2020

SCOTTISH BORDERS COUNCIL
LOCAL GEODIVERSITY SITES

TECHNICAL NOTE 5

CONTENTS

1. INTRODUCTION AND BACKGROUND

1.1 There are a series of Technical Notes which accompany the Scottish Borders Council's Proposed Local Development Plan (LDP). This Technical Note specifically outlines the approach the Council has taken in identifying Local Geodiversity Sites (LGS) and how the Proposed LDP meets the requirements set out within Scottish Planning Policy (SPP). Together with the Local Biodiversity Sites (LBS), these make up the Scottish Borders Local Nature Conservation Sites (LNCS).

1.2 SPP states that; *'International, national and locally designated areas and sites should be identified and afforded the appropriate level of protection in development plans. Reasons for local designation should be clearly explained and their function and continuing relevance considered when preparing plans'*. It should be noted that the level of protection given to local designations should not be as high as that given to international or national designations.

1.3 Planning authorities are encouraged to limit non-statutory local designations to areas designated for their local landscape or nature conservation value. Local Nature Conservation Sites should seek to accommodate the following factors:

- Species diversity, species or habitat rarity, naturalness and extent of habitat
- Contribution to national and local biodiversity objectives
- Potential contribution to the protection or enhancement of connectivity between habitats or the development of green networks
- Potential to facilitate enjoyment and understanding of natural heritage

1.4 SPP states that LNCS designated for their geodiversity should be selected for their value for scientific study and evaluation, their historical significance, cultural and aesthetic value, and for their potential to promote public awareness and enjoyment.

1.5 As part of the LDP, Policy EP3: Local Biodiversity and Geodiversity, identifies thirty five Local Geodiversity Sites. One of the purposes of this policy is to safeguard these sites which contain geological and/or geomorphological features of interest. Local Geodiversity Sites have value for one or more of the following reasons; scientific, historical, educational and/or aesthetic value. Furthermore, each of the sites are considered to be of regional importance for the Scottish Borders. The methodology and background to the identification of these sites is set out within this Technical Note. Appendix 1 contains a list of all the sites and the site forms are attached within Appendix 2.

Policy EP3

Development that would adversely affect the interest of a Local Geodiversity Site will only be permitted where:

a) The objectives and integrity of the area will not be compromised; or
b) The damage is outweighed by the social, economic or environmental benefits gained from the development, and
c) Suitable mitigation will be secured.

1.6 The Local Geodiversity Sites provide a mechanism to ensure that the value of geodiversity is given appropriate recognition. They also offer an opportunity to stimulate interest in geology and share its importance and relevance at a community (and national) level.

2. NATIONAL AND REGIONAL PLANNING POLICY, GUIDANCE AND ADVICE

2.1 Geodiversity is underpinned within national and regional policy. There are national, regional and local GeoConservation groups which work to raise the profile, protect and promote sites. National Planning Framework 3 (NPF), sets out the long term strategy for Scotland and contains four main planning outcomes. One of which states that '*Planning makes Scotland a **natural, resilient place** – helping to **protect and enhance our natural and cultural assets, and facilitating their sustainable use***' and states that '***We will respect, enhance and make responsible use of our natural and cultural assets***'.

2.2 Scottish Planning Policy (SPP) aligns with the planning outcomes contained within NPF. SPP states that the '*Environment is a valued national asset offering a wide range of opportunities for enjoyment, recreation and sustainable economic activity. Planning plays an important role in protecting, enhancing and promoting access to our key environmental resources, whilst supporting their sustainable use*'.

2.3 Strategic Development Plan 1 (SDP1) (June 2013) does not mention geodiversity or the designation of local sites in particular. The plan has an aim to '***conserve and enhance the natural and built environment***'. Policy 1B gives instruction to Local Development Plans on protecting designated areas, conserving and enhancing the natural and built environment. Together with the policy set out within SPP, the LDP should designate local sites to protect the natural environment, including those which are locally important for geodiversity.

2.4 The UK Geodiversity Action Plan (UKGAP) has been established which aims to raise the profile and importance of geodiversity and support its advocacy across the UK. It provides a framework in which actions for geodiversity can be captured in one place allowing a range of organisations, groups and individuals to demonstrate their achievements in a UK wide context. The UKGAP has six themes encompassing how we understand and care for geodiversity, how geodiversity can inspire people and the importance of carefully planning for our geodiversity;

- Furthering our understanding of geodiversity
- Influencing planning policy, legislation and development design
- Gathering and maintaining information on our geodiversity
- Conserving and managing our geodiversity
- Inspiring people to value and care for our geodiversity
- Sustaining resources for our geodiversity

2.5 The Scottish Geodiversity Forum aims to promote Scotland's geodiversity and seeks to widen the profile of geodiversity and influence national and local policies. It is a network of individuals and local groups that promotes Scotland's geodiversity and organises network and training events. The forum is open to all organisations and individuals who are interested in promoting Scotland's geodiversity and the sharing of experience and good practice.

2.6 There are a number of local GeoConservation groups throughout Scotland, who work with Local Authorities to designate Local Geodiversity Sites. They also work to raise awareness of sites and geodiversity through publicity such as leaflets, booklets, posters, websites, interpretation boards and by developing access and educational usage of sites and trails. Local Geodiversity Sites were previously known as Regionally Important Geological and Geomorphological Sites (RIGS). The Lothian and Borders GeoConservation Society is the biggest and most active GeoConservation group in Scotland, covering Edinburgh, West

Lothian, East Lothian, Midlothian and the Scottish Borders. Local GeoConservation groups work with Local Authorities and other partners to promote GeoConservation in their areas. These groups identify Local Geodiversity Sites, the most important places for geology, geomorphology and soils outside statutorily protected areas.

3. SCOTTISH NATURAL HERITAGE GUIDANCE

3.1 Scottish Natural Heritage (SNH), on behalf of the Local Nature Conservation Sites (LNCS) Working Group, published guidance for Local Authorities on LNCSs in Scotland, '*Guidance on Establishing and Managing Local Nature Conservation Site Systems in Scotland*' (2006). The SNH guidance outlines the background, purpose and selection of Local Nature Conservation Sites.

3.2 The LNCS guidance covers both sites designated for geodiversity interest (Local Geodiversity Sites) and sites designated for local biodiversity interest (Local Biodiversity Sites).

The guidance states that LGS have a well-recognised place in the history of nature conservation in Scotland. SNH states that:

> ***Local Geodiversity Sites can conserve important examples of local geodiversity, for the enjoyment and understanding of local people, and can play a significant part in geodiversity audits and action plans.***

3.3 The guidance sets out that Local Geodiversity Sites provide examples of geology and geomorphology of substantive regional and local importance, where the resource can be conserved so that people can enjoy and find out more about earth heritage. These sites can contribute to the quality of local environments, and provide opportunities for informal recreation.

3.4 SNH set out the responsibility for introducing, reviewing and managing Local Geodiversity Sites, which Local Authorities should take into consideration. It notes that the work should be carried out with the help of a panel of advisors comprising relevant interests and expertise. The involvement of the following groups should be considered:

- Local expert naturalists or earth scientists
- Local representatives of voluntary and statutory nature conservation organisations
- Land owners and managers
- Farmers and crafters
- Forestry managers
- Water resource managers
- Development planners
- Businesses
- Local communities
- For geodiversity sites, aggregates industry and educationalists

3.5 It is not intended that LGS are seen as another layer of 'designation', with complex procedural requirements, as they have no legal status and therefore no powers or duties associated with them. The SNH guidance states that a local RIGS group/Local Geodiversity Plan partnership, is likely to be well placed to form the panel of advisors to the Local Authority. The Local Authority may choose to delegate to this panel responsibility for introducing or reviewing the LGS system.

3.6 The guidance proposes that LGS should be valued for their substantive nature conservation value but should also have value for education, scientific study, historical significance and aesthetic qualities.

3.7 Site selection should be informed by the knowledge and judgement of the panel of advisors, which will include local experts. Use of a scoring system will help to clarify discussion and to assess the contribution of each of the factors to the overall importance of the site. The guidance states that Local Geodiversity Sites are selected for their importance to the available geodiversity resource, meaning those geodiversity features which are visible and accessible. Assessments should be based on the following factors, which are drawn from the RIGS handbook:

- Geodiversity value in the local context
- Site access and safety criteria
- Value for education and research

3.8 For each LGS site, a record of key information should be prepared, to be knows as a 'Site Statement'. At the minimum, this should include the following:

- A map of the boundary of the site
- A record of the reasons for selection as a LGS
- A note of outcomes sought for geodiversity and, where relevant, for access, community involvement and environmental education

4. PROPOSED LOCAL DEVELOPMENT PLAN CONTEXT

4.1 The Scottish Borders is an attractive place to live and work and this puts a clear responsibility on the Council to maintain the intrinsic qualities of the area whilst seeking the balance of promoting the economic stability and growth essential to the future viability of the area. It is essential to ensure the right development occurs in the right place, and conversely, that development does not take place in the wrong place.

4.2 The Proposed Local Development Plan (LDP) includes a range of policies in respect of environmental promotion and protection. The policy section places an emphasis on placemaking and design in relation to new development. It confirms the various landscape, natural environment and nature conservation designations within the Scottish Borders and lays down a range of criteria tests to be applied to ensure their protection and/or any potential appropriate mitigation measures. This policy section includes the following:

- Policy EP1: International Nature Conservation Sites and Protected Species
- Policy EP2: National Nature Conservation Sites and Protected Species
- Policy EP3: Local Biodiversity and Geodiversity
- Policy EP4: National Scenic Areas
- Policy EP5: Special Landscape Areas
- Policy EP6: Countryside Around Towns

4.3 Policy EP1 aims to give designated or proposed Natura sites, Ramsar sites and sites where there is the likely presence of European Protected Species (EPS) protection from potentially adverse development.

4.4 Policy EP2 aims to protect nationally important nature conservation sites and protected species. Nationally important sites are legally protected by their designations as Sites of Special Scientific Interest (SSSI) for their floral, faunal, geological and geomorphological interest, and as National Nature Reserves (NNR) for the conservation of habitats and species.

4.5 Policy EP3 aims to safeguard and enhance local biodiversity encouraging developers to consider biodiversity at the outset of a proposal. The policy aims to safeguard and protect Local Biodiversity Sites and Local Geodiversity Sites within the Scottish Borders. This Technical Note sites alongside Policy EP3, specifically in relation to the Local Geodiversity Sites. Local Geodiversity Sites contain geological and/or geomorphological features of interest. LGS have value for one or more of the following reasons; scientific, historical, educational and/or aesthetic value. Furthermore, the Council has produced Supplementary Planning Guidance for Biodiversity, Local Biodiversity Action Plan (LBAP) and Land Use Strategy, to further aid decision making alongside this policy.

4.6 Policy EP4 aims to protect and enhance the scenic qualities of the National Scenic Areas (NSA) within the Scottish Borders by influencing the nature of development both within and outwith the sites where development affects the setting and context of the NSA within the wider landscape.

4.7 Policy EP5 aims to ensure that local areas of identified landscape quality, known as Special Landscape Areas (SLA) are afforded adequate protection against inappropriate development and that potential maintenance and enhancement of the SLA is provided for.

4.8 Policy EP6 aims to ensure that the identified Countryside Around Towns (CAT) area and the high quality living environment it provides is protected and enhanced. The policy aims to prevent piecemeal development that detracts from the area's outstanding biodiversity, landscape, historical and recreational context.

5. METHODOLOGY, CRITERIA AND SITE FORMS

Methodology

5.1 This section sets out the guidelines for the identification and selection of the Local Geodiversity Sites (LGS) within the Scottish Borders. It describes the process for identifying and gaining recognition for sites of geological and geomorphological value. The LGS selection process described below ensures recognition of sites of value in the Scottish Borders region in order to give protection in planning policy so that they may be managed and conserved where necessary. LGS notification provides landowners/managers with information on the geodiversity value of their land, to assist them in making choices on management. With this information, other bodies may be able to channel resources to provide advice and practical assistance with management and practical links may be made with communities.

5.2 Lothian and Borders GeoConservation group (LBGC) is the decision making body, comprised of volunteer geology experts and Local Authority planning and natural heritage officers, that judges the suitability of proposed sites for designation as LGS. The committee has been responsible for designating sites which have been integrated into Council plans for Edinburgh, East Lothian and West Lothian, with current work also ongoing in Midlothian. The LBGC committee meet as necessary to examine survey reports, assess sites against the agreed selection guidelines and consider representations. The decision making process is transparent and consistent. The committee may seek the views of other geology experts or other relevant organisations.

5.3 Monitoring of LGS (or other sources of information) may reveal deterioration of designated sites. If this is the case, the assessment procedure will be re-applied and consideration given to the potential for restoration of the geological features of interest and the value of the site relative to other sites in the region. If restoration is not feasible, the committee may notify owners and other interested parties that formal de-selection will take place.

5.4 Sound geodiversity information is needed before a site can be assessed to determine whether or not it should be selected as a LGS. Surveys are carried out by competent geologists who are able to record the information required to make an assessment. Site owners should, wherever possible, be contacted and asked for permission for access to survey and monitor sites.

5.5 Establishing ownership has been attempted where possible during the surveying of Scottish Borders LGS (2017-2019). A Location map for each site has been provided using maps obtained from the National Library of Scotland website. A list of the proposed LGS in the Scottish Borders is contained within Appendix 1 and the site forms are contained within Appendix 2.

Criteria for Designation

5.6 The following section outlines the criteria for designating the Local Geodiversity Sites. The sites should:

- Contain geological and/or geomorphological features
- Have value for one or more of these reasons; scientific, historical, educational and/or aesthetic value, and
- Be regionally important for the Scottish Borders.

The potential LGS is important, as the site:

- Has rocks which are representative of their stratigraphic position in the Scottish Borders
- Is a good example of the rock or feature it contains
- Has an interesting or unusual geological structure or feature which is not found elsewhere in the Scottish Borders region
- Has been important for geological research
- Is particularly easy to access, especially for geodiversity educational purposes
- In combination with other nearby sites, it may tell an interesting or educational geodiversity story
- Is being permanently preserved as a rock exposure and will be accessible in the future.

It is expected that only one or two of these statements will apply to each Local Geodiversity Site.

Site Forms

5.7 Site forms for the thirty five designated 'Local Geodiversity Sites' are contained within Appendix 2 to this Technical Note. The site forms contain the following details; grid reference, current use, features, other designations, current geological designation, site map, site description, assessment of site value, geoscientific merit scoring, reference/links & photographs.

LOCAL GEODIVERSITY SITES TECHNICAL NOTE

APPENDIX 1: LOCAL GEODIVERISTY SITES

	Local Geodiversity Site name	Location	Grid Reference	Geodiversity Values
1	Adderston Shiels, Cogsmill	Hawick	NT 514 086	Small quarries in Riccarton Group greywackes and siltstones with a variety of interesting sole marks, some not seen elsewhere.
2	Allars Mill, Jedburgh	Jedburgh	NT 650 199	While the site is degraded by scree and vegetation cover, it is a classic site in the history of geological ideas, having been visited and described by James Hutton.
3	Bemersyde Hill Quarry	Melrose	NT 595 340	The quarry is the best exposure of a quartz trachyte intrusion in the Scottish Borders.
4	Birkwood Heugh Cutting	Earlston	NT 564 405	An unusually extensive exposure in the Scottish Borders of the Lower Devonian Great Conglomerate Formation (Reston Group).
5	Blyth Bridge Quarry	Blyth Bridge	NT 1335 4520	A well exposed and accessible example of the trachyte of the Biggar Volcanic Formation.
6	Borthwick Quarry, Duns	Duns	NT 768 544	Extensive exposure of dolerite with varied columnar jointing and hydrothermal veining. The dolerite is thought to be a shallow sill intrusion but the exact processes remain uncertain. It is overlain by sedimentary rocks, probably of Late Devonian age.
7	Buchtrig Gravel Quarry	Hownam	NT 764 141	An unusual example of decomposed Cheviot andesite.
8	Castleweary Quarry	Teviothead	NT 406 031	The best example in the Scottish Borders of giant flute casts, as well as many other interesting sole mark features.
9	Cockie Rig Head Quarry, Glencotho	Broughton	NT 0898 2937	The Wrae Limestone is a highly unusual rock in the Ordovician sequence of the Southern Uplands.
10	Craigburn Quarry	Penicuik	NT 237 544	The 'Haggis Rock' is an unusual lithology in the Ordovician greywackes which gives information about provenance during the early times of the Iapetus Ocean.
11	Craiglands Quarry, Lochurd	Blyth Bridge	NT 108 433	A quarry in the Auchtitench Sandstone Formation with

				evidence of alteration due to faulting.
12	Cramalt Road Cutting	Megget	NT 1985 2292 – NT 2013 2296	Sedimentary features of folded greywackes and siltstones are clearly visible at this exposure.
13	Dingleton Quarry, Melrose	Melrose	NT 540 334	The quarry is an accessible site where the rocks of the Chiefswood Vent, a particularly good example of a volcanic agglomerate, can be studied.
14	Edrington Cliff	Chirnside	NT 9400 5335	A rare natural exposure of Ballagan Formation sandstones.
15	Eildon Hills	Melrose	North Hill NT 5543 3282, Mid Hill NT 5481 3223, Wester Hill NT 5483 3160, Little Hill NT 5455 3195	The three hills are excellent examples of silicic intrusions with slightly different compositions, not otherwise found in the Scottish Borders. The geomorphology of the hills is controlled by the nature of the geological features.
16	Ettrickbridge Gorge	Ettrickbridge	Eastern end NT 38612 24123 – western end NT 38200 23786	Rare exposures of several formations of the Moffat Shale Group.
17	Grassfield Quarry, Noblehouse	Lamancha	North end NT 19544 49947, south end NT 19471 49875	The northern quarry is the type section of the Noblehouse Lava Member.
18	Habbie's Howe	Carlops	NT 1694 5648 to NT 1783 5657	A steep sided glacial meltwater gorge has unusual landforms such as river – eroded caves. Several rock types of the Lower Carboniferous Limestone Coal Formation are exposed in the valley sides and at a small waterfall and are accessible for study.
19	Hairy Craigs Quarry	Ayton	NT 9090 6108 – NT 9101 6083	Coarse lithic arenites of the Auchencrow Burn Sandstone Formation which are not otherwise exposed in the outcrop area of the Reston Group around Reston and Ayton.
20	Hell's Cleugh, Stobswood	Duns	NT 738 549 – NT 739 549	This is one of very few examples of 'badlands' landscapes in the UK and also provides an

				excellent view of unusual coarse conglomerates.
21	Jed Water River Cliff	Jedburgh	NT 658 223	The river cliff is a good example of the Stratheden Group lithofacies.
22	Kippit Hill	Dolphinton	NT 111 477	The hill is an unusually regular example of a kame, composed of meltwater sands and gravels.
23	Kitleyknowe Sand Quarry, Carlops	Carlops	NT 174 561	A very unusual poorly consolidated sandstone, exploited for sand extraction.
24	Lanton Hill Quarry, Jedburgh	Jedburgh	NT 623 205	A good exposure of the sandstone used most commonly for building in the Borders area.
25	Mountbenger Toll Quarry	Yarrow Valley	NT 3095 2625	An unusual variety of sole markings is clearly exposed on accessible greywacke bedding planes.
26	Pirn Quarry	Innerleithen	NT 341 373	The inverted greywackes in this quarry have exceptionally good examples of sole structures.
27	Preston Bridge, Duns	Duns	NT 7871 5678 – NT 7835 5710	Stratheden Group sandstones with Kelso Lava ashes and lava flow above, intruded by Lower Carboniferous dolerite igneous body (Borthwick Sill). Potentially the igneous rocks at this site could be radiometrically dates to give a date for the base of the Carboniferous period.
28	Raeshaw Wood Quarry	Heriot	NT 358 503	The Raeshaw Conglomerate is an unusual rock containing Ordovician graptolitic mudstone clasts incorporated in a Silurian greywacke.
29	Smailholm Tower	Kelso	NT 638 347	This site has the best exposed and most accessible example of the Kelso Volcanic Formation basalt lavas, with features such as columnar jointing. It is associated with an exposure of the sandstone county rocks.
30	South Minto Hills	Jedburgh	NT 5520, 5521, 5620, 5621	One of the few easily accessible and well-exposed vent agglomerates found in the Scottish Borders.
31	Southdean Quarry, Chesters	Jedburgh	NT 63450 09145 to NT 63555 09143	A fascinating example of jointing on a volcanic plug composed of nepheline basanite, an unusual rock not

				seen elsewhere in the Scottish Borders.
32	Staerough Hill, Yetholm	Kelso	NT 8237 NT 8327	Extensive lavas of pitchstone are very rare in the UK.
33	Synton Mossend Cutting	Hawick	NT 48380 20857 SE end NT 48305 20939 NW end	The cutting demonstrates clearly several types of folds and is valuable for teaching geological structures.
34	Thirlestane Score	St Mary's Loch	NT 2531 2033 to NT 2524 2021	A well-exposed example of Silurian (Llandovery) Moffat Shales, with shales of varying colours and cleavage types which contain graptolites of considerable zonal value. Exposures of Moffat Shales are not common, so this is an important site.
35	Tofts Hill Quarry, Kirkton	Hawick	NT 54564 13561 to NT 54658 13518	The Acklington Dyke is exposed in only a few places in the Hawick area and this quarry includes features of interest in the Silurian greywackes.

LOCAL GEODIVERSITY SITES TECHNICAL NOTE

APPENDIX 2: SITE FORMS

ADDERSTON SHIELS, COGSMILL

Grid Reference: NT 514 086	Current use: Grazing
Feature: Disused quarries	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 9/6/2018 & 28/7/2019

Site Map

Figure 1: Location Map 1:25,000

Site Description

Three adjacent quarries at the foot of the track to Adderston Shiels, just beyond a cattle grid on the track, expose Silurian Riccarton Group (Wenlock) slates and greywackes, previously known as the Stobs Castle Beds (Warren 1963).

The most recent quarry [NT 5142 0868] to the NW is not visible from the road but has about 1 m of exposed rock and a considerable amount of relatively fresh scree, including one loose block of grey/green greywacke which included shale clasts ranging from 3-7 cm in length.

The middle quarry [NT 5142 0867] has vertical beds of grey/green medium-grained greywacke, in beds about 10-15 cm wide. One sample had flakes of carbon on the bedding plane. The greywackes are interbedded with siltstones and mudstones which show cleavage. There are some small-scale sole marks on the siltstone bedding planes. The beds dip at 72° towards 127° and may be inverted.

A slightly larger quarry up the hillside to the SE [NT 5144 0868] has similar beds with a variety of small-scale sole markings on siltstone bedding planes.

Warren (1963) made a detailed study of the Riccarton Group rocks, which includes a sedimentological log from a site at Cogsmill which may refer to these exposures and to the adjacent roadside quarry [NT 516 086].

Assessment of Site Value

Geodiversity value: Small quarries in Riccarton Group greywackes and siltstones with a variety of interesting sole marks, some not seen elsewhere.	
Description: Three small quarries in Silurian Riccarton Group greywackes and siltstones	

Access, Safety & Fragility

Aspect	Description
Access notes	Parking for one car off the B6399 Hawick to Newcastleton road at the foot of the track to Adderston Shiels. The quarries are open access.

Current condition (fragility)	Robust
Potential use	These small quarries are useful for teaching the basics of turbidite rock types and features.

Culture, Heritage & Economic

Aspect	Description	
Historical, archaeological & literary associations	None	
Aesthetic landscape	N/A	
History of Earth Sciences	None	
Economic geology	The quarries were exploited for greywackes for construction stone and slates for roofing. They are shown on an 1859 25 inch map.	
Built Heritage	Probably used on the Stobs Castle estate for local buildings.	

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	Local	Good		
Sedimentology	Regional	Good	Warren 1963	X
Igneous/Mineral/ Metamorphic Geology	Local	Good		
Structural Geology				
Palaeontology				
Geomorphology				
Current Site Value				
Community	As it is on the track to Adderston Shiels, local people drive past frequently but probably don't enter the quarries.			0
Education	Educational groups would find the features interesting.			2

References / Links

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p. 76.

Warren, P.T. 1963 The petrography, sedimentation and provenance of the Wenlock rocks, near Hawick, Roxburghshire. *Trans. Edin. Geol. Soc.,* 19, pp. 225 - 255

1:50,000 Landranger Map 79 Hawick and Eskdale

1:25,000 Explorer Map 331 Teviotdale South

1:50,000 BGS Sheet Scotland 17W Hawick

Photo 1 NW (most recent quarry) showing about 1 m of exposed greywackes. July 2019

Photo 2 Middle quarry from the track with the newer quarry just visible on the left. July 2019

Photo 3 SE quarry with the landmark tree. July 2019

Photo 4 Typical alternations of greywacke and siltstone beds in the middle quarry. July 2019

Photo 5 Small flute casts on siltstones in the SE quarry July 2019

Photo 6 Flute casts and prod marks on siltstones in the SE quarry July 2019

ALLARS MILL, JEDBURGH

Grid Reference: NT 650 199	Current use: River cliff
Feature: Inland exposure	Other designations: None
Current geological designations: None	Other scientific: ex-SSSI (geological)
Field surveyor: Alison Tymon	Date: 22/4/2019
Site Map	

Figure 1: Location Map 1:25,000

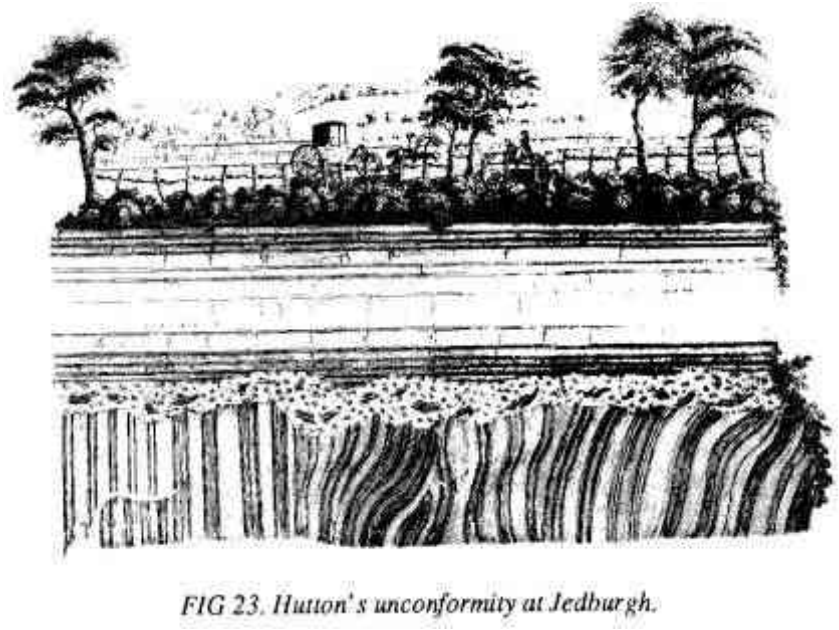


FIG 23. Hutton's unconformity at Jedburgh.

Figure 2: Drawing by Sir John Clerk in 1787, published in 1788 in James Hutton's *Theory of the Earth*. Image taken from *Scottish Borders Geology: An Excursion Guide* p.97 (see references).

Site Description (qualitative)
The famous Allars Mill unconformity between Upper Old Red Sandstone (Stratheden and Inverclyde Groups – undifferentiated) and underlying Silurian greywackes can be found 0.5 km south of the centre of Jedburgh next to the Jed Water (Figure 1). The river cliff lies below the A68, shown on the drawing (Figure 2) with horse and carriage traffic. While it is now somewhat covered by slipped material so that the line of the unconformity cannot be seen, Sir John Clerk made a drawing at the time (Figure 2) which explains the geology of the site. This site was previously designated as a geological SSSI and was referred to as Hutton's unconformity at Inchbonny, although it was subsequently delisted. Allars Mill was the name used by James Hutton. At present, about 2 m of bedded Upper Old Red Sandstone mudstones and siltstones can be seen at the top of the river cliff below the road and exposures of red silts and clays, though mostly covered by vegetation, can be seen for some metres below that, although the lower areas could be slumped soil and mud. Greywackes, probably belonging to the Hawick Group (Silurian: Llandovery-Wenlock), can be seen in the river bed upstream for some distance from the bridge which gives access to Allars Mill; at the unconformity site they extend to at least 4 m above the river bed. Structures cannot be distinguished clearly as the exposures are largely covered with branches and ivy, but at river level the greywackes appear to be near-vertical and have thin to medium-bedding. There is no sign in the cliff of the greywacke breccia which Clerk shows as lying between the vertical bedding and the overlying red mudstones and siltstones.

