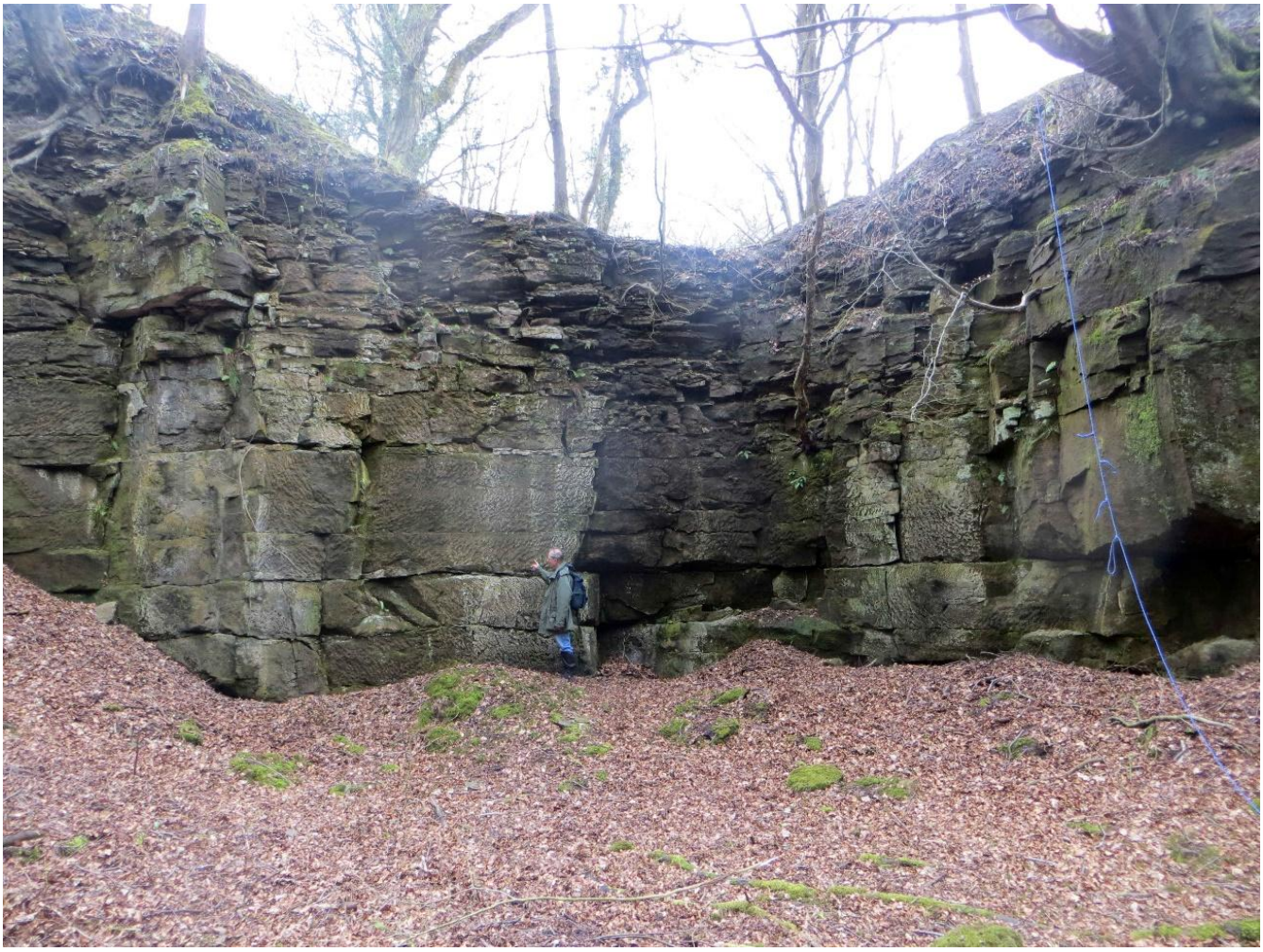
NORTH LANARKSHIRE COUNCIL GEODIVERSITY AUDIT REPORT



Strathclyde Geoconservation Group

Friends of Kelvin Valley

Scottish Geodiversity Forum

SEPTEMBER 2018

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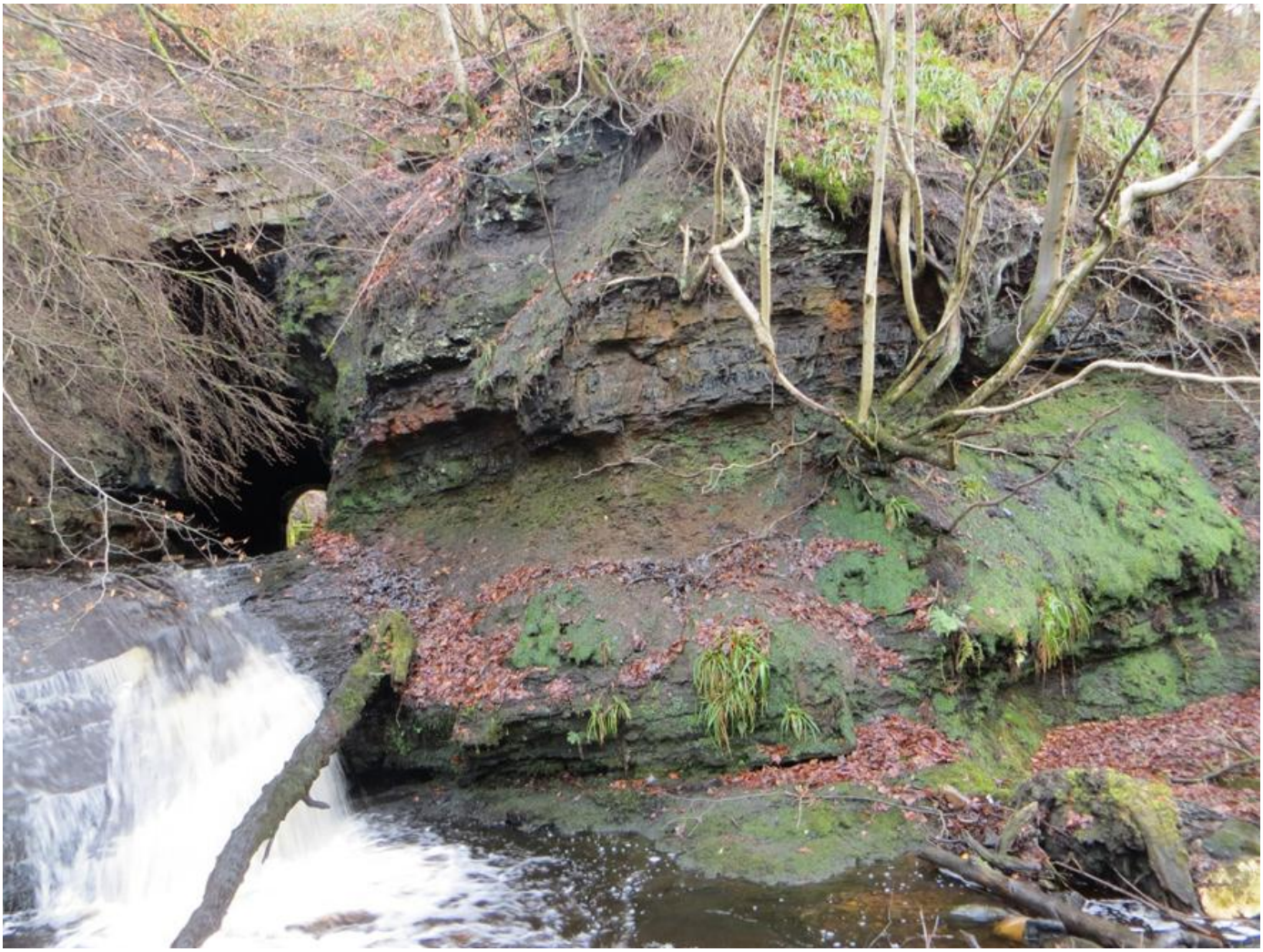
Front Cover Image South Calder Water, Ravenscraig LGS: old quarry in at least 6 m of hard, jointed, medium grained sandstone, beds from 30-90 cm thick, belonging to the Scottish Middle Coal Measures Formation above Glasgow Upper Coal



Red Burn LGS, Cumbernauld; cliff section and tunnel under railway embankment, Calmy Limestone, Upper Limestone Formation (Clackmannan Group)

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INTRODUCTION

North Lanarkshire contains strata from the entire 60 million year history of the Carboniferous Period. This period saw massive volcanic eruptions, tropical forests and warm tropical seas. In the more recent Ice Ages we were buried beneath a one km thick ice sheet. This eventful geology produced a variety of rocks and scenery that have been the building blocks of our communities and industry.

This assessment report is based on 6 years of inspecting more than 80 sites by volunteers. We describe our geoheritage and what we did and what we found, including the top twelve areas to visit and the best twenty sites for conservation. We then describe how geology built North Lanarkshire and where to go to enjoy our geoheritage. We conclude with what to do next to fulfil NLC's Geodiversity Action Plan.

The project started in 2012 with volunteers assessing geological sites in Kilsyth & Cumbernauld as part of the Friends of Kelvin Valley's activities to engage the public with their local environment. Brian Thomson, then NLC's chief biodiversity officer, invited us to extend this assessment to the whole of North Lanarkshire. We provided input to NLC's Geodiversity Action Plan, part of Biodiversity Action Plan 2015-2020, and our work became focused on achieving the aims of this plan.

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Mike Browne	Vice-Chair, Scottish Geodiversity Form
Paul Carter	Chair, Friends of Kelvin Valley
Margaret Greene	Chair, Strathclyde Geoconservation Group

1. OUR GEOHERITAGE

Scotland has world class geodiversity and many of the first major insights into Earth's history were made here. Scotland's geology, and the landscape created by geology, is a great tourist draw. This heritage is very important for forming a 'sense of place' for local communities.

