4. European Geopark Case Studies

- The North Pennines European Geopark, County Durham, UK
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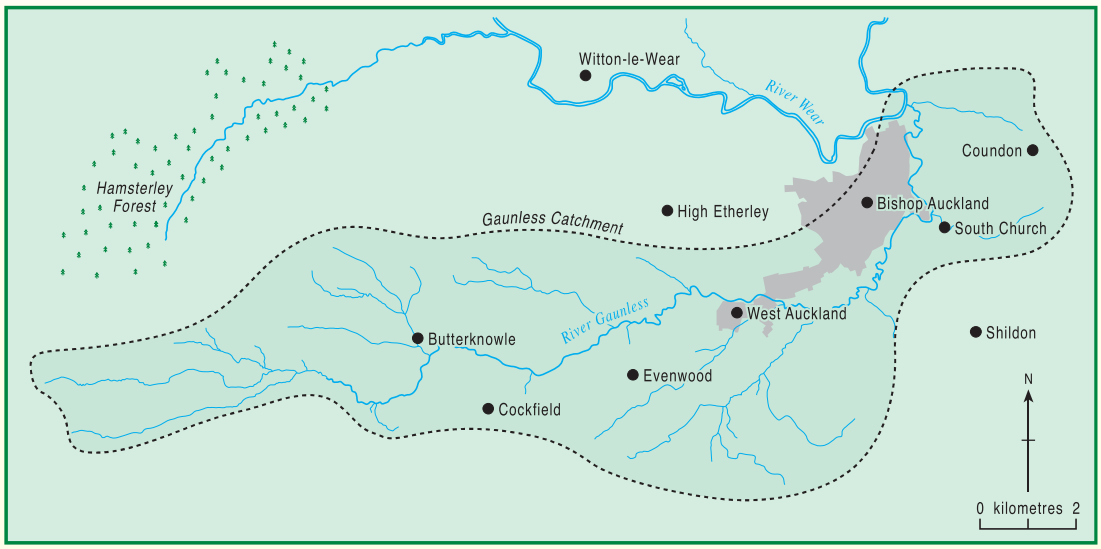
The North Pennines European Geopark
County Durham, UK

THE RIVER GAUNLESS FLOOD ALLEVIATION SCHEME, COUNTY DURHAM, UK: A CASE STUDY

The River Gaunless is a tributary of the River Wear. It has its source in the North Pennines in Northern England, rising at a height of 430m above sea level. It joins the River Wear at Bishop Auckland in Co. Durham



Why was a flood alleviation scheme needed on the River Gaunless?

The settlements of South Church and West Auckland to the south and south west of Bishop Auckland have a long history of flooding by the River Gaunless. In June 2000 there was a major flood event, in just 36 hours 77mm of rain fell. As a result the river flooded 400 homes and businesses and caused £12 million of damage.

What causes the River Gaunless to flood?

The Gaunless is a flashy catchment. This means that when it rains the river rises quickly, with a large percentage of the rainfall reaching the river. The River Gaunless is flashy because:

- It has a small catchment area or basin.
- The source of the River Gaunless is quite high at 430m above sea level on Langleydale Common on the North Pennines. This area gets a lot of rainfall.

- The top of the catchment, the headwaters, has very steep slopes.
- The soil layer is thin and quickly becomes saturated so that water flows over the land.
- The land use of the catchment is a mix of upland moorland, pasture land with towns and villages. These land uses do not intercept much rainfall and so more water flows into the river. Drains quickly take water to the main river in towns and villages.
- The geology or rock types of the area are shales, sandstone and coals. The shales in particular are impermeable and so water will not soak through them. This increases the amount of rainfall that flows overland to river.
- The area has a long industrial history, especially in coal mining and quarrying. The removal of soil, dumping of spoil and use of heavy machinery that compacts the ground will contribute to water running off, over the land.
- In the 1960s-1980s Langleydale Common were drained to improve the area for agriculture. Drainage ditches were dug across the moorland; this process is called gripping. Where gripping has occurred the peat soils do not retain rainwater so water reaches the main river channel at a quicker rate.