Assessment of Site Value	
Geodiversity value: While the site is degraded by scree and vegetation cover, it is a classic site in the history of geological ideas, having been visited and described by James Hutton.	
Description: An unconformity between Silurian greywackes and Upper Old Red Sandstone beds.	
Access, Safety & Fragility	
Aspect	**Description**
Access notes	Access for vehicles via a lane from the A68 into Allars Mill, where there is extensive parking next to the Jedburgh Bowling Club clubhouse. The unconformity is about 100 m upstream from the bridge where there is access to the shingle beach opposite the river cliff. Alternative access on foot is from the main car park for Jedburgh Abbey, where a footpath along the river through Lothian Park leads south to Allars Mill.
Current condition (fragility)	Overgrown with saplings so the rocks are only visible during the winter and early spring. Rubbish, including old road signs, has been thrown from the road onto the slope.
Potential use	There were plans in the 1990s to restore the site so that the unconformity was visible, but there are inherent difficulties because of the presence of the main road above the river cliff. Any management activities would be problematic.
Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	None
Aesthetic landscape	N/A
History of Earth Sciences	This is a classic site in the history of earth sciences, as it was described by James Hutton after he visited in 1787. A drawing of the unconformity by his friend, John Clerk, was published in 1788.
Economic geology	N/A
Built Heritage	N/A

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	International	Poor	Hutton 1788 and many later papers	X
Sedimentology	Local	Poor		
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology				
Current Site Value				
Community				0
Education				0

References / Links

Dean, D. R. 1992 *James Hutton and the history of geology* p.43

Hutton, J. 1788 *Theory of the Earth,* Trans Royal Soc. Edinburgh, Vol. 1. pp.209-304

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* pp. 96-97

McIntyre, D.B. & McKirdy, A.1977 James Hutton p.38

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p.103

OS 1:50,000 Landranger 80 Cheviot Hills and Kielder Water

OS 1:25,000 Explorer OL16 The Cheviot Hills

BGS 1:50,000 Scotland Sheet 17E Jedburgh

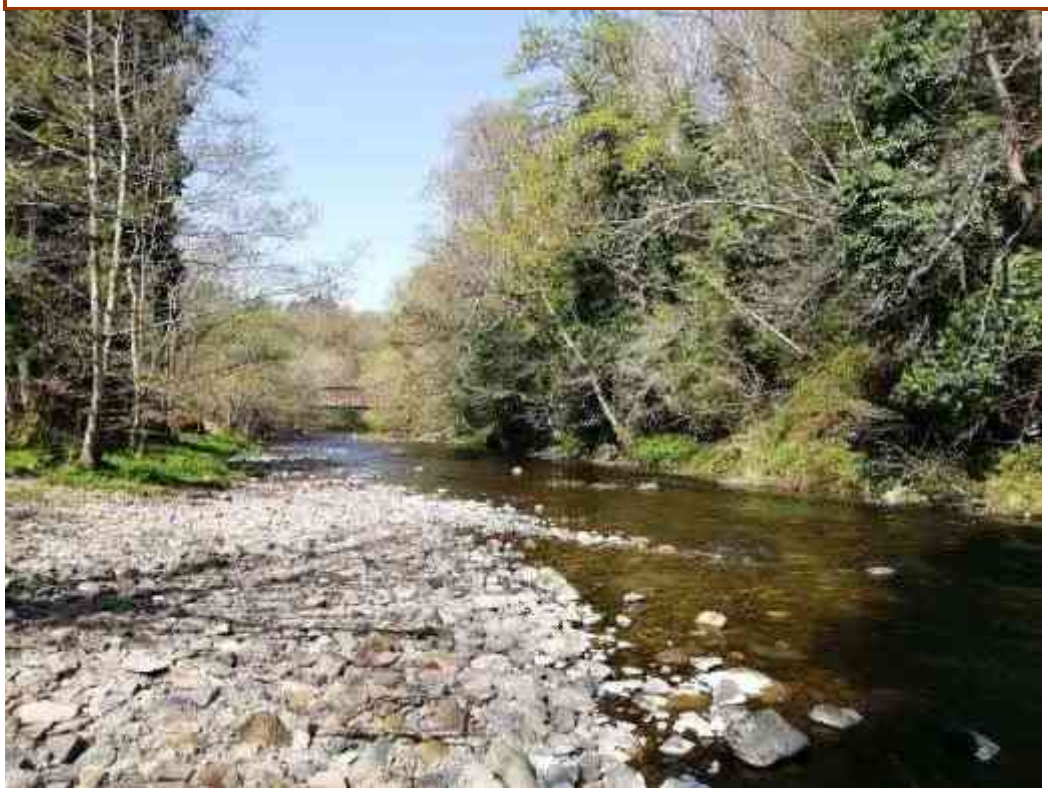


Photo 1 View downstream from opposite the exposed river cliff, towards the bridge over the Jed Water which leads to Allars Mill. April 2019

Photo 2 Jed Water river cliff, with the A68 beyond the fence at the top. The red rocks of the Upper Old Red Sandstone can be seen at the top of the cliff, just below the fence. Grey/green Silurian greywackes can be seen in the river bed and in the lower section of the cliff, though covered with vegetation in places. The unconformity is about half way up the cliff, with a breccia between the two rock types, now all obscured. April 2019

BEMERSYDE HILL QUARRY

Grid Reference: NT 595 340	Current use: Farm storage
Feature: Disused quarry	Other designations: Eildon and Leaderfoot National Scenic Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 8th April 2017 & 18th July 2019

Site Map

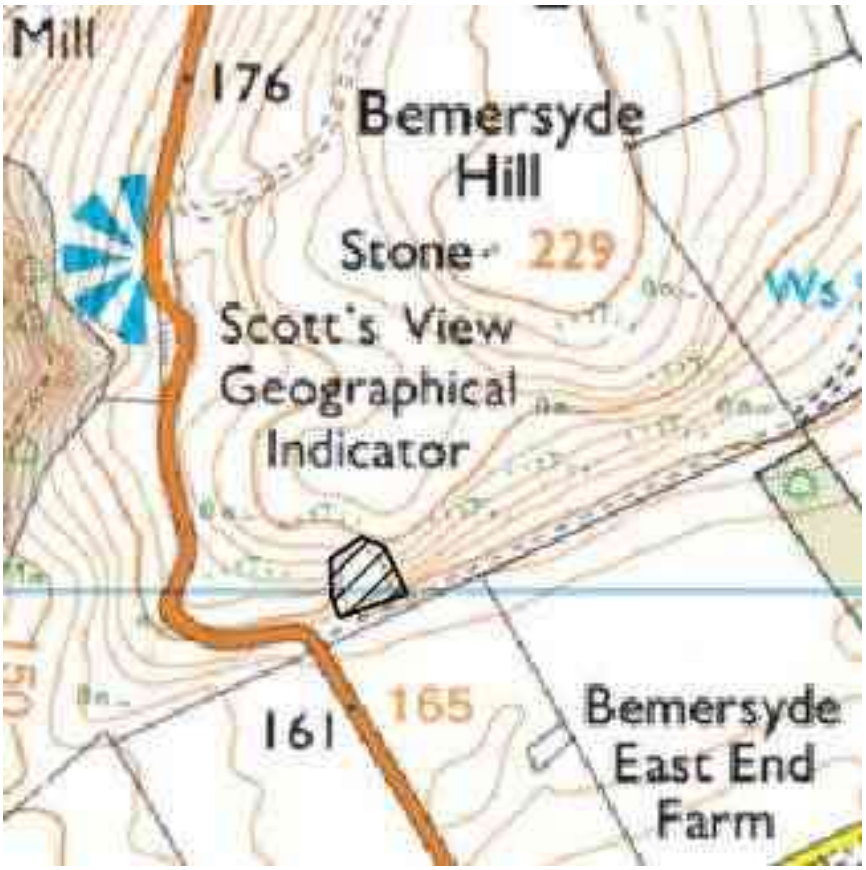


Figure 1: Location Map 1:25,000

Site Description

Bemersyde Hill, well-known as a favourite site of Sir Walter Scott because of the extensive views over Melrose and the Eildon Hills, is one of several early Carboniferous intrusions in the Earlston area with a silica-rich composition. The 50 m wide disused quarry at the southern end of Bemersyde Hill exposes quartz trachyte in heavily-jointed faces up to 20 m high.

The quartz trachyte is a fine-grained grey/red rock, which weathers to a bright orange/pink colour. The trachyte includes many 1 mm pink quartz phenocrysts. In places, amygdales up to 4 mm containing a pale green mineral can be seen.

The quarry is best visited in winter or spring, before the flower-rich vegetation on the quarry floor grows high enough to obscure the lower sections of the quarry faces

Assessment of Site Value

Geodiversity value: The quarry is the best exposure of a quartz trachyte intrusion in the Scottish Borders

Description: A disused and accessible quarry in a quartz trachyte intrusion	

Access, Safety & Fragility	
Aspect	**Description**
Access notes	Open access into the quarry from a track off the B6356 between Clintmains and Redpath. There is parking for several cars just off the B6356.
Current condition (fragility)	In good condition, although there are two old abandoned farm trailers in the quarry which is overgrown in summer. The quarry face is accessible during the winter.
Potential use	Suitable for group visits in the winter months

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	The quarry is close to Scott's View (NT 594 343).	
Aesthetic landscape	Superb views to the south and the Eildon Hills.	
History of Earth Sciences	None	
Economic geology	The quarry is recorded on the OS map of 1862 so was probably used for roadstone during the C19th.	
Built Heritage	N/A	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology	Regional	Good	McRobert 1914, Clarkson & Upton 2010	X
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value		
Community	Walkers may use the track but probably don't visit the quarry.	0
Education	Probably not visited by educational groups.	0

References / Links

Clarkson, E. & Upton, B. 2010 *Death of an Ocean* pp.175-179

McRobert, R.W. 1914 Acid and intermediate intrusions and associated ash-necks in the neighbourhood of Melrose (Roxburghshire) Quart.Journ.Geol.Soc. Vol. 70, pp.303-314

Read, W.A., Browne, M.A.E., Stephenson, D. & Upton, B.G.J. 2002 Carboniferous Chapter 9 in Trewin, N.H. (ed) *The Geology of Scotland*. p.268

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* p.105

No published BGS sheet – use BGS Geology of Britain viewer

OS 1:50,000 Map 74 Kelso & Coldstream

OS 1:25,000 Explorer 338 Galashiels, Selkirk & Melrose

Photo 1 The main face of the quartz trachyte quarry April 2017

Photo 2 North-east face of the quarry, showing the joint patterns and the orange weathering colour. April 2017

Photo 3 View to show the quarry floor and encroachment of gorse on the quarry face July 2019

Photo 4 Close-up of fine-grained quartz trachyte in the quarry, showing red/grey colour of fresh rock and presence of phenocrysts Scale in mm.

BIRKWOOD HEUGH CUTTING

Grid Reference: NT 564 405	Current use: Road cutting
Feature: Road cutting	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 8/5/2019

Site Map

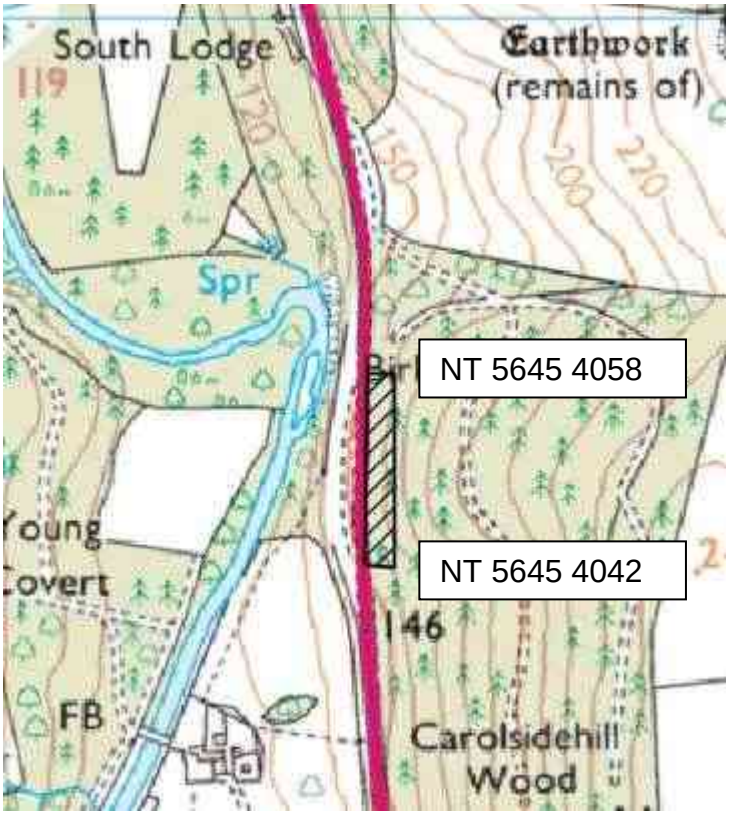


Figure 1: Location Map 1:25,000

Site Description

Birkwood Heugh is a road cutting on the east side of the A68, two kilometres north of Earlston. The cutting is 160 m long and varies in height from 6 m at the north end to about 10 m at the south end. There are a few rock bolts near the south end and in one place there are core holes, presumably taken for research.

The Great Conglomerate Formation (Reston Group) is an Old Red Sandstone (Lower Devonian) rock deposited in arid mountainous conditions when the continent of Laurasia was 20-30° south of the equator. The larger sub-rounded clasts are matrix-supported and badly-sorted, ranging up to 20 cm in length and composed largely of greywacke. The matrix is dark red in colour, with angular grains of sand and pebbles. Irregular beds range from 1-2 m in height, are sub-horizontal and wedge-out in places. No graded beds can be seen.

Assessment of Site Value

Geodiversity value: An unusually extensive exposure in the Scottish Borders of the Lower Devonian Great Conglomerate Formation (Reston Group).

Description: The exposure shows the bedding structures of the Great Conglomerate, which is rare elsewhere in the Scottish Borders. The lithology of the rock reflects the local geology in the Lower Devonian period and therefore indicates the river flow directions on the upland landforms at the time.

Access, Safety & Fragility	
Aspect	**Description**
Access notes	The cutting is on a straight section of the A68 with no parking, except a single space at the south end where one car can get off the road.
Current condition (fragility)	Photos taken in 2006 show some colonisation of the fresh rock face by small saplings. In 2019, gorse bushes are prevalent, with some pine saplings. The base of the cutting has been colonised by ash saplings which obscure the rock face in the summer and should be removed.
Potential use	This road section is suitable for geological research.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	None	
Aesthetic landscape	N/A	
History of Earth Sciences	None	
Economic geology	N/A	
Built Heritage	N/A	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	Regional	Good	Browne *et al.* 2002	X
Sedimentology	Regional	Good	Browne *et al.* 2002	X
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value		
Community	N/A	0
Education	The site is unsuitable for educational visits because of the lack of parking and dangerous access to the rock face.	0

References / Links

Browne, M.A.E., Smith, R. A. & Aitken, A. M. 2002 Stratigraphic Framework for the Devonian (Old Red Sandstone) rocks of Scotland south of a line from Fort William to Aberdeen. *British Geological Survey Search Report* RR/01/04 p.13

Stone, P, McMillan, A. A., Floyd, J.D.,Barnes, R.P. and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (Fourth Edition). Keyworth, Nottingham: British Geological Survey p.106

OS 1:50,000 Map 73 Peebles, Galashiels & Selkirk

OS 1:25,000 Explorer 338 Galashiels, Selkirk & Melrose

BGS 1:50,000 Scotland Sheet 25W Galashiels

Photo 1. Birkwood Heugh Cutting on the A68 looking from south to north. May 2019

Photo 2. Section of cutting showing sub-horizontal bedding up to 2 m in height and encroachment of gorse in the middle section of the exposure, with ash saplings at road level. May 2019

Photo 3. Higher section of cutting at the south end, showing a variety of bedding forms. May 2019

Photo 4. Close-up of Great Conglomerate with sub-rounded greywacke clasts in a sand and pebble matrix. Notebook is 20 cm long. May 2019

BLYTH BRIDGE QUARRY

Grid Reference: NT 1335 4520	Current use: Open quarry floor
Feature: Disused quarry	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 22/06/2019 & 17/8/2019

Site Map

Figure 1: Location Map 1:25,000

Site Description (qualitative)

Blyth Bridge Quarry exploited trachyte, a volcanic rock from the Biggar Volcanic Formation which dates from 411-419 million years ago (Silurian and Devonian). The Biggar Volcanic Formation is overlain by the Auchtitench Sandstone Formation, which forms the countryside to the north-west of Blyth Bridge.

The main quarry face is about 12 m high and 50 m across and exposes the fine-grained, purple/grey crystalline rock. The trachyte weathers white/green in places and elsewhere there is reddening along joints. One area shows rock that is very finely jointed with clay replacement on surfaces, indicating alteration. The east side of the quarry has regular steep jointing dipping towards the SW, but irregular jointing is widespread.

The quarry floor has several large birch and hawthorn trees. During high summer the quarry faces are less accessible because of grass and flower growth.

Assessment of Site Value

Geodiversity value: A well-exposed and accessible example of the trachyte of the Biggar Volcanic Formation

Description: A disused trachyte quarry

Access, Safety & Fragility

Aspect	Description
Access notes	From the green in Blyth Bridge (NT 132 453) where there is parking in Tarth Crescent, the wooded track to the quarry leads SE from the A701. The quarry entrance is reached from the track just before a field gate.
Current condition (fragility)	There is some growth of small bushes and grasses on the quarry face, but the rocks and features are still easily visible, particularly in winter.
Potential use	This is an accessible and safe site for a group visit.

Culture, Heritage & Economic

Aspect	Description
Historical, archaeological	None

& literary associations	
Aesthetic landscape	N/A
History of Earth Sciences	None
Economic geology	Described as a 'whinstone quarry' in 1859, the quarry probably provided roadstone or walling stone for the local area.
Built Heritage	There may be local field walls and houses built of this stone.

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology	Local	Good		X
Structural Geology				
Palaeontology				
Geomorphology				
Current Site Value				
Community	Not known			0
Education	The site is suitable for educational visits by adult groups.			0

References / Links
OS 1:50,000 Upper Clyde Valley Map 72
OS 1:25,000 Explorer Biggar and Broughton Map 336
BGS 1:50,000 Scotland Biggar Sheet 24W

Photo 1 View of the quarry from near to the entrance showing the main quarry face. June 2019

Photo 2 The main quarry face of highly-jointed trachyte. June 2019

Photo 3 Close-up of a lower face of the quarry in the eastern corner under trees, to show colour and jointing in the trachyte. June 2019

BORTHWICK QUARRY, DUNS

Grid Reference: NT 768 544	Current use: Disused quarry recently filled in with inert waste. A small area is now being used as storage for aggregates.
Feature: Disused quarry	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 12/6/17 and several other occasions

Site Map

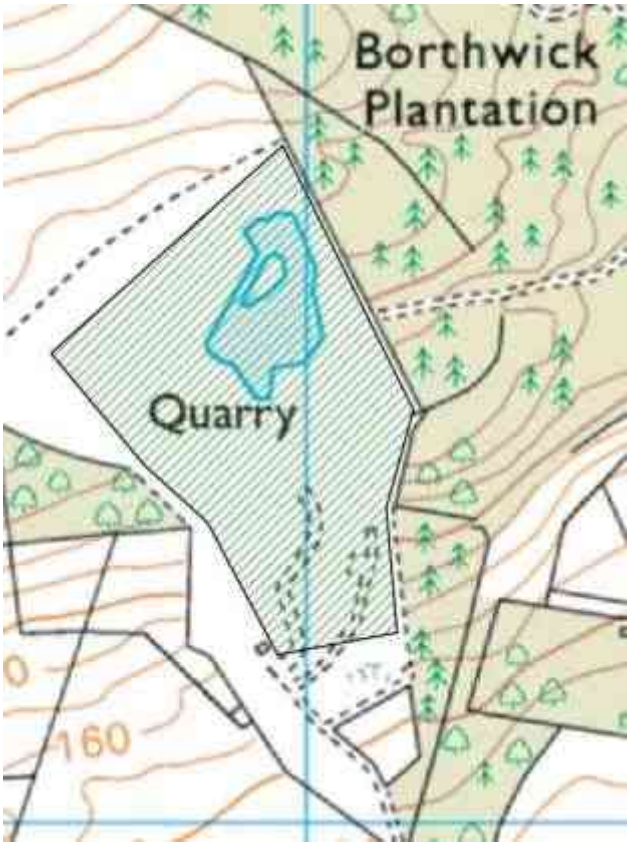


Figure 1: Location Map 1:25,000

Site Description

The site is a large disused quarry of dolerite (Borthwick Sill) with columnar jointing in many places, at various angles and with features such as brecciated hydrothermal veins with quartz and calcite crystallisation. The dolerite varies in grain-size and in mineralogy within the intrusion. Columnar jointing is variable in terms of column width and inclination which gives scope for discussion on the methods of intrusion and rate of cooling.

2 to 3 m of well-bedded Upper Old Red Sandstone (Stratheden Group) red/white sandstone lies at the top of the western face, with a weathered layer beneath, overlying the igneous rocks. About 4 m of glacial till overlies the eastern face.

The quarry is approximately 400x500 m in size with quarry faces up to about 20 m high, which are likely to include unstable rocks. The faces have columnar jointing as well as some irregular jointing.

The quarry floor is infilled with rubble and is generally flat, with a small pool of standing water in one area. There are heaps of aggregate in places, which may not be local material.

Old spoil tips, probably dating from the last period of the working quarry, are now being colonised by plants, including orchids, wild strawberries and orange hawkweed. The western part of the quarry has mature trees and is accessed by a grassed track. However, the sandstone beds above the igneous body are inaccessible at present.

Images of thin sections of rock samples from Borthwick Quarry, collected by BGS surveyors, are available online in the Rock Collections section of the BGS website at https://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks

They are numbered S33908, S33909, S48233 and S79615.

Assessment of Site Value	
Geodiversity value: Extensive exposure of dolerite with varied columnar jointing and hydrothermal veining. The dolerite is thought to be a shallow sill intrusion but the exact processes remain uncertain. It is overlain by sedimentary rocks, probably of Late Devonian age.	

Access, Safety & Fragility	
Aspect	**Description**
Access notes	The quarry track beyond the Duns golf clubhouse gives easy access, with parking for 7 to 8 cars
Current condition (fragility)	Quarry faces may be unstable, but there is very little land-slipping so the features are clearly visible.
Potential use	Suitable for on-site interpretation and use by geological groups of all types.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	Borthwick Castle, a medieval tower house, sited at NT 77021 54433, stood on the site of the present quarry. The ruins of the castle were still visible in 1979 but are now completely lost. https://canmore.org.uk/site/58629/borthwick-castle#721846	
Aesthetic landscape	N/A	
History of Earth Sciences	None	
Economic geology	Small quarry recorded in 1900s. Quarry worked intermittently for aggregate extraction in 2012, but closed since.	
Built Heritage	Most of the quarry buildings and machinery have been removed	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	Local	Poor		
Sedimentology	Local	Poor		
Igneous/Mineral/ Metamorphic Geology	Regional	Excellent	Tomkeieff 1940, Clarkson & Upton 2010	X
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value		
Community	The site could be developed for environmental, heritage, recreation and geological use by local people as it is within easy reach of Duns on foot. At present there is no access for the public although there is frequent use of the adjacent footpaths by walkers. There are nesting peregrines and a wide variety of flora on the tips, which would need to be protected.	
Education	The quarry is visited by local geology groups and could be used by schools if care is taken. It has potential for use by higher education groups and the general public with suitable interpretation and safety precautions.	

References / Links
Clarkson, E and Upton, B 2010 *Death of an Ocean: A Geological Borders Ballad* p.174

Milne, David 1835 *The Geology of Berwickshire* p. 47

Stone, P, McMillan, A. A., Floyd, J.D.,Barnes, R.P. and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (Fourth Edition). Keyworth, Nottingham: British Geological Survey, p. 154

Tomkeieff, S.I. 1940 *Petrology of the Carboniferous Igneous Rocks of the Tweed Basin*. Trans.Edin.Geol.Soc. pp.53-75

OS 1:50,000 Map 74 Kelso & Coldstream

OS 1:25,000 Explorer 346 Berwick-upon-Tweed

BGS Geology of Britain viewer

No published BGS sheet. The intrusion spans sheets 33E and 34. The quarry probably lies just off the corner of both but is described in both memoirs - 33E (1986), p 46 and 34 (1988), p. 54. The intrusion is described as a subhorizontal sill of analcime-bearing olivine-dolerite, probably of Early Carboniferous age.

Photo 1 View of Borthwick Quarry from spoil tips looking north-east June 2017

Photo 2 Exposure of Upper Devonian Stratheden Group sandstones above dolerite intrusion at south west corner of the quarry, with figure for scale. June 2017

Photo 3 Columnar jointing on east side of quarry July 2018

Photo 4 Columnar jointing at the north end of the quarry July 2018

BUCHTRIG GRAVEL QUARRY

Grid Reference: NT 764 141	Current use: Aggregate and storage for topsoil
Feature: Active quarry	Other designations: Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 22/04/2019
Site Map	

Figure 1: Location Map 1:25,000

Site Description (qualitative)

Lavas from the Cheviot Volcanic Formation (Early Devonian - 396 Ma) are andesitic in composition (Clarkson & Upton) and outcrop in a small area to the SW of the Cheviot volcano. Decomposition of the lavas may have occurred during warm periods before or during the Quaternary glaciations and rotten rock is found in pockets, such as the area around Buchtrig, where there are several quarries which have been worked for aggregates in decomposed andesites.

The two quarries lie close together on a hillside above the minor road near to Buchtrig in the upper part of the Kale Water valley and have faces up to 3 or 4 m high, which quickly become covered with scree as the rock breaks up. The andesite is a fine-grained, pale grey or pink rock, with yellow discolouration in patches, possibly along joints. Rectangular phenocrysts are up to 5 mm long, now altered to white clays. The weathered surfaces are very pale grey or pink and the clay pseudomorphs are weathered out, giving an open, loose texture to the rock, which crumbles when handled.

Both quarries have tips of andesite gravel, as well as extensive heaps of topsoil and some farm rubbish. The quarry does not seem to be mentioned on any maps before 1954, when it is described as ‘old gravel pit’, but there has been more recent extraction, as well as storage of other materials in front of the rock faces.

Assessment of Site Value	
Geodiversity value: An unusual example of decomposed Cheviot andesite	
Description: Two small excavations, now exploited for gravel	
Access, Safety & Fragility	
Aspect	**Description**
Access notes	Roadside location with parking for two cars
Current condition (fragility)	The quarries are used for storage of aggregate and farm waste but at present, the bedrock is easily visible.
Potential use	This is an unusual rock and should be kept accessible for study.
Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	None
Aesthetic landscape	The open moorland in this area is an interesting landscape type on the edge of the Cheviots.
History of Earth Sciences	None
Economic geology	Aggregate obtained from decomposed andesite, probably extracted for local use from time to time.
Built Heritage	Aggregate from the quarries may be used locally in constructions.

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology	Regional	Excellent	Clarkson & Upton 2010	X
Structural Geology				
Palaeontology				
Geomorphology				
Current Site Value				
Community	This is a site for nesting sand martins, so there may be visitors during the summer.			2
Education	The site is unlikely to be visited except by researchers.			2

References / Links
Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p.191
Clarkson, E. & Upton, B. 2010 *Death of an Ocean* p. 141
OS 1:50,000 Landranger Cheviot Hills & Kielder Water Map 80
OS 1:25,000 The Cheviot Hills Explorer OL16
No BGS map available. Use BGS Geology of Britain Viewer

Photo 1 South excavation from the road April 2019

Photo 2 Main face of south excavation April 2019

Photo 3 Variations in degree of decomposition and discolouration of decomposed andesite in the south excavation. Notebook is 20 cm long. April 2019

Photo 4 View of north excavation looking north to the Kale Water valley April 2019

Photo 5 North excavation showing some solid rock with unconsolidated gravel heaps April 2019

Photo 6 Detail of decomposed andesite in the north excavation April 2019

CASTLEWEARY QUARRY

Grid Reference: NT 406 031	Current use: Storage of road materials on quarry floor
Feature: Disused quarry	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Dates: 13/04/2018, 18/08/2019 & 29/7/2019

Site Map

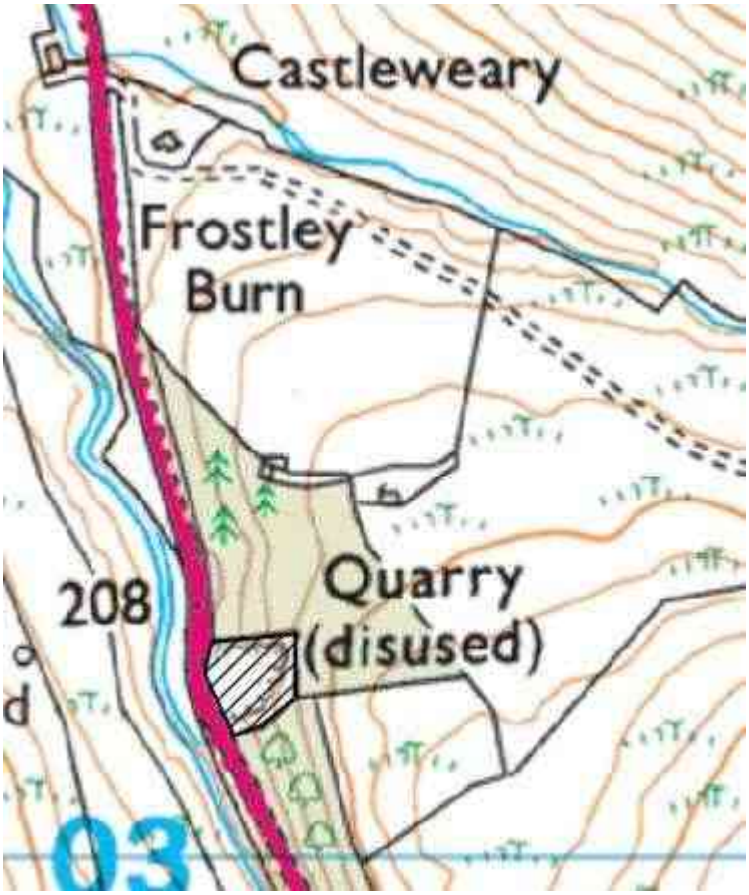


Figure 1: Location Map 1:25,000

Site Description

Castleweary Quarry is excavated into near-vertical Silurian Hawick Group (Llandovery) green, fine-grained greywackes with occasional siltstone beds and pink calcite veins. The central face of the quarry lies behind a heap of loose rock and is about 8 m high. The northern face rises directly from the base of the quarry and is approximately 25 m high. There is access to a higher face, about 12 m high, up an overgrown footpath on the south side of the quarry.

Most of the greywacke beds range in thickness from about 10–40 cm, with more massive beds to the left of the entrance gate on the north side of the quarry. The beds dip at 80° to SE (140°) and are overturned. On the north side, asymmetric ripples can be seen close to the gate, a bedding plane nearby has small flute casts superimposed on grooves up to 70 cm wide on an otherwise planar surface and another bedding plane has flattened linear flute marks. The quarry face exposes several bedding planes up to 20 m high, with a variety of sole structures. One extensive bedding plane has flute casts about 10-15 cm long, while another has giant flute casts from 30-40 cm long. The flute casts all show movement from the bottom to the top of the quarry faces. One bedding plane, high on the face, has grooves in two directions and another has lineations with occasional prod marks. The upper face exposes the same bedding planes with giant and small flute casts and the south face is a fault plane with slickensides and some mineralisation.

Assessment of Site Value

Geodiversity value: The best example in the Scottish Borders of giant flute casts, as well as many other interesting sole mark features.	
Description: A large quarry with vertical greywackes, many of which show a variety of sole structures.	

Access, Safety & Fragility

Aspect	Description
Access notes	On the east side of the A7 south of Teviothead, where there is parking space for a couple of cars at the gated entrance. Some of the features are easily visible from the gate.
Current condition (fragility)	Rock falls are likely, but they will continue to expose bedding planes and their features. Vegetation growth has not yet obscured the steep rock faces.
Potential use	This would be an excellent site for teaching greywackes and their features, if it was possible to allow students to see the cliff faces from a distance and in safety.

Culture, Heritage & Economic

Aspect	Description	
Historical, archaeological & literary associations	None	
Aesthetic landscape	N/A	
History of Earth Sciences	None	
Economic geology	A small quarry is shown on maps from 1857, enlarged by 1917 and shown as 'old quarry' in 1954. However it is now much enlarged and possibly still working spasmodically.	
Built Heritage	N/A	

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	Local	Good		
Sedimentology	National	Excellent	Warren 1963	X
Igneous/Mineral/ Metamorphic Geology	Local	Good		
Structural Geology	Local	Good		
Palaeontology				
Geomorphology				

Current Site Value		
Community	Not visited	0
Education	Unlikely to be visited at present	0

References / Links

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p. 71.

Warren, P.T. 1963 The petrography, sedimentation and provenance of the Wenlock rocks, near Hawick, Roxburghshire. *Trans. Edin. Geol. Soc.,* 19, pp. 225 - 255

1:50,000 Landranger Map 79 Hawick and Eskdale

1:25,000 Explorer Map 331 Teviotdale South

1:50,000 BGS Sheet Scotland 17W Hawick

Photo 1 View of Castleweary Quarry from the A7 entrance gate. July 2019

Photo 2 View from the upper bench of the quarry to the A7, with car for scale. September 2018

Photo 3 The north face with bedding planes covered with flute casts, looking from the floor of the quarry to the upper bench. July 2019

Photo 4 Exposure of greywacke with asymmetric ripple marks on the north face of the quarry, close to the gate. Walking pole is 1.2 m long. September 2018

Photo 5 Flute casts formed within apparent channels or grooves on a small bedding plane exposure on the north side of the quarry. Walking pole is 1.2 m long. September 2018

Photo 6 Detail of small flute casts with walking pole for scale. September 2018

Photo 7 Large flute casts on the north side of the quarry on the upper bench. September 2018

Photo 8 Fault plane at the south end of the upper bench of the quarry, with horizontal slickensides. Walking pole is 1.2 m long. September 2018

COCKLIE RIG HEAD QUARRY, GLENCOTHO

Grid Reference: NT 0898 2937	Current use: Grazing
Feature: Disused quarry	Other designations: Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 15/8/17

Site Map

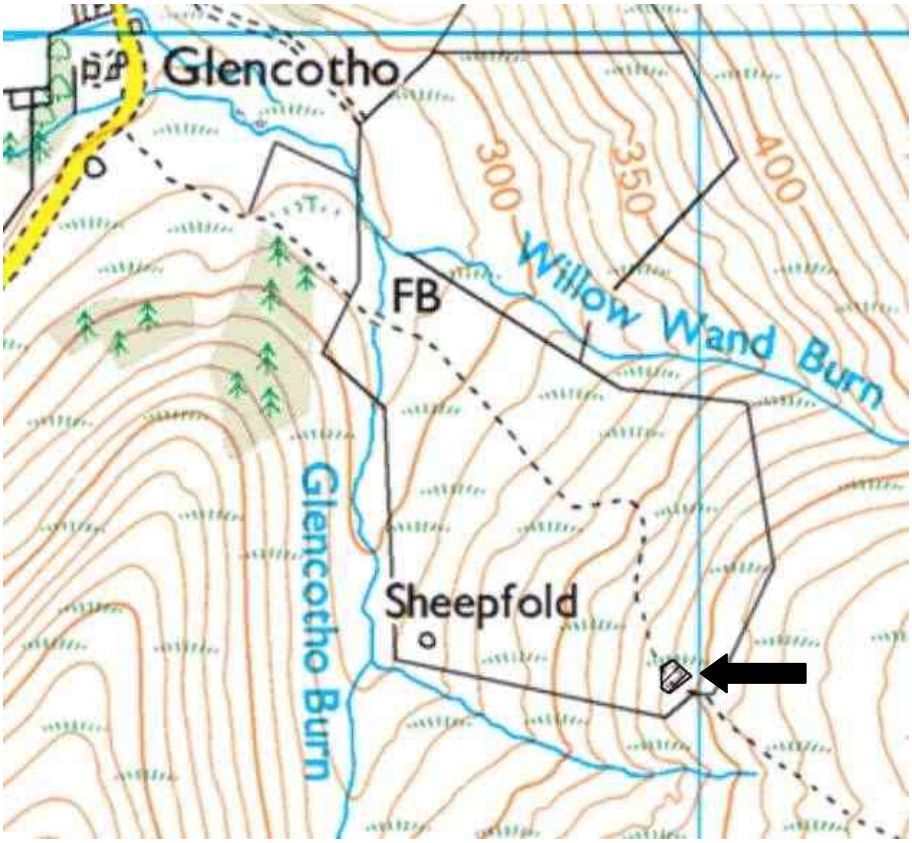


Figure 1: Location Map 1:25,000

Site Description

The Wrae Limestone, (Tweeddale Member of the Shinnel Formation, Ordovician) is found in a small quarry to the south-east of the farmhouse at Glencotho (NT 083 299). A quarry track leaves the lane just beyond the farmhouse and leads past old lime kilns at NT 08717 29710 uphill about 700 m directly to the quarry. Below the quarry are grassed-over spoil tips on the slope down into the valley of Glencotho Burn.

