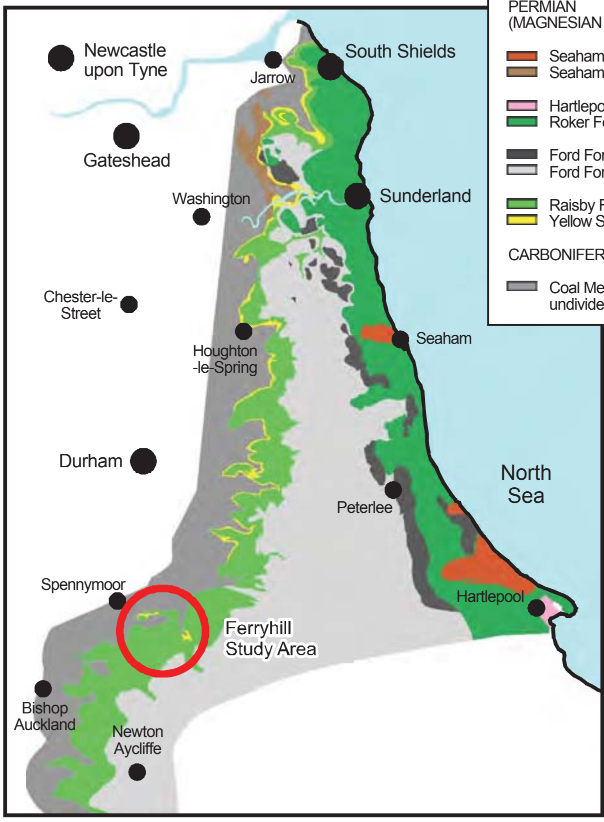
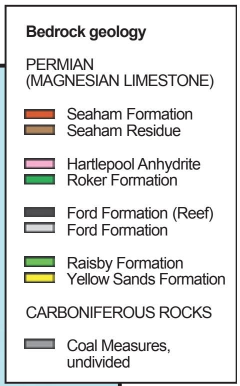
Ferryhill and the Magnesian Limestone Plateau and Escarpment - Landscape & Geology

Geology of the Magnesian Limestone area





Permian era fossil fish from the marl slate deposit in Thrislington Quarry

Looking across quarry rock face on the edge of Ferryhill Gap

Ferryhill Gap glacial meltwater channel now containing the Carrs

Looking across Thrislington Quarry

Section in Thrislington Quarry showing the sand dune deposits of the Permian era desert at the bottom with the darker band of fossil rich marl slate above overlain by magnesian limestone associated with the Zechstein Sea

4. GEO-DIVERSITY AND GEO-DIVERSITY RESOURCES

4.1 Introduction

The bedrock of Ferryhill and the landscape in which it resides are the result of the inexorable operation of geological process over many hundreds of millions of years. They are also a fundamental part of the birth and development of the town.

The area's soils, and its consequent agricultural value, are governed by the rocks on which they sit. The presence of a wealth of coal within rock seams below the town has had a massive effect on Ferryhill's growth and social development. The major rail link, an artery for trade, running through Ferryhill Gap owes its position to this melt-water channel through limestone escarpment. Latterly the town has been dominated by, physically if not in terms of employment, the extraction of magnesian limestone and the production of cement. The characteristic look of the older parts of the town is also created by the local stone and bricks, made from locally sourced clays, used for building.

The limestone escarpment on which Ferryhill sits, Ferryhill Gap and the rest of the area's landscape are a product of the different rock layers and the way in which they have been tilted, folded, faulted and in the more recent past, eroded by water and ice. This in turn controls the different habitats with distinct and diverse animals and plants to be found, for example, in the marshy land of the Ferryhill Carrs and the lime rich escarpment grasslands.

For these reasons the area's geo-diversity is an important layer in the Ferryhill Village Atlas, which has the power to explain the roots of Ferryhill's development and its environment. To this end, this report will describe the geo-diversity of the area, giving a summary of the geological history of the area, as well as a description of resources which can be used to explore the geo-diversity of the area further. Geological maps both of the solid geology and the more recent drift (uncompacted material created by ice and water action) are also provided in relationship to the areas topography.

4.2 Geological History of the Ferryhill area

When viewed from the seat of a very fast moving time-machine, so that the fingernail-growing pace of geological processes can be seen in action (like a time lapse film of a growing plant), the seemingly solid earth is a wonderfully mobile place. Entire oceans open and close, continents wander around the globe, break apart and collide forming mountains which are then worn away. Chains of volcanoes erupt serially and they too wear away exposing their vast underground magma chambers and the plumbing that fed the molten rock through them. The polar ice caps wax and wane, sometimes covering the entire world, at other times disappearing completely. Meanwhile the plant and animal kingdom can be seen on an evolutionary journey with the first multi-cellular organisms appearing some 600 million years ago passing through ages characterised by fishes, amphibians, dinosaurs and finally to mammals.

Much is created within this dynamic earth: sedimentary layers from seas, rivers and wind-blown deposits; igneous rock from volcanoes and sub-surface magma injections; metamorphic rocks are mashed up and re-crystallised within the mountains. However much rock is eroded and recycled and hidden within the earth, and in a given area there are times when no new rock is formed.

So what does this mean for Ferryhill? It means that within this continental jostling the rocks preserved beneath Ferryhill represent only a few small segments of all of the geological ages past. These small segments are, however, hugely impressive, with vast quantities of sediments laid down, some of enormous economic value, giving a glimpse of a particularly interesting period in the evolutionary story. By looking at what has been preserved we can find a rich list of clues as to what the world was like at the time they were laid down. By adding clues from adjacent areas we can tell a fascinating story about what happened to create and preserve these rocks.

The rocks which can be found around Ferryhill come from two major periods of geological time, the Carboniferous and the Permian. Geological time is divided into four major eras, in increasing age, the Cenozoic, Mesozoic, Palaeozoic and Precambrian. The first three eras have a “zoic” suffix indicating that these eras of increasing antiquity, cover the 600 Ma in which multi-celled organisms existed. The Precambrian, which in time is much longer than the other three put together at roughly four billion years, was a time when only single celled or no life existed.

The eras are subdivided into periods, of which the Carboniferous Period and the Permian Period lie at the end of the Palaeozoic Era. These periods of time represent groups of rock which have characteristics which tie them together in some way, and the names often relate to areas where there are lots of these rocks around. So, for example, the Devonian Period (previously referred to as the Old Red Sandstone Period) has lots of red sandstones, many of which can be found in Devon and were first studied in the area. That there is a preponderance of rocks of a certain character in a given period gives an indication that there was a particular configuration of the continents, with related dominant climatic conditions. So, using the Devonian Period as an example again, there were two major continental land masses in this period, both in the Southern Hemisphere, with a massive ocean in the Northern Hemisphere. Conditions were arid with no evidence of polar ice till the end of the period.

In addition to the rocks which were laid down in the Carboniferous and Permian periods, Ferryhill’s landscape takes its current form in direct consequence of the geological processes happening during the Ice Ages. To cover all of the geological ages which influenced Ferryhill, the next three sections will look in turn at each of the Carboniferous and Permian Periods, and finally the Ice Ages.

4.2.1 Carboniferous

The Carboniferous is so called because it contains rich reserves of coal, particularly, but far from uniquely in this country, where this period of time was first studied. The Carboniferous period covers the time from 360Ma to 300Ma, although in the Ferryhill area only rocks from the latter part of the Carboniferous are found at the surface.

The Carboniferous rocks in the Ferryhill area are well known for the coal seams which have been exploited for much of Ferryhill’s history. These coal seams are one of a variety of rock types which include sandstones, shales, clays and ironstones forming the Pennine Coal Measures which outcrop in an area stretching from Barnard Castle to Alnmouth and Wallsend to Allendale in the NE, as well as from Whitehaven through Workington round to the Vale of Eden on the other side of the Pennines. In addition to these surface outcrops, coal measures extend underground and under-sea to the south and east of the Durham coalfield, Ferryhill being one of the points at which the coal measures start to be covered by the more recent Permian limestones.

If you were winched down to the bottom of a deep coal mine and looked in detail at the rocks as you came back up the shaft (the rocks becoming progressively younger as you travelled higher) you would be able to observe a repeating sequence. Starting with mudstones and coarsening upwards through siltstones to sandstone finally overlaid by a seat-earth (a fossil soil) and a coal seam. The sequence then starts again, with each rock types forming bands of variable thicknesses, and sometimes completely absent. In some of the sequences, just above the coal seam, there is a thin shale containing marine fossils, called a marine band. Detailed correlation of all of these rock strata between mines, and by detailed mapping of the surface outcrop, shows that the sandstones are laterally discontinuous, so that a sandstone which is thick in one location, may be thin or even absent in a location 10 or 100m away. In contrast the coal seams are much more persistent sometimes extending for 10 or 20 km before fading away. Similarly the thin occasional marine bands are yet more extensive than the coal seams, being traceable across much of the Pennine coal field from Durham right the way into Cumbria.