The Carboniferous is by far the most important Period economically in Scotland's eventful geological history. North Lanarkshire is underlain by rock strata from the entire period, from the oldest (360 million years) in the north to the youngest (300 million years) in the south.

Indeed, it is because we have the whole of the Carboniferous that North Lanarkshire and our communities are what we are today. The rich deposits of coal, ironstone, limestone and fireclay were the foundations of our industrial history and we have used the sandstones and whinstone to build our towns and roads.

During the long and eventful 60 million years of the Carboniferous, North Lanarkshire travelled northwards across the equator. We first hosted semi deserts, followed by widespread volcanoes, tropical seas, widespread deltas and swamp forests. This was followed by a return to more arid conditions and the injection of hot molten rock deep underground. All of these different environments gave us the rocks and minerals that make up our rich geoheritage.

As a bonus, North Lanarkshire saw more drama over the last million years, repeatedly being covered in glaciers over a kilometre in thickness, interspersed with periods of great lakes and rivers. These all helped mould the landscape we see today, and gave us valuable aggregate resources, and rich farmland.

There was a time when North Lanarkshire's people were well aware of the rocks beneath our feet. We mined them, quarried them, forged them and built with them. We used them to build and power our industrial revolution. But much of this is now history. Our geoheritage is a hugely important part of North Lanarkshire's character. There is a danger of this being lost as quarries become infilled and memories fade. It is time to protect, publicise and renew our geoheritage and value our geodiversity before it slips out of the new generation's consciousness.

There has been growing recognition of this across Scotland in recent years. The Scottish Government supports Scotland's Geodiversity Charter and expects Local Authorities to value geodiversity in Local Development Plans. Local Authorities have been commissioning Geodiversity Audits, designating Local Geodiversity Sites and producing Local Geodiversity Action Plans. The Scottish Geodiversity Forum has brought together Government, Agencies, Local Authorities, businesses and geological societies to produce Scotland's Geodiversity Charter, the current issue covering 2018-2023. Geological societies have led walks, given talks, produced leaflets and assessed potential Local Geodiversity Sites.

2. WHAT WE DID

Since 2012 volunteer geologists have carried out a series of Site Assessments for North Lanarkshire Council which, along with annual summaries and this report, constitute a Geodiversity Audit for North Lanarkshire. We also provided input to NCC's Geodiversity Action Plan 2015-2020, published as part of their Biodiversity Action Plan.

We selected sites to visit by reviewing published and unpublished geological maps and other information. In this way we identified the sites which were most likely to have a likelihood of adequate rock exposure. We also aimed to get a reasonable coverage of all the strata in North Lanarkshire, and an adequate geographical coverage. Some areas have very little solid geology exposed, due to urban/industrial development and blanketing by drift deposits. The latter are themselves of interest and these were also assessed.

As it turned out, almost all of the sites with geological interest had already been designated as Sites of Interest for Nature Conservation (SINCs) by NLCs biodiversity team. Two sites are geological Special Sites of Scientific Interest (SSSI) and several sites are local Nature Reserves or Country Parks. Over the six year field work period 81 sites were visited and assessed by a two-man volunteer team of retired professional geologists, "still game" in their seventies for scrambling down steep valley sides and clambering up rock faces. These sites included 73 SINCs (out of NLCs approximately 350). Exposures were examined and recorded, photographs were taken, and samples collected for use in public engagements.

Annual reports were submitted to NLC's Senior Biodiversity Officer, including individual site assessment reports using a standard reporting template (see Appendix for examples). Strathclyde Geoconservation Group committee members helped with report preparation. NLC have incorporated these site reports into the documentation for the appropriate SINCs. We also submitted a summary report on North Lanarkshire's drift deposits.

Friends of Kelvin Valley engaged the public by giving 34 talks and rock shows to community groups and schools in the Cumbernauld and Kilsyth area. Local geology also featured in a number of local heritage walks. The Friends also produced two local leaflets 'Kelvin Valley Rocks' and 'Cumbernauld Rocks' along with a booklet, '250 years of mining in Cumbernauld and Kilsyth'

NLC provided mapping for all the SINCs, LNRs, Country Parks, and SSSIs etc. and held annual progress meetings with ourselves.

We estimate volunteer input at very approximately 250 person-days overall, including site visits, report production, research and public engagement.

3. WHAT WE FOUND

Geodiversity Sites

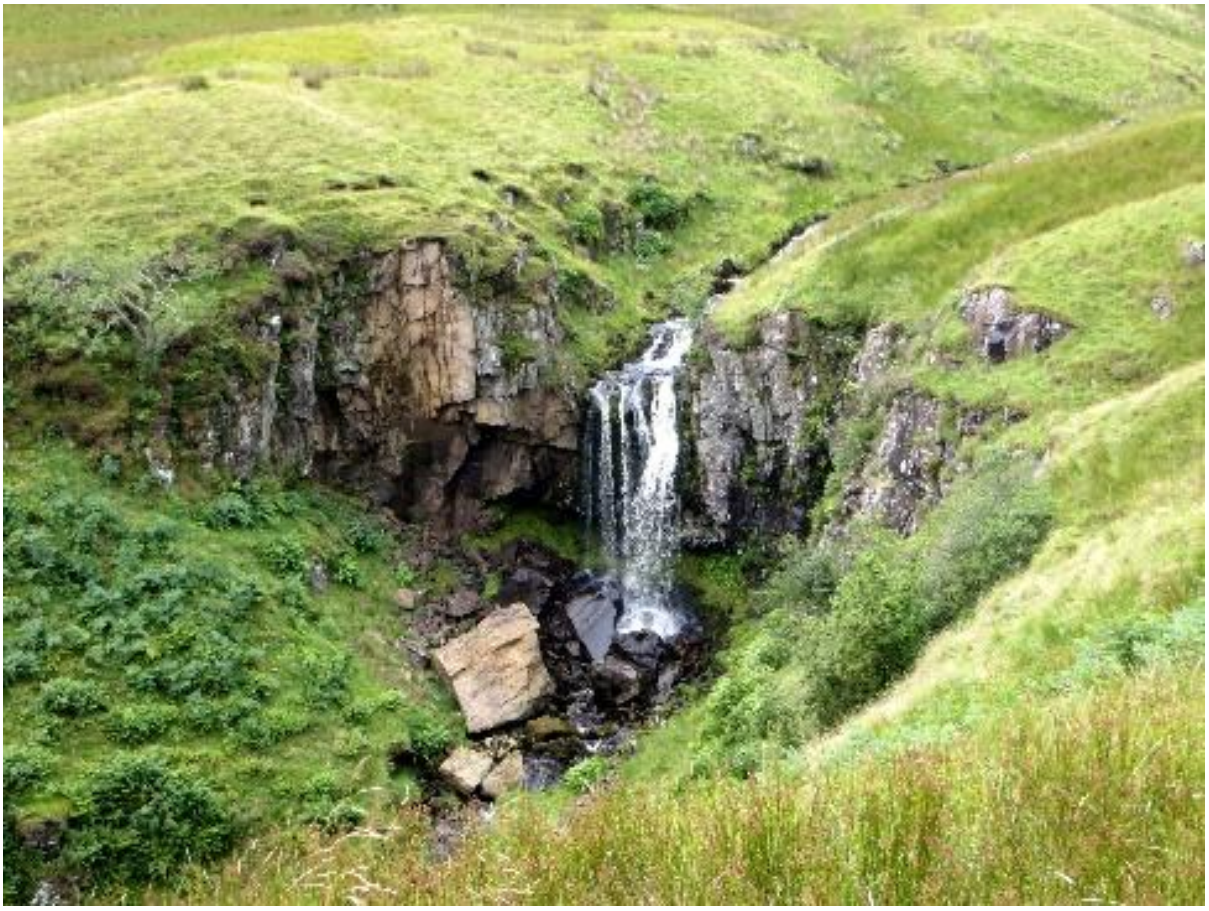
Of the 81 sites visited, 70 had sufficient geological interest for us to recommend them as Local Geodiversity Sites. Of these, 67 are already designated as SINCs and five are not designated. Eleven had insufficient geological interest to qualify.

Geographical coverage is fairly good, with a wide scatter of sites across North Lanarkshire. However there are some areas of poor coverage due to urbanisation or lack of exposure.

Geological coverage is good, with all Formations of the Carboniferous included, together with igneous intrusions, faults, fossils, superficial deposits and human impact. Broadly speaking, the older Formations from the Kinnesswood through the Ballagan, Clyde Sandstone, Clyde Plateau Volcanic, Lawmuir, Lower Limestone and Limestone Coal Formations are found in the north of North Lanarkshire. The younger formations from the Upper Limestone Formation through the Passage, Lower, Middle and Upper Coal Measures are found in the centre and south. Igneous intrusions are found in the north and centre, and superficial deposits throughout. See Table 1 for more details

There is a wide range in quality, from marginally worthwhile sites up to top class locations such as Corrie Burn SSSI.

Rock exposures include crags in the hills, cliffs and tunnels. Superficial deposits form features such as drumlins and moraines.



Garrel Burn Upper and Laird's Loup LGS (See Appendix 2)

Access to the sites is highly variable. Some are on popular footpaths whilst others require a scramble. Access conditions are given on each site report.

We enjoyed the wealth of wildlife, the woodlands, wild flowers, bird life and mammals, with much wildlife right on the edge of built up areas. We briefly refer to some of the wildlife seen on certain of the site reports.

Many of the sites had human heritage features such as mines, quarries, limekilns, industrial remains, mills etc. and these are referred to in the site reports.