Some loose stones on the track are of yellow rhyolitic tuff, but the quarry is entirely sited in thickly bedded Wrae Limestone, which is crystalline, dark grey and dips at 79° to 180° (S). Fossils were not seen. Bedding planes show typical limestone weathering along small irregular joints.

The Wrae Limestone is described as an 'exotic breccia' interbedded with the greywackes of the Shinnel Formation and is said to contain fossils that suggest that it is older than the surrounding greywackes, so has been interpreted as a submarine slide deposit (Stone *et al.* 2012).

An image of a thin section from a sample (N5315) of 'intraclast breccia' collected from this site is available online at BGS Rock Collections.
https://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks

Assessment of Site Value

Geodiversity value: The Wrae Limestone is a highly unusual rock in the Ordovician sequence of

the Southern Uplands.	
Description: A small quarry exposing Wrae Limestone.	

Access, Safety & Fragility	
Aspect	**Description**
Access notes	0.7 km walk up quarry track from Glencotho
Current condition (fragility)	The site is not overgrown and crags of limestone are well-exposed.
Potential use	This is a site of scientific and historical interest and should remain accessible for research.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	The lime kilns (clamps) east of Glencotho farmhouse have been excavated.	
Aesthetic landscape	Excellent views of the Holms Water valley.	
History of Earth Sciences	The Wrae limestone quarries on Wrae Hill were visited by Sir James Hall in 1792, which led to the interpretation of the geology of the Southern Uplands by James Hutton (Theory of the Earth 1795). The Wrae quarries are now lost so this quarry may be one of the few places where the Wrae Limestone is still visible.	
Economic geology	Working quarries and limekilns shown on OS map 1856 and mentioned in Geikie (1869) but shown as disused quarries in 1906.	
Built Heritage	N/A	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	National	Excellent	Clarkson & Upton 2010 Leggett 1980	X
Sedimentology	National	Moderately good		
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value		
Community	Walkers pass regularly	2
Education	Research groups will be interested in these unusual rocks so there may be occasional visits.	2

References / Links

Clarkson, E. & Upton, B. 2010 *Death of an Ocean* p. 51

Geikie,J & Geikie A.1869 Explanation of Sheet 24 Peebleshire. *Memoirs of the Geological Survey of Scotland.* p.22

Leggett, J.K. 1980 *Palaeogeographic setting of the Wrae Limestone: an Ordovician submarine-slide deposit in Tweeddale.* Scottish Journal of Geology, 16, 91-104

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* includes comments on the Wrae Limestone, as previously recorded at Wrae Limestone quarries on Wrae Hill pp. 150-152

Stone, P, McMillan, A. A., Floyd, J.D.,Barnes, R.P. and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (Fourth Edition). Keyworth, Nottingham: British Geological Survey p.61

https://canmore.org.uk/site/341907/cocklie-rig-head Information on the old quarry

https://canmore.org.uk/site/93007/glencotho Information on the post-medieval limekilns

http://biggararchaeology.org.uk/biggar-archaeology-groups-current-projects/upper-tweed-project/upper-tweed-glencotho-lime-kilns-and-deserted-settlement/ Excavations of the limekilns and mention of the Wrae Limestone quarries.

OS 1:50,000 Map 72 Upper Clyde Valley

OS 1:25,000 Explorer 336 Biggar and Broughton

BGS 1:50,000 Scotland Sheet 24W Biggar

Photo 1 View of Cocklie Rig Head Quarry looking east, with figure for scale. August 2017

Photo 2 Cocklie Rig Head Quarry from above, looking north-west towards Glencotho. August 2017

Photo 3 Wrae Limestone exposure, showing irregular shattered jointing patterns. August 2017

Photo 4 Exposure of fresh Wrae Limestone with hammer for scale August 2017

CRAIGBURN QUARRY

Grid Reference: NT 237 544	Current use: Overgrown quarry and farm rubbish
Feature: Disused quarry	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 19/6/2019

Site Map

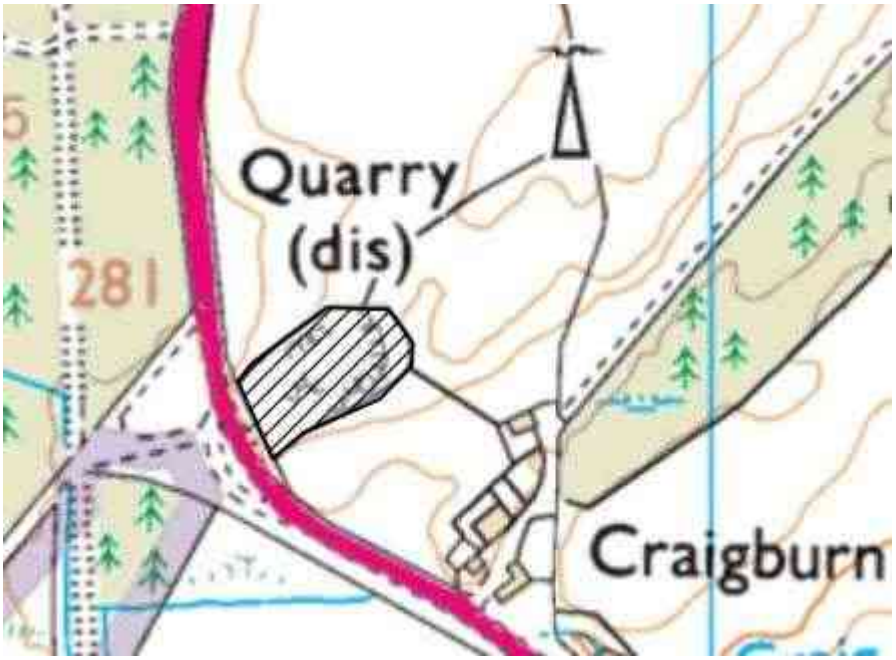


Figure 1: Location Map 1:25,000

Site Description (qualitative)

The quarry is about 150 m long and 50 m wide with near-vertical faces up to 15 m high. It is largely overgrown by mature trees and is best seen from the top of the quarry where there are some accessible rock exposures, particularly at the east end. There is some tipped farm rubbish on the north side of the quarry.

The 'Haggis Rock' is a distinctive lithology within the Marchburn Formation of the Ordovician Tappins Group, Leadhills Supergroup (Caradoc). The Tappins Group rocks are immature greywackes largely derived from the north, as a result of erosion of oceanic and volcanic rocks. The 'Haggis Rock' is a badly-sorted coarse greywacke with pebbles ranging from 1-3 cm long, composed of sub-rounded grey quartz pebbles and angular lithic fragments, including dolerite, felsite, basalt and chert. The matrix includes lithic grains with feldspar and quartz fragments. It is described in Stone *et al.* (2012) as a 'green sandy microconglomerate' with a 'colourful mix of red, grey, green and black lithoclasts'. Crags of the 'Haggis Rock' have irregular jointing and the rock is brittle and breaks into angular fragments.

Thin sections collected at this quarry are held by BGS (S96788, S69402 and S69402A).

Assessment of Site Value

Geodiversity value: The 'Haggis Rock' is an unusual lithology in the Ordovician greywackes which gives information about provenance during the early times of the Iapetus Ocean.

Description: A disused quarry with accessible crags of the 'Haggis Rock'

Access, Safety & Fragility

Aspect	Description
Access notes	The quarry lies to the east of the A703, a short distance south of the

	Leadburn junction with the A701. Parking is available in a large lay-by opposite the quarry entrance. It is possible to walk around the top of the quarry, within the barbed wire fence. Access to the bottom of the quarry is very difficult in summer because it is completely overgrown.
Current condition (fragility)	The accessible crags at the top of the quarry may become overgrown, which would diminish the value of the site for research.
Potential use	If the quarry faces were more easily accessible it would be an excellent site for geological students to study.
Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	None
Aesthetic landscape	N/A
History of Earth Sciences	None
Economic geology	From old maps it is clear that the quarry has been open since at least 1858 when one section of it was described as 'old quarry'. It was exploited for the coarse greywacke 'Haggis Rock', which is an excellent roadstone.
Built Heritage	The stone was probably used for aggregate rather than building stone.

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	Regional	Moderately good		
Sedimentology	Regional	Moderately good	Ritchie & Eckford 1935	X
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology				
Current Site Value				
Community	It is probably not visited by the general public.			0
Education	'Haggis Rock' is well-exposed and accessible with care for small groups.			8

References / Links

Craig, G.Y.& Duff, P. M.D. 1975 *The Geology of the Lothians and South East Scotland* p. 156

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* pp. 135-136

Ritchie, M. & Eckford, R.J.A. 1935 The Haggis Rock of the Southern Uplands *Trans. Edin. Geol. Soc*. 13, pp. 371-377

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p.54

OS 1:50,000 Map 66 Edinburgh

OS 1:50,000 Map 73 Peebles, Galashiels and Selkirk

OS 1.25,000 Explorer 344 Pentland Hills

BGS 1:50,000 Scotland Sheet 24E Peebles

Photo 1 View from the A703 looking north east into the quarry to show how overgrown it now is. June 2019

Photo 2 View to exposure of ‘Haggis Rock’ at the end of the overgrown quarry, with tipped farm rubbish June 2019

Photo 3 Crags at the end of the quarry, looking south east with Craigburn Farm in the distance. June 2019

Photo 4 Close-up of texture of ‘Haggis Rock’ from the exposure at the north east end of the quarry June 2019

CRAIGLANDS QUARRY, LOCHURD

Grid Reference: NT 108 433	Current use: grazing
Feature: Disused quarry	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyors: Alison & Barry Tymon	Date: 22/6/2019 & 17/8/2019
Site Map	

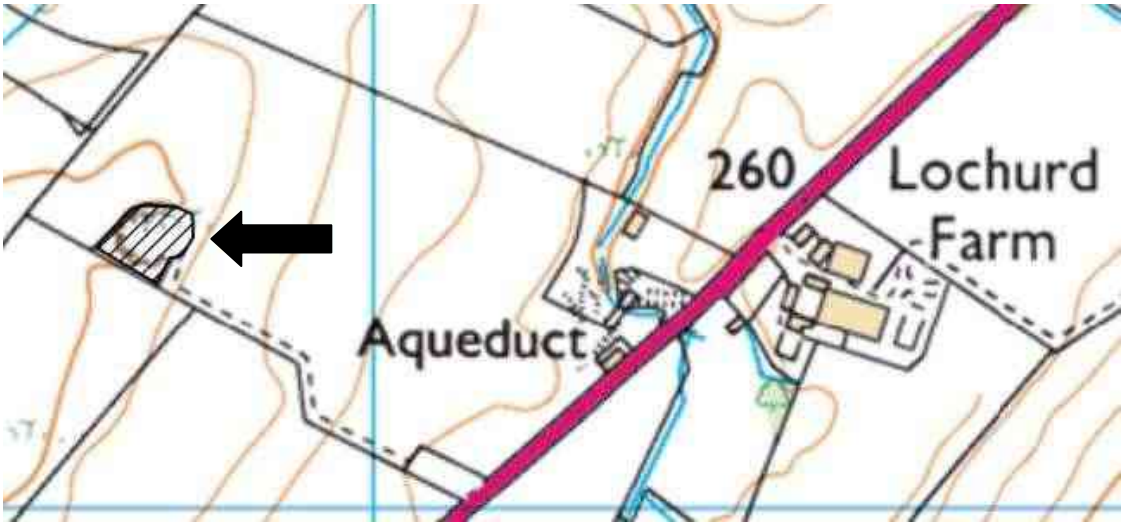


Figure 1: Location Map 1:25,000

Site Description (qualitative)

Craiglands Quarry exploited a very hard, fine-grained, green/dark grey well-cemented volcaniclastic sandstone, called the Auchtitench Sandstone Formation (Lanark Group, Early Devonian), probably for building field walls and for road stone. The quarry is about 50 m long and wide and the main face is about 7 m high in the centre. The quarry floor is clear of debris, though boggy, and access to all the rock faces is easy, particularly in dry weather.

The Auchtitench Sandstone is very hard, which makes it resistant to weathering and erosion, so it forms the upland landscapes between the Pentland Hills and the Southern Uplands in the Scottish Borders area, such as Blyth Muir and Broomy Law. It has been subjected to folding, faulting and metamorphism and so primary features of the sandstone are not easy to see in exposures.

The dark grains in the fine-grained sandstone were eroded from nearby volcanic rocks such as andesite and basalt, now called the Biggar and the Pentland Volcanic Formations, during the Lower Devonian and deposited in fast-flowing rivers. In places along the outcrop of the Auchtitench Sandstone, the sedimentary volcaniclastic rocks are interbedded with the volcanic rocks from which they are derived.

It is difficult to identify bedding planes, partly because of the lack of any visible sedimentary features and because the rock has many joint surfaces. The southern quarry face [NT 10830 43205] appears to have beds ranging from 20 cm to 100 cm in thickness, dipping NE at 40°, whereas the north side has thinner beds dipping at 74° to 344°. Alteration of the sandstones was noted, in the form of short, thin vertical veins of paler minerals, which could be seen as dark streaks on weathered surfaces, which increased in quantity towards the back (west) of the quarry. Garnet grains up to 5 mm across could be identified in many of the fresh sandstones.

A thin section, originally labelled trachyte, from a sample collected by H.H. Read is online in BGS Rock Collections (S24535). The geological map indicates that a fault along the back wall of the quarry cuts across the outcrop of the trachytes of the Biggar Volcanic Formation. However trachytes were not identified in this survey, although the sandstones showed signs of alteration due to faulting and slickensides were seen in one location.

Assessment of Site Value	
Geodiversity value: A quarry in the Auchtitench Sandstone Formation with evidence of alteration due to faulting	
Description: An accessible quarry in the Auchtitench Sandstone	
Access, Safety & Fragility	
Aspect	**Description**
Access notes	A gated field track from the A72 just south of Lochurd Farm leads to the quarry which is visible from the road. There is parking at the foot of the track for several vehicles.
Current condition (fragility)	Robust
Potential use	Research visits to see the unusual sandstone and other features.
Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	Appears as Craglands Quarry on Pastmap Scotland (post medieval), Noted in the Peebleshire OS names book 1856-1858 as Craiglands Quarry, owned by Mr Somerville of Netherurd Mains and Mr Gibson of Lochurd, and the stone was used for 'repairing roads and building dykes'.
Aesthetic landscape	There are excellent views to the south towards the Ordovician greywackes and the Moffat Shales of the Southern Uplands.
History of Earth Sciences	None
Economic geology	Shown on 1859 OS map as a whinstone quarry.
Built Heritage	Aggregate and stone for roads and field dykes.

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	Regional	Good	Browne *et al*. 2002	X
Sedimentology				
Igneous/Mineral/ Metamorphic Geology				
Structural Geology	Local	Poor		
Palaeontology				
Geomorphology				
Current Site Value				
Community	Not visited			0
Education	Unlikely to be visited by educational parties at present.			0

References / Links

Browne, M.A.E., Smith, R. A. & Aitken, A. M. 2002 *Stratigraphic Framework for the Devonian (Old Red Sandstone) rocks of Scotland south of a line from Fort William to Aberdeen*. British Geological Survey Search Report RR/01/04 p.11

Geikie, J & Geikie, A.1869 Explanation of Sheet 24 Peebleshire. *Memoirs of the Geological Survey of Scotland.* p.12

Pastmap reference to post-medieval quarry at https://canmore.org.uk/site/342081/craglands-quarry

Peeblesshire OS names book reference to Craiglands Quarry at https://scotlandsplaces.gov.uk/digital-volumes/ordnance-survey-name-books/peeblesshire-os-name-books-1856-1858/peeblesshire-volume-18/10

OS 1:50,000 Map 72 Upper Clyde Valley

OS 1:25,000 Explorer Map 336 Biggar and Broughton

BGS 1:50,000 Scotland Sheet 24W Biggar

Photo 1 The south side of Craiglands Quarry with Lochurd Farm in the valley. August 2019

Photo 2 Looking across the quarry floor to the north side of the quarry. August 2019

Photo 3 The back face of the quarry, thought to be a faulted contact with the trachyte of the Biggar Volcanic Formation, although little evidence was seen. August 2019

Photo 4 Possible faulted contact of Auchtitench Sandstone with trachytes along a slickensided surface. June 2019

CRAMALT ROAD CUTTING

Grid Reference: NT 1985 2292 – NT 2013 2296	Current use: Road cutting
Feature: Road cutting	Other designations: Tweedsmuir Hills SSSI (ecological) Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 25/6/17 & 21/6/19

Site Map

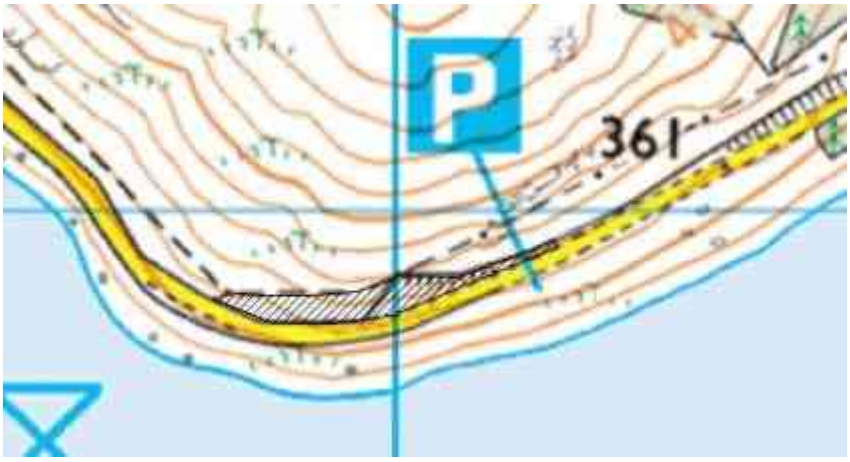


Figure 1: Location Map 1:25,000

Site Description

A 200 m long road section, dating from 1983 when the Megget Reservoir was completed, on the north side of the minor road overlooking Megget Reservoir. The face is about 8 m high.

The road section exposes the Queensberry Formation (Silurian Gala Group, Llandovery) and there is a detailed account of part of the section in *Scottish Borders Geology* pp.153-155.

At the east end of the section are siltstones dipping about 80^0 to N with a minor fault. Massive greywackes with some flute marks, lineations and other minor sole structures are found on the bend in the road with some flute marks, lineations and other minor sole structures. Tightly folded vertical laminated siltstones can be seen at the west end of section.

Thin sections of rocks collected by J.D.Floyd during BGS surveying are available at https://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks Rock numbers are S69396, S69401, S75397 – S75406

Assessment of Site Value

Geodiversity value: Sedimentary features of folded greywackes and siltstones are clearly visible at this exposure.	
Description: A long road cutting adjacent to a lay-by on the edge of Megget Reservoir.	

Access, Safety & Fragility

Aspect	**Description**
Access notes	Large lay-by on edge of Megget Reservoir opposite the road cutting.
Current condition (fragility)	Vegetation is colonising the more gentle slopes and some larger blocks have recently fallen onto the grass verge. However, the exposure will remain accessible for some time before management is needed.
Potential use	The cutting is an excellent site for educational use as the features are clearly visible. It is possible for groups to observe the rocks in the cutting

	from the wide grass verge, as long as care is taken on the minor road.

Culture, Heritage & Economic

Aspect	Description	
Historical, archaeological & literary associations	None	
Aesthetic landscape	Pleasant views from the lay-by across Megget Reservoir	
History of Earth Sciences	None	
Economic geology	N/A	
Built Heritage	N/A	

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy				
Sedimentology	Local	Moderately good		
Igneous/Mineral/ Metamorphic Geology				
Structural Geology	Local	Good	McAdam, Clarkson & Stone 1993	X
Palaeontology				
Geomorphology				

Current Site Value		
Community	The lay-by attracts many visitors but it is unlikely that many are part of the local community	0
Education	Good accessibility means that it is used by groups.	4

References / Links

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* pp. 153 - 155

OS 1:50,000 Map 73 Peebles, Galashiels & Selkirk

OS 1:50,000 Map 72 Upper Clyde Valley

OS 1:25,000 Explorer 337 Peebles & Innerleithen

OS 1.25,000 Explorer 336 Biggar and Broughton

BGS 1:50,000 Scotland Sheet 16E Ettrick

Photo 1 East end of the road cutting, showing near-vertical siltstones and greywacke beds with minor folding June 2017

Photo 2 Steeply dipping siltstones and shales at the east end of the cutting. Walking pole is 1.2 m long. June 2017

Photo 3 Massive greywackes in the central section of the cutting. June 2019

Photo 4 Near-vertical siltstones and shales at the west end of the cutting. June 2019

Photo 5 General view of road cutting looking west from lay-by. June 2019

DINGLETON QUARRY, MELROSE

Grid Reference: NT 540 334	Current use: None
Feature: Disused quarry	Other designations: Eildon and Leaderfoot National Scenic Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 3/6/2018 & 18/7/2019

Site Map

Figure 1: Location Map 1:25,000

Site Description

Dingleton Quarry exploited the Chiefswood Vent (volcanic neck) which is composed of unstratified volcanic agglomerate. It is thought that the Chiefswood Vent cut through the trachyte intrusion of the Eildon Hills to form a small volcano. The igneous rocks of the Eildon Hills have been dated at 352 million years old, so the Chiefswood volcano is probably slightly younger.

The main face is about 20 m high and 20 m long, within a quarry about 50 m across. The quarry is overgrown with trees but the main rock face is accessible. The bottom of the quarry is overgrown and strewn with dead wood, but there is little rubbish.

The face has widely spaced irregular jointing. Poorly sorted angular igneous clasts of up to 20 cm long in the brownish agglomerate are found in a matrix of fragments less than 1-2 cm and consist mostly of trachyte, but with some grits, greywacke, red sandstone and shale fragments included. The weathered rock is orange/yellow or grey/green in colour and has been used widely for construction in buildings in Melrose, where the rock's texture can be examined easily.

Assessment of Site Value

Geodiversity value: The quarry is an accessible site where the rocks of the Chiefswood Vent, a particularly good example of a volcanic agglomerate, can be studied.

Description: A disused quarry in the volcanic agglomerate of the Chiefswood Vent.

Access, Safety & Fragility

Aspect	Description
Access notes	Access from Chiefswood Road, a minor road between Dingleton and Darnick. There is no road parking, but walkers can reach the quarry face through woodland which is adjacent to the road.
Current condition (fragility)	The steep quarry face appears safe, so it is likely that the exposures will be available for the foreseeable future. However, the quarry floor is becoming increasingly overgrown with saplings, so access will become more difficult.

Potential use	The quarry can be accessed by small groups and is the best place to see the volcanic agglomerate of the Chiefswood Vent.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	The agglomerate of the Chiefswood Vent provided building stone for Melrose Abbey, although it is likely that the stone was obtained from the Chiefswood Quarry on the north side of Quarry Hill in medieval times, as map evidence indicates that Dingleton Quarry was opened in the nineteenth century.	
Aesthetic landscape	N/A	
History of Earth Sciences	None	
Economic geology	The quarry is shown as a line of crags on the 1863 OS map, but was further extended, according to maps from 1897 and 1924 and may also have been working into the 1950s.	
Built Heritage	The quarry provided building stone for the Melrose area from the nineteenth century onwards. A drill hole was noted on one of the rock faces.	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology	Regional	Good	McRobert 1914, McGregor & Eckford 1946, McAdam, Clarkson & Stone 1993, Clarkson & Upton 2010	X
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value		
Community	It is unlikely that anyone visits the quarry.	0
Education	There may be visits by small groups of geologists.	2

References / Links

Clarkson, E. & Upton, B. 2010 *Death of an Ocean* pp.181-182

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* pp. 110-111 Includes other references to the quarries in the Chiefswood Vent.

McGregor, A.G. & Eckford, R.J.A. 1946 The Upper Old Red and Lower Carboniferous sediments of Teviotdale and Tweedside and the stones of the abbeys of the Scottish Borderland. *Trans.Edin.Geol.Soc.* p. 248

McRobert, Lady Rachel W. 1914. Acid and intermediate intrusions and associated ash necks in the neighbourhood of Melrose. *Quart. Geol. Soc. London*. 70, pp. 303-315.

Stone, P, McMillan, A. A., Floyd, J.D.,Barnes, R.P. and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (Fourth Edition). Keyworth, Nottingham: British Geological Survey pp. 153-154

Upton, B. 2004 *Volcanoes and the Making of Scotland* pp.165-166

Pringle, J. 1935 *British Regional Geology: The South of Scotland* p.77

OS 1:50,000 Map 74 Kelso & Coldstream

OS 1:25,000 Explorer 338 Galashiels, Selkirk & Melrose

BGS 1:50,000 Scotland Sheet 25W Galashiels

Photo 1 View looking west across the front of the quarry face June 2018

Photo 2 Photo to show the flat worked face of the agglomerate in the main part of the quarry. July 2019

Photo 3 View to show the western end of the quarry July 2019

Photo 4 One of several large clasts, possibly andesitic in composition, embedded in the matrix of the agglomerate. The note book is 20 cm long. July 2019

Photo 5 Texture of the agglomerate rock, to show the pale colour of the fine matrix in which larger angular pebbles of various igneous rocks are embedded. Card is 10 cm long. July 2019

EDRINGTON CLIFF

Grid Reference: NT 9400 5335	Current use: River cliff
Feature: Inland exposure	Other designations: SSSI Whiteadder Water
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 17/4/2017

Site Map

Figure 1: Location Map 1:25,000

Site Description

The site is a river cliff on the east bank of Whiteadder Water exposing Ballagan Formation (Inverclyde Group, Tournasian, Lower Carboniferous) sandstones. The cliff is about 8 m high and the medium-bedded pink sandstones dip gently downstream towards the south at about 20°. Some beds have marked cross-bedding in sets about 0.5 m high.

The sandstones were quarried from faces about 12 m high in the river bank just upstream of the present exposure but the faces are now lost under vegetation and are not accessible. Chisel marks can be seen in the cutting on the lane leading from the east side of the river down to the footbridge.

The sandstones in the quarry are reported to include ‘lenticular bands of breccia in the sandstone’ with ‘numerous fragments of shale, up to 4 or 6 inches across, embedded in a sandy matrix’ (McGregor & Eckford 1946). These beds would have been worthless to the quarrymen.

Assessment of Site Value

Geodiversity value: A rare natural exposure of Ballagan Formation sandstones

Description: A wooded river cliff on Whiteadder Water with an exposure of dipping sandstones.

Access, Safety & Fragility

Aspect	Description
Access notes	Access by footpath from the lane to Edrington Castle Farm from the A6105. Walk down the lane and cross the Whiteadder Water on the footbridge, then walk south a short distance along the river bank. The cliff is visible from the opposite side of the river. There is also a footpath to the footbridge from Paxton on the west side of the river.

Current condition (fragility)	The river cliff is subject to river erosion, but is likely to remain stable.
Potential use	Geology groups would find the dipping sandstones and cross-bedding of interest and may be interested in the history of the attractive and historic hamlet of Edrington.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	A date for the building of Edrington Castle is uncertain but the nearby river cliff is likely to have been exploited for the construction stone.	
Aesthetic landscape	Whiteadder Water runs along the foot of the wooded cliff which is very attractive when seen from the footpath on the west side of the river.	
History of Earth Sciences	None	
Economic geology	Construction stone for local use which could be transported by river.	
Built Heritage	Stone from quarries near Edrington Castle was used to build the Town Hall in Berwick-upon-Tweed in the 1750s. Fuller (1799) reports that the stone 'is said to be by far the finest in this neighbourhood'.	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy				
Sedimentology	Local	Good	McGregor & Eckford 1946	X
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology	Local	Good		X

Current Site Value		
Community	The footpath and bridge by Whiteadder Water are frequently used by walkers.	10
Education	It is unlikely that geological groups visit the site at present.	0

References / Links

Fuller, J. 1799 *The History of Berwick-upon-Tweed* (reprinted 1973) p.182

McGregor, A.G. & Eckford, R.J.A. 1946 The Upper Old Red and Lower Carboniferous sediments of Teviotdale and Tweedside and the stones of the abbeys of the Scottish Borderland. *Trans.Edin.Geol.Soc.* p. 239

OS 1:50,000 Kelso & Coldstream Map 74

OS 1:25,000 Explorer 346 Berwick-upon-Tweed

BGS 1:50,000 Scotland Sheet 34 Eyemouth

Photo 1 Downstream view from the footbridge over Whiteadder Water to show the overgrown river side quarry and the exposed rock on the river's edge. April 2017

Photo 2 Exposure of Ballagan sandstones dipping downstream April 2017

Photo 3 Looking slightly upstream to show the overgrown quarry section on the left April 2017

EILDON HILLS

Grid Reference: North Hill NT 5543 3283, Mid Hill NT 5481 3223, Wester Hill NT 5483 3160, Little Hill NT 5455 3195	Current use: Archaeological, ecological and recreational site
Feature: Inland exposures	Other designations: Eildon and Leaderfoot National Scenic Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 2/8/17

Site Map

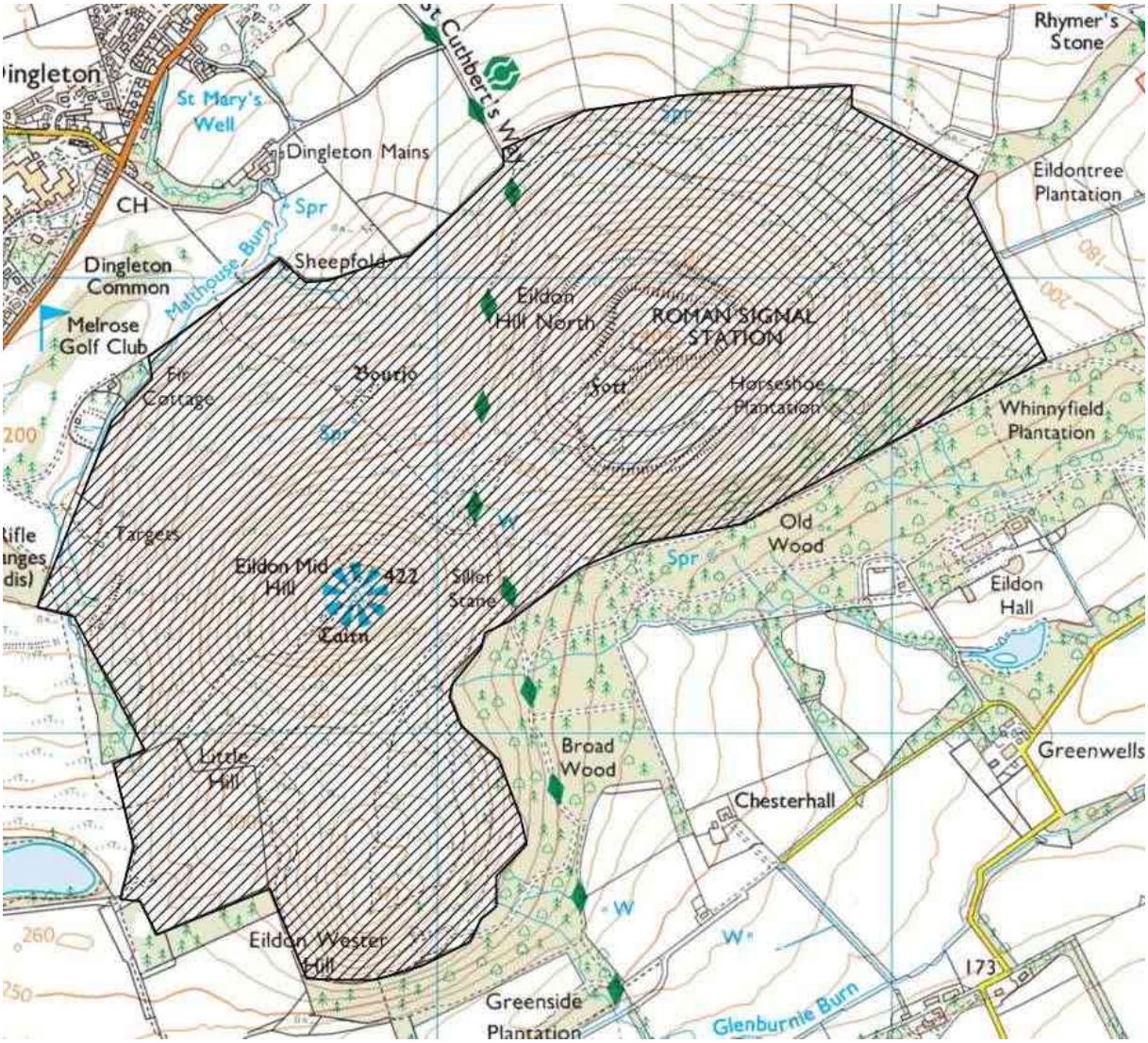


Figure 1: Location Map 1:25,000

Site Description

These well-known hills above Melrose dominate views for many miles around. The Roman town of Trimontium, which lies near the River Tweed below the hills, was named after their three prominent summits. They are largely composed of trachytic sill-like intrusions (sometimes known as the Eildon Hills laccolith) lying above Silurian greywackes (Hawick Group) and horizontal Upper Old Red Sandstone (Stratheden Group and Inverclyde Group). The igneous rocks have been recently dated at 352 million years old (Lower Carboniferous).