Because of the extensive nature of the marine bands they are very useful in correlating the coal field strata. They also contain fossils, particularly goniatites (a type of nautiloid) and some bivalves, unique to a given marine band, which gives further help to correlate the rock sequences. More recently pollen grains as well as thin volcanic ash layers found in these rock sequences, dateable using radio-isotopes, have also been used to correlate sequences as well as to give them much more accurate absolute ages.

These rocks were laid down in a vast deltaic plain forming in a basin which covered the whole of Northumberland south of the Cheviots, down to Lincolnshire, west across to Northern Ireland and east out into a sea covering parts of mainland Europe. The rivers flowed into this delta from the highland massif to the north as well as from a developing upland to the south, known as the Wales Brabant High, running from Wales through Suffolk and out to towards what is now Belgium.

The basin under this deltaic plain was slowly sinking at a rate which, over time, matched the rate at which sediments were being brought in by the rivers. This allowed for very extensive waterlogged mires to form between the rivers in which the huge thicknesses of peat could be laid down which eventually were turned into coal. The mudstones in the cyclic sequences were laid down in lakes when the water table was too high for mires to form. Some of the sandstones were formed within the river channels, which switch location as the rivers move course over the flat plain, generating the locally thick sandstones. Sandstones are also laid down along with siltstones, where rivers disgorge into one of the lakes, or where a river breaks its banks to form leaf shaped deposits (in plan) called crevasse splays. The occasional marine bands were formed when the whole area was inundated by the sea, probably in consequence of global changes in sea level, in turn caused by melting of the continental ice-cap which formed on the southern continent of Gondwana.

The coal seam called “Main Coal” which was mined at Dean and Chapter Colliery was one of the most important and thickest of the Durham coal field at 2m thick and of high rank. Rank is a measure of the quality of the coal, the higher the rank the lower the volatile content and impurities (such as sulphur). The rank of the coal is dependant both on the quality and purity of the original material laid down, but is also improved by deep burial and the consequent heating and compression that this causes. It is estimated that in order to form 2m of coal that the mires from which it was formed would have had to have laid down some 20m of peat, which was then compacted to form the coal. The sort of plants which this peat was formed from would have included trees such as Lepidodendron, a type of lycopod, a family which includes the present day club mosses, and Equisetum a giant form of the present day mares-tails. In amongst the plants fossils have been found fossils of giant insects and amphibians. These latter would have been the largest and most evolved creatures that lived at this time in an age before even the dinosaurs had arrived.

4.2.2 Please Mind the Gap

At the end of the Carboniferous, and during the Early Permian period, the two massive continents, Laurasia in the north and Gondwanna in the south, collided to form a single super-continent Pangea, joined by a mountain belt in what is known as the Variscan Orogeny. Laurasia included parts of what were to become Greenland, North America, the Baltic, and Britain and Gondwana included parts of what were to become Antarctica, Australia, Africa and South America. The remains of the Variscan mountain belt can be seen in the East coast of N America, Spain, Brittany and through the north of Europe as well as in the huge batholiths of granite in Cornwall. This continental collision uplifted, folded and faulted, albeit more gently, foreland areas around the main mountain belt. This included the North of England and Ferryhill, where the thick coal measures were uplifted, folded and faulted and in turn eroded. It is estimated that some 2000m of Carboniferous strata may have been worn away from the rolling hills that developed in the early Permian and were levelled forming a peneplain. This peneplain was to be inundated, forming the eastern margin of the Zechstein Sea in the late Permian.

For this reason there is a gap in the sedimentary record from the end of the Carboniferous Period and into the Early Permian so that the Permian rocks to be described in the next section lie unconformably (a geological term which means that there is a gap in the geological record) on the Carboniferous coal measures. This can be seen around Ferryhill where the Carboniferous rocks are cut at an angle by the overlying Permian sands and limestones.

Along with the folding and faulting, magma was generated by melting in the mantle which was then intruded in sills and dykes cutting the Carboniferous sediments. The famous Whin Sill is the most well-known of these intrusions, but just North of Ferryhill the Hett Dyke and its associated sub-swarm can be found, which extends from just north and east of Ferryhill towards Teesdale for some 35km. There is some evidence that this dyke may have been a feeder for the Great Whin Sill in Teesdale.

4.2.3 Permian

The Permian gets its name from the medieval kingdom of Permia which was located in the region of modern Perm Krai, which is about in as near the middle of Russia as you can get. It is in this region that the period was first studied by Sir Roderick Murchison in the middle 1800s, at about the same time as coal mining was becoming major business in Ferryhill. The Permian period started at 299 Ma, with a change from a tropical to a hot desert climate and finished at 250 Ma at a point which marks the biggest mass extinction which the world has seen.

During the Permian Ferryhill was located in the middle of the vast continent of Pangea, close to the equator, and slowly moved north. Hot desert conditions prevailed, and in the early to middle Permian, traditionally known as the Rotliegend (the underlying red) wind-blown sands and flash floods were the major agents of sedimentation. The discontinuous Yellow Sands Formation, which can be seen at the base of Thrislington quarry is the only remnant of this environment which reigned for the first 40 million years of the Permian. The sandstones have large scale dune cross-bedding and looking at the sand grains under a microscope shows them to be abraded and polished by wind.

Immediately above the Yellow Sands Formation, or directly above the Carboniferous rocks where the Yellow Sands Formation is absent, there is a band of grey coloured rocks known as the Marl Slate Formation. This layer is found across all of the Permian rocks outcropping in the North East of England and marks the first incursion of what is known as the Zechstein Sea, which formed in an area broadly coincident with the present North Sea. This period of time to the end of the Permian period is traditionally referred to as the Zechstein. Above the

Marl Slate Formation there are multiple layers of limestones and evapourites, which have recently been divided into seven units. These units have been identified by looking for rock units with related lithologies, that is groups of rocks which probably formed in a common environment, and by looking for unconformities, that is interruptions in sedimentation probably related to emergence from the sea. This means that these newly identified units have meaning for the tectonic and environmental climate in which they were formed. The first few of these units can be seen in the Ferryhill area and form part of the Raisby and Ford Formations, traditionally referred to as the Lower and Middle Magnesian Limestones respectively. The magnesian limestones, currently quarried at Thrislington, are within the Raisby Formation. The younger Ford Formation limestones are quarried around Bishop Markham, and will potentially be exposed by the extended workings being opened up in the Thrislington Quarry extension.

The Marl Slates have become particularly well known because of the remarkable fossil fishes and plants which have been preserved in them. It is thought that this first incursion of the Zechstein Sea, to a depth of 200-300m across the North East, had a layer of stagnant oxygen poor water at its base. This meant that fishes, sharks and plant material, amongst other creatures that dropped into the basal waters, did not decompose so quickly and were better preserved in consequence. Mineralisation of the Marl Slate may also have played a part in the fossils' preservation.

The Zechstein Sea rolled in over the uneven desert surface of the Yellow Sands, in some places eroding into these sands. This is seen in the uneven thickness of the Marl Slates and the wind-blown sand grains which can be found within the lower layers of the Marl Slates. In the succeeding Raisby formation the magnesian limestones were deposited on a sloping surface at the eastern margin of the Zechstein Sea in depths of water estimated to be between 100m and 300m.

Ferryhill Village is built on top of an escarpment formed by the Permian rocks described above, which have been extensively exploited, principally for the magnesian limestone which is used as a flux in the steel industry. The limestones are also used in the manufacture of cement and the sands for aggregate.

4.2.4 The Ice-ages

Strictly speaking we are still in an ice-age, with large polar ice-caps and relatively benign global temperatures. Within the geological time-scale this ice-age is called the Quaternary Period, stretching back about 2.6Ma. The rather unenlightening name Quaternary is a historical hangover from a system first used by Abraham Werner in the 1700s dividing rock formation into Primary, Secondary, Tertiary and Quaternary periods, with Tertiary rocks being formed after Noah's flood. Only the name Quaternary survives in the latest descriptions of geological time.

During the Quaternary Period, owing to natural cycles in global temperatures caused by variations in the earth's orbit (cf. Milankovich Cycles), there have been a series of cold episodes creating glacial periods when the polar ice caps extended much further towards the equator. We are now in a period of time between one of these cold episodes, known as an interstadial.

In Ferryhill, we are in an area which is temperate during an interstadial, but which was repeatedly covered by glaciers and ice sheets during the glacial periods. Ice sheets and glaciers have a very major effect on landscapes and the landscape of Ferryhill is no exception.

When the ice-sheets are in place three things happen:

- the sheer weight of many kilometres of ice slowly pushes down the surface of the land, which then recovers after the ice melts away, a phenomenon called isostatic adjustment.
- the weight and movement of the ice may grind away the land-surface removing softer rocks easily but having less effect on harder rocks. In this way the land surface is scoured to reveal the grain of the land.
- The huge amount of material ground away by the ice (and dropping onto it in the mountains) is deposited at the base of the ice sheet and at its sides and ends.

Whether the ice erodes the rocks underneath or deposits sediments, depends on the thickness of the ice, its temperature and how fast it is moving. The volume of sediment it creates and deposits is huge.