Geological Features

A wide range of geological features is displayed on SINCs proposed as Local Geological Sites, including sedimentary rocks and minerals, igneous rocks, faults and folds, and quaternary features. These are noted on our individual site assessments and are summarised below.

a) Sedimentary Rocks and Minerals

These underlie much of central and south North Lanarkshire. Sandstones are the most prominent, we saw lots and lots of sandstones. From the white semi desert sandstones of the north, to the golden weathering tropical forest sandstones of the centre, to the pinkish red sandstones of the south, stained red by the encroaching Permian desert. Sandstones are prominent in river valleys, sometimes forming waterfalls and the cliff sides of deep gorges, and in old quarries. A number of sedimentary features such as bedding planes, current bedding and soft bed deformation can be seen.

Mudstones and siltstones are possibly the most abundant rock types in North Lanarkshire but are much less seen than sandstones, mainly because they erode easily. Thin layers of mudstone can be found interlayered between sandstones in cliff exposures beside rivers and occasionally thicker mudstones are exposed in old brick pits.

Limestones form only a small percentage of the succession, although they were economically very important. They are found in low crags and burn exposures in the northern part of North Lanarkshire.

Coals, ironstones and fireclays were all very important economically but are rarely seen in surface exposures. All can be found in a few small outcrops in burns in the north of North Lanarkshire, But the best opportunity to see and sample these materials is in the remaining old coal pit bings.

b) Igneous Rocks

Three main types of igneous rock occur in the north of North Lanarkshire. Volcanic basalts form the Kilsyth Hills and these rocks are exposed in crags and burns. Intrusive dolerites (whinstone) of the Midland Valley Sill Complex form much of the higher ground in the centre of the area and there are many exposed quarry faces and some natural crags. Six east-west trending dolerite dykes cut across the northern and central areas, often forming narrow ridges and waterfalls. Exposures of the dykes are seen in natural crags and small quarries.

c) Structure

Most of the strata in North Lanarkshire are fairly flat lying except in the vicinity of faults, where dips can be very steep. Some folds occur, such as the natural arch of the "Riggin" in the Kilsyth area. The strata are highly faulted, with a number of major faults and very many minor ones. Many of these trend roughly east-west and are due to north-south crustal stretching. The major Campsie Fault has a southerly downthrow of around 1.5 km, it forms the boundary between the lavas to the north and the sedimentary

rocks to the south and forms the south face of the Kilsyth Hills. Major faults are seen as landscape features and minor faults are seen in natural and quarry exposures.

d) Quaternary Features

A wide range of quaternary features are seen both on SINCs and in the landscape between SINCs. They are noted on our individual site assessments and are summarised in a short report submitted to NLC by ourselves (see Appendix). In summary, quaternary deposits overlie the solid rock in much of North Lanarkshire. Glacial till (boulder clay) covers much of the area, along with glacial moraines, glacial sands & gravels, alluvium and peat.

Deposition features such as drumlins are well seen in the Stepps / Cumbernauld area in particular, erosion features include the deep glens running down the Kilsyth Hills & Slammanan Plateau, and the deep gorges of the Calders.

Man-made features include the remaining pit Bings, major ex-industrial sites such as Ravenscraig, numerous quarries, including some working quarries, and numerous infilled quarries.

e) Fossils

The Carboniferous was a period of abundant life on Earth and some of this has been preserved as fossils. Some of these fossils have been used as important marker bands, helping to delineate the Carboniferous succession and aid correlation between different areas.

Limestones such as the Hurlet, Hosie, Index and Castlecary and marine bands such as the Lowstone and Skipsey's have been used to act as boundary beds for Carboniferous formations. These beds have characteristic fossil assemblages, and contain a variety of shellfish and sea lily fossils. Most of these can be found at SINC/LGS locations.

Coal pit Bings are the best source of fossils from the coal bearing formations. These include fossilised tree roots and tree branches and trunks, such as Lepidodendron, Calamites and Sigillaria. Bings are also a source of mussel bed materials. Bings are rarely SINC sites and the few remaining need protection.

Landscape

North Lanarkshire's wonderfully varied landscape is the direct result of our areas equally varied geology. Many of these landscape features are included in, but also spread beyond, the SINC/LGS sites.

Hills – the Kilsyth Hills in the north are created by the hard lava flows and some of the individual flows are shown by the stepped nature of the hill profiles in places. The massive East Campsie Fault forms the front (south) face of the hills.

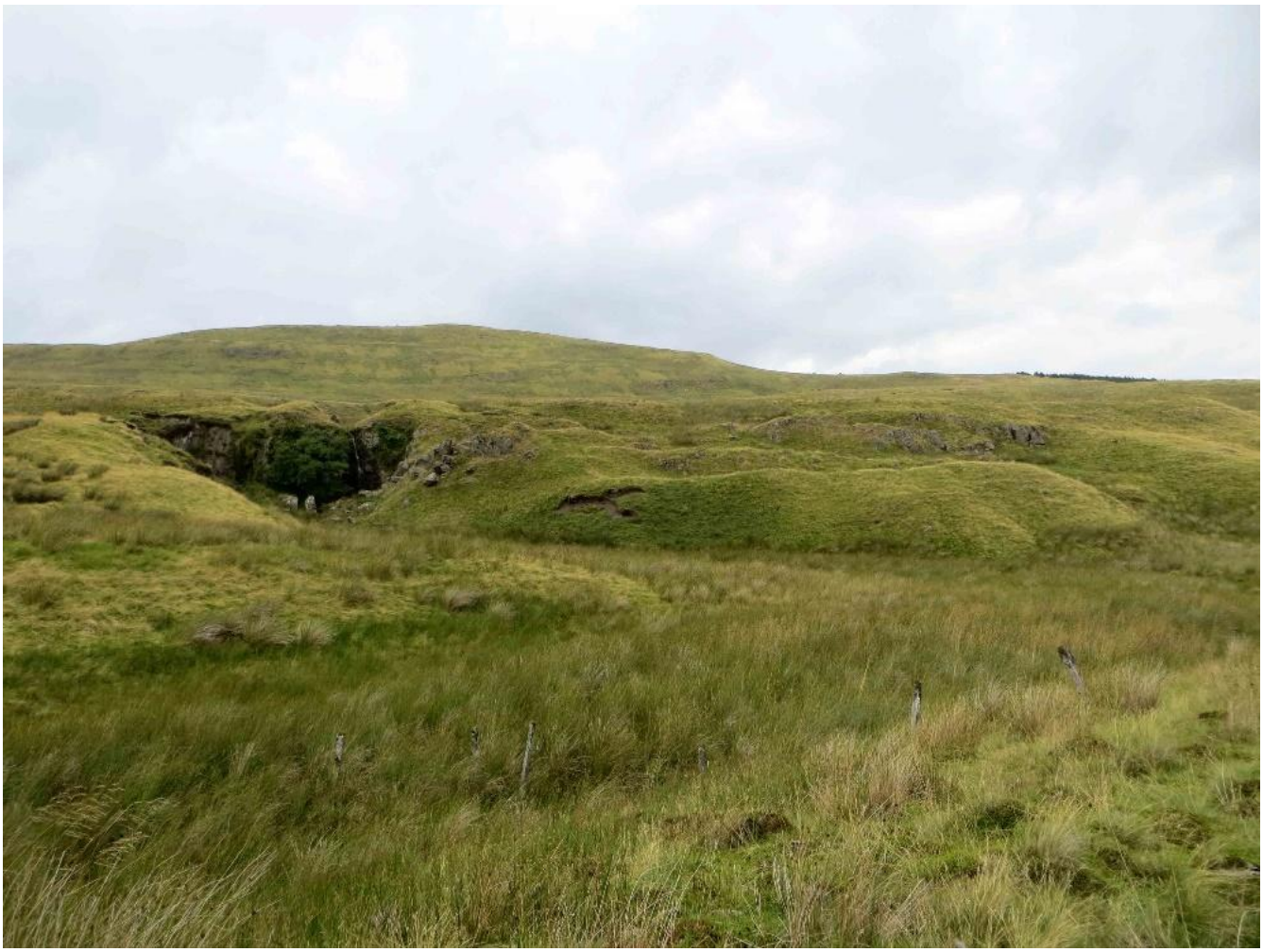
Muirs –the hard dolerite of the Midland Valley Sill Complex form low hills along the Antonine Wall and moorlands throughout eastern North Lanarkshire, often pockmarked by quarries. Thick sandstones such as in the Passage Formation also form heathery moorland, such as Fannyside Muir.

Ridges – the hard dolerite of the dyke complex creates a series of low ridges running east–west across the country.

Rolling Countryside – the alternating harder sandstones and softer mudstones form the rolling landscape which is typical of the centre and south. Glacial drumlins accentuate the rolling nature of the countryside in many areas. Glacial till (boulder clay) blankets much of the area, smoothing off the landscape.

Glens, gorges and waterfalls, - all caused by post glacial erosion, form a spectacular, if often hidden waterscape. The Calders in particular show dramatic incised meanders and cliff bound gorges. We have many waterfalls, cascading over hard sandstone beds, igneous dykes and structural faults. Water has also filled in the post glacial hollows, forming the Seven Lochs, Fannyside Lochs and many others.

Broad flat alluvial plains – created by post glacial infilling of many valleys including the Clyde and Kelvin Valleys, along with lowland marshes, peat bogs and river meanders.



South Slopes of Kilsyth Hills LGS; waterfall and landslides to right

Threats

We did not find many major threats to North Lanarkshire's geodiversity, but some definitely exist:-

- Road building, this can give with one hand and take away with the other. An example is the M80 which has created an excellent section through a typical sedimentary sequence at Condorrat, easily seen from an overbridge, whilst fragmenting the previous strong dyke feature and SSSI at Mollinsburn.

- Bing removal, most of North Lanarkshire's Bings have been taken away. Bings are important as heritage features, and as places where students and the public can see and sample Carboniferous rocks and fossils. Remaining Bings should be kept. Small scale excavations are good as fresh material is exposed. Whole scale "greening over" is bad as the feature and rock materials become hidden.

- Quarry infilling, many old quarries have been landfilled, removing valuable windows into our underlying geology. Sympathetic restoration such as Auchinstarry Quarry in Kilsyth, is much preferred.