North Hill is composed of several horizontal trachyte sills and there is an exposure of finely jointed rock on the path to the summit at NT 5543 3283. The summit has a cairn of broken trachyte boulders.

The north and east faces of Mid Hill are characterised by benches dipping to the north-east formed by sills of trachyte and rhyolite.

A small trachyte quarry is found in the col between North Hill and Mid Hill (NT 55068 32516). One face has some slickensides and there is evidence of rock smoothed by chisels at the end of the quarry.

Wester Hill (NT 5483 3160) is composed largely of pale rhyolite, as seen by exposures and loose rock in the path to the summit from the north.

Little Hill (NT 5455 3195) is a basaltic neck with crags to the western slope and an exposure of basaltic breccia (agglomerate) on the summit and is probably the site of an eroded volcano.

Assessment of Site Value

Geodiversity value: The three hills are excellent examples of silicic intrusions with slightly different compositions, not otherwise found in the Scottish Borders. The geomorphology of the hills is controlled by the nature of the geological features.

Description: The classic scenery of the three peaks of the Eildon Hills is underlain by unusual igneous rocks which can be studied in exposures on footpaths, crags and in a small quarry.

Access, Safety & Fragility

Aspect	Description
Access notes	There are many public footpaths across the hills, which are well-signposted. St Cuthbert's Way long distance footpath runs through the col between North Hill and Mid Hill.
Current condition (fragility)	The area is very well-walked so footpath erosion exposes the underlying rock for viewing by geologists.
Potential use	Geological groups already visit the Eildon Hills. There is potential to develop interpretation for the general public, with information boards or a leaflet, which might include other nearby LGS.

Culture, Heritage & Economic

Aspect	Description
Historical, archaeological & literary associations	North Hill was a large Bronze Age hillfort surrounded by extensive ramparts. A first century Roman signal station, connected with the Roman town of Trimontium, was built within the abandoned fort and possibly used for several centuries.
Aesthetic landscape	The hills are covered with heather moorland and have wonderful views of the surrounding landscapes.
History of Earth Sciences	The geology of the Eildon Hills, with other similar igneous areas, was described in the early 20th century by Lady Rachel McRobert, an American geologist who was one of the first women to be elected a Fellow of the Geological Society of London.
Economic geology	The Bourjo is thought to be a quarry located close to the path between Eildon Mid Hill and North Hill (NT 5474 3285) but there is little sign of any workings except spoil tips. In 1939 it was reported that the quarry appeared to be of great age and it is therefore probable that this quarry was a source of the yellow sandstone that was used in the rebuilding of Melrose Abbey after 1385 (Eckford & Anderson 1939). There is a small disused trachyte quarry close to the col between the two hills (NT 55068 32516) recorded on a map from 1863.
Built Heritage	See above

GeoScientific Merit	Rarity	Quality	Literature /Collections	First
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology	Regional	Good	McRobert 1914, Pringle 1935, Eckford & Anderson 1939, McGregor & Eckford	X

			1946, McAdam & Clarkson 1993, Clarkson & Upton 2010, Stone *et al.* 2012	
Structural Geology				
Palaeontology				
Geomorphology	Regional	Excellent		X
Current Site Value				
Community	The hills are walked by visitors and local people.			10
Education	Educational groups visit the area.			4

References / Links

Clarkson, E. & Upton, B. 2010 *Death of an Ocean* pp. 180-181

Eckford, R.J.A. & Anderson, F.W. 1939 Report on the building-stones used in the construction of the Abbey of St Mary at Melrose. *History of the Berwickshire Naturalists Club*, XXX, pp.178-182.

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* pp. 112-120

McGregor, A.G. & Eckford, R.J.A. 1946 The Upper Old Red and Lower Carboniferous sediments of Teviotdale and Tweedside and the stones of the abbeys of the Scottish Borderland. *Trans.Edin.Geol.Soc.* p. 248

McRobert, Lady Rachel W. 1914. Acid and intermediate intrusions and associated ash necks in the neighbourhood of Melrose*. Quart. Geol. Soc. London*. 70, pp. 303-315.

Stone, P, McMillan, A. A., Floyd, J.D.,Barnes, R.P. and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (Fourth Edition). Keyworth, Nottingham: British Geological Survey pp.153-154

Upton, B.2004 *Volcanoes and the Making of Scotland* p.165

Pringle, J. 1935 *British Regional Geology: The South of Scotland* pp.75-77

http://www.geologynorth.uk/southern-uplands/igneous-rocks-in-the-southern-uplands/eildon-hills/

OS 1:50,000 Kelso & Coldstream Map 74

OS 1:25,000 Explorer 338 Galashiels, Selkirk & Melrose

BGS 1:50,000 Scotland Sheet 25W Galashiels

Photo 1 Mid Hill (right peak) and Wester Hill (left peak) from North Hill August 2017

Photo 2 North Hill from the south west showing the hill fort ramparts and rock exposures in the footpath August 2017

Photo 3 Mid Hill, showing the benches which result from the differential erosion of trachyte and rhyolite sills August 2017

Photo 4 Crags of basalt and breccia of the Little Hill volcanic neck from the north August 2017

Photo 5 Trachyte quarry at the col between Mid Hill and North Hill (NT 55068 32516) August 2017

Photo 6 Close-up of trachyte in small quarry shown in Photo 5. Scale in mm. August 2017

ETTRICKBRIDGE GORGE

Grid Reference: eastern end NT 38612 24123 western end NT 38200 23786	Current use: Mixed woodland, some of which has been recently planted on the south side
Feature: Inland exposures	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison & Barry Tymon	Date: 29/7/2019, 17/8/2019 & 18/9/2019

Site Map

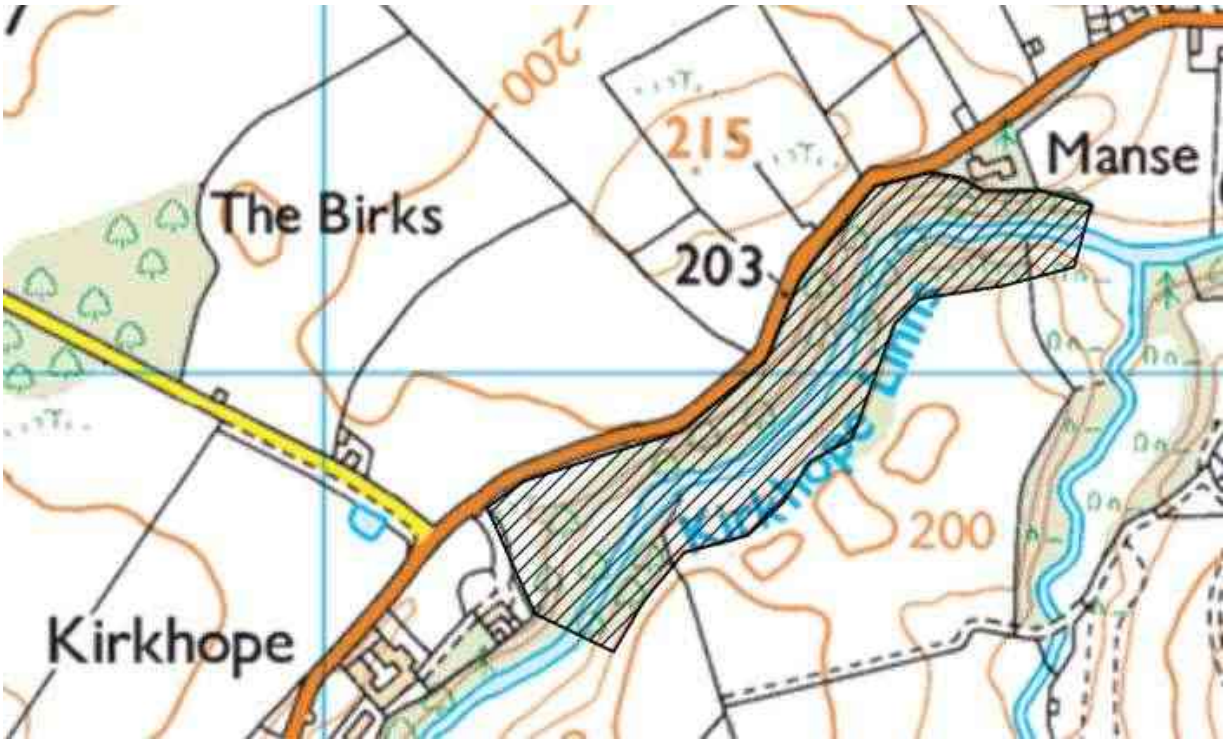


Figure 1: Location Map 1:25,000

Site Description

Ettrickbridge Gorge is a 700 m long wooded gorge of the Ettrick Water below Kirkhope House (formerly called the Manse) upstream from the village of Ettrickbridge. The river has eroded through soft shales and siltstones which are faulted between the tougher greywackes which form the hills around Ettrickbridge.

The rocks in the gorge are inliers of Ordovician Moffat Shale Group strata. The inliers lie within the Ettrick Group (Kirkhope Formation, Llandovery, Silurian) along a thrust plane (BGS Sheet Scotland 17W Hawick). The Moffat Shales exposed in the river bed and banks are thought to include the Glenkiln Shale Formation (Caradoc, Ordovician), Upper and Lower Hartfell Shales (Caradoc and Ashgill, Ordovician) and the Birkhill Shales (Ashgill and Llandovery, Ordovician and Silurian), as well as Crawford Group (Arenig and Llandeilo, Ordovician) radiolarian cherts (Stone *et al*. 2012 p. 50).

At the eastern end of the gorge is a small shingle beach on the north bank [NT 38613 24126] exposing 1 m of pale grey jointed siltstones, dipping at 68° to 336°, below about 4 m of red and green laminated shales. Above a vegetated gap in exposure, thinly-bedded fine to medium-grained sandstones in beds about 15 cm thick, some with sole markings and interbedded with shales, become more prominent higher in the cliff below Kirkhope House (known as Manse Cliff in former geological literature). These rocks are probably part of the Upper and Lower Hartfell Shale Formations. Gently dipping exposures in the middle of the river and low down on the south bank include the Glenkiln Shale Formation and the Crawford Group cherts, but cannot be reached except at low water levels.

The western end of the gorge is accessed by an unmarked footpath to the east of Kirkhope Farmhouse which leads steeply down to the river bank. A 2 m high exposure of dark red mudstone is seen near the top of the footpath [NT 38185 23883]. The beds range from 5 – 30 cm in thickness and dip at 15° to

278°. These are probably part of the Birkhill Shale Formation. Rock exposures, which could be accessed from the south side of the gorge, can be seen in the river bed at this point.

Silurian Hawick Group greywackes form a 20 m high cliff on the wooded north side of the river from the footpath near Kirkhope Farmhouse eastwards, most clearly observed at the western end [NT 38226 23914] where the rocks dip at 39° to 232°. Beds of greywacke, up to 40 cm thick, are interbedded with siltstones 20-60 cm thick, which often wedge out laterally. Thicker beds of greywacke form the top of the cliff but are difficult to observe through the tree canopy.

Access to the north side of the gorge is difficult but a cliff of exposed rock [NT 3826 2309] at river level can be seen from across the gorge. The cliff is probably comprised of the Birkhill Shale and the Lower and Upper Hartfell Shale Formations.

Assessment of Site Value

Geodiversity value: Rare exposures of several formations of the Moffat Shale Group.

Description: A river gorge which exposes greywackes, sandstones, siltstones and mudstones on steep river cliffs.

Access, Safety & Fragility

Aspect	Description
Access notes	Ask at Cherrydeane, opposite Ettrickbridge Village Hall, for permission to go through the field to get access to the east end of the river bank through a field gate. Access to the west end of the gorge is possible from an unmarked path on the drive to Kirkhope Farmhouse, with parking at the road junction nearby. Access to the river from the south side of the gorge may be obtained by permission from Helmburn Farm (NT 392 242). Visits are best made when there are no leaves on the trees and the river level is low.
Current condition (fragility)	It is likely that all the exposures close to the river bed will be kept clear by river erosion.
Potential use	Scientific research only

Culture, Heritage & Economic

Aspect	Description
Historical, archaeological & literary associations	Not known
Aesthetic landscape	A narrow winding gorge about 700 m long, with wooded cliffs about 15-20 m high.
History of Earth Sciences	None
Economic geology	N/A
Built Heritage	N/A

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	National	Poor	Stone *et al.* 2012	X
Sedimentology	Local	Good		
Igneous/Mineral/ Metamorphic Geology				
Structural Geology	Local	Good		
Palaeontology				
Geomorphology	Regional	Good		

Current Site Value

Community	Access is difficult so it is unlikely that many visit the gorge.	0

Education	It is likely that research geologists visit the exposures of Moffat Shale, which are unusual in the Scottish Borders.	4

References / Links

Pringle, J. 1935 *British Regional Geology: The South of Scotland* pp. 25, 40.

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, pp. 50, 70.

1:50,000 Landranger Map 73 Peebles, Galashiels and Selkirk

1:25,000 Explorer Map 337 Peebles and Innerleithen

1:50,000 BGS Sheet Scotland 17W Hawick

Photo 1 View upstream of Ettrick Gorge taken from the south side of the gorge. August 2019

Photo 2 View downstream from Kirkhope from the north bank of Ettrick Water. August 2019

Photo 3 Shingle beach at the east end of the gorge [NT 38612 24123] which is accessible from the field by Cherrydeane in Ettrickbridge, showing exposures of the Upper and Lower Hartfell Shales. July 2019

Photo 4 Mudstones of the Lower Hartfell Shale Formation at NT 38612 24123 July 2019

Photo 5 Birkhill Shale Formation red mudstones just below Kirkhope Farmhouse at NT 38185 23883. August 2019

Photo 6 View upstream from the shingle beach at the eastern end of the gorge showing rock exposures in the river which would be accessible at low water and consist of the Glenkiln Shale Formation and the Crawford Group cherts September 2019

GRASSFIELD QUARRY, NOBLEHOUSE

Grid References: north end NT 19544 49947, south end NT 19471 49875	Current use: The site is surrounded by commercial forestry.
Feature: Disused quarries	Other designations: None
Current geological designations: Type section of the Noblehouse Lava Member	Other scientific: None
Field surveyor: Alison Tymon	Date: 28/6/17 & 16/8/2019

Site Map

Figure 1: Location Map 1:25,000

Figure 2: Outline of present quarries on recent satellite image with proposed boundary. Note new forest tracks.

Site Description

The quarries expose the Ordovician Marchburn Formation (Tappins Group, Caradoc) which lies

between the Southern Uplands Fault to the NW and the Grassfield Fault to the SE. The northern quarry is the type section of the basalt pillow lavas and red cherts which have been defined as the Noblehouse Lava Member and are thought to be characteristic of oceanic island basalts (Stone *et al.* 2012)

The southern quarry exposes basalt pillow lavas at NT 1955 4995 on a 6 m high face about 15 m wide. As the rocks are steeply dipping to the SE, the view is of the tops of the pillows. Many are bounded by margins of spilite and chert resulting from extrusion into sea water and there are several near-vertical alteration zones cutting the exposure. The basalts contain small amygdales, many filled with calcite. On the northern side of the quarry, basalts dip at 70^{o} towards the SE (132^{o}). Grey siltstones of the Ordovician Kirkholm Formation, gently dipping to the SE, can be seen to the right of the main quarry face.

The northern quarry at NT 1954 4995, a few tens of metres to the NE, has a face about 2 m high of steeply dipping, heavily-jointed and reddened cherts, which are blue/grey when fresh. They are adjacent to a mass of pillow lavas about 4 m high, similar to those in the southern quarry, which form the main face and are probably faulted against the cherts. The basalt spoil below the quarry face includes many whole pillows, cross-sections of which show that they have a green spilitic margin and contain calcite-filled amygdales.

A thin section of the pillow lava, rock number S96606, is available online athttps://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks

Assessment of Site Value

Geodiversity value: The northern quarry is the type section of the Noblehouse Lava Member.

Description: Two disused quarries with exposures of Ordovician pillow lavas and cherts

Access, Safety & Fragility

Aspect	Description
Access notes	The two quarries lie about 1.25 km up a forestry track east from the A701. Parking is available on an access road just in front of Noblehouse Farm and permission should be requested.
Current condition (fragility)	The quarries are surrounded by forestry and may be vulnerable to infilling and planting.
Potential use	Groups of students and adults use the quarries for educational visits and that should be continued.

Culture, Heritage & Economic

Aspect	Description
Historical, archaeological & literary associations	None
Aesthetic landscape	Surrounded by commercial forestry
History of Earth Sciences	None
Economic geology	The quarries are marked on old maps and were probably exploited for road stone.
Built Heritage	It is unlikely that the stone was used for construction purposes.

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy				
Sedimentology	Local	Poor		
Igneous/Mineral/ Metamorphic Geology	National	Excellent	Craig & Duff 1975, McAdam *et al.* 1993, Floyd 1996, Clarkson & Upton 2010	X
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value		
Community	Commercial forestry surrounds the site so visitors are rare.	0
Education	The site is the best exposure of Ordovician pillow lavas in the Scottish Borders and is suitable for visiting groups, with permission from the owner.	10

References / Links

Clarkson, E and Upton, B *Death of an Ocean: A Geological Borders Ballad* 2010 pp.47-49

Craig, G.Y.& Duff, P. M.D. 1975 *The Geology of the Lothians and South East Scotland* p.162

Floyd, J D, 1996. Lithostratigraphy of the Ordovician rocks in the Southern Uplands: Crawford Group, Moffat Shale Group, Leadhills Supergroup. *Transactions of the Royal Society of Edinburgh: Earth Sciences,* Vol.86, pp.153-165.

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* pp.136-137

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p. 55.

OS 1:50,000 Map 72 Upper Clyde Valley

0S 1:25,000 Explorer 344 Pentland Hills

BGS 1:50,000 Scotland Sheet 24W Biggar

Photo 1 The southern quarry from the south August 2019

Photo 2 The main quarry face of the southern quarry looking east, showing pillow lavas. August 2019

Photo 3 Main face of the southern quarry, showing basalt pillows. June 2017

Photo 4 Close up of spilitic pillows in the main face of the southern quarry with walking pole for scale. June 2017

Photo 5 View of northern quarry, showing red cherts on the left and basalt exposures on the right with scree of pillow lavas on the quarry floor. August 2019

Photo 6 Main face of basalt pillows in the northern quarry August 2019

Photo 7 Red chert exposure in the northern quarry. August 2019

Photo 8 A pillow on the scree in the northern quarry, showing green spilitic alteration. June 2017

HABBIE'S HOWE

Grid Reference: NT1694 5648 to NT 1783 5657	Current use: Recreational walking and nature reserve
Feature: Inland exposure/geomorphological site	Other designations: Not known
Current geological designations: One section of the Carlops Melt-water Channels SSSI	Other scientific: Not known
Field surveyors: Howard Turner, Alison Tymon, Barry Tymon	Dates: 20/6/2019 & 16/8/2019
Site Map	

Figure 1: Location Map 1:25,000

Site Description (qualitative)

The River North Esk flows through a steep-sided and, in places, narrow valley about a kilometre long between Mill Bridge near Amazondean and Craigy Bield. The valley is thought to be a glacial meltwater channel and the waterfall is a knick point, produced by headward erosion of the river in the valley. The remarkable formations caused by erosion and under-cutting of the relatively unresistant sandstones in the bottom of the valley may reflect varying levels of water in the channel during glacial or post-glacial times.

The sedimentary rocks consist of limestones, sandstones and mudstones of the Carboniferous Lower Limestone Formation (Clackmannan Group, Visean). Exposures are found in the sides of the valley but rarely in the river bed. The succession is cut by several faults, indicated by frequent changes of dip angle and direction. There are many interesting exposures, described below.

1. Limestone exposure at NT16938 56475 near Mill Bridge, Amazondean. This is a limestone within the Limestone Coal Formation (Clackmannan Group) (BGS Sheet 32W Livingston), although it appears similar to the Blackhall Limestone seen at Location 2. It is a crystalline, fossiliferous, cream-coloured limestone, which effervesces freely with dilute HCl, and has a characteristic yellow weathering skin. Fragments of crinoid stems, a solitary coral and shells were visible in a loose, weathered block. Rubbly beds of limestone range in thickness from 10 cm to more than 1 m and the dip was measured at 83° towards the SE. The steep dip suggests the proximity of a fault.
2. An exposure at NT 17295 56387 on the steep path down to the river from the top of the valley on the S side exposes 1 m of grey Blackhall Limestone which weathered to an ochre colour and effervesces slowly with dilute HCl. Vugs and small shells were seen, with crystals of calcite within the rock. This limestone was also seen on the river bank downstream and dipped at 35° SE (109°).
3. Reaching the River North Esk and turning upstream, the path follows the N bank, passing several extensive cliffs of the Blackhall Limestone up to 10 m high on both sides of the river. The general dip is 12° to the SW (205°).

4. A waterfall is reached at NT 1710 5633. It falls over 2 m of crinoidal Blackhall Limestone, underlain by dark grey mudstone, which gives rise to the plunge pool below (Peggy's Pool). Brown (1874) mentions a conglomerate above the waterfall which contains Ordovician limestones with associated fossils, similar to the Wrae Limestone but the recent survey was unable to find this exposure in the woodlands.
5. Returning downstream, at NT 1739 5646 are two adjacent exposures, a little more than 1 m high, which show thinly-bedded sandstones overlying black mudstones which dip at 28° NE (055°). Further downstream, there is a significant gully running up the hillside to the E of the folly, which may represent a fault, as loose blocks of sandstone are seen in the river bed nearby.
6. A river cave/arch (Sandy's Cave) is seen at NT 1749 5646 opposite a footbridge. The feature appears to have been a natural arch in yellow sandstone of the Limestone Coal Formation, into which has been cut an opening which widens out into a low cave. There are some indistinct pick marks on one side of the inner arch, which suggests that some of the excavation has been man-made, perhaps as part of the early 19th century landscaping of Habbie's Howe. In places, letters have been incised into the sandstone. The sandstone is medium to fine-grained with massive bedding dipping at 12° to the W (290°). Major joints are marked by iron and there are Liesegang rings in places.
7. There are several cliffs of similar massively bedded sandstone downstream for at least 200 m on the south river bank, one of which (NT 17678 56515) is about 6 m high and is very undercut. Into one of the sandstone exposures is carved an inscription from 'The Gentle Shepherd' by Allan Ramsay.
8. At the east end of the gorge, at about NT 1783 5657, the valley widens and an extensive exposure of sandstone is seen on the N bank. A footbridge crosses the river and just beyond is a second plaque with a quotation from Allan Ramsay's 'The Gentle Shepherd'.

Assessment of Site Value	
Geodiversity value: A steep-sided glacial meltwater gorge has unusual landforms such as river-eroded caves. Several rock types of the Lower Carboniferous Limestone Coal Formation are exposed in the valley sides and at a small waterfall and are accessible for study.	
Description: A wooded gorge about 1 km long, with riverside cliffs of limestones, mudstones and sandstones as well as a small waterfall and eroded sandstone river caves.	
Access, Safety & Fragility	
Aspect	**Description**
Access notes	Ask for permission to park at Amazondean Farm or Newhall Estate, or walk from the public car park in Carlops.
Current condition (fragility)	The exposures of limestone, mudstones and sandstone are already wooded, so some management might be needed to maintain visibility.
Potential use	It would be possible to create a geological trail along the main footpaths.
Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	There are two plaques carved into sandstone in the downstream section of the valley, now much weathered, but their wording is clarified by notices nearby. They consist of quotes from 'The Gentle Shepherd', a pastoral comedy by Allan Ramsay published in 1725. The landscape of Habbie's Howe was undertaken during the late 18th century and remodelled in the early 19th century by the owner of the Newhall Estate, Robert Brown, as a setting for 'The Gentle Shepherd'. The sandstone cave/arch (Sandy's Cave) has early graffiti.
Aesthetic landscape	A delightful wooded valley, with pleasant footpaths along the top of the south side and along the River North Esk. Interesting features include a waterfall with plunge pool (Peggy's Pool), views of a folly tower and Newhall House on the north side of the valley. The downstream section has water-eroded and undercut sandstone caves, possibly adapted in earlier times to provide grottos and shelters along the river bank during the 19th century landscaping.

History of Earth Sciences	None
Economic geology	None
Built Heritage	Mary's Bower, a circular folly built in the late 18th century, stands on the north bank of the gorge.

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	Local	Good	Brown 1974, Henderson 1874	
Sedimentology	Local	Good	Tulloch & Watson 1958	
Igneous/Mineral/ Metamorphic Geology				
Structural Geology	Local	Poor		
Palaeontology	Local	Moderately good		
Geomorphology	Regional	Excellent		X
Current Site Value				
Community	Frequent use by walkers.			10
Education	A good site for local groups to see a variety of geological features.			5

References / Links

Brown, D.J. 1874 On the Silurian rocks of the south of Scotland: Part II Llandovery rocks. *Trans.Edin.Geol.Soc.* p. 320

Henderson, J. 1874 Notice of some fossils from the conglomerate at Habbie's Howe, Logan Burn, near Edinburgh. *Trans.Edin.Geol.Soc.* p. 389

Historic Environment Scotland Summary 2001

Tulloch, W. & Walton, H.S. 1958 *The Geology of the Midlothian Coalfield.* Memoir of the Geological Survey of Scotland. p. 24

OS 1:50,000 Map 66 Edinburgh

OS 1:50,000 Map 72 Upper Clyde Valley

OS 1.25,000 Explorer 344 Pentland Hills

BGS 1:50,000 Scotland Sheet 32W Livingston

Photo 1 Near-vertical limestone, probably associated with faulting, at Mill Bridge, Amazondean, at NT16938 56475. June 2019

Photo 2 Sandy's Cave, which is likely to have been formed by river erosion as a natural arch but possibly modified to make a cave when Habbie's Howe was landscaped during the early 19th century. June 2019

Photo 3 The interior of Sandy's Cave showing the nature of the erosion of the soft sandstones. June 2019

Photo 4 Sandstone crags, undercut when the valley contained glacial or post-glacial drainage at higher levels than the present river (NT 17678 56515). June 2019

Photo 5 Sandstone crags at the end of the gorge by the footbridge at NT1783 5657. June 2019

Photo 6 Waterfall of horizontal crinoidal Blackhall Limestone, underlain by mudstones. The plunge pool (Peggy's Pool) is formed by the undercutting of the less resistant mudstones (NT 1710 5633) June 2019

Photo 7 Crags of Blackhall Limestone to the east of the waterfall. August 2019

Photo 8 Mary's Bower, the early 18th century folly at the top of the north side of the valley. August 2019

Photo 9 View into Habbie's Howe meltwater valley from Mary's Bower, looking south. August 2019

Photo 10 Plaque carved into sandstone at NT 17610 56492 bearing a quotation from 'The Gentle Shepherd' by Allan Ramsay. June 2019

HAIRY CRAIGS QUARRY, AYTON

Grid Reference: NT 9090 6108 – NT 9101 6083	Current use: Sheep grazing
Feature: Disused quarry and inland exposures of natural crags	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 29/11/2018 & 6/6/2019

Site Map

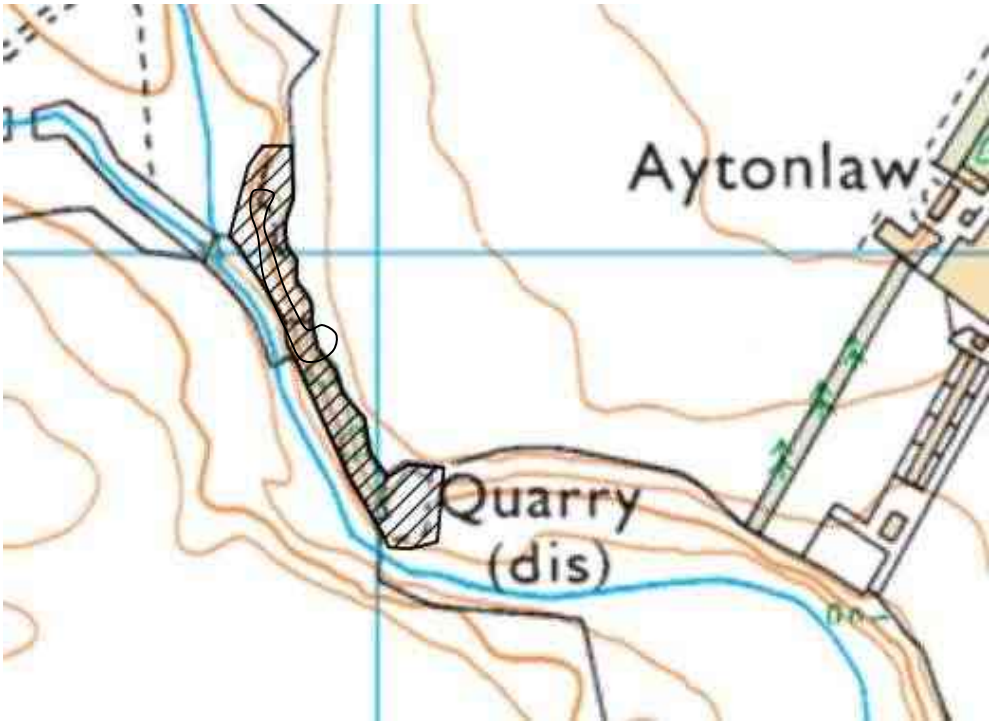


Figure 1: Location Map 1:25,000

Site Description

This quarry and associated natural crags are excellent exposures of early Devonian (Lower Old Red Sandstone) volcaniclastic sediments of the Auchencrow Burn Sandstone Formation (Reston Group).

Hairy Craigs Quarry (named on old maps as Hare Crag Quarry and Harry Craig Quarry, but known by the owners as Hairy Craigs Quarry) is found on the north side of the Eye Water river cliff to the west of Ayton Cottages. The quarry face is about 5 m high and 12 m wide and consists of a vertical, planar surface with beds dipping at about 45° to 110° (SE). The rock is a coarse lithic arenite, with I mm angular particles and occasional clasts up to 4 cm long, interbedded with lenses of finely-bedded fine lithic arenites up to 20-30 cm wide and showing small-scale cross-bedding. There are some discontinuous lenses of coarser material, with clasts up to 3 cm. White calcite crystals, up to 2 cm long, are seen within the coarse arenites in places. The sand grains are dark red, yellow and purple in colour and one large purple clast was seen to have a yellow reaction rim. The materials are probably derived from the erosion of local lavas.

Nearby exposures to the NW of Hairy Craigs Quarry are of interest. The first exposure along the riverside path to the NW shows thinly-bedded arenite, with occasional clasts up to 3 cm in length, dipping at 58° to 112° (SE). Other exposures, up to 3 or 4 m high and of the same rock, continue northwards along the east bank of the Eye Water as far as the field edge at NT 909 611, with dips of 30 - 40°. Beds of fine-grained dark pink quartz arenite up to 1 m thick are found in places, although they are not exposed in the main quarry face.

The Eyemouth memoir describes these rocks as ‘coarse, agglomeratic tuffs’ (Greig 1988, p. 27).

Assessment of Site Value

Geodiversity value: Coarse lithic arenites of the Auchencrow Burn Sandstone Formation which are not otherwise exposed in the outcrop area of the Reston Group around Reston and Ayton.	
Description: A small quarry face and natural crags which can be examined for their lithology and features.	