As the ice melts away it leaves rather a mess behind. The huge volume of sediment dumped under and behind the retreating glaciers, is also worked on by the huge glacial outwash streams created by the melting ice. The sediment may on occasion find its way into lakes dammed at the head of ice sheets, or trapped between them where the sediments can settle out.

Evidence of previous glacial periods tends to get wiped out by subsequent glacial events. This is the case in Ferryhill where the most visible signs of ice impact are from the latest glacial period, the Main Late Devensian Glaciation. This glaciation started about 27000 years ago (27 Ka BP) and by 14 Ka BP the area was ice free. The area around Ferryhill was particularly interesting as it was located in an area affected by three ice sheets flowing from different sources. Ice builds up in mountainous areas and flows away from them. In the case of Ferryhill these mountainous source regions are:

- The Pennines, creating ice which flowed through the Tyne and Stainmore gaps in a westerly direction.
- The Cheviot and Scottish Highlands which generated ice travelling in a southerly direction along the coast.
- Scandinavia and the highlands of Norway. The ice sheets from this area probably didn't make landfall in the NE but it is likely they forced the ice from the northern highlands to flow in a southerly direction a long way down the eastern coast of Britain.

Many of the general post-glacial features seen across the whole of the region can be found in the Ferryhill area including a covering of glacial sands, gravels and boulder clays left behind by the ice. These superficial, or drift deposits, are shown on the Drift map attached to this report. In addition the map clearly shows a ribbon of river deposits which wind through Ferryhill Gap. This feature is a consequence of the unique configuration of the three ice-flows described above interacting with the line of hills formed from the Permian limestones. The Cheviot ice travelling down the coast trapped both its own melt-water and that from the westerly Pennine ice in a series of glacial lakes. The massive glacial Lake Wear stretched from Newcastle to Sunderland extending up the current River Wear through Chester le Street toward Durham and up the Team Valley. Smaller lakes also formed south of Durham along the River Wear and to the west of Peterlee in what has been named Glacial Lake Edder Acres. The water from these lakes drained to the south in what must have been very significant rivers, and it was through Ferryhill Gap that this water was funnelled into an exit through the Permian limestone hills, scouring out a deep sided channel. It has been suggested that this channel was active in more than just the most recent Main Late Devensian Glaciation, with this last glacial event re-activating and deepening a pre-existing glacial melt-water channel. Certainly geo-physical and borehole data shows that the present day, relatively shallow, topography through which the main intercity line runs, has a much deeper channel now in-filled by glacial river deposits and by lacustrine and peaty deposits from the Carrs.

4.3 Geological Time

Our understanding of geology starts from mapping the rocks, in other words, going to places where rock is exposed, looking at the rocks and working out what they are (and in the case of sedimentary rocks what sort of fossils they have in them) and putting that information onto a topographic map. By doing this geologists can systematically build up a picture of the way in which the different rock types succeed each other. In the case of sedimentary rocks this succession is a series of layers of rock piled one on top of each other, with older rock at the bottom of the pile and progressively newer rock as you move up the pile. Yet further information about this succession can be gleaned from quarries and from mines.

From this geologists can start interpreting what sort of environment the rocks were formed in, as well as understanding what happened to the rocks by way of folding and faulting after they were laid down. This process of geological mapping and generating rock sections, called stratigraphy, needs the rocks to be named so that sections from different areas can be discussed and correlated. In the first instance geologists give names to rocks which describe where they are found and what sort of rock it is (e.g. the Boulby Halite Formation). This description of rock sections using their rock type is termed litho-stratigraphy. This is obviously a good descriptive tool, however what it doesn't tell us about is the absolute time when the rocks were laid down. This science of chrono-stratigraphy draws principally on two major fields.

The first is palaeontology. Some creatures evolve little over time; the coelacanth is probably the most well-known example of this as a primitive fish that was re-discovered alive in the 1970s and has evolved hardly at all over 400 million years (Ma). Others evolve very rapidly and make a very short appearance in the geological record, for example in the Carboniferous period creatures called goniatites (a type of nautiloid) evolved small but significant changes in the form of its shell occurred in geologically rapid timescales. As such these zone fossils are extremely useful as time-markers within the sedimentary record.

The second is by using radio-active isotopes in igneous rocks. Some elements have radioactive isotopes, which have the useful property that they decay to generate daughter elements at a rate which is measurable and constant. This means that by measuring the isotopic ratios of particular elements it is possible to accurately measure the age at which the igneous rock solidified. Once the age of an igneous rock has been established then its relationship to other rocks can be used to infer their age. So rocks cut by the igneous rock will be older and rocks overlying or cross-cutting it will be younger, as would be sediments containing fragments of the igneous rock.

Through a combination of the relatively precise, absolute rock-dates gleaned from igneous rocks and their radioactive isotopes, and the relative timings worked out from zone fossils, it has been possible to create an internationally agreed consolidated chrono-stratigraphy. The local litho-stratigraphy can then be related to this. It is important to understand that the litho-stratigraphy has evolved and changed over the years, starting with very local names which then become more widely geographically applicable, and consolidated as beds are correlated over wider areas (for example using the Marine Bands in the coal measures). This means that, particularly in older literature, different names are used to describe the same beds. Recent books on the regional stratigraphy (e.g. the Geology of Northern England 5th Edition pub HMSO) are helpful in understanding the abundance of terminology applied to the stratigraphy of this area.

4.4 Geological resources

To gain a better understanding of the geo-diversity of the area there are a wide range of resources available.

A visit to the Hancock Museum in Newcastle is highly recommended as a good starting place for anyone, having an excellent display of rocks and fossils from both the Carboniferous and Permian and reconstructions of what it might have been like.

For students wishing to understand in some detail about the geology of the broad area around Ferryhill the 5th Edition of the “Northern England” book from the British Regional Geology series (published by HMSO) is a good general text. This is detailed and comprehensive and a good route to locating specific research papers. It has recently been significantly revised and is much clearer to read than earlier versions, with excellent photographs of locations. It also has a much enhanced section on the economic geology of the area.

4.4.1 Things to do

Ferryhill Carrs: this is a great place to walk and explore and gives an opportunity to understand the scale of the ice-age meltwater channel created in Ferryhill Gap. It is also possible to look at the disused lime kilns as well as a disused quarry with access to limestone within the Raisby Formation. On the western bank of the gap it is also possible to explore the limestone grasslands, a habitat rich in flora, which is dependent on the underlying limestone.

Thrislington Quarry: Run by Lafarge, it is possible to arrange visits to the quarry by prior arrangement with access to a viewing platform above the quarry where the Yellow Sands and Raisby Formations can be clearly identified. The management have also extracted a pile of Marl Slate in which it may be possible to hunt for fossils.

Durham Mining Museum: This museum can be found in Spennymoor town hall and is crowded with all sorts of items and photographs from the local coal mines, which give a good feel of what it may have been like to be a miner. There also a website, which has lots of useful historic and photographic material contained in it. http://www.dmm.org.uk/mindex.htm

Hancock Museum: This museum can be visited as an individual or by arrangement will cater for groups, organising activities, particularly for schools. The website gives more details on what is available. http://www.twmuseums.org.uk/great-north-museum/about-us.html

Sunderland Museum: This museum is also worth visiting to understand more about the social history of the area related to the geo-diversity in particular the coal mining history. The museum is operated in a similar way to the Hancock.
http://www.twmuseums.org.uk/sunderland/about-us.html

Killhope Mining Museum: Whilst this museum is devoted to the lead mining industry, which is not represented in the Ferryhill area, this is a very good resource to understand about the Weardale ore-field, another form of local mining heritage. By understanding more about the regional geology it is possible to give the geology of the Ferryhill area more context.

Beamish Museum: A bit further to travel but a great place to explore the industrial heritage associated with the coal mining industry. http://www.beamish.org.uk/

4.4.2 Coal Mining Resources:

These websites include archive material as well as links to further information.

National Coal Mining website: http://www.ncm.org.uk/home

Durham County Records Office:
http://www.durhamrecordoffice.org.uk/Pages/CoalMining.aspx

BBC Archives: http://www.bbc.co.uk/archive/mining/6940.shtml

Access to Mining Heritage: http://mininghistory.thehumanjourney.net/edu/NEIntro.shtml

4.4.3 Educational material

There is a large amount of specific and more general material on geology, geo-diversity and on the Ferryhill area specifically. This is a short pointer to some material, most of which can be accessed on the web. A short paragraph has also been added to explain why geology is such a useful and fascinating subject to explore.

Geology is a fundamentally important study giving an understanding of the earth's processes as well as the structure and rock types of the earth beneath our feet. Fundamental because ultimately most of our material resources come from the rocks be it energy (oil, gas, coal), mineral resource needed for everything from concrete to the Tantalum used in mobile phones, or the soils (derived from the rocks) which provide our agricultural resources and biodiversity. Fundamental because all of our structural engineering from houses to bridge building to tunnelling needs to understand the structure of the rocks within which structures are placed to make them safe. Fundamental because an understanding of earth processes is crucial to the prediction of catastrophic events caused by volcanic eruption and earthquakes.