What could be done to reduce the risk of flooding?

The Environment Agency wanted to provide protection to the houses at risk from flooding. Working with consultants the Environment Agency investigated the options that were available to lessen the flood risk to South Church and West Auckland. The options were:

1. Increasing maintenance to the river channel cutting back riverbank vegetation and removing debris. This would enable water to pass quickly through the river system;
2. Building a flood relief culvert to take river water away from South Church:
3. Widening the river channel so it can hold more water;
4. Building several reservoirs to temporarily store river water during high flows;
5. Build a large dam and reservoir that would hold storm water during the peak of an event.

The first four options were discarded due to excessive cost or because they were not technically possible.

Option 5, "Build a large dam and reservoir that would hold storm water during the peak of an event", was the most cost effective and provided the greatest environmental benefits. The solution was to build a large dam and reservoir at Spring Gardens in West Auckland, which can hold back 1.2 million cubic metres of water equivalent to eight million baths. The dam is 15 metres high, 320 metres long, 80 metres wide, and is built from 80,000 cubic metres of clay. During storm events the dam stores water limiting the river levels downstream. Once the river level starts to fall the water in the reservoir is slowly released back into the river.

This scheme is supported by flood defence walls, embankments and strengthened banks in West Auckland, South Church and on Oakley Cross Beck. The operation of the dam means that these walls and embankments can be much lower than if there was no dam. The completed project protects against the 1 in 200 year flood (0.5% chance of happening in any year). The scheme has already experienced a severe flood in August 2004 and proved to be successful. During this one event it is estimated to have prevented £10 million worth of damage. This was more than the cost of the scheme.

The Dam at Spring Gardens

The Hydro-brake during construction

Flood Wall

Environmental, recreational and educational benefits

Wetland habitats

The area upstream of the Spring Mill Wildlife Dam has been transformed into an 11-hectare wetland habitat. A mosaic of wetland habitats has been created which include four ponds, wet woodland, reed beds and wet meadow areas. These habitats will support important native wildlife species such as wetland plants, invertebrates like dragonflies, birds, otter and water vole. The dam itself has been designed to 'fish-friendly' and allows fish to migrate upstream.

Aerial photograph of Spring Gardens

Recreation

A new 2.4km multi-user route, along the wetland habitats, now connects West Auckland and Ramshaw. This route follows the old Haggerleases railway line and provides access for walkers, wheelchair users, pushchairs, cyclists and horse riders.

Community Involvement

The local community of South Church and West Auckland have been involved throughout this project in consultation, engagement, and celebration. Over 40 people were involved in the first consultation event. In October 2005 a Community Festival was held to celebrate the project and the wetland. A wide range of activities were available including creating willow and wood sculptures for the wetland, face painting and magic shows.

Education

The site will also be a valuable educational resource allowing people to learn about wetland habitats and wildlife species. A nature trail through the wetland provides seating, viewing areas, interpretation and leaflets.

Further information

- The Environment Agency has produced 2 leaflets about the River Gaunless flood alleviation scheme called 'Reducing the risk of flooding' and 'Accessing wetlands and beyond'. Email enquiries to enquiries@environment-agency.gov.uk

- More information and an update of the developing wetland habitats is available on The Mineral Valleys Project website, www.mvp.org.uk and follow the link to 'Accessing wetlands and beyond'.

Further Improvements

The Environment Agency has also developed a Catchment Flood Management Plan (CFMP) which considers the best ways of managing flooding at a catchment scale. This consideration includes land use management for example afforestation.

Partners

Marble Arch Caves European Geopark
County Fermanagh, Northern Ireland, UK

A LIMESTONE LANDSCAPE - MARBLE ARCH CAVES AND CUILCAGH MOUNTAIN: A CASE STUDY

Location

County Fermanagh is the most south-westerly county in Northern Ireland. The Marble Arch Caves European Geopark is southwest of Enniskillen and shares a border with Southern Ireland.