Access, Safety & Fragility

Aspect	Description
Access notes	A footpath from Victoria Jubilee Bridge [NT 917 604] on the minor road between Ayton and Reston runs NE along the Eye Water about 500m. The quarry is at the end of the field on the north bank of the river. Follow the footpath along the river NE through woods to see further exposures.
Current condition (fragility)	The quarry face is stable and clear of vegetation and likely to stay accessible and visible. Gorse growing in places on the natural crags has been recently burned and access and visibility is good.
Potential use	The site would be of interest to students and adult groups.

Culture, Heritage & Economic

Aspect	Description	
Historical, archaeological & literary associations	Ayton Golf Club used this stretch of the Eye Water from 1891- 1937. One of the greens was sited in front of the quarry and named after it.	
Aesthetic landscape	The quarry is sited on the river cliff of the Eye Water in an attractive and unspoiled valley.	
History of Earth Sciences	None	
Economic geology	The quarry has been used for building stone, but is considered by the owner to be poor quality as it breaks easily.	
Built Heritage	Aytonlaw Farmhouse and probably other houses in Ayton were built of this stone.	

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	Regional	Excellent	Browne *et al.* 2002	X
Sedimentology	Regional	Excellent	Browne *et al.* 2002	X
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology	Local	Good		

Current Site Value

Community	Unknown to most local people	0
Education	Probably not visited at present.	0

References / Links

Browne, M.A.E., Smith, R. A. & Aitken, A. M. 2002 Stratigraphic Framework for the Devonian (Old Red Sandstone) rocks of Scotland south of a line from Fort William to Aberdeen. *British Geological Survey Search Report* RR/01/04 p.15

Geikie, A. 1863 The Geology of Eastern Berwickshire Map 34 *Memoirs of the Geological Survey of Great Britain* p.26

Greig, D.C. 1988 Geology of the Eyemouth district. Memoir of the British Geological Survey, Sheet 34

(Scotland). pp.26-27

OS 1:50,000 Map 67 Duns, Dunbar & Eyemouth

OS 1:25,000 Explorer 346 Berwick-upon-Tweed

BGS 1:50,000 Scotland Sheet 34 Eyemouth

Photo 1 Main quarry face June 2019

Photo 2 Exposures in field to NW of Hairy Craigs Quarry June 2019

Photo 3 Close-up of coarse lithic arenite(sandstone) in the main quarry face, with calcite crystals and a reaction rim around a purple lava clast. Scale in mm. June 2019

Photo 4. Area of coarse clasts in main quarry face. Scale card is 10 cm long. November 2018

Photo 5 Exposure a few metres to the NW of quarry showing lithic arenite beds dipping at 58° to 112° (SE). Nov 2018. Walking pole is 1.2 m long. November 2018

Photo 6 Fine-grained dark pink sandstones interbedded with lithic sandstones beds at the location shown in Photo 2. Walking pole is 1.2 m long. June 2019

HELL'S CLEUGH, STOBSWOOD

Grid Reference: NT 738 549 to NT 739 549	Current use: Grazing
Feature: Inland exposure	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 20/4/2019 & 13/5/2019
Site Map	

Figure 1: Location Map 1:25,000

Site Description (qualitative)

The Great Conglomerate Formation is a Lower Old Red Sandstone (Lower Devonian) rock deposited in arid mountainous conditions when the continent of Laurasia was 20-30° south of the equator.

The exposures of the Great Conglomerate (Reston Group) in Hell's Cleugh are found in a deep gorge of a tributary to Mill Burn which reaches Whiteadder Water to the north of Duns. The gorge is about 150 m long and 35 m deep with a very narrow valley bottom. The SW end of the gorge [NT 73811 54946] has a small waterfall (a knick point) as the valley deepens suddenly and at the NE end [NT 73934 54972] the valley widens out as it reaches Mill Burn. The conglomerate is exposed on both sides along the whole length of the gorge, in gullies, stacks and cliffs.

The conglomerate is an orange-red, badly-sorted rock, with sub-rounded cobbles up to 40 cm (long axis) in a dark red matrix of flakes of dark mudstone/slate mixed with sand grains. The clasts are composed largely of greywacke, but there is a small percentage of other lithologies, particularly igneous rocks such as dacite, rhyolite and basalt, with some chert pebbles. The conglomerate is matrix-supported. Bedding in some exposures, ranging from 1–3 m thick, is marked by thin beds of red sandstone and mudstone which wedge out laterally. Graded bedding is perceptible on a large scale but not always seen within beds, which have a low angle of dip towards the NW.

Assessment of Site Value

Geodiversity value: This is one of very few examples of 'badlands' landscapes in the UK and also provides an excellent view of unusual coarse conglomerates.

Description: Hell's Cleugh is a spectacular gorge exposing the Lower Devonian Great Conglomerate in stacks, cliffs and in gullies. It is possible to reach exposures In the lower part of the gorge which allow study of the lithology of the Great Conglomerate.

Access, Safety & Fragility

Aspect	Description
Access notes	Parking is available in a large car park at Hardens Hill [NT 741 541] on the minor road between Duns and Longformacus. Take the farm track (not the track into the woodland as the paths are difficult to find) through the gate and up to the first mast. To reach the bottom of the cleugh for a close look at the conglomerates, walk due north from the mast, skirting the plantation, over the moor (heather and tussock grass) keeping to the west of the minor gullies, thus avoiding wet ground, and drop down in the cleugh at its confluence with Mill Burn. Return the same way. Total walking distance is about 4 km.
Current condition (fragility)	The sections are exposed constantly by weathering, so exposure will remain clear.
Potential use	The cleugh is accessible for small groups who are able to navigate across moorland landscapes.
Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	None
Aesthetic landscape	This is a rare example of 'badlands' scenery, where weathering and slope wash are the dominant processes in the formation of a steep gorge.
History of Earth Sciences	None
Economic geology	N/A
Built Heritage	N/A

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	Regional	Excellent	Browne *et al*. 2002,	X
Sedimentology	Regional	Good	Browne *et al.* 2002, Davies *et al*. 1986	
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology	National	Excellent		X
Current Site Value				
Community	Very few people would approach the valley on footpaths.			0
Education	The site is probably not visited by geologists at present.			0

References / Links

Browne, M.A.E., Smith, R. A. & Aitken, A. M. 2002 Stratigraphic Framework for the Devonian (Old Red Sandstone) rocks of Scotland south of a line from Fort William to Aberdeen. *British Geological Survey Search Report* RR/01/04 p.15

Davies, A., McAdam, A. D., and Cameron, I. B. 1986 Geology of the Dunbar district. *Memoir of the British Geological Survey.* Sheet 33E and part of Sheet 41 (Scotland), pp.12-15.

Stone, P, McMillan, A. A., Floyd, J.D.Barnes, R.P. and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (Fourth Edition). Keyworth, Nottingham: British Geological Survey p.106

OS 1:50,000 Sheet 67 Duns, Dunbar & Eyemouth

OS 1:25,000 Explorer 346 Berwick-upon-Tweed

No BGS sheet available. Use BGS Geology of Britain Viewer.

Photo 1 View of Hell's Cleugh from above the confluence with Mill Burn, looking SW. May 2019

Photo 2 View into upper part of gorge from NT 73899 55014. May 2019

Photo 3 View into upper gorge showing coarse bedding. May 2019

Photo 4 Exposure at NT 73899 55014, showing the nature of the conglomerate and including a 12 cm sandy bed and a pale grey decomposing rhyolite clast amongst greywacke cobbles and pebbles. The scale card is 12 cm long. May 2019

JED WATER RIVER CLIFF

Grid Reference: NT 658 223	Current use: River cliff
Feature: Inland exposure	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 18/4/2014 & 16/2/18

Site Map

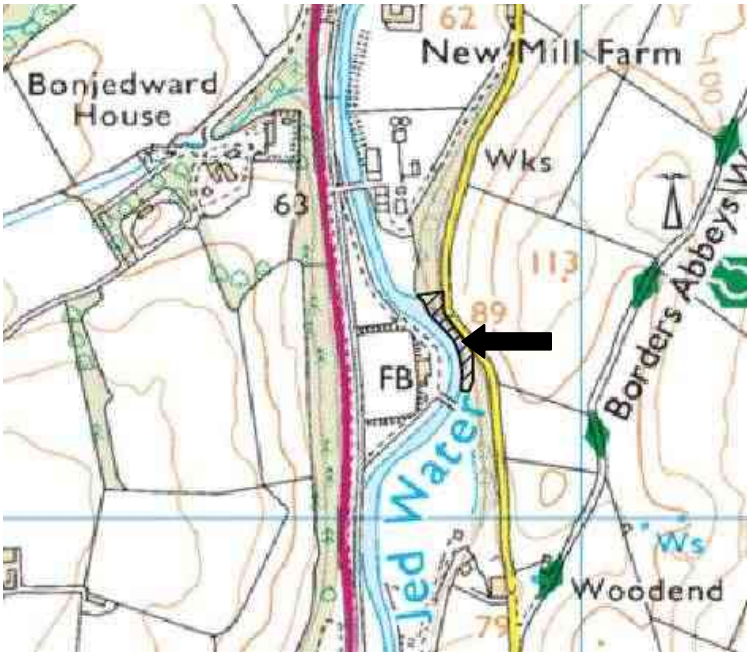


Figure 1: Location Map 1:25,000

Site Description

The site consists of 100 m long river cliff above the Jed Water. There are excellent views from the Jed Forest Rugby Ground.

The 20 m high cliff is comprised of Stratheden Group (Upper Old Red Sandstone) Redheugh Mudstone Formation thinly-bedded sandstones, siltstones and mudstones, generally dark red in colour but occasionally green or cream. There is very gentle dip to the south and a slight anticline is apparent in the centre of the river cliff.

Assessment of Site Value

Geodiversity value: The river cliff is a good example of the Stratheden Group lithofacies.

Description: A river cliff exposing Upper Old Red Sandstone thinly bedded siltstones and mudstones

Access, Safety & Fragility

Aspect	Description
Access notes	Jed Forest Rugby Ground 1.5 km north of Jedburgh gives good views of the river cliff. Ask permission to park.
Current condition (fragility)	Erosion at the base of the river cliff by the Jed Water will maintain good exposure.
Potential use	Public information could be given on an interpretation board and this is a useful site for educational groups at all levels.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	None	
Aesthetic landscape	Pleasant river landscape with woodland.	
History of Earth Sciences	None	
Economic geology	N/A	
Built Heritage	N/A	

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	Regional	Good	Browne *et al.* 2002	X
Sedimentology	Local	Good	McAdam *et al.* 1993	
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology	Local	Good		
Current Site Value				
Community	The rugby ground is open all the year round and the river bank is accessible to the general public.			10
Education	Visited by geologists as it is mentioned in several guide books.			6

References / Links

Browne, M.A.E., Smith, R. A. & Aitken, A. M. 2002 Stratigraphic Framework for the Devonian (Old Red Sandstone) rocks of Scotland south of a line from Fort William to Aberdeen. *British Geological Survey Search Report* RR/01/04 p.50

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* p. 96

OS 1:50,000 Map 74 Kelso & Coldstream

OS 1:25,000 Explorer OL16 The Cheviot Hills

BGS 1:50,000 Scotland Sheet 17E Jedburgh

Photo 1 View along the length of the river cliff from the Rugby club buildings. Feb 2018

Photo 2 A slight anticline in the beds is visible through the trees. Feb 2018

KIPPIT HILL

Grid Reference: NT 111 477	Current use: grazing
Feature: Geomorphological site	Other designations: Dolphinton and West Linton Fens SSSI (ecological)
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 22/06/2019
Site Map	

Figure 1: Location Map 1:25,000

Site Description (qualitative)

Kippit Hill is a geomorphological feature called a kame, an isolated hill of sand and gravel probably deposited on, in or below decaying ice. The glacial deposits are not exposed under the grassland but the superficial geology is described on BGS Scotland Sheet 24 W (Biggar & Broughton) as 'glacial sand and gravel'.

Assessment of Site Value

Geodiversity value: The hill is an unusually regular example of a kame, composed of meltwater sands and gravels.

Description: A conical landform (kame) created by meltwater streams close to an active ice-sheet.

Access, Safety & Fragility

Aspect	Description
Access notes	Permission from Kippit Farm is required.
Current condition (fragility)	As part of the Dolphinton and West Linton Fens SSSI (ecological), the site is protected because of the quality of the calcareous grassland, so public access to the summit of Kippit Hill is limited and the site is protected from footpath erosion.
Potential use	An interpretation board could be placed in Dolphinton village.

Culture, Heritage & Economic

Aspect	Description
Historical, archaeological & literary associations	In 1920 a burial cist containing the bones of a male adult was found on the summit of the hill. The monument on the summit was erected in memory of Kenneth MacKenzie of Dophinton, killed in action in France 1914-18 War.
Aesthetic landscape	An unusual conical hill which features in textbooks as a classic example of a kame landform

History of Earth Sciences	None
Economic geology	N/A
Built Heritage	N/A

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology	National	Excellent	McAdam *et al.*1993	X
Current Site Value				
Community	As there are no public footpaths on the hill, it is unlikely that it is visited by the local community.			0
Education	The kame can be seen clearly from the residential road near to the A702, so is an excellent site for teaching glacial geomorphology.			10

References / Links
McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* p. 144
OS 1:50,000 Map 72 Upper Clyde Valley
OS 1:25,000 Explorer Map 336 Biggar and Broughton
BGS 1:50,000 Scotland Sheet 24W (Superficial) Biggar

Photo 1 View of Kippit Hill from Ingraston sand hills looking south

Photo 2 View of Kippit Hill from the A702 looking north east

KITLEYKNOWE SAND QUARRY

Grid Reference: NT 174 561	Current use: Storage for bales and farm trailers
Feature: Disused quarry	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyors: Alison & Barry Tymon, Howard Turner	Date: 20/6/2019 & 18/8/2019

Site Map

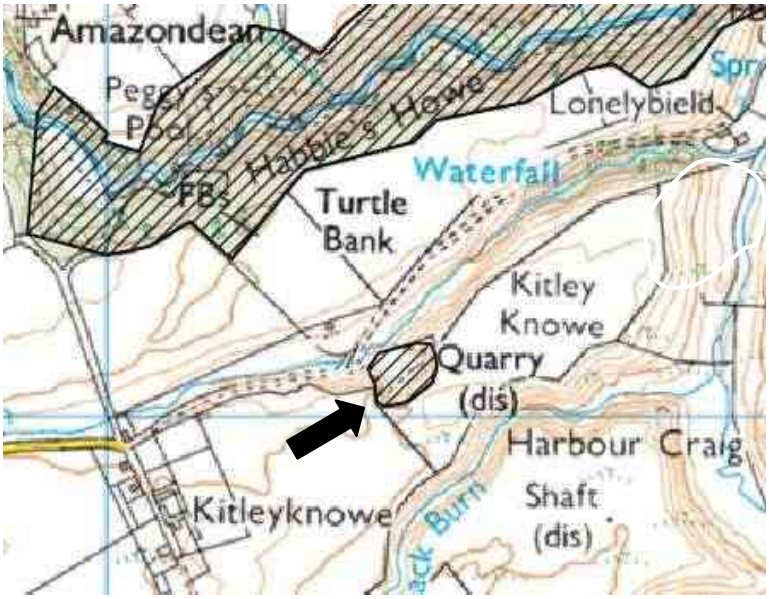


Figure 1: Location Map 1:25,000

Site Description (qualitative)

The Kitleyknowe Sand Quarry has been excavated in relatively unconsolidated sandstone of the Upper Carboniferous Limestone Coal Formation (Clackmannan Group) (Pendleian). The rock surfaces weather quickly to form sand debris slopes at the foot of the quarry faces, which are now largely vegetated.

At the west end of the quarry, an 8 m high cliff of thickly-bedded poorly-consolidated white sandstone is easily accessible. The horizontal sandstone, which dips at about 10° towards the south, contains muscovite mica flakes and occasional clear quartz grains. The coarse-grained sand layers, only a few centimetres thick, are interbedded with thin beds of fine sands. The lower 4 m of the face is massively cross-bedded, showing flow towards the SSW (190°). A coal bed approximately 10 cm thick, about 4 m from base of the face, demarcates the lower sandstone beds from upper beds of similar sandstones.

The upper beds are accessible in the middle part of the quarry and can be inspected at NT 17377 56020. They are coarse to fine-grained, with some angular quartz grains up to 5 mm, with several directions of cross-bedding and scouring at the base of each. Some cross-beds are outlined with iron precipitates and some with black disseminated carbon.

The east end of the quarry has a 10 m high cliff of similar white sands, at the base is which is 2.5 m of consolidated sandstone which forms a vertical face.

The Memoir of the Geological Survey of Scotland (1958 p.139) describes it as ‘a current-bedded coarse-grained kaolinitic sandstone in the Limestone Coal group’ which ‘was worked between 1937-1943 in Kitleyknowe Quarry… as a source of silica sand; the processed sand was used for pig-iron mounding, for steel moulding, for acid open-hearth furnaces and for the manufacture of bottle-glass.’

Assessment of Site Value

Geodiversity value: A very unusual poorly-consolidated sandstone, exploited for sand extraction.

Description: A disused sand quarry	
Access, Safety & Fragility	
Aspect	**Description**
Access notes	From A702, take the minor road just south of Carlops, sign-posted Kitleyknowe. After the hamlet of Kitleyknowe the track continues eastwards and the quarry is reached after about 400 m. Parking for several cars is available at the entrance to the quarry. The quarry faces can be reached after climbing over loose sand and debris slopes.
Current condition (fragility)	The quarry faces are becoming overgrown. Removing sand debris at the base of the faces would maintain a continuous exposure of bedrock.
Potential use	An interesting quarry for groups of students to visit and discuss.
Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	None
Aesthetic landscape	N/A
History of Earth Sciences	None
Economic geology	Maps from the 1850s show coal pits close to the present quarry, so it appears that both coal and sand were exploited at this site in the mid -19th century. There are concrete foundations at the entrance to the quarry which show that extraction, crushing and loading took place on the site in more recent times.
Built Heritage	The sandstone is too friable to be used for building.

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	**Rarity**	**Quality**	**Lit/Collections**	**First**
Lithostratigraphy	Regional	Good		
Sedimentology	Regional	Excellent	Tulloch & Walton 1958	X
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value		
Community	Local people may walk along the track past the quarry.	0
Education	The quarry may be visited by local geology groups.	2

References / Links

Tulloch, W and Walton, HS. 1958 *The Geology of the Midlothian Coalfield.* Memoir of the Geological Survey of Scotland, p.139

OS 1:50,000 Map 66 Edinburgh

OS 1:50,000 Map 72 Upper Clyde Valley

OS 1.25,000 Explorer 344 Pentland Hills

BGS 1:50,000 Scotland Sheet 24W Biggar

Photo 1 View towards the east end of the quarry, which shows consolidated beds of sandstone at the base of the exposure with less consolidated sandstones above. June 2019

Photo 2 View to the western end of the quarry, showing relatively unconsolidated cross-bedded sandstones and a thin coal seam. June 2019

Photo 3 Exposure at the west end of the quarry at NT 17363 56053 showing thickly-bedded cross-bedded sandstones separated by a thin coal seam. June 2019

Photo 4 Upper sandstones of the middle section of the quarry, showing cross-bedding with iron and carbon along bedding and scoured surfaces. June 2019

LANTON HILL QUARRY, JEDBURGH

Grid Reference: NT 623 205	Current use: Overgrown with gorse
Feature: Disused quarry	Other designations: None
Current geological designations:	Other scientific: None
Field surveyor: Alison Tymon	Date: 11/8/2018

Site Map

Figure 1: Location Map 1:25,000

Site Description

The disused quarry of Upper Old Red Sandstone (Stratheden Group) Greenheugh Sandstone Formation is about 30 m wide with the highest face reaching 10-11 m. Sandstone faces are visible on the NW and NE sides and are about 40 m long in total, though the highest face cannot be reached across a wide depression filled with nettles and small trees.

Sandstones in some beds are very fine-grained while others are much coarser. The top bed on the north face is about 2 m thick with a noticeably scoured base. The beds below have cross-bedded sets from 30-60 m in thickness. The direction of cross-bedding is generally eastwards and there are some trough-bedded sets.

About 2 m from the top of the face on the NE corner of the quarry is a reddened bed of breccia which wedges out laterally. The breccia includes large clasts of red sandstone and many smaller clasts of red mudstone. The weathering texture suggests that the bed has been exposed to evaporation, leaving carbonates as the matrix.

Assessment of Site Value

Geodiversity value: A good exposure of the sandstone used most commonly for building in the Borders area	
Description: A disused quarry in red and white sandstone, with excellent sedimentary features.	

Access, Safety & Fragility

Aspect	Description

Access notes	From Gospel Hall Farm to the SW or from the lane to dwellings on Lanton Hill from the NE. The field is accessible over a gate. There is a trodden path into the quarry which is best visited in winter when the undergrowth has died down.
Current condition (fragility)	The quarry is already overgrown with gorse, which means that some of the features are not well seen and access is difficult.
Potential use	This would be an excellent site for educational purposes, if access was easier and the faces were cleared of some of the vegetation.

Culture, Heritage & Economic

Aspect	**Description**	
Historical, archaeological & literary associations	None	
Aesthetic landscape	On top of a ridge with good views across the Teviot valley.	
History of Earth Sciences	Rev. James Duncan of Denholm recorded in 1855 the discovery at Lantonhill of fish scales of *Holoptychius nobilissimus,* a Devonian fish (McGregor & Eckford 1946).	
Economic geology	The main quarry and smaller ones nearby are recorded on six inch maps of 1863 and 1899, but labelled as disused in 1923.	
Built Heritage	This extensive quarry, close to Jedburgh, could have provided building stone for the town and possibly the Abbey, although McGregor & Eckford (1946) do not mention this in their account.	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	Local	Good		
Sedimentology	Regional	Good	Browne *et al.* 2002, McGregor & Eckford 1946	X
Igneous/Mineral/ Metamorphic Geology				
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value

Community	There is a track nearby but the quarry is overgrown so it is unlikely that it is much visited.	0
Education	It is probably not visited at present, in spite of the quality of the sandstone and its features.	0

References / Links

Browne, M.A.E., Smith, R. A. & Aitken, A. M. 2002 Stratigraphic Framework for the Devonian (Old Red Sandstone) rocks of Scotland south of a line from Fort William to Aberdeen. *British Geological Survey Search Report* RR/01/04 p.49

McGregor, A.G. & Eckford, R.J.A. 1946 The Upper Old Red and Lower Carboniferous sediments of Teviotdale and Tweedside and the stones of the abbeys of the Scottish Borderland. *Trans.Edin.Geol.Soc.* p. 233

OS 1:50,000 Map 74 Kelso & Coldstream

OS 1:25,000 Explorer OL16 The Cheviot Hills

BGS 1:50,000 Scotland Sheet 17E Jedburgh

Photo 1 View of the quarry from the overgrown track into the quarry looking NE. August 2018

Photo 2 The NW quarry face showing about 3 m of red and white sandstone beds, with cross-bedded sets and noticeable scouring by the top bed. August 2018

Photo 3 Close-up of face in Photo 2, to show features in detail. August 2018

Photo 4 The north corner of the quarry The height of the face is about 3 m. August 2018

Photo 5 A cross-bedding set below a wedge of breccia on the north corner of the quarry. August 2018

Photo 6 NE side of the quarry showing faces with cross-bedded sets in different directions, as well as scouring at the base of the face on the left. August 2018

Photo 7 NE corner of the quarry with wedging-out bed of breccia. August 2018

Photo 8 Close-up of the wedge of red breccia about 2 m below the top of the quarry in the NE corner.

MOUNTBENGER TOLL QUARRY

Grid Reference: NT 3095 2625	Current use: Grazing
Feature: Disused quarry	Other designations: Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 25/6/17

Site Map

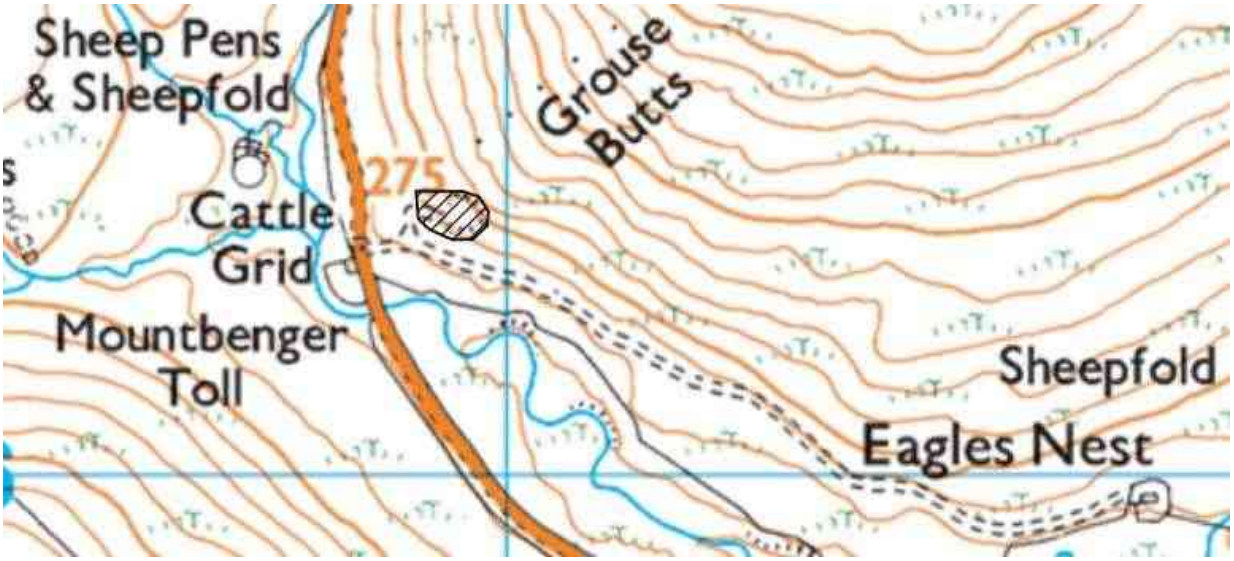


Figure 1: Location Map 1:25,000

Site Description

A disused quarry, also known as Eagle's Nest Quarry, in the Silurian Selcoth Formation, Ettrick Group, (Llandovery) is found on the track to Eagle's Nest house about 100 m from the B709 at Mountbenger Toll.

The face is about 30 m wide and 10 m high and the exposure shows medium-bedded greywackes from 10–100 cm thick with siltstones in between, some up to 10 cm thick, dipping at 82^{o} towards the north. BGS Sheet 16E Ettrick indicates that the beds are not inverted. The undersides of the greywacke beds have a variety of sole structures, including grooves, flute casts, gutter casts and lineations with many superimposed sole marks.

A thin section of the greywacke from this quarry, rock number S96846, is available at https://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks

Assessment of Site Value

Geodiversity value: An unusual variety of sole markings is clearly exposed on accessible greywacke bedding planes	
Description: A disused greywacke quarry with steeply dipping beds.	

Access, Safety & Fragility

Aspect	Description
Access notes	Space to park at the cattle grid close to the house at Mountbenger Toll. The quarry is on the track to Eagle's Nest.
Current condition (fragility)	The quarry face has very little vegetation or scree and the bedding structures are likely to remain visible.
Potential use	This is an excellent site for geological groups to study greywacke sole structures.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	None	
Aesthetic landscape	The quarry cuts into typical upland moorland slopes.	
History of Earth Sciences	None	
Economic geology	Disused roadstone quarry shown on 1858 map, but given as old quarry on 1900 map.	
Built Heritage	The stone may have been used for local buildings and walls as well as for roads and tracks.	

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	Local	Good		
Sedimentology	Regional	Excellent		X
Igneous/Mineral/ Metamorphic Geology	Local	Good		
Structural Geology	Local	Good		
Palaeontology				
Geomorphology				
Current Site Value				
Community	The access is on a private road so it is unlikely that it is used by the local community.			0
Education	Some geological groups visit this site.			4

References / Links

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p.66.

OS 1:50,000 Map 73 Peebles, Galashiels & Selkirk

OS 1:25,000 Explorer 337 Peebles & Innerleithen

BGS 1:50,000 Sheet 16E Ettrick

Photo 1 View of quarry from the quarry track looking east. June 1917

Photo 2 Main rock face with greywacke beds dipping steeply NW. June 1917

Photo 3 Grooves on bedding plane. June 1917

Photo 4 Bedding plane with grooves and superimposed, irregular casts. June 1917

Photo 5 Greywacke bedding plane with gutter casts. June 1917

PIRN QUARRY, INNERLEITHEN

Grid Reference: NT 341 373	Current use: Overgrown quarry
Feature: Disused quarry	Other designations: ex-SSSI (geological) Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 23/6/17 & 19/6/19

Site Map

Figure 1: Location Map 1:25,000

Site Description

Pim Quarry exploited greywackes of the Silurian Gala Group, Gala 4/5 tract (Llandovery) and is now disused and overgrown. The quarry is about 100 m long and at least 12 m high, with rock exposures 4-5 m in height, though very overgrown in places by grasses, brambles and tree saplings, particularly along natural joints. At the east end of the quarry thick greywacke beds 10–100 cm wide, interbedded with thin siltstones, can be seen in section, dipping to the SE (126^{o}) at 50^{o}. The main bedding planes, which slope towards the road, show spectacular casts of sole structures, particularly long, straight grooves in several phases, some with prod marks and flute casts. The relationship of the beds to the sole structures indicates that the beds are overturned (inverted).

Wilson (1890 p.114) recorded that black shales with abundant graptolite fossils were found in a pocket between thick greywacke beds 'in a quarry on the roadside in Pirn Craig Hill, which has long been worked.' Charles Lapworth identified the graptolite species, which are typical of the Birkhill Shale Formation (Moffat Shale Group). However, the quarry is overgrown and it would be difficult to identify the fossil locality at present.

Dr. J. D. Floyd (British Geological Survey) reported on this site on January 5th 2005. Much of the rock exposure that he describes has been covered by undergrowth since, so it is worth reporting his observations. The following is the detailed geological interpretation in his report.

'The main surface exposed in the south-west corner carries two intersecting sets of groove casts. Dragging relationships indicate consistent relative ages for the sets, and so denote a marked change in the current direction. The plastic mud displaced from the grooves has been rucked up into rope-like structures. Immediately below (though stratigraphically above) the grooves, one internal surface within the greywacke displays smaller grooves. These rare structures are internal grooves, the origin of which is revealed by the presence of small shale clasts which terminate a few of the structures. The bed is otherwise a pale grey, graded greywacke typical of the Gala Group at this locality. Farther east another

sole carries, in addition to continuous groove casts, discontinuous tool-markings including prod marks and brush marks. The exposure of the first horizon continues into the middle of the face, and reveals numerous shale and siltstone clasts up to 20 cm across, which may be the tools responsible for inscribing many of the markings. Groove casts also occur in the north-east corner of the quarry, which is otherwise noteworthy for channel fills. These generally have a fluted structure, though one wide example lacking significant fluting is seen high up on the quarry face.

Characteristic of the greywackes here is delayed grading. A thin basal zone of coarse grains with large and dispersed shale clasts is succeeded upwards by uniformly medium-grained greywackes containing only sporadic shale clasts. This in turn is succeeded by a thin, graded top which terminates in cross-laminated and laminated siltstone and merges into the overlying pelite interval.'

Thin sections from samples of greywacke from this quarry can be found online in BGS Rock Collections https://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks
Rock numbers are S63332, S89591, N9296 and N3061.

Assessment of Site Value

Geodiversity value: The inverted greywackes in this quarry have exceptionally good examples of sole structures.

Description: An overgrown greywacke quarry with dipping bedding planes showing a variety of unusual sole structures.

Access, Safety & Fragility

Aspect	Description
Access notes	Quarry on A72 about a mile east of Innerleithen. There is a large car park in front of the quarry, which is fenced with 2 m high fencing to prevent access.
Current condition (fragility)	The quarry faces are being rapidly overgrown and the unusual features are becoming harder to study.
Potential use	Management would involve clearance of the rock face and removal of some of the recent tree and sapling growth on the quarry floor, to allow geological visits by groups to resume.

Culture, Heritage & Economic

Aspect	Description
Historical, archaeological & literary associations	None
Aesthetic landscape	N/A
History of Earth Sciences	Charles Lapworth identified graptolite fossils from this quarry, reported in Wilson (1890).
Economic geology	Quarry not shown on 1856 map but is shown from 1900 onwards. The stone could have been used for wall construction or roadstone.
Built Heritage	Local buildings could have been built with stone from the quarry.