Geology is also a very useful cross-curricular subject as it can connect with every conceivable subject. In particular it has direct links to bio-diversity, evolution, built environment, social history, industrial archaeology, geography, mapping, history and philosophy and draws on mathematics, chemistry and physics.

Geology also provides good skills development in mapping, drawing and technical drawing, 3-D thinking, scientific methodology and report writing. As geology requires an understanding of immense periods of time, the operation of very slow processes within this time frame, and on scales from microscopic to global, it also has significant and exciting intellectual challenges.

Useful web-sites:

Northumbrian Earth: http://www.northumbrianearth.co.uk/

Limestone Landscapes homepages:
http://www.limestonelandscapes.info/Pages/HomePage.aspx

Limestone Landscape Ferryhill Village Atlas page:
http://www.limestonelandscapes.info/Pages/FerryhillVillageAtlas.aspx

Natural England: FerryhillCarrs Nature reserve:
http://www.lnr.naturalengland.org.uk/Special/lnr/lnr_details.asp?C=0&N=Ferryhill&ID=1070

An example of what can be done by amateur interest:
http://ferryhilllocalhistory.com/Index2.htm

British Geological Survey (BGS) downloads including some nice volcano models:
http://www.bgs.ac.uk/downloads

Tyne and Wear museums online search; really useful for finding what specimens are available to examine. These include specimens of fossil fishes collected at Thrislington Quarry with a few photos. This portal can also be used to ask questions about rocks and fossils in the collections and to arrange to see specimens. http://www.twmuseums.org.uk/geofinder/search/

Information on Durham Quarries:
http://dre.durham.gov.uk/pgDre.aspx?&SEARCH=By+Keyword&TERM=Quarries

Northern Echo article on fossil stingray find:
http://www.thenorthernecho.co.uk/news/council/durhamcountycouncil/10631613.Rare_fossil_unearthed_during_community_dig/?ref=rss

BBC article on a new species found at Thrislington: http://www.bbc.co.uk/news/10361199

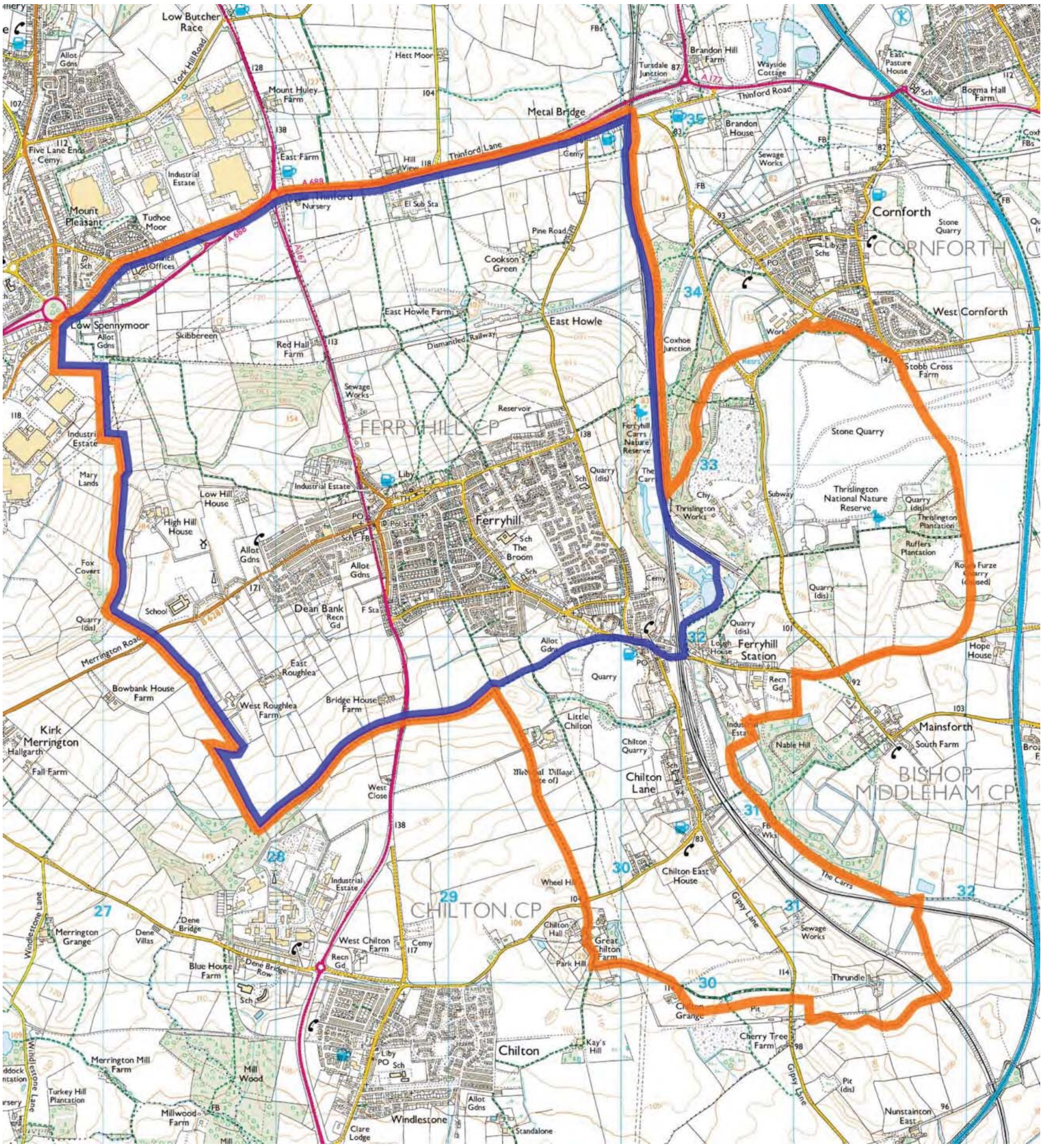
BBC article on the impacts of colliery waste on an allotment site at Thrislington:
http://news.bbc.co.uk/1/hi/england/wear/4952574.stm

BBC article regarding the planning decision on the Thrislington expansion:
http://news.bbc.co.uk/1/hi/england/7672071.stm

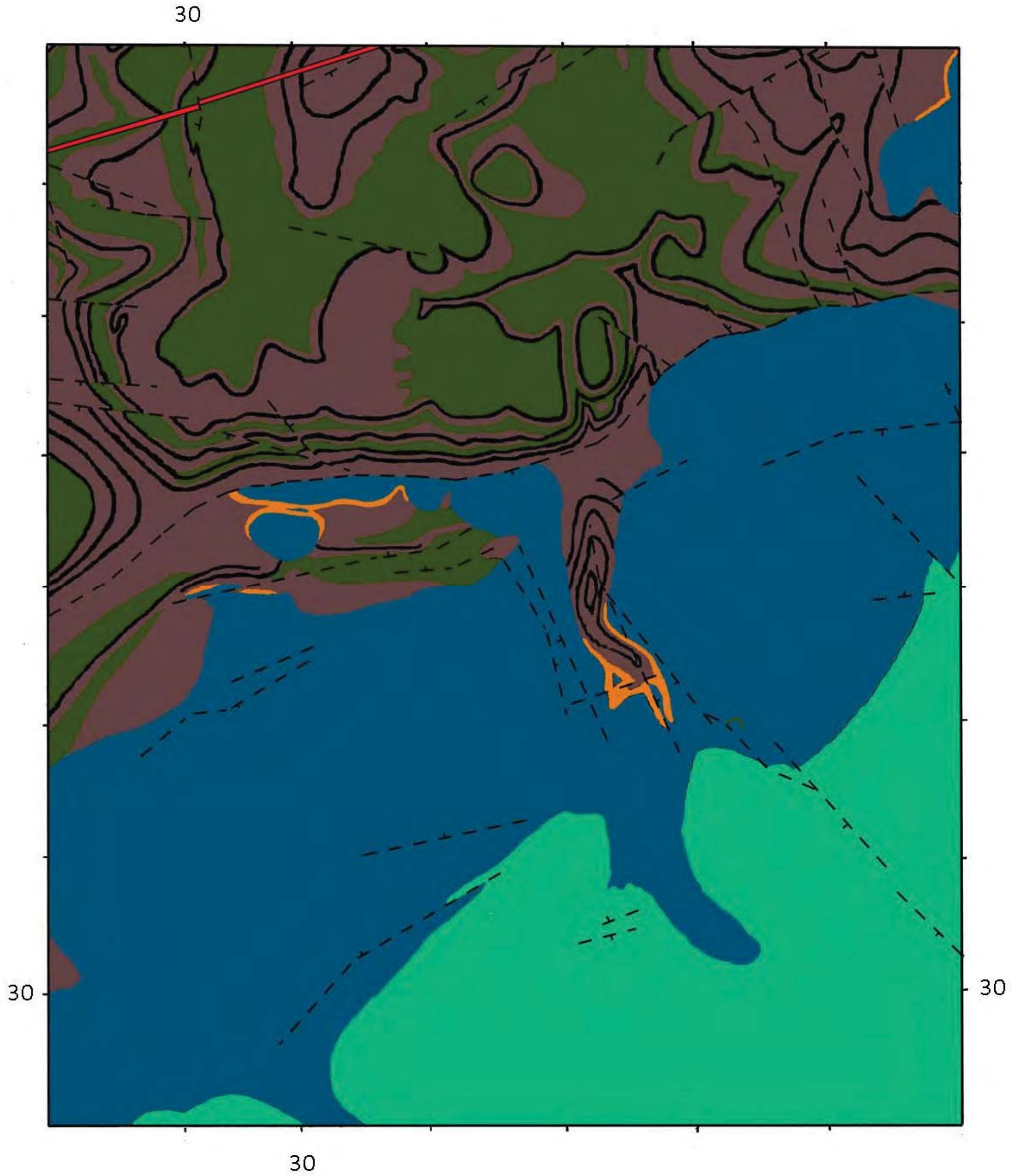
BBC article about the First female manager at Lafarge in charge of Thrislington:
http://news.bbc.co.uk/1/hi/england/4083464.stm