Introduction

Marble Arch Caves and Cuilcagh Mountain Park were jointly awarded the title of European Geopark in October 2001, known as the Marble Arch Caves European Geopark. The Geopark is managed by Fermanagh District Council.

The area is underlain by Carboniferous sedimentary rocks. It is renowned for some of Ireland's best preserved blanket bogs which occur on the sandstone rocks of the middle slopes of Cuilcagh Mountain. The area also has the most extensive karst scenery in Northern Ireland occurring on the lower limestone slopes.

Geology of the Geopark

Photograph A below shows a view of the Geopark looking south across Lough Macnean. Beyond the lough there are limestone cliffs, which form the lower slopes of the mountain. Rounded limestone hills can also be seen, which are reef knolls and are evidence of reef formation in a shallow tropical sea over 300 million years ago. Higher up the mountain is a rolling expanse of blanket bog, which has formed on the sandstone. The summit ridge of Cuilcagh Mountain is coarse sandstone and formed as a great sand bar in the ocean.

Photograph A – Cuilcagh Mountain looking south across Lough Macnean

The area is drained by 3 main rivers, the Sruh Croppa, the Aghinrawn and the Owenbrean. These rivers drain from the mountain through the blanket bog before flowing through an extensive cave system on the limestone. The rivers emerge from the limestone as the Cladagh river, which joins the Arney River that drains out of Lough Macnean.

The limestone

Limestone is a sedimentary rock formed from the organic remains of plant and animal life that would have inhabited an ancient tropical sea. Early in the Carboniferous Period, about 350 million years ago, Ireland was an arid landscape surrounded by a warm ocean in which limestone was formed. Sometimes floods struck the deserts of Ireland and washed large amounts of sediment into the ocean. These sediments meant that the ocean was not very clear and the limestone that formed was not very pure. The limestone that formed is called the Glencar limestone and due to the sediment in it caves rarely form.

Later in the Carboniferous Period, 340 million years ago, shallow lagoons and coral islands formed in a clear tropical ocean and these conditions resulted in the formation of a purer, whiter limestone. This limestone is called the Dartry limestone. Large cave systems such as the Marble Arch Caves have formed on the Dartry limestone and this area is perhaps the most famous caving area in the whole of Ireland.

Towards the end of the Carboniferous Period, 320 million years ago, the climate changed and layers of mud and sand were deposited on top of the limestone by large rivers. These sediments form the horizontal layers of mudstone, siltstone and sandstone that form Cuilcagh Mountain.

Limestone features

The Marble Arch Geopark has excellent examples of limestone or karst scenery. The main features of the area include caves, stalactites and stalagmites, resurgent streams, limestone pavements, dolines and sink holes.

Caves – The Marble Arch cave system has been formed by the action of 3 rivers – the Sruh Croppa, the Owenbrean and the Aghinrawn. These rivers have their source at 670m on the northwest slopes of Cuilcagh Mountain. The rivers join underground within the cave system and emerge at the Marble Arch resurgence as the Cladagh River. The caves are formed in the Dartry limestone. Underlying the Dartry limestone is an impure limestone called the Glencar limestone, which contains muddy deposits and so is not affected by solution weathering in the same way as the pure Dartry limestone and so no caves have formed. Photograph B shows part of the Marble Arch Cave system.

Photograph B – Part of Marble Arch Cave

The cave system has good examples of stalactites, stalagmites and pillars. Photograph C below shows some of the straw stalactites.

The Marble Arch Caves, first fully explored by Edouard Martel in 1895, opened to the public in 1985.

Limestone pavement – The Marble Arch Caves European Geopark also has areas of limestone pavement. Limestone pavement is one of Europe's rarest and most threatened landforms and the British Isles and Southern Ireland in particular has much of the total limestone pavement resource in Europe.