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	Local	Good		
Sedimentology	Regional	Excellent	Craig & Duff 1975, McAdam, Clarkson & Stone 1993	X
Igneous/Mineral/ Metamorphic Geology	Local	Good		
Structural Geology	Local	Good		
Palaeontology	Local	Poor	Wilson 1890	
Geomorphology				

Current Site Value

Community	The fence deters local visits to the quarry.	0
Education	Geological groups have visited this quarry in the past, but it is now too overgrown to give access for groups.	0

References / Links

Craig, G.Y.& Duff, P. M.D. 1975 *The Geology of the Lothians and South East Scotland* pp. 153-154

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* pp.131-132

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p.63.

Wilson, J. 1890 Birkhill Fossils at Innerleithen, Peebleshire. *Trans.Edin.Geol.Soc*. pp.113-115

OS 1:50,000 Peebles, Galashiels & Selkirk Map 73

OS 1:25,000 Peebles & Innerleithen Explorer 337

BGS 1:50,000 Scotland Sheet 24E Peebles

Photo 1 Pirn Quarry lies behind the fence at the lay-by on the A72 east of Innerleithen. June 2017

Photo 2 The unobscured rock face at the east end of the quarry, showing beds dipping at 50° to the SE. July 2019

Photo 3 Rock exposure at the west end of the quarry, showing linear grooves and small flute casts. July 2019

Photo 4 Close-up of the lower section of the western exposure, showing grooves, prod marks and small scale flute casts. Walking pole is 1.2 m long. June 2017

Photo 5 The highest and most extensive rock face in the quarry is covered with grooves and other sole structures. July 2019

Photo 6 Detail of the lowest section of the grooved face in Photo 5. July 2019

PRESTON BRIDGE, DUNS

Grid Reference: NT 7871 5678 (Preston Bridge) to NT 7835 5710 (Anger my Heart)	Current use: Whiteadder Angling Association. Walkers use the permissive footpaths along the river.
Feature: Inland exposure (river bank and bed)	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon, David Stephenson	Date: 09/02/2018 (AT & DS) & 27/08/2018 (AT)

Site Map

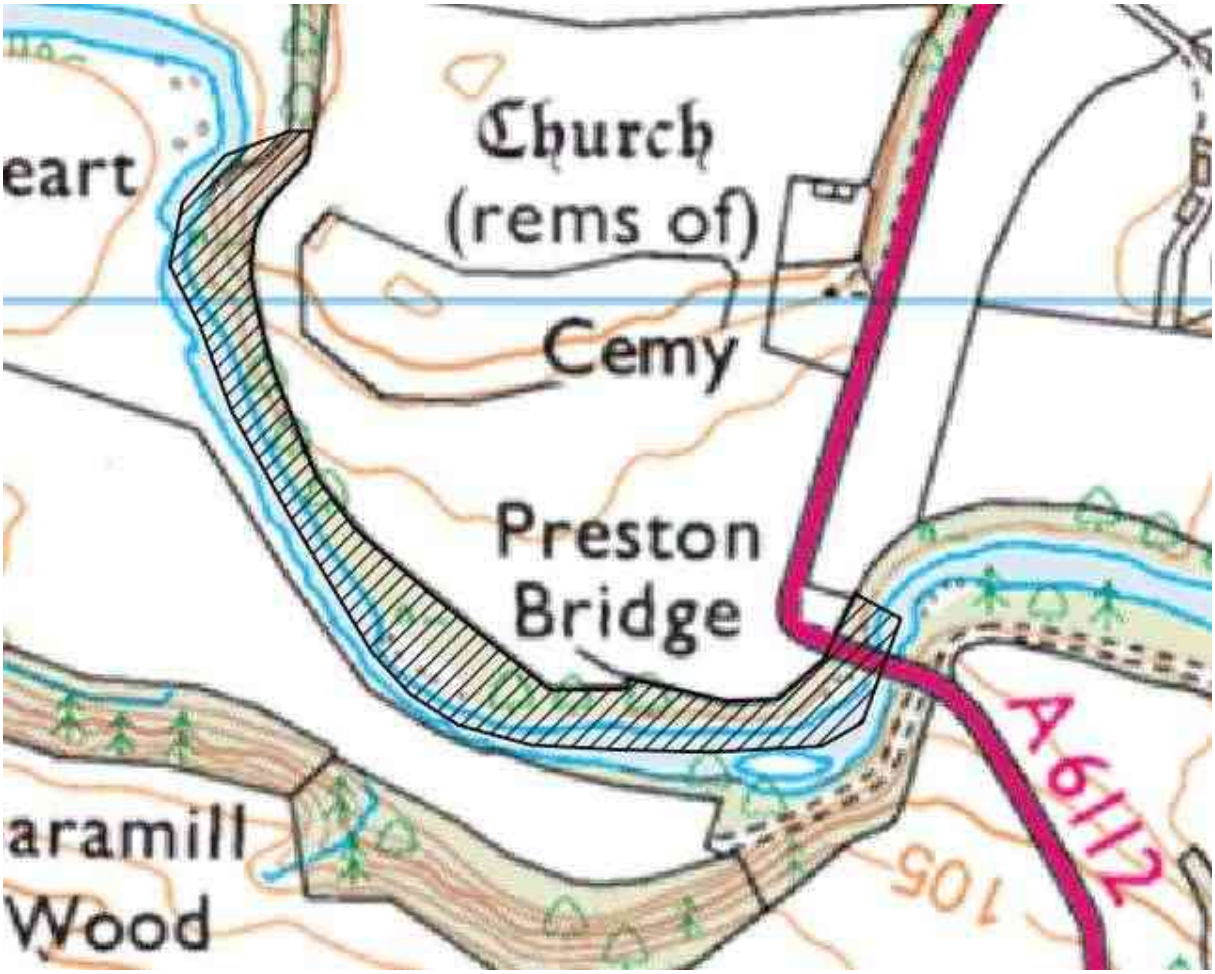


Figure 1: Location Map 1:25,000

Site Description

Location 1. Preston Bridge over Whiteadder Water (NT 7871 5678). Porphyritic dark grey basalt found under the bridge and extending at least 10 m upstream. The basalt contains many phenocrysts of pale plagioclase feldspar up to 2 mm long. There are occasional amygdales. Thin sections of basalt can be seen online at BGS Rock Collections, rock numbers S48212 and S32673

Upstream from the bridge for at least 5 m, the basalt is heavily jointed with infillings of quartz. In places, the rock is brecciated with irregular veins which indicate a fault, shown on BGS Scotland Sheet 34 Eyemouth. A thin section from an exposure on the N bank at NT 7865 5675 is available from BGS Rock Collections, rock number S48230.

Location 2. Upper Devonian Stratheden Group sandstones are found upstream along the northern bank, between NT 7864 5674 and NT 7861 5674. About 2 m of finely-bedded fine to medium-grained red sandstones and cornstones dip at 22° towards 012°. One prominent bedding plane has symmetrical ripple marks. Reduction spots and patches are found commonly. Friable red mudstones are interbedded with sandstone in some places.

Location 3. Shingle beach From NT 78428 56781 to NT 78416 56798. Exposures of bedded ash are found along the shingle beach. The extent of the bedded ashes, which dip at 47° towards 350°, was measured along the beach and found to be at least 16 m, giving a true thickness of the bedded ashes of at least 12 m.

The lowest beds at NT 78428 56781 are finely-bedded, fine-grained green and brown sandstones and cornstones with several thin beds of angular pale clasts ranging from 0.5 to 5 cm in size, in a coarse brown matrix. These may be volcanic ashes. In places, the green sandstones appear to be deformed by individual clasts and by ash beds.

A colour change about 1 m above the base marks the disappearance of the yellow sandstones which are replaced by grey bedded ashes. The alternating beds of fine and coarse ash range from 1 to15 cm in thickness. The ash fragments are angular and generally dark grey in colour, with occasional white, light grey and red clasts, and the largest are about 1 cm in size. The matrix is pale grey or white and is paler than the clasts.

Upstream, the ash beds become inaccessible in the river bank but may continue further.

Location 4 (known as Rocky Corner to local fisherman) [NT 7831 5702] where an unbedded exposure, at least 1.5 m thick, juts out into the river. It is composed of ash and blocks of lava ranging from less than 1 cm to at least 10 cm in size. A thin section of a sample of basalt from an exposure [NT 7833 5705] in the wood close to Rocky Corner is available from BGS Rock Collections, rock number S48231.

Location 5. The river runs over low rapids at Anger my Heart. At NT 78324 57045, a few metres upstream from Rocky Corner, columns of fresh basalt with occasional black augite phenocrysts and red/brown olivine crystals can be seen in the river. The columns extend from the river to the top of the wood and can be accessed by a very narrow path along the river bank. The composition may be similar to the rocks seen in Borthwick Quarry, Duns, so this exposure may be an extension of that igneous body. Thin sections of basalt from this exposure are available at BGS Rock Collections, rock numbers S32669, S32670 & S32671.

British Geological Survey Rock Collections thin sections can be found at:
https://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks

Assessment of Site Value	
Geodiversity value: Stratheden Group sandstones with Kelso Lava ashes and lava flow above, intruded by Lower Carboniferous dolerite igneous body (Borthwick Sill). Potentially the igneous rocks at this site could be radiometrically dated to give a date for the base of the Carboniferous period.	
Access, Safety & Fragility	
Aspect	**Description**
Access notes	There is a car park next to Preston Bridge with a permissive footpath going upstream as far as Anger my Heart.
Current condition (fragility)	Robust
Potential use	May be a dateable boundary between the Devonian and Carboniferous periods – potential golden spike? Visits by geology groups are welcomed by the owner.
Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	The ruins of Preston church and graveyard, a Scheduled Monument, are found north of the bridge. A settlement of unknown date is found at Kirkfield Brae, close to Anger My Heart.
Aesthetic landscape	Very attractive river banks
History of Earth Sciences	None
Economic geology	N/A
Built Heritage	Preston Bridge dates from 1770 and is built of local red sandstone.

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	International	Good		X
Sedimentology	Local	Moderately good	Geikie 1863, Greig 1988	
Igneous/Mineral/ Metamorphic Geology	Regional	Good	Geikie, 1863, Greig 1988, Tomkeieff 1940	X
Structural Geology				
Palaeontology				
Geomorphology				
Current Site Value				
Community	Occasionally walked by the general public. The river banks are used for fishing by the Whiteadder Angling Association.			4
Education	Visits by local geology groups			4

References / Links

Geikie, A. 1863 The Geology of Eastern Berwickshire Map 34 *Memoirs of the Geological Survey of Great Britain* p.37

D.C.Grieg 1988 *Geology of the Eyemouth District,* Memoir for Sheet 34 (Scotland) pp. 44-45

Tomkeieff, S.I. 1940 Petrology of the Carboniferous Igneous Rocks of the Tweed Basin. *Trans.Edin.Geol.Soc.* p. 54

OS 1:50,000 Sheet 67 Duns, Dunbar & Eyemouth

OS 1:25,000 Explorer 346 Berwick-upon-Tweed

1:50,000 BGS Scotland Sheet 34 Eyemouth

Photo 1 Preston Bridge looking downstream from NT 7872 5678 to show basalt lava. In the foreground the rocks are jointed, altered and brecciated due to faulting. December 2017

Photo 2 Upper Devonian Stratheden Group red sandstones and cornstones at NT 7863 5674 in the river bed, dipping at 22° towards 012°. July 2018

Photo 3 Shingle beach at NT 7843 5678 showing exposures of 12 m+ of grey bedded volcanic ash dipping at 47° to 350° August 2018

Photo 4 Unbedded volcanic ash and lava agglomerate at ‘Rocky Corner’ at NT 78310 57013 August 2018

Photo 5 Columnar jointing in basalt at Anger My Heart NT 7832 5705 December 2017

RAESHAW WOOD QUARRY

Grid Reference: NT 358 503	Current use: Small tips of roadstone on the quarry floor
Feature: Disused quarry	Other designations: Moorfoot Hills SSSI
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 23/6/2019

Site Map

Figure 1: Location Map 1:25,000

Site Description (qualitative)

The quarry below Raeshaw Wood is about 10 m high and 50 m wide and exploits a massively bedded greywacke conglomerate (the Raeshaw Conglomerate) which dips steeply to the north. The conglomerate is part of the Silurian Gala Group (Llandovery) and incorporates rounded mudstone lenses which are reported (Peach and Horne 1899) to contain graptolites of Ordovician Moffat Shale Group (Llandeilo-Caradoc) age and have been incorporated into the conglomerate during the erosion of the sea-bed by turbidity currents.

An irregularly-jointed face, sloping towards the quarry floor on the east side (NT 3588 5036) is made of a dark grey to green, medium to fine-grained greywacke with angular quartz and lithic particles. Loose blocks under this face contain large dark grey to purple mudstone clasts and lenses with shiny surfaces up to 40 cm long, which are less easy to see in the bedrock.

At the west end of the main face of the quarry pebbly beds are clearly exposed, composed of angular fragments of variable composition in a matrix of quartz grains, squeezed between large mudstone lenses many centimetres long.

Under heather-covered slopes on the east of the quarry, lie mudstones and siltstones, with minor folds. A contact on the west side of the quarry at NT 35832 50370 between conglomerate and greywackes is near-vertical.

Thin sections from samples are online in BGS Rock Collections at https://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks

Rock numbers are S68737, S68738 and S75135.

Assessment of Site Value

Geodiversity value: The Raeshaw Conglomerate is an unusual rock containing Ordovician graptolitic mudstone clasts incorporated in a Silurian greywacke.

Description: A disused quarry which exploited the Raeshaw Conglomerate.

Access, Safety & Fragility

Aspect	Description
Access notes	The quarry is close to the B709 minor road between Heriot and Innerleithen. There is parking for several cars on the verge and it is possible to reach the quarry face through a gap near the field gate.
Current condition (fragility)	The quarry faces are largely clear of vegetation and the rock is well-exposed.
Potential use	The quarry is an accessible site for students and researchers to see the Raeshaw Conglomerate.

Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	None
Aesthetic landscape	The Moorfoot Hills have high quality upland landscapes.
History of Earth Sciences	Peach and Horne noted the unusual features, including graptolites, in the Raeshaw Conglomerate (Peach & Horne 1899)
Economic geology	Noted on Six-inch map 1854 as a whinstone quarry.
Built Heritage	Stone was probably used for wall and road building.

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	National	Excellent	Stone *et al.* 2012	X
Sedimentology	National	Excellent	Craig & Duff 1976, McAdam *et al.* 1993	X
Igneous/Mineral/ Metamorphic Geology	Local	Good		
Structural Geology	Local	Moderately good		
Palaeontology	Regional	Poor	Peach & Horne 1899	
Geomorphology				

Current Site Value		
Community	A remote quarry which is unlikely to be visited by local people.	0
Education	The quarry may be visited by geological groups, as it is recorded in several geological guide books.	4

References / Links

Craig, G.Y.& Duff, P. M.D. 1975 *The Geology of the Lothians and South East Scotland* pp.148-149

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* pp.126-127

Peach, B.N. & Horne, J. 1899. *The Silurian Rocks of Britain. Volume 1. Scotland*. Memoirs of the Geological Survey of the United Kingdom p. 270

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p.62

OS 1:50,000 Map 73 Peebles, Galashiels & Selkirk

OS 1:25,000 Explorer 337 Peebles & Innerleithen

BGS 1:50,000 Scotland Sheet 24E Peebles

Photo 1 Quarry from the B709 minor road. June 2019

Photo 2 View from west to east across the face of the quarry. June 2019

Photo 3 Close-up of shale/mudstone clasts held within a pebbly matrix. Scale card shows cms. June 2019

Photo 4 West side of quarry with near-vertical greywacke beds in contact with Raeshaw Conglomerate. June 2019

Photo 5 Close-up of contact of massive greywacke bed (left) with Raeshaw Conglomerate (right). Notebook is 20 cm long. June 2019

SMAILHOLM TOWER

Grid Reference: NT 638 347	Current use: Smailholm Tower is open to the public during the summer months.
Feature: Inland exposure	Other designations: Scheduled Ancient Monument Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 8th April 2017 & 18th July 2019

Site Map

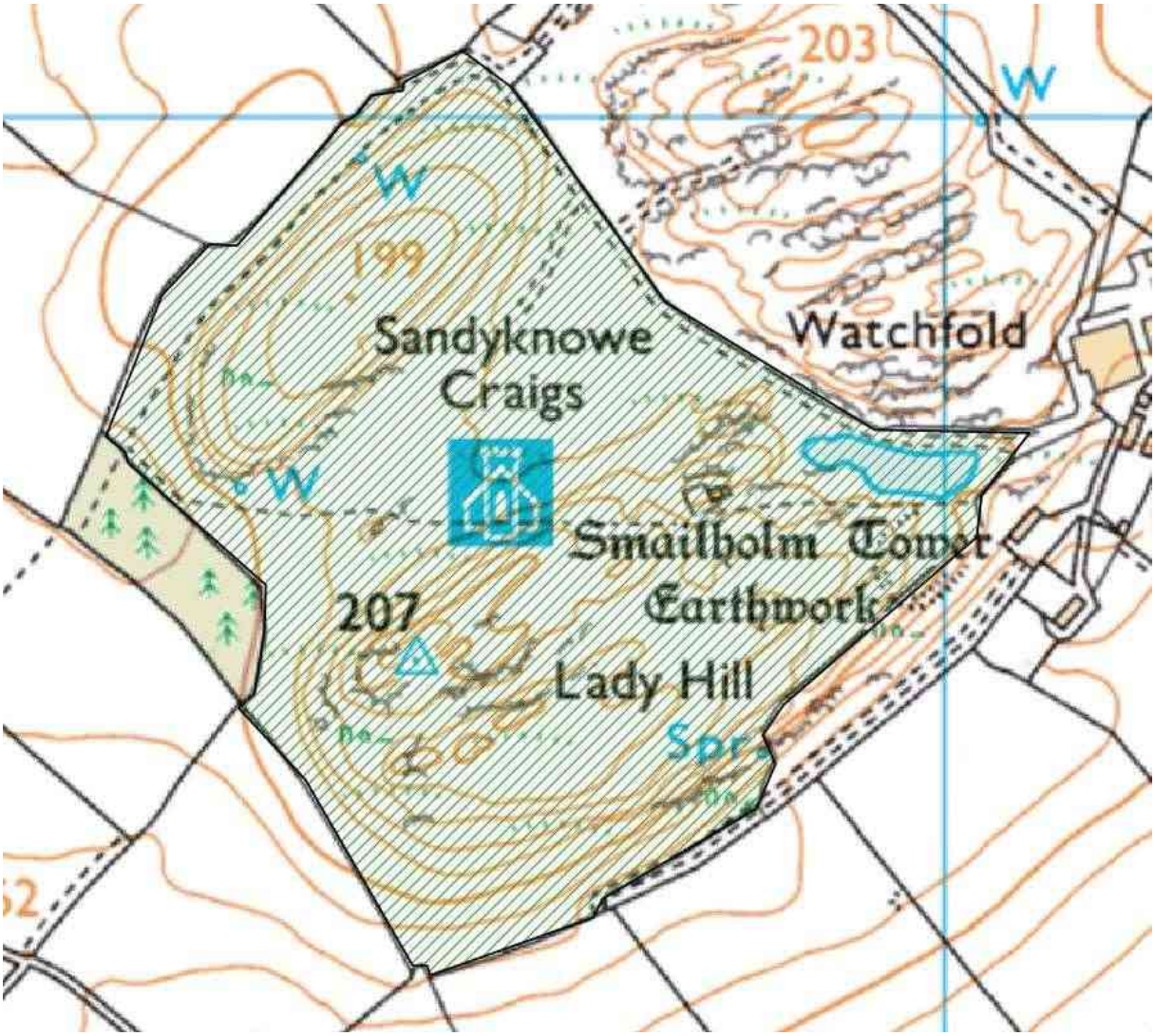


Figure 1: Location Map 1:25,000

Site Description

Smailholm Tower stands on one of many crags of dark grey basalt at Sandyknowe Crags SW of Smailholm village. The basalts are part of the Lower Carboniferous Kelso Volcanic Formation (Inverclyde Group, Famennian) and are thought to have cooled as lava flows which are interbedded with sedimentary rocks. Early workers regarded the feature as an intrusive plug.

Close examination of fresh surfaces indicate that the rocks are basalts, with black phenocrysts. Several texts mention the presence of small intrusions of dolerite in this area which are related to the extrusive basalt lava flows. Some of the crags have columnar jointing at various scales, but elsewhere jointing is irregular and generally massive. The columnar jointing is oriented in varying directions which suggests that the lavas flowed over an uneven surface.

An exposure of Devonian/Carboniferous sandstone (Stratheden/Inverclyde Group – undifferentiated) can be seen at NT 6400 3467 at the east end of the mill pond. The dark grey sandstone is medium grained with planar beds ranging from 15-25cm in width, which dip at 25° to the NW (319°).

Assessment of Site Value		
Geodiversity value: This site has the best exposed and most accessible example of the Kelso Volcanic Formation basalt lavas, with features such as columnar jointing. It is associated with an exposure of the sandstone country rocks.		
Description: Basalt crags, on which stands Smailholm Tower.		
Access, Safety & Fragility		
Aspect	**Description**	
Access notes	Public access	
Current condition (fragility)	Robust	
Potential use	This site is a very accessible example of the Kelso Volcanic Formation, so could be used for group visits at all levels. Interpretation panels on the geology of the site could be incorporated into the Historic Scotland displays.	
Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	The tower was built in the 1400s as a peel tower and lived in by the Pringle family, followed by the Scott family who also owned Sandyknowe Farm. Sir Walter Scott spent summers there as a child and was inspired to record local ballads and tales, subsequently published.	
Aesthetic landscape	High quality landscape with excellent views	
History of Earth Sciences	None	
Economic geology	The stone was probably used for local buildings, including the tower.	
Built Heritage	Smailholm Tower is a four storey tower house, now restored, with a barmkin within defensive walls at least 1m thick. It is built largely of unworked rubble blocks of basalt with wall, door and window quoins of grey/red sandstone. Internal chimney places and doorways are made of large sandstone blocks, probably from the local sandstones.	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	Local	Moderately good		
Sedimentology	Local	Moderately good		
Igneous/Mineral/ Metamorphic Geology	Regional	Excellent	Eckford & Ritchie 1939, Tomkeieff 1940, McAdam *et al.*1993, Clarkson & Upton 2010	X
Structural Geology				
Palaeontology				
Geomorphology	Local	Excellent		

Current Site Value		
Community	The tower and surrounding crags are open to the public, so there is considerable use of this attractive site throughout the summer.	10
Education	Visitors to the tower may be aware of the geological features.	2

References / Links

Clarkson, E. & Upton, B. 2010 *Death of an Ocean* p.166 & pp.174 – 176

Eckford, R.J.A & Ritchie, M. 1939 The Igneous Rocks of the Kelso District. *Trans.Edin.Geol.Soc.* p.470

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide*.p.94

Pringle, J. 1935 *British Regional Geology: The South of Scotland* p.73.

Read, W.A., Browne, M.A.E., Stephenson, D. & Upton, B.G.J. 2002 Carboniferous Chapter 9 in Trewin, N.H. (ed) *The Geology of Scotland*.

Tomkeieff, S.I. 1940 Petrology of the Carboniferous Igneous Rocks of the Tweed Basin. *Trans.Edin.Geol.Soc.* pp.53-75

Scott, Walter. 1802 *Minstrelsy of the Scottish Borders.*

Upton, B. 2004 *Volcanoes and the making of Scotland* p.167

https://www.historicenvironment.scot/visit-a-place/places/smailholm-tower/

OS 1:50,000 Map 74 Kelso & Coldstream

OS 1:25,000 Map 339 Kelso, Coldstream & Lower Tweed Valley

No published BGS sheet BGS Geology of Britain viewer

Photo 1 Smailholm Tower on massive basalt crags April 2017

Photo 2 Columnar jointing on the crag near the car park July 2019

Photo 3 Fresh basalt Scale card is about 6 cm long

Photo 4 View of Smailholm Tower looking from the sandstone beds at the millpond towards the basalt crags April 2017

Photo 5 Beds of sandstone dipping NW at 25° towards the mill pond. Note book is 20 cm long. July 2019

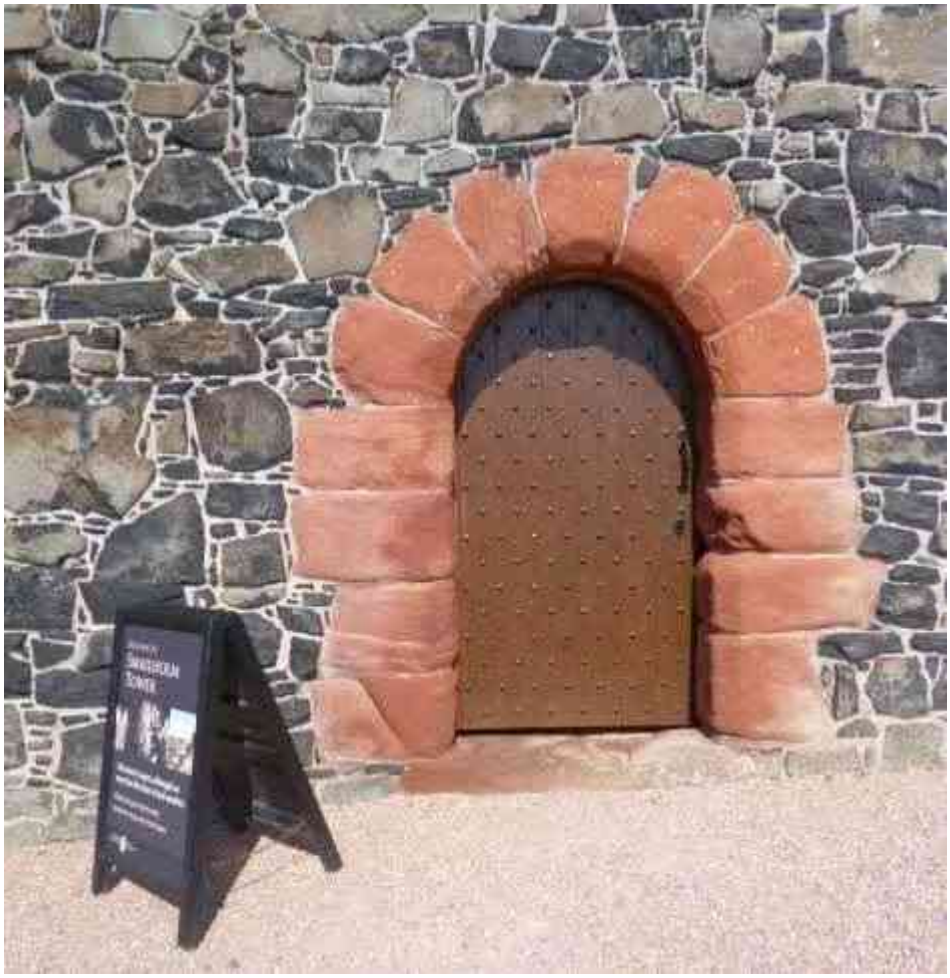


Photo 6 Doorway to the tower, to show use of basalt for walling and local red sandstone for quoins.

SOUTH MINTO HILL

Grid Reference: NT 5520, NT 5521, NT 5620, 5621	Current use: Grazing land
Feature: Inland exposures	Other designations: Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 12/8/2018 & 26/7/2019

Site Map

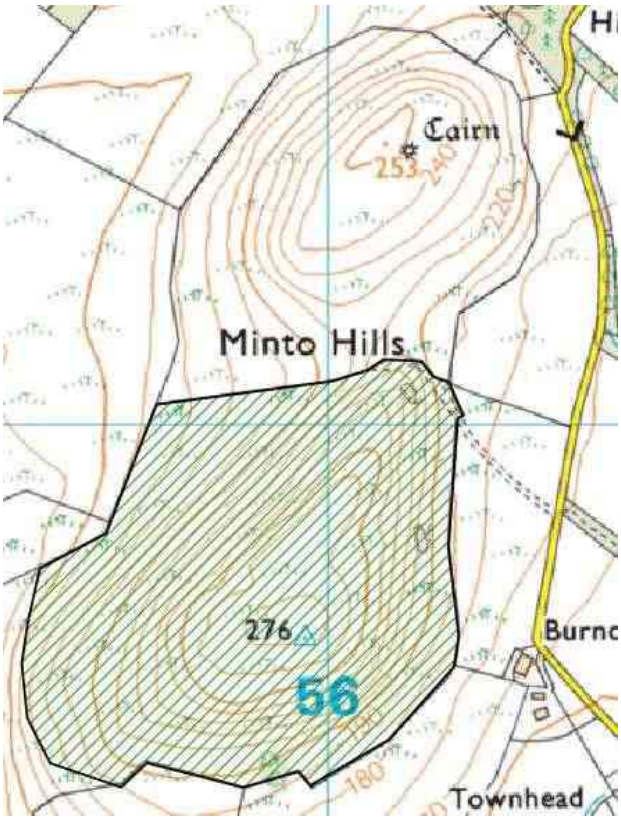


Figure 1: Location Map 1:25,000

Site Description

The Minto Hills are two oval volcanic necks (vent agglomerates) which were intruded into Stratheden Group (Upper Old Red Sandstone) rocks around 340 million years ago (Carboniferous period). No contacts with the Stratheden rocks can be seen on the hills, though the position of the contact can be inferred by the abrupt change in slope around the base of both hills, as the Stratheden sandstones are more easily eroded than the vent agglomerates.

There are no rock exposures on the north hill, but South Minto Hill has six exposures of unusual vent agglomerates, two of which were quarried, so it therefore has value as a geological site.

1. The quarry at the north end of the south hill, at NT 562 211, is just off the footpath through the col between the hills and is accessible up a short, steep path. The lowest exposure at NT 56143 21086 consists of 2 m of irregularly jointed coarse agglomerate which weathers yellow. The matrix consists of angular particles ranging from 2-10 mm with occasional larger clasts up to 7 cm. Some could be identified as greywacke and basalt. Slightly higher up the path at NT 56130 21068 is a low rock face several metres long and 1 m high, which consists of beds of fine-grained agglomerate, although one rounded clast of basalt more than 8 cm long was seen. The north face is about 1 m high and shows apparent trough and cross-bedding in fine agglomerate, although one greywacke clast 15 cm long was noted. Graded bedding was seen on one well-exposed surface, suggesting a volcaniclastic origin. The lower surface of one plane dipping gently to the west has a straight ridge with a rounded crest, which appears to be a sole structure. The highest face at NT 56125 21053 is 4 m high. The lower section is of

coarse-grained agglomerate, similar to other exposures, but a sharp junction separates it from the upper 2 m which is a dark grey agglomerate with particles ranging from 2- 5 mm with no larger clasts visible.

2. At NT 5615 2081 on the east side of the hill, protected by two pine trees, is a quarry about 4 m high face and 25 m across consisting of widely jointed grey agglomerate which weathers a khaki colour. The agglomerate has many angular clasts up to 2 cm, with occasional larger clasts up to 10 cm long seen.
3. About 150 m south of the quarry is a natural exposure at NT 5614 2064 showing about 4 m of agglomerate, weathering pale green/ochre.
4. At the south end of the hill, high above a small woodland at NT 5581 2050, is a small quarry with similar jointing, which was not examined closely.
5. On the NW side of the hill at NT 5596 2086, just below the summit plateau, is an exposure about 8 m high and 20 m across of agglomerate beds dipping gently to the SE, which was not visited.
6. Lower down the hillside at NT 5597 2100 is an exposure of similar agglomerate in the footpath.

Excellent images of the vent agglomerate from the two quarries can be seen on the GeologyNorth website cited below.

Assessment of Site Value

Geodiversity value: One of the few easily accessible and well-exposed vent agglomerates found in the Scottish Borders.	
Description: An attractive hill with good exposures of volcanic agglomerate.	

Access, Safety & Fragility

Aspect	**Description**
Access notes	A public footpath runs from a small lay-by on the minor road north of Minto at NT 564 208 across a field to the col between the two hills and continues to Minto Kames.
Current condition (fragility)	Robust
Potential use	The hill has suitable exposures for groups to visit and study.