Maps

The Topography



Solid Geology



Key:

Carboniferous, Pennine Middle Coal Measures Formation

- Mudstone/Siltstone
- Sandstone
- Coal

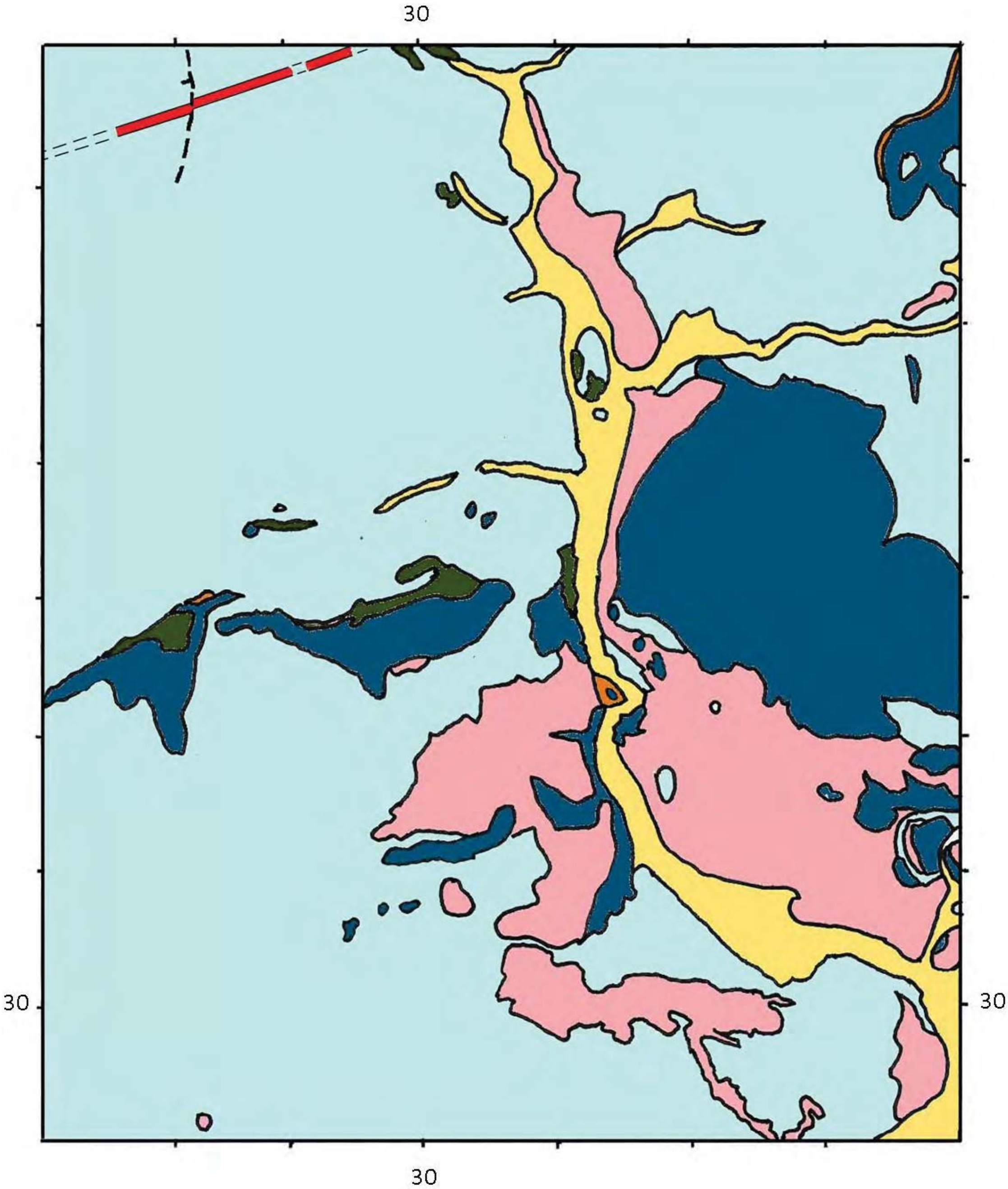
Permo-Carboniferous igneous rocks

- Quartz Dolerite

Permian

- Yellow Sands Formation
- Raisby Formation – limestone and dolostone
- Ford Formation – dolostone and some anhydrite

Drift



Key

Drift

Boulder Clay and Glacial Drift	
Glacial Sand and Gravel	
River Terrace Deposits	

5. THE BIODIVERSITY OF FERRYHILL

5.1 Durham Magnesian Limestone Natural Area

The Durham Magnesian Limestone Natural Area extends from the mouth of the River Tyne down the North East coast to Hartlepool and inland as far as Shildon in the west. It covers an extent of over 44,000 ha.

The landscape is characterised by the steeper escapement slope to the west, leading to gently rolling contours on the plateau itself which gently slopes towards the North Sea in the east ending at dramatic coastal cliff faces.

The limestone grassland of the area is one of the most important habitat types in the country providing homes to some of the rarest species. However only 336ha (0.76%) of the area can be categorised as Unimproved Calcareous Grassland , the majority being found along the western scarp, within disused limestone quarries or the cliff tops to the east. In addition to the scarcity of the underlying geology (magnesian limestone is only found in 1.5% of the UK mainland), another reason for the rarity of the species is that the area is situated on the most northern extremity of the range for certain plants, yet also being at the most southern point for other species. This overlap of ranges provides an interesting ecosystem, making it unique in the British Isles. One of the aims of the project was to map the species distribution to use as a base point to gauge the effect of climate change in the region.

The majority of the area is agriculture, both grazing and intensive arable production, but both coal mining and quarrying have influenced the land over past centuries, leaving very distinctive features within the landscape itself. This includes mining settlements and railways.

Glacial deposits are also found there resulting in more neutral grassland area in the hollows. However there are also a number of steeply cut denes leading to the coast as well as glacial melt-water channels in the area, both the result of water erosion. These area are also very important for wildlife

Due to the permeable nature of limestone, wetland habitats tend to scarce unless they are in the forms of ponds sitting on top of glacial deposits. However, due to the rolling nature of the landscape there are a number of these wet hollows, some fairly large in extent.

As the water has to go somewhere there are a number of wet flushes situated along the coastline and the western scarp end where springs emerge. The largest expanse of swamp and aquatic vegetation is to be found at Ferryhill Carrs, where springs feed the area, which forms the head waters of both the River Tees and the River Wear.

The underlying geology heavily influences the soil and vegetation types of the area. Steeper slopes and exposed cliff faces, including man-made features such as quarries, show the best examples of magnesian limestone flora.

The area also has a number of other important habitats, including wetlands, semi-ancient woodlands and unimproved grasslands.

5.2 Ferryhill Landscape Assessment

While the majority of the magnesian limestone is more coastal, Ferryhill is situated along the northern edge of the spur that runs inland towards Shildon and Newton Aycliffe. This spur reduces the scarp effect found elsewhere but leaves Ferryhill standing high above the two flood plains of the River Tees and Wear.

The porous nature of the limestone restricts the number of rivers and streams over most of the area, however the glacial melt-water channel that is now Ferryhill Carrs is the largest swamp area within the magnesian limestone natural area. As this cutting is perpendicular to the limestone spur it forms the watershed of both the River Tees and the River Wear. The majority of the water flows south forming the River Skerne, which flows into the Tees.

Very wet areas prevent the same vegetation decomposition process that would in other areas become soil. Here the vegetation breaks down differently, releasing acids into the water by fermentation which helps to preserve organic matter by pickling. Over a period of time this becomes peat. As plant material isn't breaking down the levels of peat can build up quite dramatically raising the surface of the land. Once the land has raised sufficiently the water level falls further beneath the surface allowing subsequent decomposition to form soil. Ferryhill Carrs is still as the 'wet' stage, but as the conservation value is of such importance, small scrapes and ponds are maintained to keep areas of open water and marshland. Without such work the area would eventually build up to such a stage where wetland species could not survive. This is known in ecological terms as succession.

Ferryhill Carrs is atypical of the area and the majority of land around the village is very dry and suitable for intensive arable farming. The dryness is assisted by the fact that most of the fields are situated on rolling banks, where the steepness encourages draining. Having dry soil helps it warm up earlier in the spring allowing crops to grow over an extended season.

