/woodland areas
- recreation parks, special areas, geological and nature trails
- nature conservation zones.

Site restoration may result in new landforms, with raised or lowered land surface levels. River valleys may be transformed as lakes. Sites may also be filled in with wastes including:

- soil or subsoil from elsewhere
- construction or demolition waste
- commercial or industrial waste*
- Domestic waste (household waste)*.

(* Such uses are carefully controlled – see *EIOH 9, Landfill & Waste*)

In many cases sites are not only restored, but improved. Tracts of land that may have been of limited use (e.g., poor farming potential) can be transformed into areas of outstanding beauty for recreation, used and appreciated by whole communities (and as golf courses, sailing lakes, fishing waters etc.). In other cases the former quarry may be used for building.

Regulation and legislation

Government Policy is expressed through the former Department of the Environment's Mineral Planning Guidelines for aggregate provision in England (MPG6) (currently being revised), and the National and Regional Guidelines for Aggregates Provision in England: 2001 – 2016 (June, 2003) of the Office of the Deputy Prime Minister (ODPM).

Welsh aggregates policy is currently evolving through a consultation process, following the issue of the draft Aggregates M/TAN in early 2002, and is likely to be published before the end of 2003.

In Scotland, all minerals including aggregates are covered by the former Scottish Offices NPPG4 (National Policy Planning Guidance Note 4) issued in 1994. The Scottish Executive intend to revise this document shortly.