- Urbanisation, new development needs to respect geological features, both natural and artificial, to prevent loss of even more of our geoheritage.

- Neglect, many geological features are now neglected and fairly inaccessible. Many interesting features, such as shell beds, shown on 50 year old original surveys (field slips) were not found by ourselves, mainly due to overgrowth and loss of paths.

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Glencryan LGS – Fireclay Mine (see Appendix 2)

4. TOP TWENTY SITES TO CONSERVE

We have selected a 'top twenty' list of sites which give the best exposures of each of the main Formations etc and which also give a degree of geological spread. All the proposed Local Geodiversity Sites merit conservation but the 'top twenty' deserve the greatest protection, see Table 2. Some of these sites are not readily publicly accessible, but are needed to ensure the best of north Lanarkshire's geodiversity is conserved, and kept available for the likes of specialist student research. Publically accessible sites are discussed in the next section. It should be noted that Duntilland Quarry, a working hard rock aggregate site with a long term planning permission (decades), is included in the list but has not actually been proposed as an LGS because of all the regulations concerning health and safety.

However it provides a case study for all working or suspended (dormant) quarries that when the time arrives for consideration of final closure and aftercare/uses, its geological features should be considered too and LGS status may be appropriate at this stage for the likes of Croy, Airdriehill, Riskend and others.

5 HOW GEOLOGY BUILT NORTH LANARKSHIRE

We have already dealt with how geology shaped our natural landscape, but how has geology helped build man-made landscape? Geology has had a profound influence on our buildings and roads, agriculture and industry, water supply and transport.

Buildings

Stone, and sandstone in particular, has long been in use for building in North Lanarkshire. One of the earliest examples is the Roman Bath House at Strathclyde Park. Our town and village centres have many stone buildings, from grand churches and civic buildings down to countless dwellings and small shops. Earlier buildings used locally quarried stone, usually lighter grey sandstone in the north and browner & redder sandstone in the south. Some later buildings were built with "posh" bright red sandstone from Ayrshire and Dumfries. Some of the original quarries, and crags exposing the sandstone in river valleys, can be seen in some SINC/LGS sites.

Brick buildings also became popular with the industrial revolution and North Lanarkshire had many brickworks. A whole variety of geological clayey materials were used, Carboniferous shales from 'brick pits' Queenzieburn and Cumbernauld, the same shales from many coal pits, glacial till from small local clay pits such as Banton, and late glacial clays. Some of these old pits and Bings can still be seen on SINC/LGS sites and distinctive local bricks are seen in local older buildings.

Roads

Roads require particularly hard wearing rock and North Lanarkshire is blessed with many outcrops of hard dolerite, in the Midland Valley Sill Complex and the dyke swarm. Quarries large and small pockmark the area. Quarrymen handmade kerbs and setts, many for export out with the area. These days a few large quarries supply crushed stone for road surfacing materials. Crushed rock and natural sand & gravel aggregate are also used for concrete production.

Many old quarries can still be seen, and a few are in SINC/LGS sites. The quarry at Auchinstarry in Kilsyth has been turned into a popular local park with a well-used natural climbing wall. Recently closed Croy Quarry is also being transformed into a local park. The old Craighalbert quarry face forms an attractive cliff feature in Cumbernauld Community Park.

Agriculture

The agricultural revolution of the early 1700s and beyond relied on spreading copious amounts of lime to sweeten the generally acidic soils of North Lanarkshire and helped to increase production dramatically. Limestone beds such as the Hurlet, Hosie, Index, Orchard and Castlecary Limestones, occurring in the northern part of North Lanarkshire, were extensively quarried and mined and then burnt to make lime in clamp kilns and draw kilns. Lime was also in great demand for building mortar and rendering. Remains of workings and kilns can be seen on several SINC/LGS sites, such as Corrie near Queenzieburn (SSSI) and Red Burn at Castlecary and Vault Glen.

Industry

Lanarkshire's growth was built on industry, and industry was built on geological resources.

Coal was king in North Lanarkshire for many years, for 200 years from the beginning of the industrial revolution in the late 1700s through to the last decades of the 1900s. Lanarkshire saw around 100 coal mines & pits brought into the NCB in 1947, plus around 150 small private mines. Many mines had come and gone by 1947, and the number of mines as a whole could easily exceed one thousand.

The mines produced a whole variety of coals, anthracite for steel making, steam coal for steam engines & electricity, coking coal for coke and gas, household coal to keep the home fires burning. Much of the evidence for this vast industry has been swept away, but some old coal Bings thankfully remain, such as Dullatur and Dewshill, but these are rarely current SINC/LGS sites. Coal seams, generally up to 1.0m thick and sometimes thicker are rarely now seen, but can be spotted in glens like Garrel Glen in Kilsyth. Many of North Lanarkshire's Local Nature Reserves, such as Dumbreck and Kingshill, are restored former colliery sites.

Iron and steel was the other major Lanarkshire industry, built on the thin and hard won bands of Carboniferous ironstone, and the coal to smelt it with. Transatlantic liners were built using Lanarkshire iron and steel, but little evidence remains. Lumps of heavy ironstone can be found in old Bings and thin seams seen in riverside cliffs. Cliffs of congealed slag and the remains of old iron works can be seen at Calderbank. The great new sports centre at Ravenscraig is built on the former steel works site, the South Calder runs 20m underground, buried beneath decades of slag, a true Anthropocene deposit. Thanks to iron and steel we also have quarries for moulding sand in Passage Formation strata around Cumbernauld. We also have mines for fireclay to make furnace bricks and moulded clay products around Cumbernauld, Glenboig and Chapelhall, also mainly in the Passage Formation. Some of these locations are on SINC/LGS sites and are still visible.

Infrastructure

Water supply is a basic human need and ground water springs were a valued source of clean water. Many such springs like St. Mirrens Well and Katie Fristy Well issuing from the basalt lavas of the Kilsyth Hills were well used. During the industrial revolution many boreholes were sunk to supply groundwater for industry and they were very important before mains water became widely available.

Geology also came to the fore during the industrial revolution when canals and then railways required huge volumes of earth for embankments and large volumes of sandstone masonry for lock chambers, bridges, aqueducts and viaducts, many still in use today.

6. WHERE TO GO

So, where can the public go to enjoy some reasonably accessible geology and geoheritage? The following suggestions are based partly on geology and partly on accessibility. They are arranged very approximately north to south and up the sequence through 60 million years of Carboniferous history. The following descriptions are not intended as detailed excursion guides. Always observe Scottish Access Code and Scottish Fossil Code, collect from loose rock only. The few remaining old Bings are also a good place to see and collect a good range of Carboniferous rocks and fossils, in particular Dullatur, Dewshill and Wester Braco Bings.

1. Kilsyth Hills

The Kilsyth Hills dominate the north of North Lanarkshire. They are shown as a Visitor Economy area in the Local Development Plan (LDP) and as a Special Landscape Area. The Core Path Network (NLC publication) and O.S. Explorer Map 348 give access routes into the hills from Queenzieburn, Kilsyth and

Banton. The Tak Ma Doon road crosses right over the hills, and has informal lay byes for parking and the formal 'Car Park in the Sky' at NS 734 812.

Lavas of the Clyde Plateau Volcanic Formation are seen in numerous crags and screes. The stepped nature of the hills in places reveals individual lava flows. Various branches of the Campsie Fault form the south face of the hills, best seen in waterfalls such as Corrie Spout and Lairds Loup on the Garrel Burn, and Berryhill Waterfall on the Banton Burn. See excursion 11, for more detail in 'A Geological Excursion Guide to the Stirling and Perth Area' (M.A.E. Browne and C. Gillen, 2015). The south face of the hills also shows numerous old post-glacial landslides. On the north side, around Carron Bridge, glacial terminal moraines can be seen. The Kilsyth Hills also offer magnificent views, north into the Highlands, and east to the Pentlands, and south across the central lowlands to the Southern Uplands and west to the Isle of Arran.

2. Corrie Burn

The Corrie Burn cascades down the south face of the Kilsyth Hills towards Queenzieburn. This is the only accessible geological SSSI in North Lanarkshire. Access is by farm track and rough walking from Burnhead Farm (try and check with farmer). Burnhead has new holiday pods, which can be booked for a stay. Road access is by very minor roads from the A803 and there are one or two very small lay byes, best to park in Queenzieburn village and walk up, it is a nice walk, with more geology if you take the footpath known as the Joe Moses Road.

Geology includes Clyde Plateau Volcanic Formation lavas, Kinnesswood and Lawmuir formations. Kirkwood Formation volcaniclastic rocks, Lower Limestone Formation limestones and Limestone Coal Formation mudstones (shales) and ironstones. The limestones are often fossiliferous, search loose scree for samples. Corrie Spout marks the Campsie Fault. Bedrock in the partly drained Corrie Reservoir shows glacial grooving. The limestones were quarried and mined, and then burnt in clamp kilns, and probably the best preserved draw kiln in North Lanarkshire. See 'Geological Excursions around Glasgow and Girvan', Lawson and Weedon, Geological Society of Glasgow, 1992, for further details.

3. Garrel Burn

The Garrel Burn flows down the south face of the Kilsyth Hills to Kilsyth. There are several SINC/LGS locations, and above Allanfauld Farm the burn is shown as a Special Landscape Area and Visitor Economy Area in the LDP. Road access is by very minor roads with the very little parking, best to walk up from Kilsyth. Access up the glen is on very informal paths with several burn crossings, intrepid hill walkers only.

Starting upstream from Allanfauld Bridge (Allanfauld does B&B) exposures in the burn show coals, shales, ironstones and sandstones of the Limestone Coal Formation plus a small mine entrance. These are followed upstream by white Kinnesswood Formation sandstones including the Craiglinns Falls, followed by basal tuffs and agglomerates, overlain further upstream by basalt lava flows. Keep going to meet a pleasant waterfall, but keep going for the big one, the dramatic Lairds Loup. Look out for landslips, rock falls, mudflows (squidgy!) and natural river diversions en-route. There is a new farm hydro-electric weir above Lairds Loup, and a track back to Allanfauld.