The limestone of the pavements was laid down 340 million years ago but it was not until the last glaciation, which ended 13,000 years ago, that the scouring action of the glaciers exposed the limestone. Since then the limestone surface has been subject to solution weathering by slightly acidic rainwater and created the present day pattern of clints and grykes. Photograph D shows an area of the limestone pavement.

Photograph C – Calcite formations in Marble Arch Cave

Photograph D – Limestone pavement in Marble Arch Cave European Geopark

Dolines – Dolines are very characteristic of this area and are depressions formed in limestone overlain by glacial deposits. The action of solution weathering beneath the glacial deposits enlarges cracks and joints to create a hollow. The glacial drift subsides into the hollow to form the doline.

Sink holes – The rivers that drain Cuilcagh Mountain have their source on impermeable Glenade sandstone rock. When these rivers reach the Dartry limestone they disappear down enlarged joints. The hole they disappear down is called a sink hole or swallow hole and the enlargement of the joint forms a pot hole. The Owenbrean River disappears underground at a 15m high cave entrance known as Pollasumera.

Economics

The traditional economy of the Marble Arch Caves European Geopark has been based on primary industry – farming, quarrying and the cutting of peat turf for fuel. The Glenade sandstone has been used for building stone and the limestone for aggregate for building roads.

More recently tourism has become an important part of the economy, with visitors coming to see the caves, the limestone scenery and to walk in Cuilcagh Mountain Park. There is conflict between the traditional industries of quarrying and mechanised peat cutting and tourism, as the tourists see these industries damaging the environment they have come to see.

Threats to the area

The peat bogs of Cuilcagh Mountain

Peat bogs form in cool wet climates due to a build up of organic matter, usually on waterlogged land. At the end of the last ice age the climate of the British Isles was very wet and many lakes formed with reeds and rushes growing in them. As the plants died they did not decay because of the lack of oxygen and so layers built up. The lower layers became compressed to form peat. Eventually the lakes filled and the peat became higher than the water level of the original lake and raised bogs were formed. In higher rainfall areas these bogs spill out of the lake basins and covered the surrounding area as blanket bogs.

The middle slopes of Cuilcagh Mountain are covered in blanket bog. The blanket bog is a unique habitat but it is also important as a natural regulator of rainwater. Bogs hold rainwater like a sponge and release it slowly so that flooding is reduced. However, the blanket bog is under threat from afforestation, peat cutting and overgrazing.

Cuilcagh has traditionally been used by people as an area of grazing for hardy upland sheep and as a source of hand cut peat for domestic fuel. Ancient agreements called turbary rights allow peat cutting without planning permission as long as the turf is used only on the home fires of those who cut it. Since the 1980s turbary rights on Cuilcagh have been abused. Roadways have been cut for vehicles, drainage ditches cut to dry out the surface of the peat and mechanical peat cutting machines have been used that enable larger areas to be cut and compact the surface of the peat. Since 1994 the peat has been protected. As a result of the peat cutting rainwater reaches the streams and rivers quicker and more water is contributed to the river at one time. The result has been noticed in the Marble Arch Caves where the river now rises much quicker after a rainstorm and the discharge is much higher. The caves now need to be closed when water levels are high and some of the formations in the caves are threatened with damage from the debris in the river.

The limestone pavement

The limestone pavement in Cuilcagh Mountain Park has come under threat due to people removing it for garden rockeries. The weathered limestone and water-worn features make very attractive rock for use in the garden. Some of the limestone pavement in Ireland has been protected but not all of it. There is still much illegal extraction.