There are also a few areas where cattle are grazed, but in an area with little surface water and more suited to arable farming there weren't many.

Being so close to houses makes the area popular for horse and pony grazing. Horses leave a much lower sward than cattle and this has a marked effect on the vegetation, where only a few species are capable of surviving.

The area near South Carrs was also being grazed by horses. At the moment the vegetation is too rank, so horse grazing would be of benefit. However if intensive grazing continues over a number of years then the floristic value of the pasture will deteriorate.

The most distinctive feature of the landscape is the tower at Thrislington Quarry. This can be seen from almost anywhere in the parish (and from quite a long way outside it in certain areas). This is a reminder of the industrial heritage of the parish. While Thrislington is just outside the designated village atlas boundary, the impact on quarrying in the area is obvious. Some of the best nature conservation sites in the county can be found in this area, most notably Thrislington National Nature Reserve and Bishop Middleham Old Quarry Local Nature Reserve. By removing the glacial deposits and top soil, old quarry areas have reverted back to true magnesian limestone grassland with very high wildlife value.

Industry needs an infrastructure to deliver the end product, and this is very obvious in Ferryhill as the railway line and terminal show. The terminal has been so important that it influenced the village around Ferryhill Station. The railway line is also important for wildlife. Like the quarries, railway cuttings expose the limestone bedrock underneath providing calcareous conditions for lime-loving plants. It also acts as a wildlife corridor, allowing species to spread between similar habitats.

A breakdown of the ecological value of the habitat types is shown below.

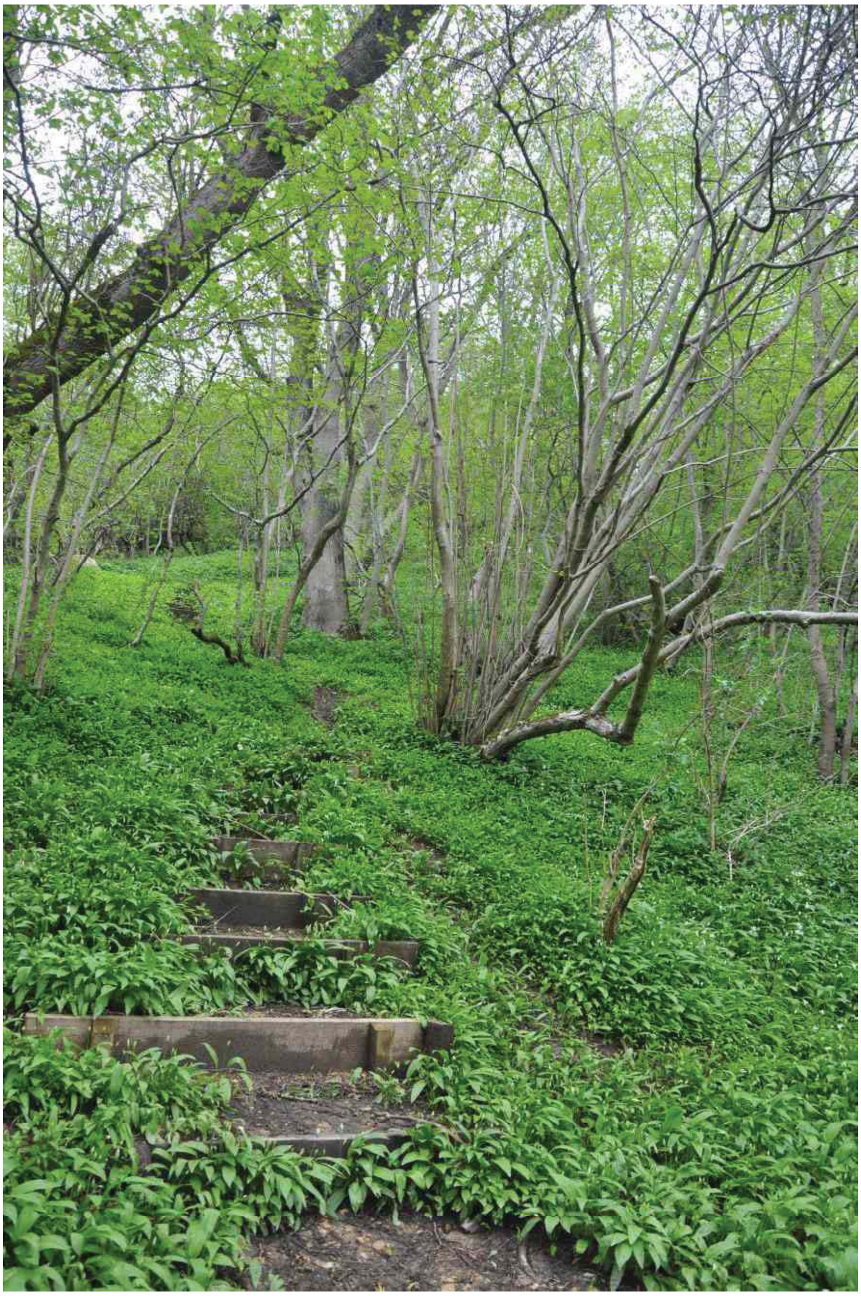
5.3 Ferryhill Carrs

Or more accurately Ferryhill marsh and lakes, sits in the bottom of a shallow valley separating Ferryhill from Thrislington. There are remnants of Willow Carr along the woodland edge, but the majority of the site comprises of rush, with other wetland plants such as Yellow Flag Iris. However the site is still very important for wildlife, especially as wetland habitats of this size are scarce on the magnesian limestone, where the rocks being porous don't hold much standing water unless there is a suitably thick layer of boulder clay to support it.

To the north of the site is a wet meadow. This year it was particularly impressive with good populations of Orchids as well as Adders-tongue.

The site forms the watershed between the River Wear and River Tees, with the majority of the outflow from the site heading south along the River Skerne into the Tees.

5.4 Ferryhill Carrs Woodland Survey



The woodland at Ferryhill Carrs can be split into three distinct sections. To the north there is a section of Hawthorn scrub. This is ideal for birds and a number of warblers and tits were in evidence.

The main woodland compartment is Ash standards with Hazel under story. A survey was carried out in conjunction with Durham Countryside Ranger Service on 11th July 2013 to look for signs of Ash die-back. Fortunately the survey did not find any signs, but one or two trees did show damage caused by heart-rot or similar fungal damage. The hazel is obviously very old and has been coppiced for some time in the past. Unfortunately the stools have not been coppiced for some time and special care will be needed to prevent shock from killing the trees outright. The ground flora consists primarily of Ramsons and Dog's Mercury although quite a few other species were noted. Re-establishing coppicing will improve the ground flora considerably.

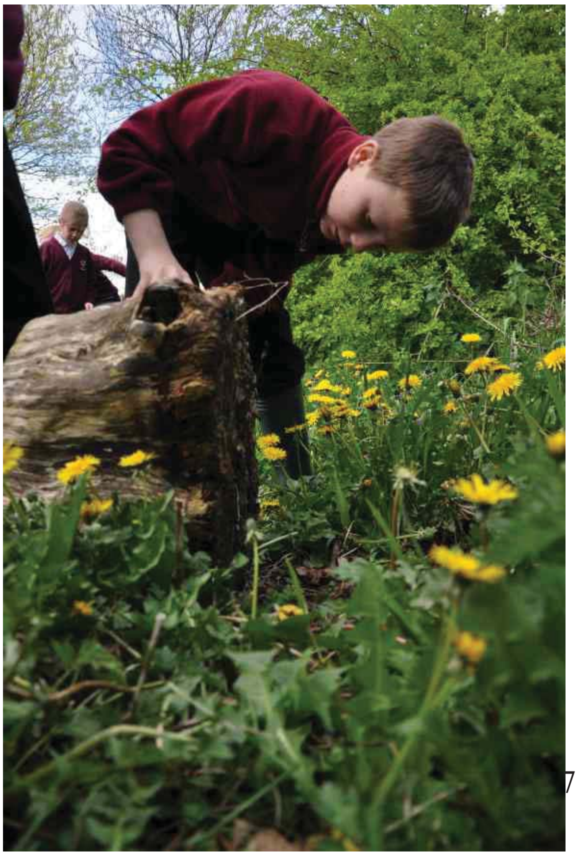
The most northern section of the wood is being dominated by Sycamore. Here light levels to the woodland floor is so low that there are extensive bare areas. The only frequent flora was Dog's Mercury and Wild Arum, although a few species are managing to find patches of light at the moment.

The site also has old field boundaries. These are fairly diverse, but again have Ash standards which are important for woodland birds. The hedges show evidence of mounding which may indicate an old drovers way.

5.5 Schools Involvement

The primary schools in Ferryhill were very enthusiastic about learning about their environment and we decided to cover three different topics to look at.