4. Kelvin Valley and Antonine Wall

The Kelvin Valley runs along the foot of the Kilsyth Hills from Banton to Queenzieburn. It contains several SINC /LGS locations and is Visitor Economy Area in the LDP. The valley is accessed by the

A803 plus a number of minor roads together with an extensive path system, see Friends of Kelvin Valley leaflets available in Kilsyth Library.

The valley is home to Dumbreck Nature Reserve, once part of the major Dumbreck Pit, Auchinstarry Quarry park and climbing wall, Colzium Estate and Glen, the Forth and Clyde Canal and Auchinstarry Marina, Auchinstarry Woodlands and other community woods, the Antonine Wall including Bar Hill Fort (EDC) and Croy Hill, and the John Muir Way. Mining for coal and ironstone in the Limestone Coal Formation was the valley's lifeblood. The Antonine Wall runs along high ground formed by the hard dolerite of the Midland Valley Sill complex, which was much quarried. Large old sandstone quarries can be seen at Dullatur.

Kelvin Valley Quaternary. Glaciofluvial sands and gravels form an attractive rounded moulded landscape along the north side of the Kelvin valley. The flat valley bottom is underlain by thick alluvium in a glacially deepened valley. Marsh lands such as Dullatur Marsh SWT reserve are formed on top of the alluvium.

For further information see NLC leaflets on Dumbreck N R , Colzium Estate and Antonine Wall, along with FKV publications including 'Kelvin Valley Rocks' and '250 Years of Mining in Cumbernauld and Kilsyth'.

5. Cumbernauld Glens

Cumbernauld is situated right on Scotland's watershed, celebrated by the iconic Arria statue by Andy Scott beside the M80. The Red Burn heads off to the North Sea whilst the Luggie Water flows down to the Atlantic. There are several SINC/LGS locations, and path systems give access to both glens, see NLC Core Path Network report and NLC Walk Cumbernauld leaflet. There is a variety of car parking available, but Cumbernauld House car park is for Cumbernauld Glen, and Greenfaulds Station car park for Luggie Water. Both glens are public parks.

Both glens cut through Upper Limestone Formation strata including sandstones, shales and limestones, together with occasional dolerite dykes. Sandstones were quarried in Cumbernauld Glen, probably for the Castle/ Cumbernauld House and Village. Brick shales were quarried in Luggie Glen. Limestones and coal were mined in the Vault Glen and an old draw kiln can be seen, along with old bell pit workings round the 'Mote'. There is an old mill lade and weir on the Luggie. See Friends of Kelvin Valley publication 'Cumbernauld Rocks' for more information.

6. Palacerigg Country Park

Palacerigg is a Country Park with visitor centre, café and parking situated just south of Cumbernauld. There is an extensive path system.

The Park is situated on heathland formed by Passage Formation sandstones. Highlights include waterfalls in Glencryan Woods, old fireclay mines including outcrops of sandstone and fireclay, extensive peat deposits and Fannyside Lochs. A line of kame like glacial melt out tills runs along the south side of the Lochs. Other fireclay mines can be seen in Jockey's Well (upper Luggie Burn) just south of Palacerigg, along with waterfalls formed by resistant limestones. See NLC Palacerigg Country Park leaflet and 'Cumbernauld Rocks' for further information.

7. Drumpellier and Summerlee

Drumpellier Country Park lies just west of Coatbridge, with Summerlee Industrial Museum close by, linked by sections of the Monkland Canal. Both have car parking, visitor centres with cafes, and foot path systems.

Lochend Loch and Woodend Loch at Summerlee are both good examples of inter-drumlin hollows which have become flooded to form lochs. Much of the Country Park is covered in a layer of lowland peat, now mainly wooded.

Summerlee is an excellent industrial museum and the exhibits contain much to do with the Lanarkshire coal and iron industries. The 'mock mine' is very well worth a visit, particularly if you have children in tow, who will be impressed with the hard work of a miner, busy digging out our geological resources. How the miners and their families lived is well shown by the row of cottages. The replica canal boat 'Vulcan' shows how local coal and ironstone were brought together to create the world's first iron boat.

See NLC leaflets on Summerlee and Drumpellier for more information, and if the kids are still full of energy, try a swim in the highly imaginative Time Capsule across the road from Summerlee.

8. North Calder Heritage Trail

This heritage trail runs from Coatbridge to Caldercruix via Calderbank following the route of the Monkland Canal and the North Calder Water. Good well used paths follow the route and there are artworks and information panels in places. Various roads cross the route and there is ample on-street parking.

The section from Cairnhill to Moffat Mills has the greatest geological and heritage interest. Starting at Cairnhill head along the Monkland Canal towpath. This area was at the centre of Monklands coal and iron industry, the canal was built in the late 1700s to export the products to Glasgow. At one point the North Calder has a wide alluvial plain with impressive meanders. At Calderbank the river flows through a deep steep sided valley created by post glacial down cutting which has produced incised meanders. Sandstones and shales are exposed in river cliffs. Remains of the Calderbank ironworks can be seen. Upstream, past Monkland Bridge and on beyond Moffat Hills, the river flows through a succession of alluvial plains with meanders, and steep valleys with rocks exposures.

For further information see NLC booklet 'North Calder Heritage Trail'

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9. South Calder Water

There is quite a bit to see along the South Calder Water, starting at the massive new Ravenscraig sports complex and finishing about 20 km upstream at the Shotts Ironworks, using a mixture of old estate paths, NLC maintained paths, and minor roads. There are car parks at both ends of the route and plenty of on-street parking at intermediate points. Some of the old estate paths are in very poor condition and great

care is needed. A few geological ‘snapshots’ follow. Much of this stretch is covered by SINC/LGS locations.

Geology includes mainly Scottish Lower and Middle Coal Measures formations, gorges with deeply incised meanders sandstone crags and waterfalls, and glacial deposits. Ravenscraig is probably the best example of Anthropocene in North Lanarkshire (and we have plenty). Mankind has entirely altered the landscape. The South Calder has been culverted deep underground for one kilometre, buried beneath 20 m of steel work slag.

Heading east across this wasteland from the Sports Centre we eventually find the river, and ourselves in another, secret world of deep treed valleys and sandstone cliffs, including the Ravens Craig itself. Further upstream at Coltness access is much more civilised with a network of paths, see NLC leaflet ‘Coltness and North Branchal Woods’ with more sandstone gorges and evidence of mining and quarrying. Around Newmains the valley is still deep and wooded with incised meanders and sandstone outcrops.

Above Bonkle, and as far as Shotts, the valley is much gentler, pastoral, and contains the characteristically rounded landforms of glaciofluvial sand and gravel. At Shotts, admire the great masonry furnace range and chimney of the old Shotts Ironworks.

10. Strathclyde Country Park

This 400 ha Country Park was created in 1975 when the 2.5km long Strathclyde Loch was impounded, flooding an area of old derelict industrial and mining land. The park has a visitor centre and café, water sports centre, theme park and a good path network. Access is from the A723 Hamilton –Motherwell road and from the M74/A725 roundabout. There are several large car parks along the park’s spine road, which runs along the east side of the loch.

A good place to start is in the Foreshore Car Park, and then follow approximately the park’s 5km long yellow walking route. The car park is close to the site of the lost Bothwellhaugh mining village and Hamilton Palace (The Palace) pit. Started in 1884 and closed in 1959 this pit had a peak workforce of over 600, producing more than 500 tons of coal per day from seams up to 200m below ground. The splint coals were so valued for steam locomotives they were exported as far as Argentina.

Head east along the spine road, cross South Calder Bridge and check out the Roman Bath House, a good example of Roman masonry and modern restoration. Now follow the yellow route anticlockwise, diverting to older estate paths nearer the river where possible. Scottish Upper Coal Measures Formation sandstones and shales, sometimes reddened, can be seen in a number of exposures in and beside the river. Corby Craig is an impressive sandstone crag. Sometimes the river is in a narrow gorge, for example at the impressive masonry railway viaduct, and sometimes meanders across a flat valley bottom formed from alluvial and glaciolacustrine clay, a remnant of the once massive glacial lake Clydesdale.

See NLC leaflet ‘Paths around Strathclyde Country Park’ for further information.

11. River Clyde Tributaries

South of Motherwell and Wishaw, the Dalziel Burn, Adders Gill, Cambusnethan Burn, and Garrion Gill all offer windows into Middle and Upper Coal Measures strata, including sandstone gorges and

waterfalls. At Cambusnethan, moulded landscape on the valley side indicates glaciofluvial sand and gravel, whilst terraced alluvium forms the floor of the Clyde valley. The river itself has active shingle bars, geology in action.

See NLC leaflets 'Cambusnethan Woods and Priory' and 'Explore Dalzell Estate and Barons Haugh', NLC Core Paths Plan and SWT Garrion Gill on line leaflet for further information.

12. Sills and Dykes

Dolerites of the Midland Valley Sill Complex and then the Dyke Swarm were intruded into all the Carboniferous strata referred to above, around the time the Carboniferous ended. Many exposures can be seen, particularly in quarries but also in natural crags and road cuttings.

The sill complex (about 307 m years old) is extensively exposed and quarried in the Kilsyth area and in a broad band from Airdrie through to Shotts, forming hills and moors, including Croy Hill and the Cant Hills. Natural exposures include Duntilland Hill and Papperthill Craigs near the working Duntilland Quarry. The latter quarry revealed a superb and very temporary exposure of glacially gouged dolerite surface, including roche mountonée, grooves and scratches. Other local hard rock quarries, both working and dormant may also have interesting exposures that could be of interest for conservation when the time comes to plan their end-life uses.