North Pennines European Geopark
Ladycross Quarry, Northumberland, UK

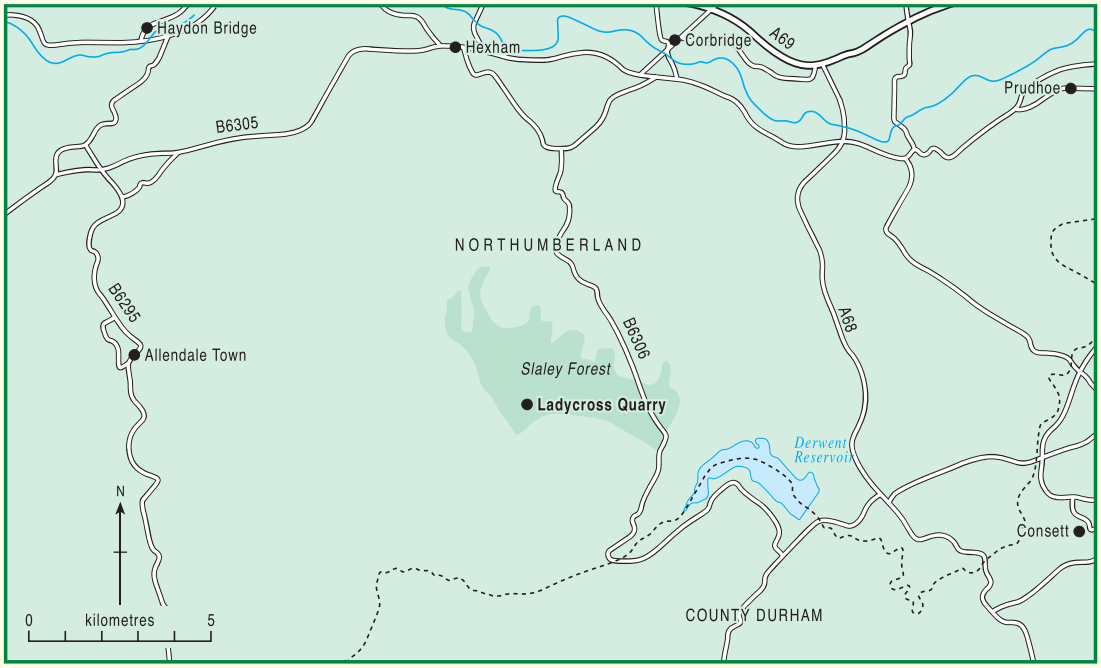
RECLAIMING A QUARRY FOR PEOPLE AND WILDLIFE: A CASE STUDY

Introduction

Ladycross Quarry is a sandstone quarry, where stone is quarried or won by hand, as it has been for the last 300 years. Although it is still a working quarry it is being gradually reclaimed as areas of the quarry become redundant.

Location

Ladycross Quarry lies in the middle of Slaley Forest, six miles south of Hexham in Northumberland. The origin of its name is uncertain, but it is thought to be the site of a crossroads between the ancient drove road from Edinburgh to York and the lead road from the Allen Valley to Blaydon. The word 'Lady' may be a corruption of the local pronunciation of 'lead'. The map below shows the location of the quarry.



Geology

The sandstone at Ladycross Quarry was laid down in the Carboniferous Period (350 – 300 million years ago). Sandstone is a sedimentary rock and this Carboniferous sandstone was formed in delta conditions where rivers deposited sand in a shallow tropical sea. From time to time a layer of clay and mica was deposited on the sand and this has meant that the layers or bedding planes of the sandstone are very level and the layers of can be easily separated.

Uses of the stone

Stone has been quarried from Ladycross for at least 300 years. The nearby village and Abbey of Blanchland were slated with Ladycross stone in 1740 and the stone has been used in the repair of Durham Cathedral, Morpeth Castle and Hexham Abbey.

Quarrying the stone by hand means that a decision can be made about the most appropriate use of the stone and cut accordingly. In this way all the stone is used whether it be a 'thick inch' or 'thin inch' for roofing slates, thicker flags for flooring or paving, large blocks of stone for lintels, doorsteps or randomly cut blocks for building and walling. The sandstone is cemented with an iron cement giving it a very attractive appearance and the stone itself is very durable.