Culture, Heritage & Economic

Aspect	**Description**	
Historical, archaeological & literary associations	South Minto Hill's summit has features which may represent a fort of unknown period or a roundhouse which is possibly prehistoric.	
Aesthetic landscape	Very attractive countryside with excellent views in all directions.	
History of Earth Sciences	None	
Economic geology	Vent agglomerate is easy to cut and attractive to use as a building stone. The two quarries are marked on the 1863 map, but shown as old quarries by 1899.	
Built Heritage	Some of the older cottages in Minto village are built of the local vent agglomerate.	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology	Regional	Good	Clarkson & Upton 2010	X
Structural Geology				
Palaeontology				

Geomorphology	Local	Good		
Current Site Value				
Community	The footpath between the Minto Hills is frequently walked.			7
Education	The quarries have been visited by student groups.			6

References / Links

Clarkson, E. & Upton, B. 2010 *Death of an Ocean* p. 173

McAdam, A.D., Clarkson, E.N.K. & Stone, P. 1993 *Scottish Borders Geology: an excursion guide* p. 96

http://www.geologynorth.uk/southern-uplands/igneous-rocks-in-the-southern-uplands/minto-hills/

https://ougs.org/eastscotland/event-reports/220/the-minto-hills-and-rubers-law-scottish-borders/

OS 1:50,000 Map 73 Peebles, Galashiels & Selkirk

OS 1:25,000 Explorer 338 Galashiels, Selkirk & Melrose

BGS 1:50,000 Scotland Sheet 17W Hawick

Photo 1 View of the south and east faces of South Minto Hill from Denholmhill July 2019

Photo 2 Main crag of vent agglomerate in the quarry at the north end of South Minto Hill (NT 562 211) close to the col between the north and south Minto Hills. August 2018

Photo 3 Beds of fine ash in the quarry in Photo 2. There is a large grey clast in the middle of the exposure. Scale card is 9 cm long. August 2018

Photo 4 showing quarry on the east side of South Minto Hill July 2019

Photo 5 Vent agglomerate at the east quarry shown in photo 4 The scale card is 9 cm long. July 2019

Photo 6 Natural exposure of vent agglomerate at the south end of South Minto Hill at NT 56144 20635 July 2019

Photo 7 View of the north hill from the west side of South Minto Hill with the Eildon Hills in the distance. July 2019

SOUTHDEAN QUARRY, CHESTERS

Grid Reference: NT 63450 09145 to NT 63555 09143	Current use: Intermittent use and storage for quarry spoil
Feature: Disused quarry	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 10/6/2018 & 26/7/2019

Site Map

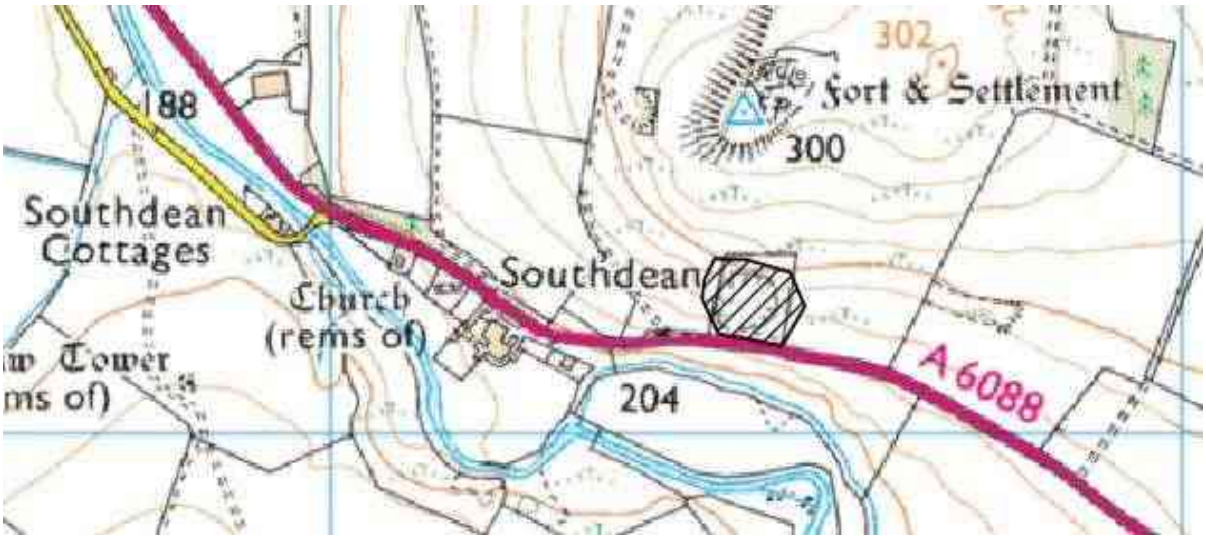


Figure 1: Location Map 1:25,000

Site Description

A large quarry at least 120 m across with faces up to 40 m high has been worked into the south side of Southdean Law. The central section is weathered which suggests that it was worked in the past, but clearly the quarry has been reopened and exploited more recently, as the two side faces have fresh rock. There are large piles of quarry spoil in front of the face and some plastic bag rubbish, although there is still good access to the rock faces.

The Southdean nepheline basanite intrusive plug is in contact with Stratheden Group and Inverclyde Group (undifferentiated) Devonian-Carboniferous rocks to the south and west and also in contact with Ballagan Formation (Lower Carboniferous) rocks to the north and east. It was reported (Tomkeieff 1952) that a contact with the surrounding sedimentary rocks was visible when the quarry was still active.

Nepheline basanite is described on BGS Scotland Sheet 17E Jedburgh as being a dark-coloured, fine-grained basaltic rock containing analcime, plagioclase and nepheline and was intruded during a period of early Carboniferous magmatism. The rock is fine-grained and very black with cream and orange weathering colours. Tomkeieff (1952) suggests that the Southdean Law plug has both vertical radial jointing and parabolic concentric jointing which cross-cut each other. This is seen in the quarry as planar or slightly curved joints, ranging in thickness from 20-40 cm, dipping at 46° towards the south (186°), appearing initially like columnar jointing.

In the central face of the quarry the rock is weathered into a gully about 5 m wide. The rock in that area is closely jointed and brittle, with slickensides and mineralisation along joints, which suggests that a vertical fault traverses the plug, although this is not indicated on the BGS sheet.

A second quarry, long disused, is found on the west side of Southdean Law at NT 634094 and can be reached by walking up a track from the A6088. It shows the parabolic jointing in nepheline syenite described by Tomkeieff (1952) and is worth visiting in combination with a visit to Southdean Quarry.

Assessment of Site Value

Geodiversity value: A fascinating example of jointing on a volcanic plug composed of nepheline basanite, an unusual rock not seen elsewhere in the Scottish Borders.	
Description: A disused quarry in nepheline basanite, with unusual joint patterns	

Access, Safety & Fragility

Aspect	Description
Access notes	Access from the A6088 Bonchester Bridge to Carter Bar road. There is a short track into the quarry where cars can park off the road.
Current condition (fragility)	There is some shrub growth on the older central section of the quarry but jointing features and fresh rock are visible on the east and west faces.
Potential use	Geological parties can visit this site, as it is open access.

Culture, Heritage & Economic

Aspect	Description	
Historical, archaeological & literary associations	An early Iron Age hill fort is found at the top of Southdean Law, with a 2^{nd}-4^{th} century settlement close to the summit of the Law.	
Aesthetic landscape	The quarry lies close to the edge of the Cheviots in moorland with commercial forestry, overlooking the Black Burn valley.	
History of Earth Sciences	None	
Economic geology	A small quarry on the south side of Southdean Law is recorded from maps in 1863 and 1899. A map of 1924 shows a new quarry, clearly being worked at the time, on the west side of Southdean Law, perhaps replacing the southern quarry, which however was enlarged by 1964. Since then, the quarry has expanded to east and west, as shown by the degree of weathering on the rock faces. The quarry appears to be disused at present.	
Built Heritage	The rock is probably unsuitable for building stone as it breaks irregularly but is an ideal material for roadstone and is used locally for field tracks.	

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology	National	Excellent	Pringle 1935, Tomkeieff 1952	X
Structural Geology				
Palaeontology				
Geomorphology				

Current Site Value

Community	It is unlikely to be visited by local people.	0
Education	The site is visited by geological groups.	4

References / Links

Pringle, J. 1935 *British Regional Geology: The South of Scotland* p.78

Tomkeieff, S.I.1952 Nepheline-basanite of Southdean, Roxburghshire. *Trans. Edin. Geol. Soc*.,14, pp.349-359

http://www.geologynorth.uk/southern-uplands/igneous-rocks-in-the-southern-uplands/southdean-law/

OS 1:50,000 Sheet 80 Cheviot Hills & Kielder Water

OS 1:25,000 Explorer OL16 The Cheviot Hills

1:50,000 BGS Scotland Sheet 17E Jedburgh

Photo 1 Entrance to quarry looking west July 2019

Photo 2 West end of quarry showing curved jointing in nepheline basanite July 2019

Photo 3 Possible fault in gully Altered rock can be examined in the dark rocks to the left. July 2019

Photo 4 View across the face of the quarry from the relatively fresh rock to the west, across the possible fault zone to the weathered face, colonised by vegetation, at least since the 1950s. June 2018

Photo 5 East end of the quarry, showing jointing in recently quarried section. July 2019

Photo 6 A block of nepheline basanite to show the fresh texture and colour, by comparison with the weathered surface. June 2018

STAEROUGH HILL, YETHOLM

Grid Reference: NT 8327 – NT 8327	Current use: Grazing
Feature: Inland exposure	Other designations: Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 25/6/2018

Site Map

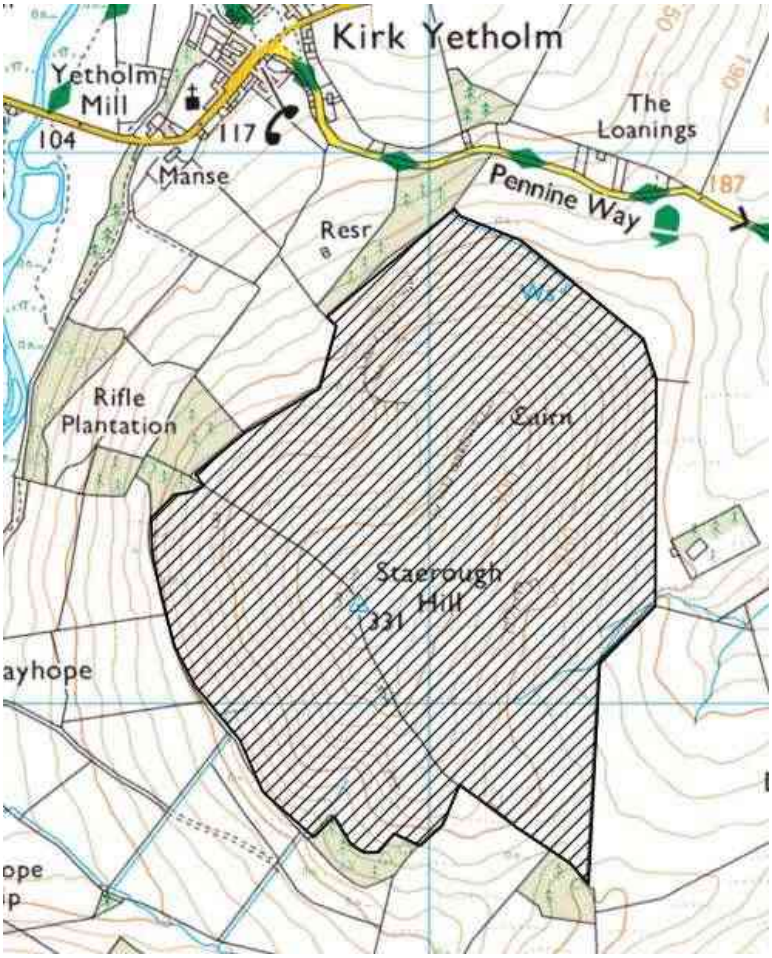


Figure 1: Location Map 1:25,000

Site Description

Staerough Hill is 331 m high with a triangulation pillar at NT 829 272 and is composed of andesite lavas of the Cheviot Volcanic Formation radiometrically dated at 396 ±4 Ma (Early Devonian times) as a late episode related to the closure of the Iapetus Ocean. The andesites are pink in colour, with small phenocrysts and are amygdaloidal and flow-banded. Several of the lava flows are glassy, with limited crystal development and are regarded as super-cooled lavas called pitchstones.

On Staerough Hill there are many small patches of reddish andesitic scree. An andesite crag about 150 m long and generally 5 m high is found on the east side of the hill extending from NT 83134 27141 to the north. The rock has a white weathering colour and a variety of jointing directions giving large blocks of stone which was quarried, as recorded on OS sheet NT82 from 1954. There are extensive spoil tips below the crag.

The northern end of the summit ridge has a north-west facing scar of andesite about 300 m long, with extensive screes below. Exposures of andesite are seen at the base of the scar.

The major crag [NT 8305 2777 to NT 8295 2755], which is at least 200 m long and 20 m high, is illustrated in Clarkson & Upton (2010). It is made of black amygdaloidal pitchstone (called pitchstone-andesite in old accounts), with irregular patches of pale crystals up to 3/4 mm. The pitchstone has thin

bright red veins, probably jasper, and parallel to joint surfaces. The fresh rock is best seen in Kirk Yetholm church where it is the main building stone. Well-spaced but irregular jointing gives an appearance of columns in the main crag. Flow banding can be seen on loose blocks. Outcrop patterns indicate abrupt lateral thinning of the pitchstone lava flows.

Small quarries have been opened up in the pitchstone, one of which is at NT 8283 2742 on the west side of Staerough Hill where spoil tips are visible.

An image of a thin section of andesite, numbered S667, from the summit of Staerough Hill is available online from the British Geological Survey Rock Collections website at https://www.bgs.ac.uk/data/britrocks/britrocks.cfc?method=searchBritrocks

Assessment of Site Value	
Geodiversity value: Extensive lavas of pitchstone are very rare in the UK.	
Description: Hill of andesite lavas, with three pitchstone lava flows, one of which forms a large cliff overlooking Kirk Yetholm. Other smaller quarries and exposures of pitchstone are seen elsewhere on the east slopes of the hill.	

Access, Safety & Fragility	
Aspect	**Description**
Access notes	The farm track to the NE side of Staerough Hill leaves the minor road east of Kirk Yetholm at NT 838 278. Good parking is available at NT 840 277 at Halter Burn. Access to crags on the west side of the hill is via a gate at the summit triangulation point.
Current condition (fragility)	Most of the hill is grazed. As the andesite and pitchstone scars are not vulnerable to scree formation at present, the rocks will continue to be well-exposed.
Potential use	As the igneous rocks are unusual and well-exposed, geological groups will be interested in visiting.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	None	
Aesthetic landscape	Superb views in all directions from the summit ridge	
History of Earth Sciences	None	
Economic geology	Small quarries on Staerough Hill provided local building stone.	
Built Heritage	Many of the old buildings in Kirk Yetholm are built of pitchstone with thatched roofs. The church was rebuilt with pitchstone in 1836-37.	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy				
Sedimentology				
Igneous/Mineral/ Metamorphic Geology	National	Good	Clarkson & Upton 2010	X
Structural Geology				
Palaeontology				
Geomorphology	Local	Excellent		
Current Site Value				
Community	The hill is open access, so is walked by local people.			8
Education	The hill may be visited by geologists interested in the unusual volcanic rocks.			2

References / Links

Stone, P, McMillan, A. A., Floyd, J.D.,Barnes, R.P. and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (Fourth Edition). Keyworth, Nottingham: British Geological Survey p. 108

Clarkson, E and Upton, B *Death of an Ocean: A Geological Borders Ballad* 2010 p. 143

OS 1:50,000 Map 74 Kelso & Coldstream

OS 1:25,000 Explorer OL16 The Cheviot Hills

BGS 1:50,000 Scotland sheet unavailable but see BGS Geology of Britain viewer

Photo 1 View of Staerough Hill looking south west. June 2018

Photo 2 South end of andesite crag at NT 83134 27141 looking north east. June 2018

Photo 3 Main pitchstone crag which extends from NT 8305 2777 to NT 8295 2755. June 2018

Photo 4 South end of pitchstone scar at NT 82953 27543 looking west over Town Yetholm. June 2018

Photo 5 View from near the summit triangulation point north-west to Kirk Yetholm. June 2018

Photo 6 Kirk Yetholm church, rebuilt with pitchstone in 1836-37. June 2018

Photo 7 Close-up of pitchstone block with jasper vein in Kirk Yetholm church wall. June 2018

SYNTON MOSSEND CUTTING

Grid Reference: NT 48380 20857 SE end NT 48305 20939 NW end	Current use: A7 road cutting
Feature: Inland exposure	Other designations: None
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 13/04/2018 & 29/7/2019

Site Map

Figure 1: Location Map 1: 25,000 The cutting is on the east side of the road and the 10-figure grid references above mark the limits at each end.

Site Description

The road cutting is about 100 m long on the east side of the A7 about 4 miles north of Hawick and lies behind a wide grass verge, with a ditch and some trees at the base of the cutting. It is about 4 m high at maximum.

Hawick Group (Silurian) greywackes, with beds up to 2 m wide, are interbedded with mudstones, siltstones and thin greywackes. Folds on different scales can be easily seen, from a wide antiform with a rounded crest in thick greywackes in the middle of the cutting, to minor antiform-synform pairs, with rounded and angular hinges at either end of the cutting. Greywacke and mudstone beds wedge and fault in places.

At the SE end of the cutting, green and purple slates are interbedded with fine-grained green greywackes 0.5 – 1.5 m thick, all dipping at 67° to the NW (308°). Northwards, 10 m of thick greywacke beds, occasionally interrupted by thin siltstones, are replaced by increasingly intensely folded siltstones and thin greywackes, often with rounded fold hinges. The central face of the cutting consists of a gentle antiform in greywackes with beds at least 2 m thick. The northern limb of the anticline dips at 61° towards the NE (029°) and is succeeded by several metres of grey mudstones, which wedge out at the top of the anticline. The NW end of the cutting is similar to the SE end, with vertical siltstones and thin greywackes, occasionally intensely folded. Small-scale flute casts were seen on loose rocks at the foot of the cutting, but none were seen in situ.

Assessment of Site Value

Geodiversity value: The cutting demonstrates clearly several types of folds and is valuable for teaching geological structures.

Description: A road cutting showing greywackes, siltstones and mudstones which have been folded.

Access, Safety & Fragility

Aspect	Description
Access notes	The road cutting on the NE side of the A7 lies behind a wide grassy verge

	so access for groups is relatively safe, given the speed of traffic on the A7. Parking for a few cars is available along the minor road to Synton or the farm road to Synton Mossend close to the cutting.
Current condition (fragility)	There are several small trees close to the cutting which impede the view of some of the rocks. Sapling growth will eventually block access to the cutting, if allowed to continue.
Potential use	This is an excellent site for the study of structural geology for higher level students.

Culture, Heritage & Economic

Aspect	**Description**	
Historical, archaeological & literary associations	None	
Aesthetic landscape	The slope above the road cutting is forested.	
History of Earth Sciences	None	
Economic geology	N/A	
Built Heritage	N/A	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	Local	Good		
Sedimentology	Local	Good		
Igneous/Mineral/ Metamorphic Geology				
Structural Geology	Regional	Excellent		X
Palaeontology				
Geomorphology				

Current Site Value

Community	Unlikely to be visited	0
Education	Unlikely to be visited, although it has potential for teaching.	0

References / Links

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, p. 71.

1:50,000 Landranger Map 73 Peebles, Galashiels and Selkirk

1:25,000 Explorer Map 338 Galashiels, Selkirk and Melrose

1:50,000 BGS Scotland Sheet 17W Hawick

Photo 1 Synton Mossend Cutting on the A7 between Selkirk and Hawick April 2018

Photo 2 Antiform with rounded hinge in thick greywackes in the centre of the cutting, with siltstones and mudstones above, which wedge out towards the crest of the fold. July 2019

Photo 3 Synform at the SE end of the cutting in thin greywackes and siltstones, part of a small section of intensely folded rocks July 2019

Photo 4 Synform in siltstones and mudstones at the NW end of the cutting July 2019

Photo 5 Vertical siltstones, mudstones and thin greywackes at the NW end of the cutting July 2019

THIRLESTANE SCORE

Grid Reference: NT 2531 2033 to NT 2524 2021	Current use: Sheep grazing
Feature: Inland exposure	Other designations: Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyors: Alison & Barry Tymon	Date: 21/06/2019
Site Map	

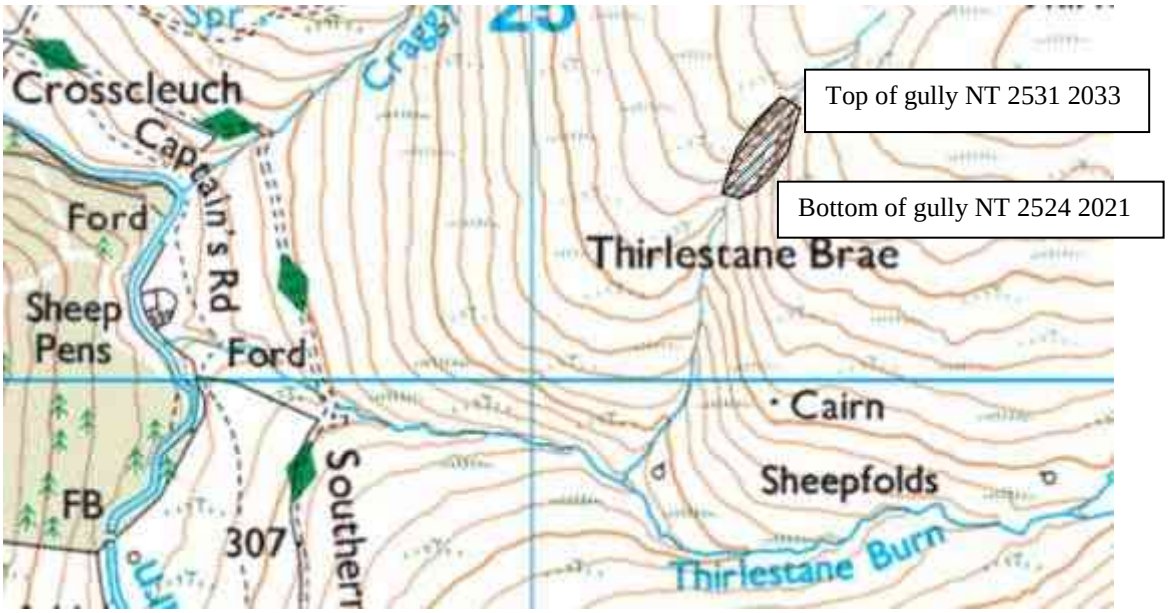


Figure 1: Location Map 1:25,000

Site Description (qualitative)

Thirlestane Score is a rocky gully about 100 m long on a steep tributary of the Thirlestane Burn which cuts through Thirlestane Brae. The fine-grained, cleaved mudstones belong to the Moffat Shale Group which is a deep-water sequence of mudstones that formed in the Iapetus Ocean throughout the Ordovician and Silurian periods.

The eastern side of the gully consists of laminated black to dark grey, oily and iron-rich shales, which break into irregular cleavage fragments. The beds are vertical and trend N-S (189°). About half way down the gully the dip reduces to 74° and small-scale crumpling can be seen.

The western side of the gully has finely-cleaved green shales at the top of the gully, with the cleavage planes often covered with manganese minerals (wad), sometimes with dendritic habit. The beds are vertical and trend N-S, although the dip reduces to 29° in a westerly direction within a few metres, suggesting local folding. The scree from these beds contains both green and purple shales. A loose block of green shale had small-scale sole marks on one surface and another of purple fine-grained muscovite-rich sandstone contained rounded clasts of purple shale, up to 2 cm long.

At the bottom of the gully on the west side at NT 25261 20249 is a 15 cm thick bed of greywacke, dipping W (290°) at 65°. The bedding surface has broad flute casts, although they were not clear enough to indicate direction of flow but they show that the greywacke bed is inverted. The BGS map (Sheet 16E Ettrick) shows a fault on the E side of the gully, downthrown to the W.

The black shales on the east side of the gully belong to Lapworth's *Monograptus spinigerus* Zone, which now belongs to the *Monograptus halli* and *Stimulograptus sedgwicki* zones. The overlying green and purple shales are part of the *Monograptus guerichi* Zone (Clarkson & Upton 2010) but contain *Rastrites maximus* which does not occur outside Southern Scotland. The *maximus* Zone has been incorporated in the widely recognised *guerichi* Zone, the Silurian (Llandovery) Moffat Shale Group.

The literature mentions that bentonite layers (volcanic ash), interbedded with the fossiliferous shales, have been recorded here as in other local sites, particularly Dob's Linn (Dumfries and Galloway).

Assessment of Site Value
Geodiversity value: A well-exposed example of Silurian (Llandovery) Moffat Shales, with shales of varying colours and cleavage types which contain graptolites of considerable zonal value. The laminated beds vary in dip and strike and include minor folds and are probably also faulted. A bed of greywacke has sole marks which indicate that the beds are inverted. Exposures of Moffat Shales are not common, so this is an important site.
Description: A steep, rocky gully exposing fossiliferous Moffat Shales

Access, Safety & Fragility	
Aspect	**Description**
Access notes	Park opposite the Glen Café (Loch of the Lowes) NT 238 204 where public toilets are available. Distance from the car park to Thirlestane Score is about 2 km with a climb of 200 m. Follow the Southern Upland Way from Tibbie Shiels Inn eastwards. At the second tributary on the left, turn left up Thirlestane Burn, then left at the first pinfold. Climb steeply up the valley for about 500 m to reach Thirlestane Score, a narrow gully about 100 m long.
Current condition (fragility)	The steep gully is subject to freeze-thaw weathering resulting in constant scree formation, which increases the likelihood of finding important fossils.
Potential use	Research purposes only.

Culture, Heritage & Economic	
Aspect	**Description**
Historical, archaeological & literary associations	None
Aesthetic landscape	Wonderful Scottish Upland scenery, with narrow valleys and rolling summits and long views to the south
History of Earth Sciences	Charles Lapworth collected fossils at this site. The graptolite zones as defined by Lapworth are of local use in Scotland, but have been superceded by a global zonation system.
Economic geology	N/A
Built Heritage	N/A

GeoScientific Merit rankings must be used in conjunction with LBGCSiteSurveys-RankingCriteria2019 to ensure consistency among all surveyors and reviewers

GeoScientific Merit	Rarity	Quality	Literature/Collections	First
Lithostratigraphy	National	Excellent		X
Sedimentology	Local	Moderately good		
Igneous/Mineral/ Metamorphic Geology				
Structural Geology	Local	Moderately good		
Palaeontology	National	Excellent	Rigby *et al.* 2000, Rigby 2003, Clarkson & Upton, 2010	X
Geomorphology	Local	Moderately good		

Current Site Value		
Community	Thirlestane Brae is not on a footpath, so visitors are rare.	0
Education	Geology groups visit occasionally.	2

References / Links
Clarkson, E. & Upton, B. 2010 *Death of an Ocean* pp.116-118 Rigby, S. & Davies, S.J. 2000 Volcanically mediated plankton blooms in the Central Belt of the

Southern Uplands, Scotland, during the Llandovery *Trans. Royal. Soc. Edinburgh*, 91 (3-4), pp.457-470

Rigby, S. 2003 The functional morphology and population structure of *Rastrites maximus* from the Southern Uplands. *Scottish Journal of Geology,* 39, pp. 51-60

Stone, P, McMillan, A.A, Floyd, J.D, Barnes, R. P, and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (4th edition) British Geological Survey, pp. 49-51

1:50,000 Landranger Map 73 Peebles, Galashiels and Selkirk

1:25,000 Explorer Map 337 Peebles and Innerleithen

1:50,000 BGS Scotland Sheet16E Ettrick

Photo 1 View from above Thirlestane Score from NT 2531 2033 looking south-west June 2019

Photo 2 Black shales on the east side of the gully (left) with purple and green shales on the west side (right) June 2019

Photo 3 Minor folding in black shales June 2019

Photo 4 View towards the north-east, looking up into Thirlestane Score June 2019

TOFTS HILL QUARRY, KIRKTON

Grid Reference: NT 54564 13561 to NT 54658 13518	Current use: None
Feature: Disused quarry	Other designations: Special Landscape Area
Current geological designations: None	Other scientific: None
Field surveyor: Alison Tymon	Date: 9/6/2018

Site Map

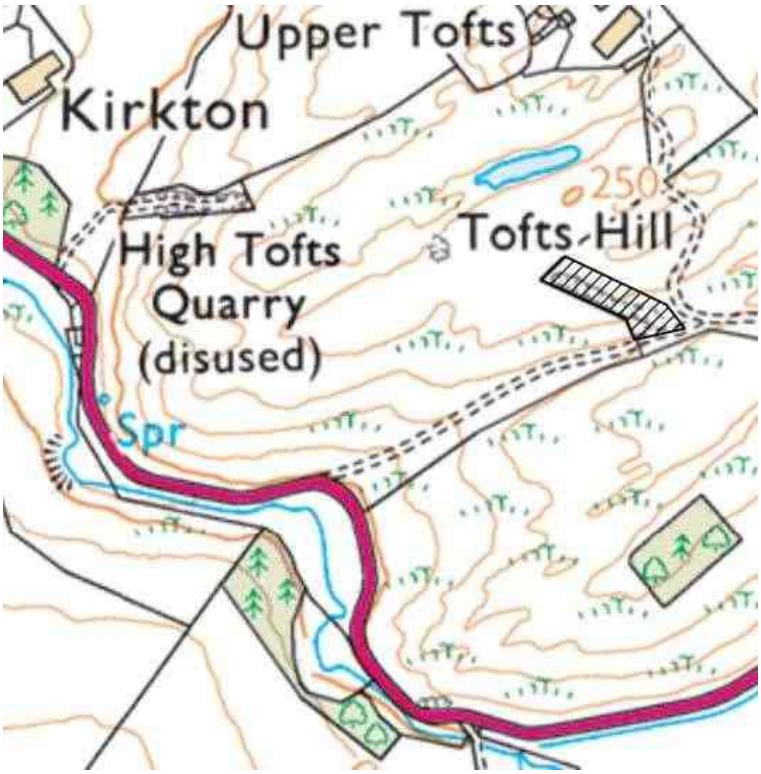


Figure 1: Location Map 1:25,000

Site Description

A steep-sided quarry about 100 m long following the outcrop of the Palaeogene (60 – 55 Ma) Acklington Dyke. Gala Group (Llandovery, Silurian) greywackes are exposed on the quarry sides. At the NW end of the quarry, beds dip at18°/114°, but become steeper towards SE end of quarry, at 80°. Greywacke beds are 30-40 cm wide, with many siltstone beds. Several bedding planes on the north side of the quarry near the entrance have sole marks, including flute casts, showing younging to the NW indicating that the beds are inverted.

At the NW end of the quarry is dolerite scree below a vertical face of dolerite about 2 m high with well-spaced sub-horizontal jointing. The black dolerite is vesicular in places with no phenocrysts visible and weathers orange. The width of the quarry and therefore of the Acklington Dyke is 7/8 m throughout. Halfway along the quarry and at the quarry entrance are other exposures of dolerite in contact with greywackes. Core holes are seen in dolerite near the quarry entrance.

Assessment of Site Value

Geodiversity value: The Acklington Dyke is exposed in only a few places in the Hawick area and this quarry includes features of interest in the Silurian greywackes.	
Description: Disused quarry along the Palaeogene Acklington Dyke, showing dolerite exposures at the quarry face and contacts with Silurian greywackes, which are intensely folded and show sole structures.	

Access, Safety & Fragility	
Aspect	**Description**
Access notes	From A6088 access is along a grassed quarry track, though gates at each end of the track have to be climbed. The quarry is fenced so is not accessible for grazing. Permission would need to be obtained for a visit.
Current condition (fragility)	Condition excellent currently, with good exposure of the dolerite dyke and the greywackes.
Potential use	This is an excellent teaching site for understanding dyke intrusion into sediments.

Culture, Heritage & Economic		
Aspect	**Description**	
Historical, archaeological & literary associations	None	
Aesthetic landscape	It is an attractive quarry, with some wildlife.	
History of Earth Sciences	None	
Economic geology	The quarry is first shown on a 1916 map.	
Built Heritage	The stone was probably used as aggregate and road stone.	

GeoScientific Merit	**Rarity**	**Quality**	**Literature/Collections**	**First**
Lithostratigraphy	Local	Moderately good		
Sedimentology	Local	Moderately good		
Igneous/Mineral/ Metamorphic Geology	Regional	Excellent	Clarkson & Upton 2010	X
Structural Geology	Local	Poor		
Palaeontology				
Geomorphology				

Current Site Value		
Community	It is unlikely that it is visited because of the difficulty of access.	0
Education	Not used at present.	0

References / Links

Pringle, J. 1935 *British Regional Geology: The South of Scotland* p. 88.