The dyke swarm stands out in places as waterfalls and ridges. See the Mill Spout Castlecary dyke at Queenzieburn, waterfall on the Walton Burn near Castlecary on the same dyke. The Lenzie-Torphichen dyke forms a narrow ridge with great views and a minor road on top, east of Mollinsburn. The same dyke (SSSI) is also seen in cuttings for the M80 at Mollinsburn. The Cleddans Dyke forms a prominent ridge crossing the B802 Condorrat-Glenmains road at Cleddans, forest tracks and paths give good access. The same dyke forms a ridge that forces the Cameron burn into a right angled bend at Cameron Glen south of Cumbernauld. Small quarries and natural exposures allow the rock itself to be seen, along with hexagonal jointing, cooled margins, and spheroidal weathering.

7. WHAT NEXT?

NLC published a Geodiversity Action Plan as part of the Council's Biodiversity Action Plan 2015-2020. The work described in this report goes a long way towards fulfilling the objectives of the Geodiversity Action Plan, in particular regarding site assessments and public engagement. Actions are now needed by NLC to build on this work and meet the targets of the Geodiversity Action Plan. Our proposals are listed below using the format of the table on page 177 of the Action Plan.

1. Policy and Legislation

1.1. Designate new sites.

Designate all SINCs identified in our 80 or so Geodiversity Site Assessment reports as being worthy of LGS status, as SINCs/LGS locations.

Designate the small number of potential LGS localities which are not already SINCs, as SINC/LGS or LGS locations, where practicable. See Table 3 for locations.

NLC consider working quarries for LGS status when final closure and aftercare are being planned; ensure conservation of geological features where possible.

Sign the Charter. 'Scotland's Geodiversity Charter 2018-2023' is supported by the Scottish Government and has been signed by the City of Edinburgh Council, East Dunbartonshire Council, Glasgow City Council, Perth and Kinross Council, West Lothian Council amongst others. Go to www.scottishgeodiversityforum.org

1.2. Include sites in Local Plan.
Ensure Geodiversity is included in wording of new Local Development Plan and other policies.

Ensure LGS locations are taken into account and given appropriate protection/conservation in any relevant planning applications. We are happy to be consulted if NLC wishes.

Include our geological site audits along with the relevant SINC assessments in NLC and/or NL Biodiversity databases.

2. Site Safeguard and Management

2.1. NLC to monitor sites.

Monitor sites along with existing SINC monitoring, paying particular attention to the 'Top Twenty' sites given in this report. Act against any threats.

2.2. Voluntary groups input.

Voluntary groups, including Strathclyde Geoconservation Group and Friends of Kelvin Valley to submit site monitoring records to NLC where appropriate.

3. Monitoring and Research

3.1. Survey programme to establish LGS.

This has now been completed and reported herein by ourselves.

4. Communications and Publicity

4.1. Develop list and map.

NLC develop list (see Table2) and map of all designated sites using the 80 or so Geodiversity Assessment Reports submitted and used alongside SINC information. Make available in same way as SINC information.

4.2. Publish and maintain publicity material.

Friends of Kelvin Valley have already produced and distributed leaflets 'Kelvin Valley Rocks' and 'Cumbernauld Rocks' and published a booklet '250 Years of Mining in Kilsyth and Cumbernauld'.

NLC produce geodiversity leaflet for North Lanarkshire as a whole and distribute through Country Parks, libraries etc.

NLC add geodiversity information to future local leaflets.

NLC produce geodiversity display panels for Country Parks and main libraries, to complement biodiversity information.

NLC publish this report on- line on NLC website in an easily accessible way. Also make paper copies available in NL reference libraries.

4.3. Publicise sites to partners.

As stated in Geodiversity Action Plan.

4.4 Public Engagement.

Friends of Kelvin Valley continue with walks, talks and schools events in the Kilsyth and Cumbernauld area.

NLC incorporate geodiversity element into ranger led events.

Friends of Kelvin Valley and Strathclyde Geoconservation Group are willing to assist NLC in meeting any of the above actions. We will also alert NLC to any issues that we see on LGS. We also suggest annual progress meetings with the NLC biodiversity team.

We expect NLC will wish to carry out these actions by 2020, which is the end date of the 2015- 2020 Biodiversity Action Plan. We will be happy to input to the subsequent 2020- 2025 plan.

REFERENCES

North Lanarkshire Council
Biodiversity Action Plan 2015 - 2020. Geodiversity Action Plan

Scottish Geodiversity Forum
Scotland's Geodiversity Charter 2018 – 2023

British Geological Survey reports
23W Geology of the Hamilton District
31E Geology of the Falkirk District
31W Geology of the Airdrie District

British Geological Survey maps
Sheet 23 Hamilton, solid edition
Sheet 23 Hamilton, drift edition
Sheet 31E Falkirk, solid geology
Sheet 31E Falkirk, solid and drift edition

Sheet 31W Airdrie, solid edition
Sheet 31W Airdrie, drift edition

British Geological Survey
Published 6 inch to 1 mile maps, where available.

British Geological Survey
Unpublished field slips.

Other references
Guidebooks and leaflets cited as appropriate in text.

ORGANISATIONS

Friends of Kelvin Valley – Local environmental volunteer group, part of Kilsyth and Villages Community Forum.
www.friendsofkelvinvalley.org.uk

Scottish Geodiversity Forum - a voluntary body supported by Scottish Local and National government bodies, commercial and community groups, universities and geological societies.
www.scottishgeodiversityforum.org

Strathclyde Geoconservation Group – conservation committee of the Geological Society of Glasgow
www.geologyglasgow.org.uk

Garrel Lower Glen LGS, Kilsyth, Limestone Coal Formation (Clackmannan Group), east bank cliff in sandstone with striped burrowed siltstone and sandstone, upward coarsening unit, also with thin coals and ironstone

TABLE 1 GEOLOGICAL FORMATIONS IN NORTH LANARKSHIRE

Formations and Units	Main Rock Types	Other Rock Types	Where Seen
Quaternary	Peat		Kilsyth Hills, Higher ground in east.
	Alluvium		All river valleys, particularly Kelvin and Clyde
	Sand & Gravel		Kelvin, Calders and Clyde
	Moraine		Carron Valley Fannyside Muir
	Till		Widespread
Intrusions			
Dyke Swarm	Dolerite		Running east-west across northern areas
Sill Complex	Dolerite		High ground in central parts
Top of Carboniferous			
Westphalian			
Scottish Upper Coal Measures	Sandstones, mudstones	Seat rocks, a few coals	Bellshill, Motherwell South Calder & Clyde
Scottish Middle Coal Measures	Sandstones, mudstones	Ironstone, coals	Coatbridge to Clelland North & South Calder
Scottish Lower Coal Measures	Sandstones, mudstones	Ironstone, coals	Gartcosh to Longriggend
Namurian			

Passage	Sandstones,	Mudstones, Fireclays	Gartcosh – Glenboig – Fannyside
Upper Limestone	Sandstones, mudstones	Limestones, coals	Cumbernauld and Kilsyth, Luggie, Red Burn and Kelvin
Limestone Coal	Sandstones, mudstones	Ironstones, coals	Kilsyth, Kelvin tributaries
Visean			
Lower Limestone	Sandstones, mudstones	Limestones	Corrie Burn Banton Burn
Lawmuir	Sandstones, mudstones	Limestones, coals	Corrie Burn
Kirkwood	Volcaniclastic, sediment		Corrie Burn
Clyde Plateau Volcanic	Basalt lavas		Kilsyth Hills
Tourniasian			
Clyde Sandstone	Sandstones		Carron Valley, Border with East Dunbartonshire
Ballagan	Mudstones	Cementstones	Banton Burn
Base of Carboniferous			
Famennian			
Kinnesswood	Sandstones	Concretionary Limestone (cornstones)	Garrel Burn

Notes

1) Table 1 is partly based on the introductory table in ‘Geology of the Airdrie District’. British Geological Survey (BGS)
2) Rock types very simplified, ‘mudstones’ includes siltstones.
3) ‘Where seen’ column very simplified. See geological maps published by BGS 1:50,000 series, Scotland sheets for detail, and our detailed Geodiversity Site Assessment Reports.
4) All Carboniferous formations are listed here, and proposed Geodiversity Sites and existing SINCs contain exposures of all of these.
5) Approximate total thickness of entire Carboniferous strata is around 3 kilometres.
6) The Carboniferous lasted between approximately 360 and 300 million years ago.