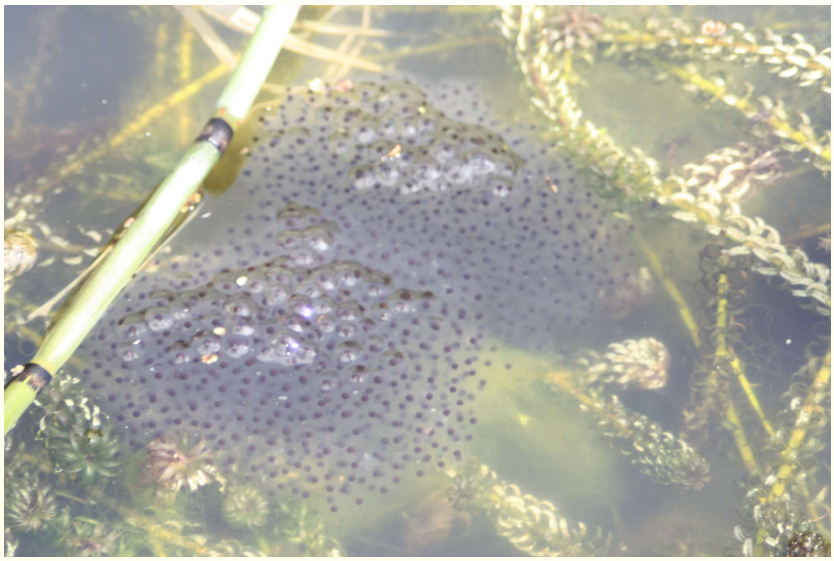
Reclaiming the quarry

The gradual reclamation of the site, as areas of the quarry have become redundant, have made the quarry a haven for wildlife and a wonderfully peaceful place for people to visit. The story of the reclamation began 28 years ago.

The early days

In the early years it was noticed that frogs were laying spawn in puddles in the quarry but these puddles soon dried up and the spawn didn't survive. The idea was born to create pools and ponds that would retain water all year round. Making permanent ponds not only encouraged the frog spawn but also attracted other wildlife such as the osprey that is seen annually and a red kite. The idea to reclaim the quarry had begun.

Frogs spawn in one of the ponds



Work completed to date

Encouraging wildlife – As quarrying becomes redundant in an area, a mix of hills and hollows are created with the planting of native tree species for shelter and the forming of wetland areas. The quarry now has nine permanent ponds and numerous wetland scrapes. Areas have been planted with sacrificial crops and rabbit control areas have been left to seed naturally to encourage birds. There are bird-feeding stations and a nesting wall to encourage sand martins, breeding and hibernating bats and redstarts as well as serving as a site for over-wintering tortoiseshell butterflies. To date 151 species of bird have been recorded, 17 species of butterfly, 10 species of dragonfly and over 100 species of moth and numerous other insects.

Providing access – Access to Ladycross Quarry is restricted to pre-booked visits as it is still a working quarry. However, a number of projects have been undertaken that provide for visitors including a 'Raptor Watch Point', which was opened in 2000 and provides a sheltered spot for viewing birds of prey, whatever the wind direction. The Raptor Watch Point was built by local craftsmen using Ladycross stone and won a prestigious design and construction award. A stone circle has been created using finger stones from the quarry and is known as 'Nature's Calendar'. Quarrymen looked for signs of spring as this indicated when they could start work again – and they only got paid when they produced stone. The finger stones represent important occasions both for nature and the quarry – the first frogs spawn indicating the arrival of spring, the curlew flying to the Solway for the winter, the swallows moving north and the redwings and fieldfares flying over marking the end of the summer.

Raptor Watch Point

The future

The quarry has about 30 years of stone left. The reclamation will continue and a fenced walkway is planned so that people can access the site more easily. Once quarrying has finished the whole site will be a nature reserve with access throughout.

Further information

- Ladycross Quarry can be contacted on 01434 673302 for further information or to arrange a tour.
- Visit the website www.ladycrossquarry.co.uk