Cleves Cross chose to look at their wildlife area within the school grounds. Here a mixture of imported and indigenous plants had been managed to provide habitats for insects and birds. The area had been fenced off to restrict access to the area by a single gate and bark-chip paths laid out to encourage people to stay off the wild flowers. The number of flowers we recorded were fairly extensive and included species such as Cowslip, Knapweed, Common Dog Violet and Meadow Cranesbill (hybrid). The bird feeding area also attracted a number of birds to the area. This included Chaffinch, Blackbird, House Sparrow and Starling.



Ferryhill Station chose to look specifically at the birds which visited their 'wild' area. We made some bird boxes, looking at the different requirements that different species of birds had and how theses affected the type of nesting box that a bird would use. Over the two sessions we recorded a wide variety of birds that used the area. This included summer visitors such as Chiffchaff, Swift, Swallow, House Martin and resident species such as Wren, Blackbird, Jackdaw, Great Tit and Goldfinch. Pigeons, Doves and Gulls were also evident, flying over the school grounds.

With Dean Bank Primary we looked at the wildlife growing in the playground and how the area could be improved for wildlife. As most of the school grounds are hard standing, the main species to thrive tend to be what most people class as 'weeds'. We found a variety of species growing in cracks in the wall, beside fences and hedges and creeping into the flower beds. The commonest species where Groundsel, Pineapple Weed and Daisy, but we also recorded a number of spiders and other mini-bugs. To help provide homes for wildlife the classes made a number of nest boxes and bee houses, which were to be put up in the school grounds.

5.6 North of Ferryhill

The land to north of Ferryhill is primarily arable but with some horse grazing areas. The fields are mainly bordered by hedges, providing important habitats for birds, insects and providing protection for certain plants species to survive. There are also a few standard trees within the field boundaries. These are primarily Ash.

5.7 West, Laurel Road to Chiltern

Once you leave the village, the main land use is arable agriculture, but there are also areas used as paddocks for horse grazing. Both have limited appeal to wildlife, but some of the hedges provide valuable habitats. There are also a number of standard trees, mainly Ash.

The field margins provide habitats for certain plant species. We recorded area a number of species in this area, including White Campion, White Dead-nettle, Black Horehound and various Willowherbs.

The hedges were of particular importance to a number of Butterfly species. We saw healthy populations of Small Tortoiseshell, Green-veined White and Peacock.

5.8 Thrislington

Thrislington National Nature Reserve is one of the crown jewels of the Magnesian Limestone. The populations of Blue Moor-grass and Small Scabious make it particularly important, and it is the largest area of this type of vegetation in the country. The eastern end of the site is undisturbed grassland, but in the western end the grassland has been trans-located by the large excavators used in the nearby quarry. The turf and soil beneath was lifted, as intact as possible and put down in a patchwork effect to create a new meadow on an area that had been quarried previously.

The site has scattered trees and shrubs which are also important for birds. These included Greater-spotted Woodpecker and Tree Pipit.

The site is home to many rare species, including the Dark-red Helleborine, Mountain Everlasting and Perennial Flax. Rare invertebrates include the Durham Argus, Least Minor Moth and the Glow-worm.

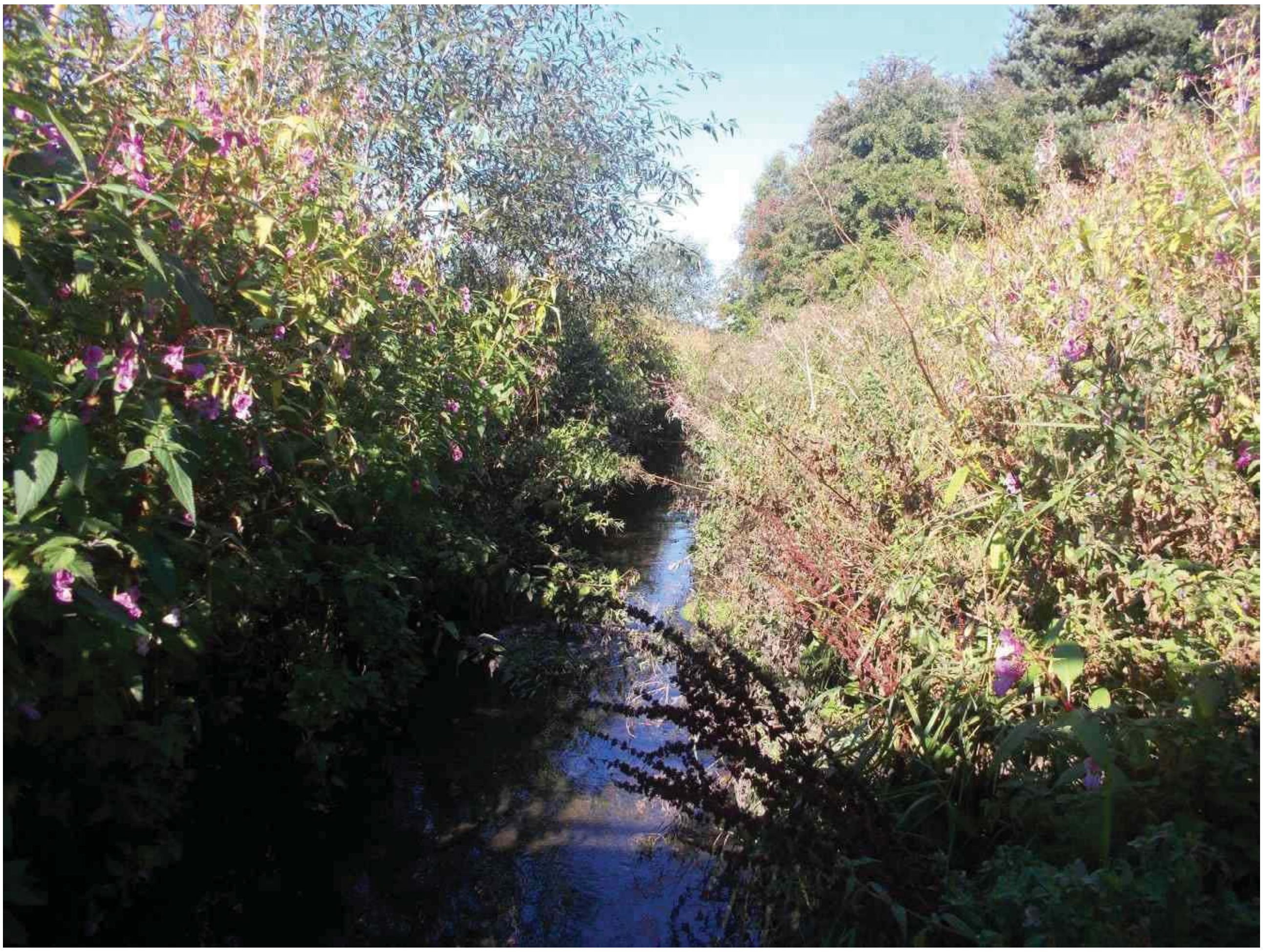
The woodland sections and old quarries to the south of the site are also important for wildlife. Here we saw a number of important species such as Cat's-ear, Mouse-ear Hawkweed, Common Centaury, Fairy Flax and Common Milwort. Like other sites we surveyed this year, the populations of orchids were particularly impressive, especially the Early Purple Orchid in the woodland areas.

5.9 South Carrs and the River Skerne

After the stream leaves Ferryhill Carrs it flows towards the south in a heavily cannalised ditch. This reduces the chance that the stream will flood into nearby houses or industrial units. On one hand it reduces the amount of marginal habitat suitable for marsh plants, but on the other it creates steep banks that are required by some birds including Kingfisher and Sand Martin. However being in an urban area has effected the water quality as run-off and other forms of pollution have had a negative effect on the river.

Kick samples in the stream showed that the water quality degrades as if passes through the town. By the time it has gone beyond Ferryhill Station, the populations of pollution intolerant species drops. Here the commonest species by far is the Fresh Water Shrimp. Other creatures found included Cased Caddisfly, Caseless Caddisfly, Water Louse, Greater Diving Beetle and Blue Winged Olive Mayfly (in descending order of numbers caught).

Himalayan Balsam is very common along the stream banks. This invasive species is a particular problem in such areas as it will eventually dominate the vegetation, preventing other species from growing there. The method of seed dispersal used by Himalayan Balsam is fairly spectacular; once the seed is ripe, the outer casing releases like a spring, throwing the seed for a few metres. The popping sound can often be heard during late summer, especially when the weather is warm and dry.



In between the South Carrs and Mainsforth there is an area of woodland and an old brown-field site. Both are very important for wildlife. The southern and eastern areas are primarily coniferous woodland, but with some scattered broadleaves planted around the edge. At its current stage there is still some ground flora. However this will deteriorate as the canopy closes. In this area we found

Tall Melilot and Birds-foot Trefoil. The area was also fairly good for butterflies with a number of Speckled Wood and Common Blue being seen.

The woodland to the eastern end was mature broadleaved and here the ground flora was much better showing examples that you would associate with semi-ancient woodland. This included Bluebell, Wood Anemone and Wild Arum. The site also had a small population of Wall Brown and various White butterflies.

The brown-field site had a very good ground flora. This is primarily due to the lack of top soil preventing grasses from becoming too dominant. Here we saw various Orchids, Scarlet Pimpernel, Birds-foot Trefoil as well as a wide variety of butterfly species.