TABLE 2 SITE SUMMARY

SITE NAME	SINC Number	PLACE TO VISIT	GEOLOGICAL FEATURES	ACCESS	NOT LGS
ARNBRAE BURN, QUEENZIEBURN	77/01A		ULF LSC	NA	
AUCHINBEE QUARRY	77/31		MVSC	A	0
BERRYHILL WATERFALL	78/07	1	CPV BGN Geomorph	A	
BOILING GLEN	78/10		LSC brick shale		0
BOTHLIN BURN	67/12A		Geomorph Mine	Ap	
BROADWOOD LOCH	77/11		Geomorph	Ap	0
CAMBUSNETHAN WOODS	Nos?		Geomorph MCMS	Ap	
CAMERON GLEN	77/57A	12	CSTD Geomorph	Ap	
CARRON VALLEY	78/12		Geomorph CPV	A	
CAST GLEN	67/07		Geomorph Till	A	
CHANTICLEER BURN	77/38C		ULF	A	
CLEDDANS DYKE	77/44	12	CSTD	Ap	
COLZIUM ESTATE	77/22	4	MVSC Geomorph	Ap	
CORRIE BURN UPPER	67/04	2	LLF KIR CPV Geomorph	Ap	
CORRIE PLANTATION	67/09		CPV LLF Fault	A	
CROY HILL	77/28	4 12	MVSC LSC	Ap	
CUMBERNAULD COMMUNITY PARK	77/36	5 12	MVSC ULF fossil	Ap	
CUMBERNAULD GLEN	77/60	5	ULF CSTD PGP Geomorph	Ap	
CURRY (SHOTTS) BURN	86/57		LCMS	A	0
DALZELL PARK	75/05		MCMS	Ap	
DEWSHILL	86/40 &86/43	12	MVSC (MCMS) fossil MAN	Ap	
DULLATUR GLEN QUARRY	77/38B	4	ULF	NA	0
DULLATUR MARSH	77/50	4	ULF QUAT Mine Lyoncross Coal	A	
DULLATUR WEST QUARRY	77/38A	4	ULF	NA	
DUNTILLAND QUARRY	Active Quarry	12	MVSC LCMS Geomorph	NA	0
DYKEHEAD BURN, SOUTH SITE	67/11B		ULF Index Limestone LSC CSTD	NA	
EAST CRINDLEDYKE, SOUTH CALDER WATER	85/10A		LCMS	Ap	
GAIN QUARRY	77/27		PGP	NA	
GARREL LOWER GLEN	77/06 (part)	3	LSC coal Geomorph	A	

GARREL MIDDLE GLEN	77/06 (part)	3	LSC coal Mine Geomorph KNW Fault	A	
GARREL UPPER GLEN LAIRDS LOUP	77/06 (part)	3	Geomorph CPV	A	
GARRION GILL (part South Lanarkshire)	No?	11	MCMS LCMS Mine	NA	
GARTVERRIE QUARRY	76/27		PGP Mine	A	
GLENCRYAN	77/59	6	PGP Mine	Ap	
HIRST BURN	AWIS		ULF Calmy and Hirst	NA	
INCHNEUK WOODLAND	76/20	12	MVSC PGP Mine	Ap	
JOCKEY'S WELL Luggie Water	77/61		PGP Mine fossil	NA	
KINGSHILL NATURE PARK	85/22		MAN	Ap	
LAVEROCK QUARRY	76/49		LCMS	NA	
LOSSIT BURN - CENTRAL	67/10B (part)		LSC CSTD Mine	A	
LOSSIT BURN - SOUTH	67/10B (part)		MVSC ULF	NA	
LUGGIE WATER CENTRAL	77/49		ULF flowstone	Ap	
LUGGIE WATER EAST	77/55A		ULF	Ap	
LUGGIE WATER WEST	77/39		QUAT	Ap	
M80 CONDORRAT CUTTING	by 77/26		ULF MVSC	NA	
MOFFAT MILLS. NORTH CALDER	76/62c & 76/66	8	MCMS	Ap	0
MOLLINSBURN DYKE	77/07	12	CSTD	A	
NORTH CALDER (PART) & MONKLAND CANAL	76/44	8	Geomorph LCMS MAN	Ap	
NORTH CALDER (PART)	76/58	8	LCMS Fault MAN	Ap	
NORTH CALDER AITKENHEAD	76/05	8	MCMS	A	0
NORTH CALDER HALL BANK	76/26				0
NORTH CALDER VIEWPARK and RED BURN	76/18	8	UCMS	Ap	
NORTH CALDER LUGGIE BURN	76/10B & 10A	8	UCMS	Ap	
NORTH CALDER, PETERSBURN	76/62A	8	MCMS	Ap	
NORTH CALDER, MILL BANK AND WILDERNESS	76/26	8	MCMS	Ap	0
NORTH CALDER, NEWLANDS GLEN	66/08	8	MCMS UCMS	Ap	
NORTH CALDER VIEWPARK	76/18				
NORTH SIDE SEAFAR WOODS	SWT		ULF	Ap	0
PALACERIGG COUNTRY PARK	several	6	PGP fossil MINE	Ap	
PAPPERTHILL CRAIGS	86/46	12	MVSC Geomorph	A	
RAVENSWOOD CUMBERNAULD	77/40				0
RED BURN CUMBERNAULD	77/66	5	ULF PGP CSTD MAN	NA	
RIVER CLYDE. AIRBLES RAILWAY VIADUCT	Not		MCMS UCMS	Ap	
SHOTTS BURN BUDSHAW MINE	76/67		LCMS MINE	NA	

SMITHSTONE QUARRY	77/20	12	MVSC	Ap	
SOUTH CALDER FORGEWOOD	75/02A	9	UCMS	Ap	
SOUTH CALDER WATER, RAVENSCRAIG	75/09 & 09A	9	MCMS UCMS MAN Geomorph	A	
SOUTH CALDER WATER, STRATHCLYDE COUNTRY PARK SITE UPSTREAM	75/01C	10	UCMS QUAT	Ap	
SOUTH CALDER WATER, STRATHCLYDE PARK	75/01B	10	QUAT UCMS	Ap	
SOUTH CALDER, COLTNESS WOODS	75/12A	9	MCMS MAN	Ap	
SOUTH CALDER, RAILWAY VIADUCT TO CALDER PARK	75/04A	9	MAN Geomorph	Ap	
SOUTH CALDER, TODHOLE	75/04B	9	MAN	Ap	
SOUTH SLOPES OF KILSYTH HILL	78/02, 78/05, 78/06	1	CPV Geomorph	A	
SPRINGBANK QUARRY	86/02	12	MVSC LCMS	A	
STAYLEE GLEN	77/56 A & B		LCMS	NA	
STONEREE GLEN	67/11D		LSC	A	
UPPER BACHILLE BURN	south of 67/13		CPV BGN	A	
UPPER BANTON BURN	78/09		CPV BGN LLGS LSC	A	
WESTER BRACO TIP	By 86/22		MVSC MAN fossil	A	
WESTERWOOD GOLF COURSE	77/38D, 47A & B		PGP MAN	Ap	
WHAM GLEN	67/05		ULF	NA	

Abbreviations

MAN	Man-made deposits and features
MINE	Mining related features
Geomorph	Landform features
QUAT	Quaternary deposits
UCMS	Scottish Upper Coal Measures Formation (FM)
MCMS	Scottish Middle Coal Measures FM
LCMS	Scottish Lower Coal Measures FM
PGP	Passage FM
ULF	Upper Limestone FM
LSC	Limestone Coal FM
LLF	Lower Limestone FM
LWM	Lawmuir FM
KIR	Kirkwood FM
CPV	Clyde Plateau Volcanic FM
BGN	Ballagan FM
KNW	Kinnesswood FM
MVSC	Midland Valley Sill Complex
CSTD	Central Scotland Tholeiitic Dyke Suite

Access and Interest

NA	No public Access
A	Access by informal routes
Ap	Access by paths and trails
0	Not proposed as a Local Geodiversity Site
Places to visit 1-12	As described in text
Corrie Burn	Geological Site of Special Scientific Interest
Red Burn, Cumbernauld	Local Geodiversity Site (highest quality)

TABLE 3

Proposed LGS, not already SINCs

Visited	Site	Description	Recommendation
2012	Hirst Burn. NS 764 777 Eastern boundary of Westerwood Golf Course.		Designate SINC/LGS
2015	Condorrat, M80 rock cutting beside overbridge towards St. Maurice's School, NS 733 735. Adjacent to St. Maurice's Pond SINC.		Designate LGS
2016	River Clyde, Airbles, either side of main viaduct.		Designate SINC/LGS
2016	Wester Braco coal tip, just north of Blackhill T.V. masts NS 826 657. Adjacent SINC 86/22		Extend this SINC to include tip and designate LGS.
2016	Duntilland Hill NS 831 640		Designate SINC/LGS
2017	Dewshill Bing NS 853 640		Join up the adjacent SINC 86/40 and 86/43 to include bing and designate LGS.

Appendix 1

DRIFT DEPOSITS QUATERNARY SUMMARY

Site specific geodiversity assessments have been made for around 80 SINCs and other sites across North Lanarkshire. These have concentrated on the bedrock (solid) geology. The overlying 'Drift' deposits, glacial and post glacial have also been mentioned where they are well shown on these sites. However North Lanarkshire has an extensive covering of Drift deposits, underlying most or all of the 350 or so SINCS, and we summarise these here. Exposures are rarely seen, except in temporary excavations such as borrow pits, foundations and road cuttings. These deposits are mainly less than 35 000 years old.

Glacial Till

Glacial till, deposited by ice sheets, covers most of North Lanarkshire commonly to a depth of a few metres, but 20 m or more in places. It is usually a tough brownish grey silty sandy clay forming a matrix to pebbles, gravel and boulders.

Drumlins are landforms that are associated with thicker deposits, where the glacial till has been moulded by the moving ice into east-west trending whale-backed mounds, usually several 100m long and up to about 30m high. Place names such as Drumgrew and Drum Mains reflect this landscape. They are particularly prominent in the Kirkintilloch to Cumbernauld area and the Seven Lochs area. Hollows between the drumlins are sometimes filled with inter-drumlin lochs such as Woodend Loch, Drumpellier Country Park.

Thick glacial deposits also mantle some valley sides, such as the south slopes of the Kilsyth Hills where narrow steep glens are incised into 10m or more of glacial till.

Thick glacial deposits of all kinds also infill the buried valleys of rivers such as the Kelvin, North Calder, South Calder (e.g. at Ravenscraig) and Clyde. These valleys were cut to as much as 50m below present sea level and 100m below ground level during previous glacial periods by fast flowing sub-glacial meltwaters. By definition, they are not usually visible at surface.

Glacial Morainic drift deposits and Melt-out Tills

Moraines are mounds of sand, gravel and till deposited at the termini and sides of glaciers, melt out tills are generally blocks of sandstone in a sandy silty matrix left behind by stagnant melting ice.

Good examples of cross-valley glacial morainic deposits can be seen at Carronbridge in the far north of North Lanarkshire. Hummocky melt out tills form an east-west band across North Lanarkshire south of Cumbernauld from Luggiebank to Fannyside Loch.

Glaciofluvial Deposits

These consist of sand and gravel, laid down as the ice melted and large torrents of melt water eroded and sorted all the loose glacial debris, much exploited for construction aggregate. They usually form an attractive moundy landscape with dry valleys. Three main bands of deposits are present, the Kelvin Valley,

the South Calder between Newmains and Shotts, and the edges of the Clyde Valley and a fair number of SINCs are situated on these.

Glaciolacustrine and Glaciomarine Deposits

Though not seen during our surveys, Glaciolacustrine clay and silt occur both in the buried valleys and at higher levels on valley sides above the 45 m OD contour. In the Faskine area, peat and clay were noted as occurring under till in the 19th century scientific literature. The valley side deposits formed as the last glacier retreated downstream through Glasgow damming up Lake Clydesdale. Glaciomarine clays and silts do occur in the Uddingston –Bothwell at levels over 30 m OD, reflecting ingress of the sea from the Clyde estuary at the end of the last glaciation in North Lanarkshire about 14 000 years ago.

Postglacial Gorges and Meltwater Channels

After the ice melted our rivers and burns roared back into action. Lots of water, bare soil and rock, and an initially high postglacial sea level, all led to high energy erosion emphasised by sea-levels falling to present levels in the 13 000 years after deglaciation. As a result our river valleys such as the North and South Calder are often cut deeply into the landscape, as are burns which drain off the Kilsyth Hills and Slammanan Plateau. Many of North Lanarkshire's SINCs are native woodland areas growing in these valleys.

Holocene Alluvium

All this activity resulted in layers of alluvial gravel, sand and silt being laid down by the rivers and burns. The thickest and widest deposits were laid down by the rivers Kelvin and Clyde and form characteristically flat valley bottoms. However all the small rivers and burns have at least some alluvium, some terraced.

Peat

Peat formed extensively over North Lanarkshire as the climate warmed up sufficiently for plant growth aided by wetter conditions. The undulating poorly drained surface left behind by the glaciers was particularly favourable for peat growth from about 8000 years ago onwards. Much has been removed by agriculture, opencast and drainage but extensive peat coverage remains in the Kilsyth Hills, Fannyside Muir, and Eastern villages areas. Many of North Lanarkshire's SINCs are situated on these peat areas.

Anthropocene

North Lanarkshire has lived off its geological resources for more than 200 years, and this still continues. Geologically speaking we have now added our own layers to the geological record, with extensive areas of mine spoil, infilled valleys, iron and steel waste, quarries, opencast sites, old and new transport lines, and our towns and cities. Most, if not all, North Lanarkshire's attractive and well used Local Nature Reserves are created from such man made landscapes. There is also an argument for taking more of these post-industrial areas into the SINC network as they are often the last refuges of many of our wild flowers (e.g. orchids) and insects.

Appendix 2

Geodiversity Site Assessment Reports (Examples)

SITE NAME –**LAIRDS LOUP- GARREL BURN UPPER**

Location	Top of Garrel Glen
Grid Ref	Centred on 702 804
Description	Gorge with waterfalls
Current Use	Hill pasture
Designation	SINC 77/06 (part)
Access	Reasonable to difficult, hill walking, very steep in places

GEOLOGY

Age	Quaternary
Formation	n.a.
Position	n.a.
Rock Types	(Basalt)
Description	The Garrel Burn starts at Lairds Loup where the Birkenburn leaps over the Lairds Loup waterfall and changes its name to the Garrel. The horseshoe shaped crags over which the burn falls are made of basalt lava with a top level of about 330m AOD. Over a distance of about 200m the burn falls about 50m to a level of about 280m AOD. The top fall is the highest, at about 10 to 15m high, with a spectacular corrie formed where the burn crosses a major lava flow. Continued erosion is shown by the presence of a massive recently fallen block of lava at the foot of the fall. There is an undercut cave behind the fall. The burn continues falling via series of falls, rapids and plunge pools to a lower fall, before exiting to the glen below. There is evidence of post glacial landslips on both banks of the glen below.

ASSESMENT

Main interest	Waterfalls and gorge
Heritage	Tradition of a laird making a loup
Threats	None known
Public Use	Hill walkers and picnickers
Importance	Local

SITE NAME - **GLENCRYAN**

Location	South side of Cumbernauld
Grid Ref	Centred on 772 740
Description	Wooded glens with burn and waterfalls
Current Use	Public park
Designation	SINC 77/59, AWIs, SWT reserve, Palacerigg CP
Access	Good, CP 138

GEOLOGY

Age	Upper Carboniferous
Formation	Passage Formation Upper Limestone Formation
Position	Strata near junction between formations
Rock Types	Sandstone, shale, fireclay
Description	Glencryan is a deep glen with sandstone exposures and a cliff in thick sandstone. A waterfall over this main sandstone is seen from the path at about 7763 7398, about 3m high over thick bedded sandstone, with rapids above and below. Iron staining is seen on the east bank. Two mine adits (fenced off) are seen near the head of the main glen at 7770 3395 with adjacent fireclay exposures. There is a larger mine adit with public access to the barriered mine mouth and an interpretation board describing fireclay working at 7773 7390. The mine adit has a 1.5m high by 2.0m wide, brick arch lining. A small dam occurs upstream from the mine entrance with a small old quarry at 7791 7387 showing hard sandstone over dark carbonaceous mudstone. At 7809 7388 there is a fairly spectacular swallow hole, fenced off, where the burn disappears underground into old mine workings, over a 2m high waterfall. The sandstone roof can be seen spanning about 5m with a central pillar or stoop, and open workings or rooms to either side. There are assumed to be old fireclay workings. The old Glencryan Quarry is infilled and wooded. An old tramway cutting, still visible, and tunnel run along the south side of the quarry. This took wagons of fireclay from the mines downhill to the fireclay works which were situated just east of Cumbernauld Station. A second subsidiary glen runs downhill just west of Glencryan Glen, shown as the Deep Stank on an 1850's O.S. map, with a limekiln indicated at the foot of the glen. A large area of iron stained water issues was seen in the bottom of this glen, from old workings? Both Glencryan and the Deep Stank are deep glens, deeply incised into the

	hillside during post glacial times. But why two glens, so close together?

ASSESMENT

Main interest	Deep glens and waterfalls, mining
Heritage	Mine workings, quarries, old tramway, limekiln
Threats	None known, but ‘Community Growth Area’ adjacent
Public Use	Walkers and cyclists
Importance	Local

Glen Cryan, view south of 3 m high waterfall in burn, sandstone of the Upper Limestone Formation

Site Name **South Calder Water, Ravenscraig**

Location	Ravenscraig, Motherwell
Grid Ref	770 570 to 792 564
Description	River gorge, woodland, brownfield site
Current Use	Occasional walkers
Designation	SINC 75/09 and 75/ 09A
Access	Difficult, some old and unmaintained estate paths
Year visited	2015

Geology

Age	Upper Carboniferous
Formation	Scottish Lower and Middle Coal Measures
Position	Kiltongue Mussel Band to Glasgow Main Coal
Rock Types	Sandstone, siltstone, mudstone
Description	Travelling upstream from Ravenscraig Sports Centre, on the south bank. Cross the large area of cleared industrial land, once site of the major Ravenscraig Steel Works, the South Calder has been culverted through the steel works. At the Calder culvert portal (Carfin Bridge) there is a 6 metres high near vertical face in sandstone, formed by cutting, on the north bank (19910). It is approximately horizontally bedded, thin to medium bedded, showing current bedding. Just east of the railway viaduct a tributary burn joins in on the north side, occupying its own gorge, with sandstone walls 5 metres high showing trough bedding. Continuing upstream, the main gorge has sandstone walls up to 6 metres high on both sides. An old quarry (19920, 19925) is present at around 781 576. A 6 metres high face of strong thick bedded sandstone is seen, with bedding separations up from base of 30, 40, 70, 40, 40, 50 and 50 centimetres representing river channel deposits. Overlying these are flaggy sandstones, possibly flood plain over-bank deposits**.** Overall the beds dip gently west. Main joint directions are 160 degrees and 80 degrees and near vertical. Quarryman's tool-markings can be seen. On the north bank, opposite the quarry, sandstone cliffs up to 10 metres high show similar thick bedding. At the Ravens Craig itself, about 785 576 there is a superb 30 metres deep gorge cut in sandstone, with honey coloured rock forming near vertical cliffs and buttresses. A shingle bank is present beside the river below the Ravens Craig (19928). On the opposite (north) bank the cliff has been undercut about 4 metres up from river level. Could this be the

	'Wallace's Cave' shown on old maps? A big boulder fall on the south side, including blocks up to 50 tonnes each and over 1000 tonnes overall, shows that river erosion by rock falls is still taking place. Continuing upstream, at around 786 575 the Calder forms a sharp meander with a wide flat alluvial terrace on the north side. A small sandstone quarry on the south side shows current bedding and tool marks. The valley bottom widens out a little to form a narrow floodplain with a small island in the river and an informal picnic area around 787 574. Just uphill of this, old mine workings are present on the south side including a masonry channel, old walls and remains of an old bing. There is a further incised meander at 788 570. Altogether there are nine incised meanders along this stretch of the Calder between the Ravenscraig culvert portal and the east end of the SINC at Calder Bridge. The gorge is incised between 30 and 50 metres into the surrounding countryside. Wildlife seen and heard included dipper, blackcap, nuthatch, buzzard, sparrow hawk, roe deer and skylarks.

Assessment: **South Calder Water, Ravenscraig**

Main interest	Incised gorge in sandstone showing cliffs, buttresses, caves and rock falls. Sedimentary features in sandstone including trough and current bedding.
Heritage	Steelworks, quarrying, mining
Threats	None known
Public Use	Very little, but improved access to this beautiful area would much increase local use
Importance	Local Geodiversity Site

South Calder Water, Scottish Middle Coal Measures Formation above Glasgow Upper Coal, view upstream, east of old Carfin Bridge and top of major culvert at former Ravenscraig Steelworks