5.10 Species Lists

Birds

Blackbird	Turdus merula
Blackcap	Sylvia atricapilla
Bullfinch	Pyrrhula pyrrhula
Chaffinch	Fringilla coelebs
Chiffchaff	Phylloscopus collybita
Collared Dove	Streptopelia decaocto
Coot	Fulica atra
Cormorant	Phalacrocorax carbo
Dunnock	Prunella modularis
Goldfinch	Carduelis carduelis
Greenfinch	Carduelis chloris
Grey Heron	Ardea cinerea
Herring Gull	Larus argentatus
Jackdaw	Corvus monedula
Lapwing	Vanellus vanellus
Linnet	Carduelis cannabina
Little Grebe	Tachybaptus ruficollis
Magpie	Pica pica
Mallard	Anas platyrhynchos
Moorhen	Gallinula chloropus
Reed Bunting	Emberiza schoeniclus
Sand Martin	Riparia riparia
Turtle Dove	Streptopelia turtur
Common Whitethroat	Sylvia communis
Garden Warbler	Sylvia borin
Great Spotted Woodpecker	Dendrocopos major
Great Tit	Parus major
House Sparrow	Passer domesticus
Long-tailed Tit	Aegithalos caudatus
Mute Swan	Cygnus olor
Robin	Erithacus rubecula
Rook	Corvus frugilegus
Sedge Warbler	Acrocephalus schoenobaenus
Siskin	Carduelis spinus
Sky Lark	Alauda arvensis
Song Thrush	Turdus philomelos

Sparrowhawk	Accipiter nisus
Starling	Sturnus vulgaris
Swallow	Hirundo rustica
Swift	Apus apus
Tit, Blue	Cyanistes caeruleus
Tit, Great	Parus major
Tree Pipit	Anthus trivialis
Willow Tit	Poecile montanus
Willow Warbler	Phylloscopus trochilus
Wood Pigeon	Columba palumbus
Wren	Troglodytes troglodytes
Yellowhammer	Emberiza citrinella

Invertebrates

Common carder bee	Bombus pascuorum
Red-tailed bumblebee	Bombus lapidarius
White-tailed bumblebee	Bombus lucorum
Blue-tailed Damselfly	Ischnura elegans

Butterflies

Comma	Polygonia c-album
Common Blue	Polyommatus icarus
Green-veined White	Pieris napi
Large White	Pieris brassicae
Meadow Brown	Maniola jurtina
Orange-tip	Anthocharis cardamines
Painted Lady	Vanessa cardui
Peacock	Inachis io
Red Admiral	Vanessa atalanta
Ringlet	Aphantopus hyperantus
Small Heath	Coenonympha pamphilus
Small Tortoiseshell	Aglais urticae
Small White	Pieris rapae
Speckled Wood	Pararge aegeria
Wall	Lasiommata megera

Mammals

Fox	Vulpes vulpes
Mole	Talpa europaea

Rabbit	Oryctolagus cuniculus

Trees

Ash	Fraxinus excelsior
Beech	Fagus sylvatica
Birch	Betula pendula
Elm, Wych	Ulmus glabra
Hazel	Corylus avellana
Maple, Field	Acer campestre
Oak, Pedunculate	Quercus robur
Sycamore	Acer pseudoplatanus

Plants

Adders-tongue	Ophioglossum vulgatum
Agrimony	Agrimonia eupatoria
Anemone, Wood	Anemone nemorosa
Avens, Water	Geum rivale
Avens, Wood	Geum urbanum
Bartsia, Red	Odontites vernus
Bedstraw, Ladys	Galium verum
Bindweed, Hedge	Calystegia sepium
Bittersweet	Solanum dulcamara
Black Medick	Medicago lupulina
Bluebell	Hyacinthoides non-scripta
Bryony, Black	Tamus communis
Bugle	Ajuga reptans
Burnett, Salad	Sanguisorba minor
Buttercup, Meadow	Ranunculus acris
Campion, Bladder	Silene vulgaris
Campion, Red	Silene dioica
Campion, Sea	Silene uniflora
Campion, White	Silene latifolia
Carrot, Wild	Daucus carota
Cats-ear	Hypochaeris radicata
Centaury, Common	Centaurium erythraea
Cinquefoil, Creeping	Potentilla reptans
Clover, Red	Trifolium pratense
Clover, White	Trifolium repens
Clover, Zigzag	Trifolium medium

Colts-foot	Tussilago farfara
Columbine	Aquilegia vulgaris
Comfrey, Common	Symphytum officinale
Cowslip	Primula veri
Cranes-bill, Meadow	Geranium pratense
Cranesbill, Meadow	Geranium pratense
Crosswort	Cruciata laevipes
Cuckooflower	Cardamine pratensis
Daisy, Ox-eye	Leucanthemum vulgare
Dead-nettle, White	Lamium album
Dogs Mercury	Mercurialis perennis
Enchanters-nightshade	Circaea lutetiana
Eyebright	Euphrasia arctica
Figwort, Common	Scrophularia nodosa
Flax, Fairy	Linum catharticum
Flax, Perennial	Linum anglicum
Forget-me-not, Field	Myosotis arvensis
Goats-beard	Tragopogon pratensis
Gorse	Ulex europaeus
Harebell	Campanula rotundifolia
Harts-tongue	Phyllitis scolopendrium
Hawkbit	Leontodon hispidus x saxatilis
Hawkbit, Rough	Leontodon hispidus
Hawks-beard, Northern	Crepis mollis
Hawkweed, Mouse-ear	Pilosella officinarum
Helleborine, Dark-red	Epipactis atrorubens
Herb Robert	Geranium robertianum
Hogweed	Heracleum sphondylium
Horehound, Black	Ballota nigra
Nettle, White Dead	Lamium album
Iris, Yellow	Iris pseudacorus
Knapweed	Centaurea nigra
Knapweed, Greater	Centaurea scabiosa
Ladys Mantle	Alchemilla sp.
Lords-and-Ladies	Arum maculatum
Marjoram	Origanum vulgare
Meadowsweet	Filipendula ulmaria
Melilot, Tall	Melilotus altissimus
Mignonette, Wild	Reseda lutea

Milkwort, Common	Polygala vulgaris
Mountain Everlasting	Antennaria dioica
Mouse-ear, Field	Cerastium arvense
Mugwort	Artemisia vulgaris
Orchid, Common Spotted	Dactylorhiza fuchsii
Orchid, Early Purple	Orchis mascula
Orchid, Northern Marsh	Dactylorhiza purpurella
Pignut	Conopodium majus
Pineapple Weed	Matricaria discoidea
Plantain, Hoary	Plantago media
Primrose	Primula vulgaris
Ragwort	Senecio jacobaea
Ramsons	Allium ursinum
Rock-rose, Common	Helianthemum nummularium
Sandwort, Thyme-leaved	Arenaria serpyllifolia
Scabious, Devils-bit	Succisa pratensis
Scabious, Field	Knautia arvensis
Scabious, Small	Scabiosa columbaria
Scurvygrass, Common	Cochlearia officinalis
Sedge, Glaucous	Carex flacca
Self-heal	Prunella vulgaris x laciniata
Speedwell, Germander	Veronica chamaedrys
Speedwell, Heath	Veronica officinalis
St Johns Wort	Hypericum sp.
St Johns-wort, Hairy	Hypericum hirsutum
St Johns-wort, Pale	Hypericum montanum
St Johns-wort, Perforate	Hypericum perforatum
Stitchwort, Greater	Stellaria holostea
Strawberry, Wild	Fragaria vesca
Thistle, Carline	Carlina vulgaris
Thyme, Wild	Thymus polytrichus
Tormentil	Potentilla erecta
Trefoil, Birds-foot	Lotus corniculatus
Trefoil, Hop	Trifolium campestre
Twayblade	Listera cordata
Valerian, Common	Valeriana officinalis
Vetch, Bush	Vicia sepium
Vetch, Kidney	Anthyllis vulneraria
Vetch, Tufted	Vicia cracca

Vetchling, Meadow	Lathyrus pratensis
Vetchling, Yellow	Lathyrus aphaca
Violet, Common Dog	Viola riviniana
Violet, Sweet	Viola odorata
Willowherb, Broad-leaved	Epilobium montanum
Willowherb, Great	Epilobium hirsutum
Willowherb, Marsh	Epilobium palustre
Willowherb, Rosebay	Chamerion angustifolium
Wood-sorrel	Oxalis acetosella
Woodruff	Galium odoratum
Woundwort	Stachys sylvatica
Yarrow	Achillea millefolium
Yellow Rattle	Rhinanthus minor

Grasses

Dogs-tail, Crested	Cynosurus cristatus
Fescue, Red	Festuca rubra
Fescue, Sheeps	Festuca ovina
Meadow-grass, Rough	Poa trivialis
Oat-grass, False	Arrhenatherum elatius
Oat-grass, Yellow	Trisetum flavescens
Quaking-grass	Briza media
Rye-grass, Perennial	Lolium perenne
Yorkshire-fog	Holcus lanatus