Stone, P, McMillan, A. A., Floyd, J.D.,Barnes, R.P. and Phillips, E.R. 2012 *British Regional Geology: South of Scotland* (Fourth Edition). Keyworth, Nottingham: British Geological Survey pp. 171-172

Clarkson, E and Upton, B *Death of an Ocean: A Geological Borders Ballad* 2010 p. 187

1:50,000 Landranger Map 79 Hawick and Eskdale

1:25,000 Explorer Map 331 Teviotdale South

1:50,000 BGS Scotland Sheet 17W Hawick

Photo 1 View from east end of quarry showing greywackes on either side, with dolerite forming the end slope. June 2018

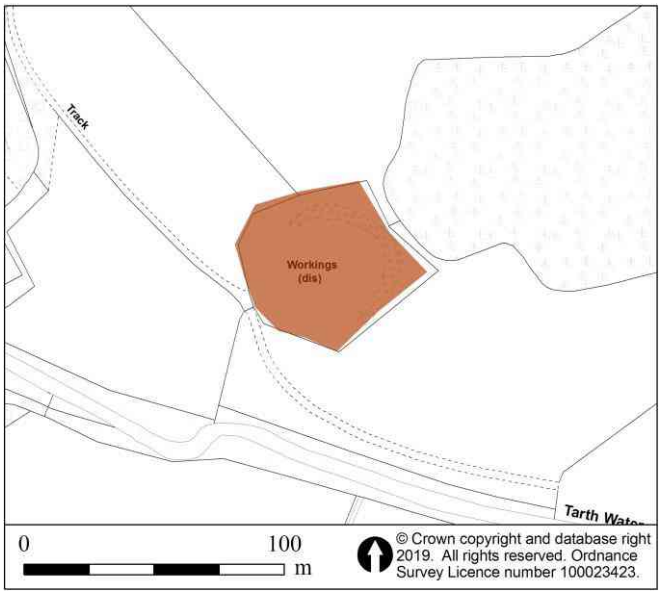
Photo 2 Dolerite scree at the west end of the quarry, with dolerite exposures on the left of the photo. June 2018

Photo 3 Steeply dipping greywackes half way along the quarry on the north face. June 2018

Photo 4 Flute casts on greywackes at the east end of the quarry. June 2018

LOCAL GEODIVERSITY SITES TECHNICAL NOTE

APPENDIX 3: LOCAL GEODIVERSITY SITES AND DESCRIPTIONS



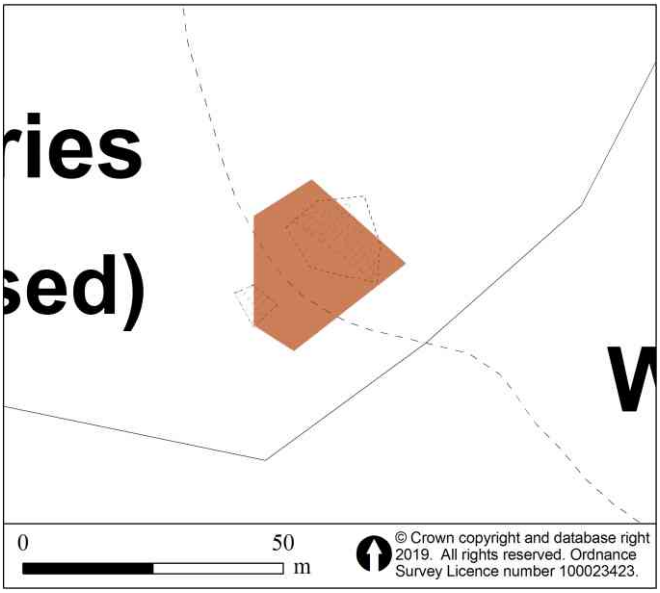
Site Ref: 1

Site Name: Blyth Bridge Quarry

Area (ha): 0.3

Site Description
Biggar Volcanic Formation

Shown on Map 1



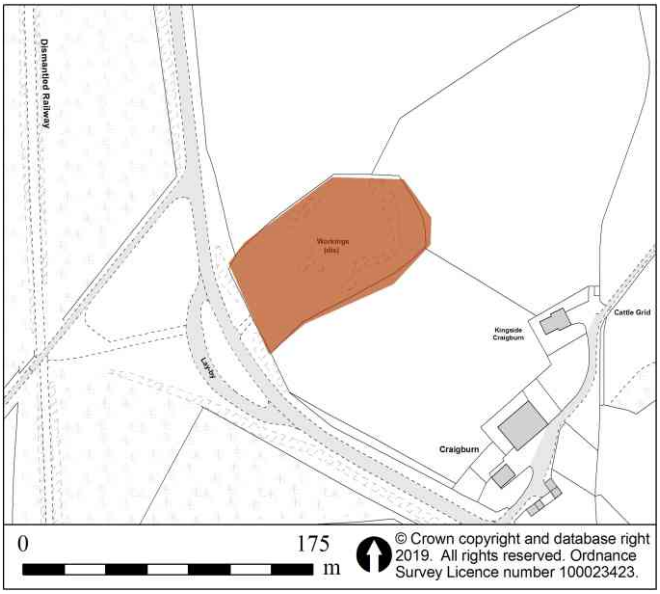
Site Ref: 2

Site Name: Cocklie Rig Head Quarry, Glencotho

Area (ha): 0.1

Site Description
Wrae Limestone, Ordovician

Shown on Map 1



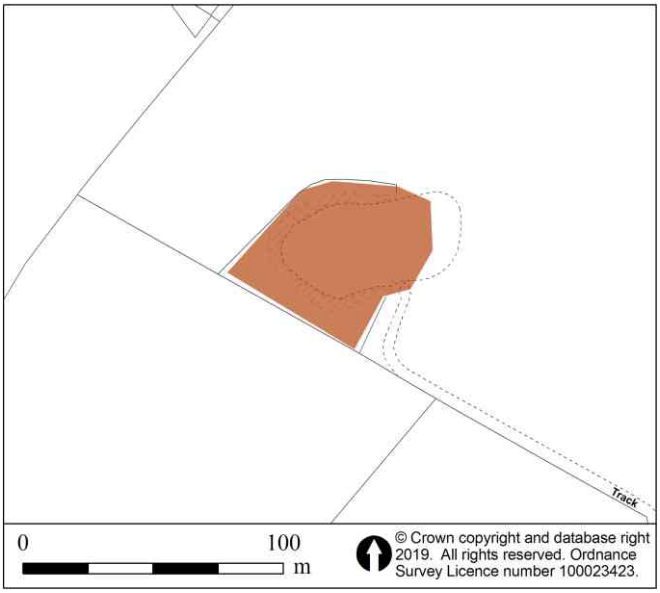
Site Ref: 3

Site Name: Craigburn Quarry

Area (ha): 0.8

Site Description
Haggis Rock, Ordovician

Shown on Map 1



Site Ref: 4

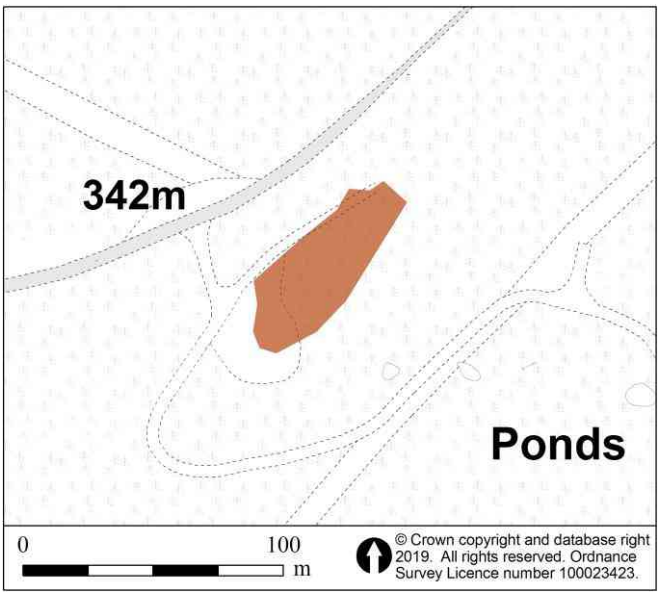
Site Name: Craiglands Quarry, Lochurd

Area (ha): 0.3

Site Description

Auchtitench Sandstone Formation, Lower Devonian

Shown on Map 1



Site Ref: 5

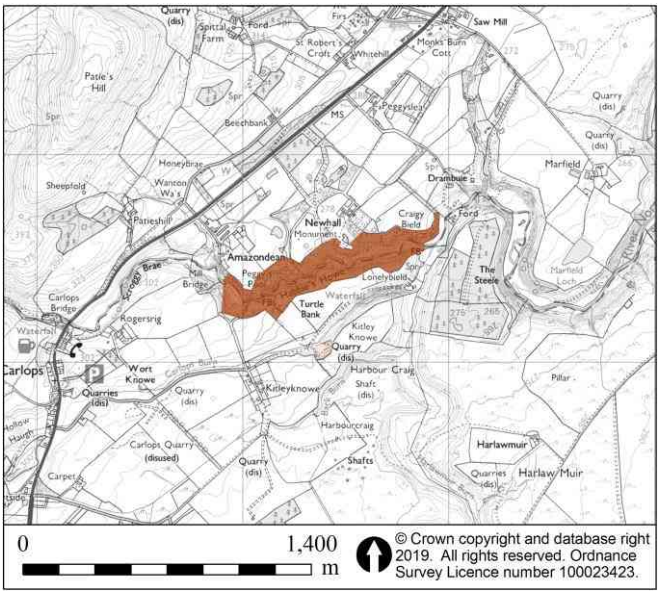
Site Name: Grassfield Quarry, Noblehouse

Area (ha): 0.2

Site Description

Noblehouse Lava Formation

Shown on Map 1



Site Ref: 6

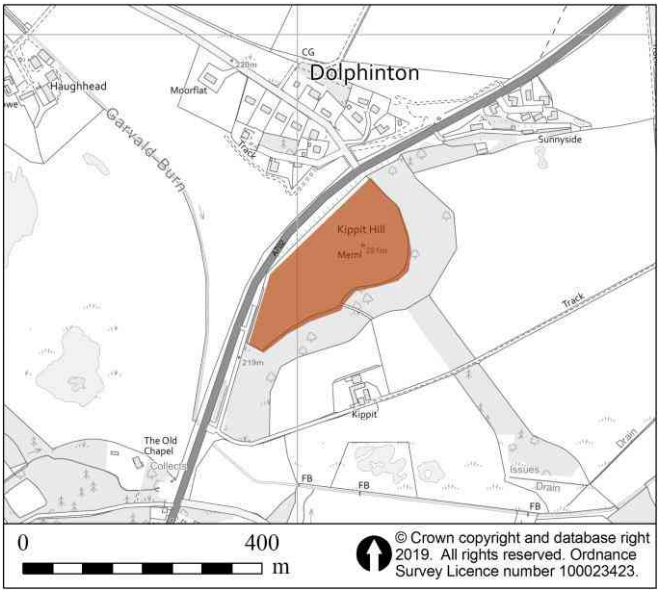
Site Name: Habbie's Howe

Area (ha): 18.5

Site Description

Carboniferous, Quaternary

Shown on Map 1



Site Ref: 7

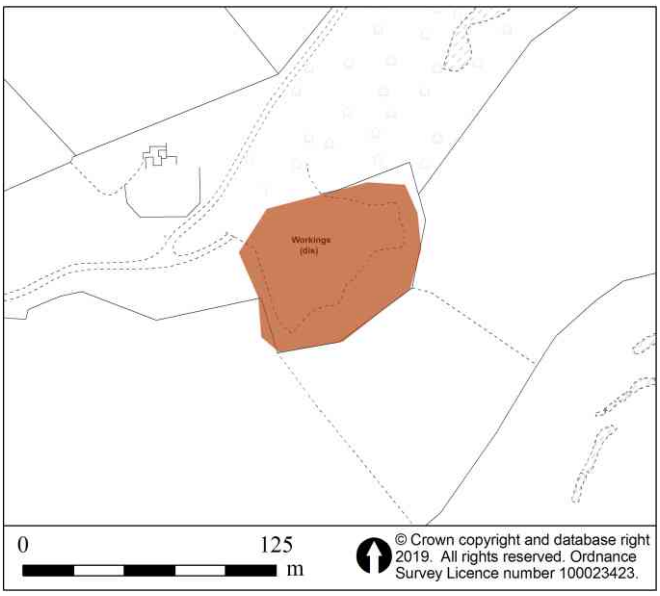
Site Name: Kippit Hill

Area (ha): 3.6

Site Description

Fluvio-glacial kame, Quaternary

Shown on Map 1



Site Ref: 8

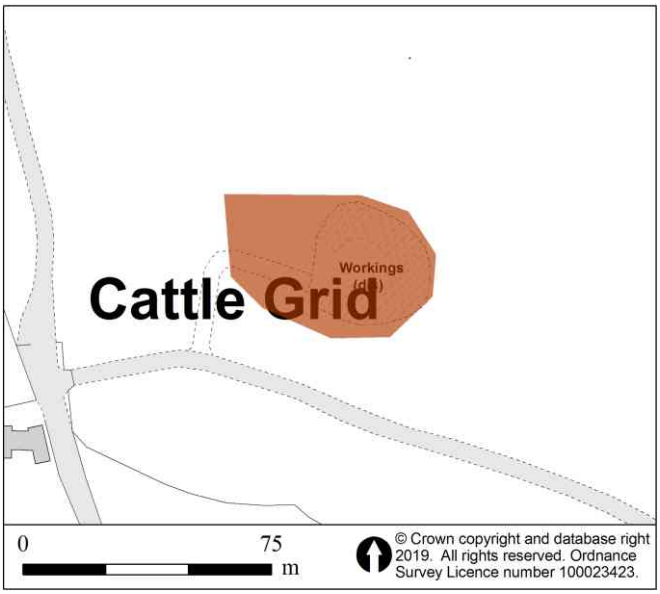
Site Name: Kitleyknowe Sand Quarry, Carlops

Area (ha): 0.5

Site Description

Carboniferous sandstone

Shown on Map 1



Site Ref: 9

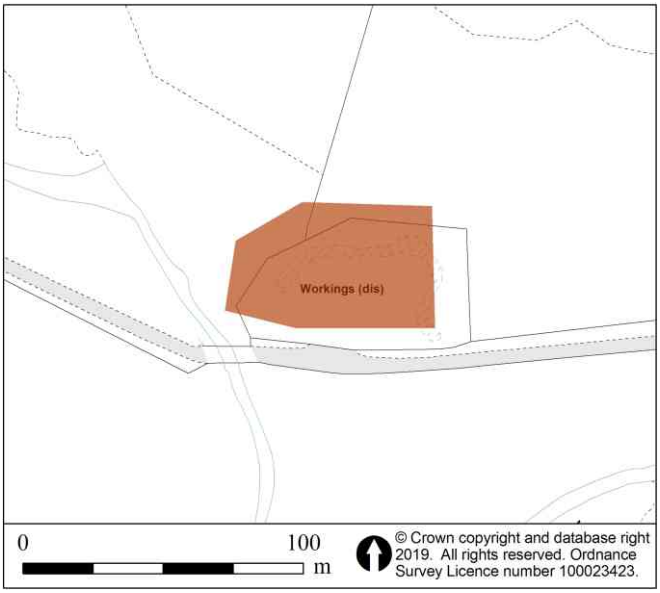
Site Name: Mountbenger Toll Quarry

Area (ha): 0.2

Site Description

Ettrick Group,Silurian

Shown on Map 1



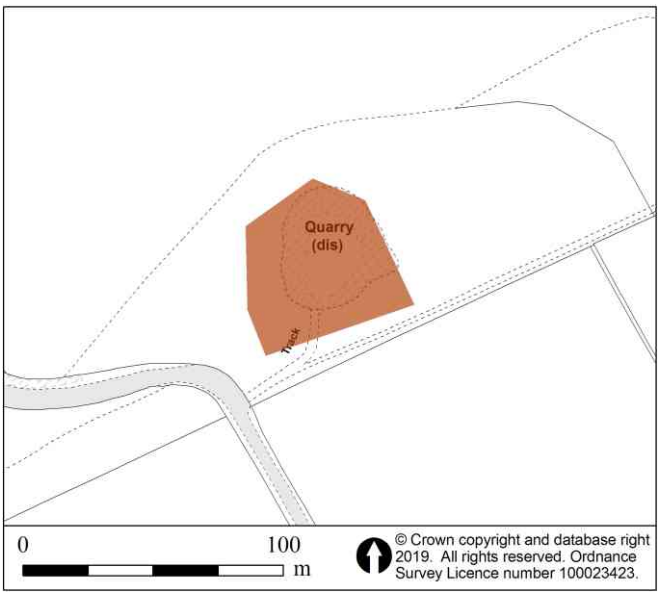
Site Ref: 10

Site Name: Raeshaw Wood Quarry

Area (ha): 0.3

Site Description
Raeshaw Conglomerate, Silurian

Shown on Map 1



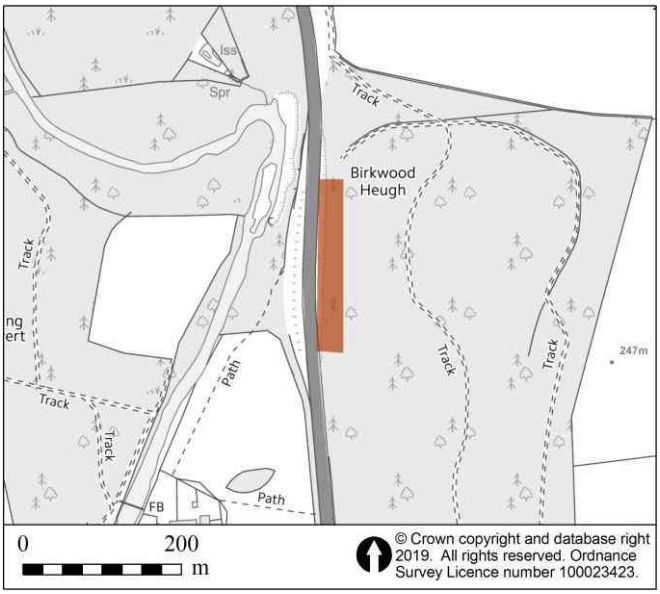
Site Ref: 11

Site Name: Bemersyde Hill Quarry

Area (ha): 0.3

Site Description
Quartz-trachyte intrusion

Shown on Map 2



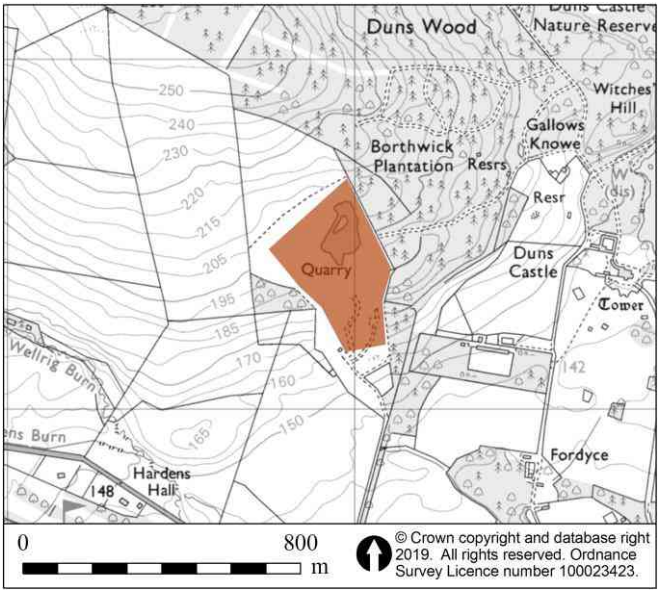
Site Ref: 12

Site Name: Birkwood Heugh Cutting

Area (ha): 0.7

Site Description
Great Conglomerate, Lower Devonian

Shown on Map 2



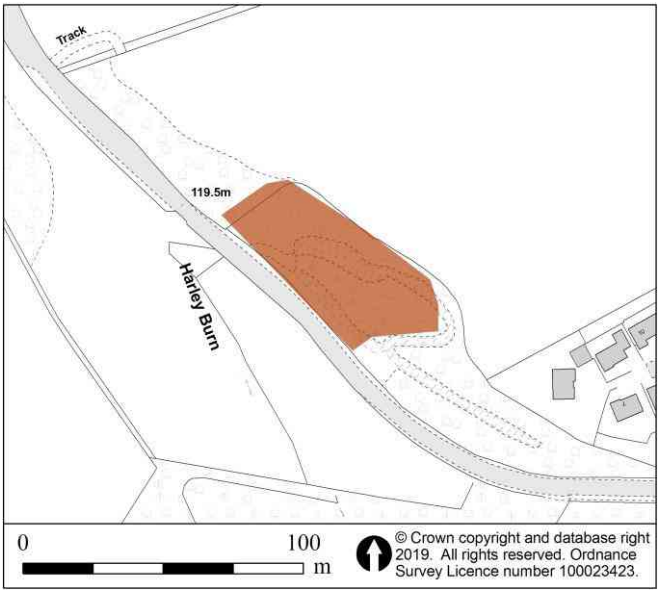
Site Ref: 13

Site Name: Borthwick Quarry, Duns

Area (ha): 9.5

Site Description
Carboniferous dolerite sill

Shown on Map 2



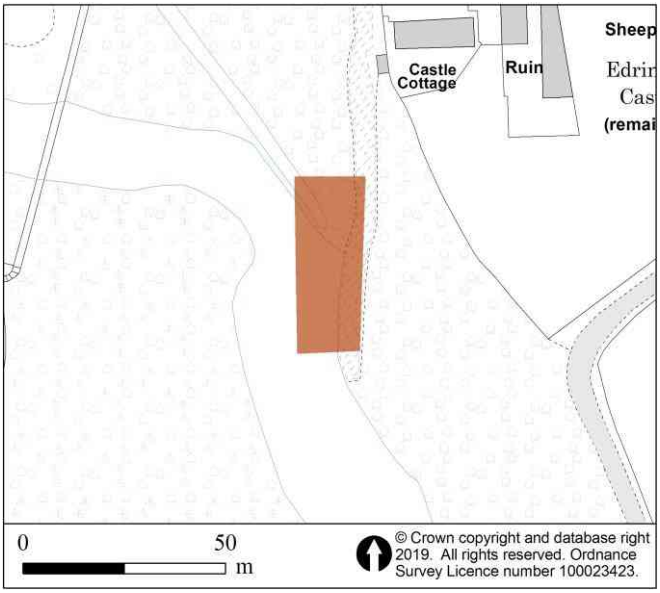
Site Ref: 14

Site Name: Dingleton Quarry, Melrose

Area (ha): 0.2

Site Description
Chiefswood agglomerate

Shown on Map 2



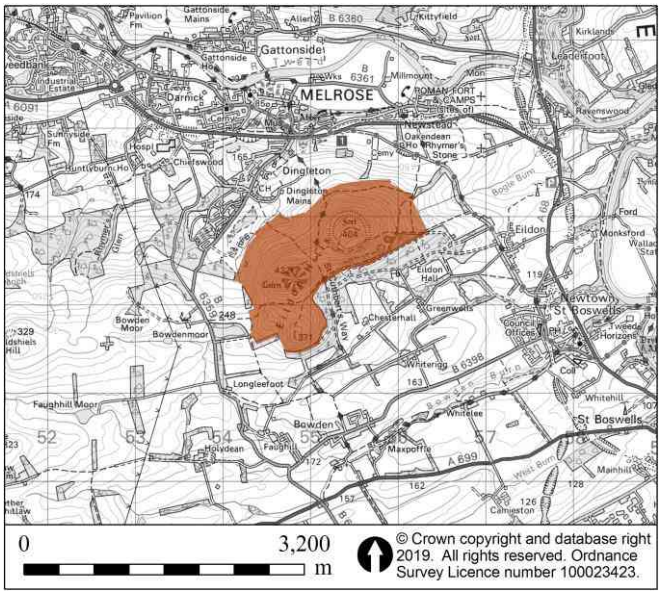
Site Ref: 15

Site Name: Edrington Cliff

Area (ha): 0.1

Site Description
Ballagan Formation, Carboniferous

Shown on Map 2



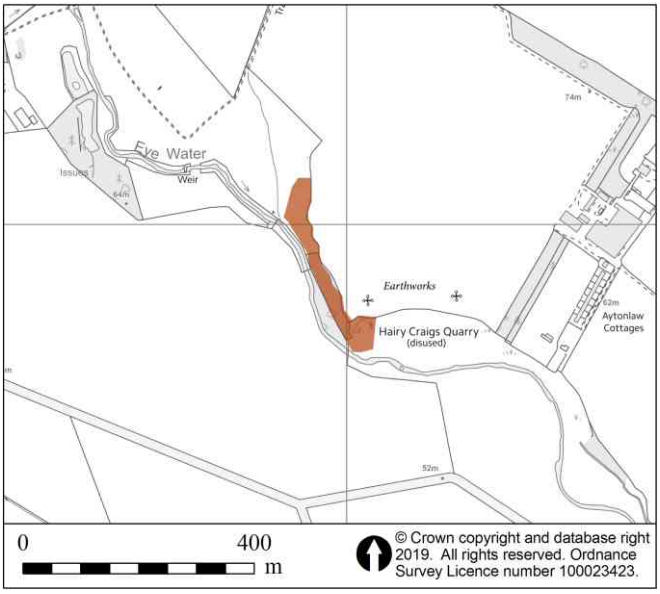
Site Ref: 16

Site Name: Eildon Hills

Area (ha): 219

Site Description
Silicic sills and landscape

Shown on Map 2



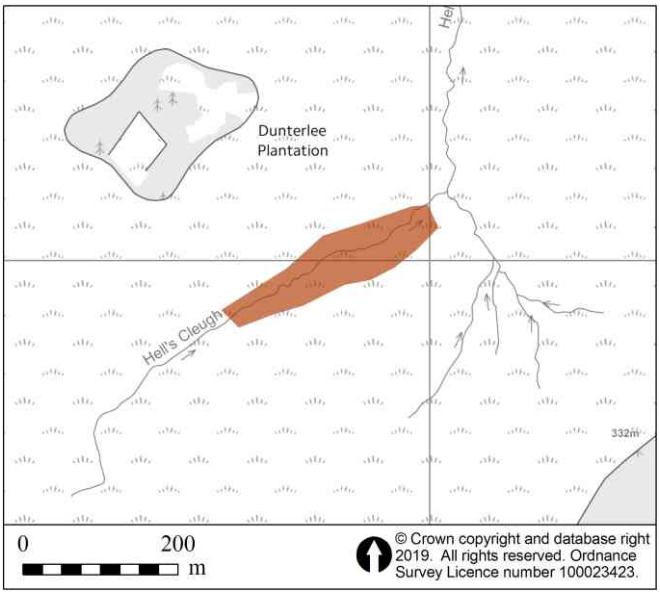
Site Ref: 17

Site Name: Hairy Craigs Quarry, Ayton

Area (ha): 1

Site Description
Auchencrow Burn Sandstone, Lower Devonian

Shown on Map 2



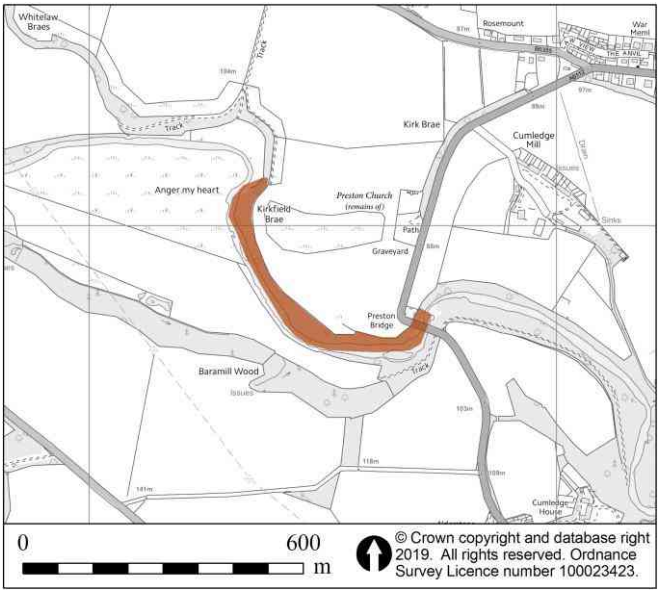
Site Ref: 18

Site Name: Hell's Cleugh, Stobswood

Area (ha): 1.6

Site Description
Great Conglomerate, Lower Devonian

Shown on Map 2



Site Ref: 19

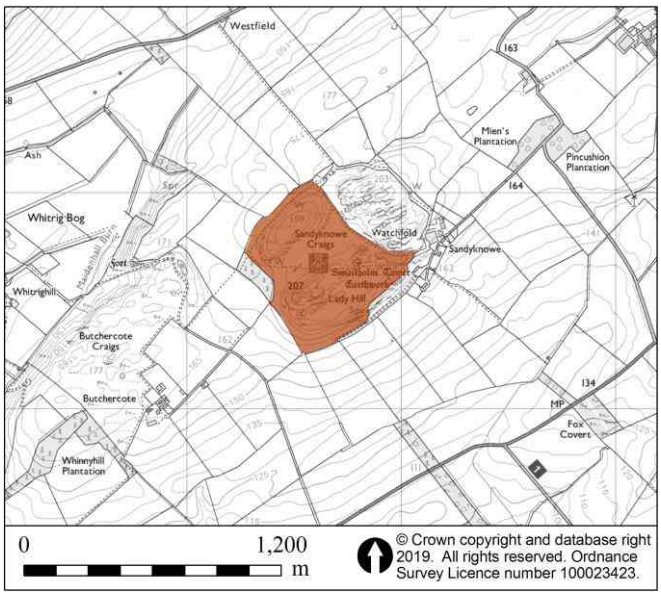
Site Name: Preston Bridge, Duns

Area (ha): 2.5

Site Description

Upper Devonian and Lower Carboniferous volcanics

Shown on Map 2



Site Ref: 20

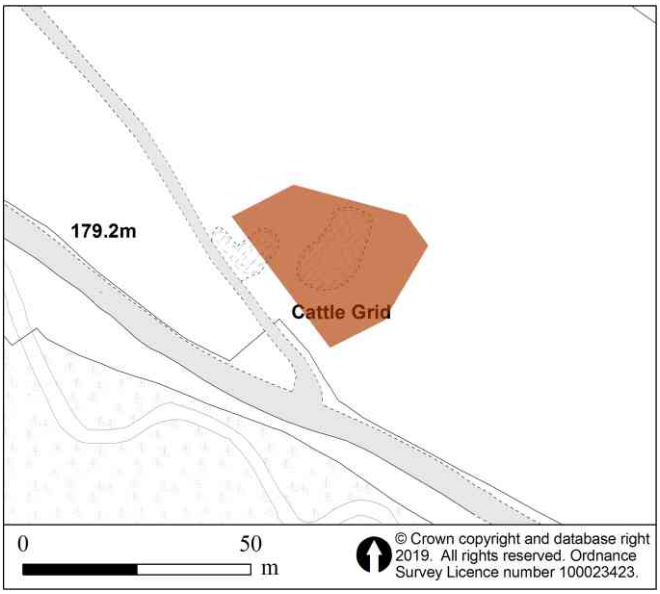
Site Name: Smailholm Tower

Area (ha): 33.1

Site Description

Kelso Volcanic Formation

Shown on Map 2



Site Ref: 21

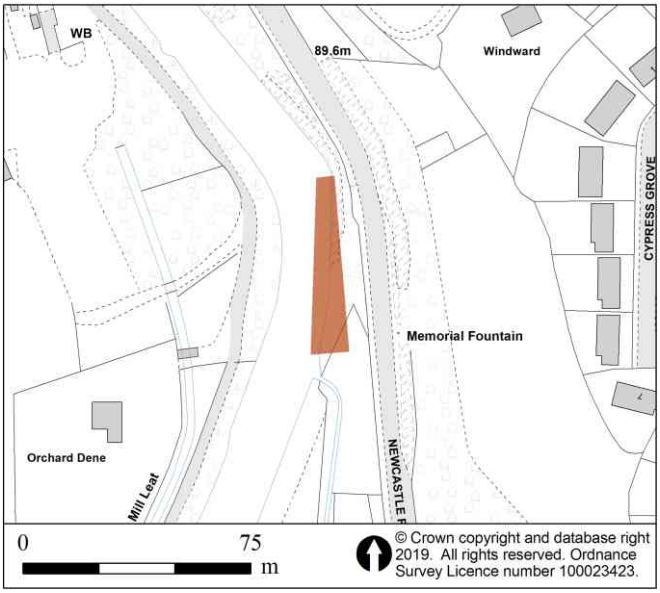
Site Name: Adderston Shiels, Cogmill

Area (ha): 0.1

Site Description

Riccarton Group, Silurian

Shown on Map 3



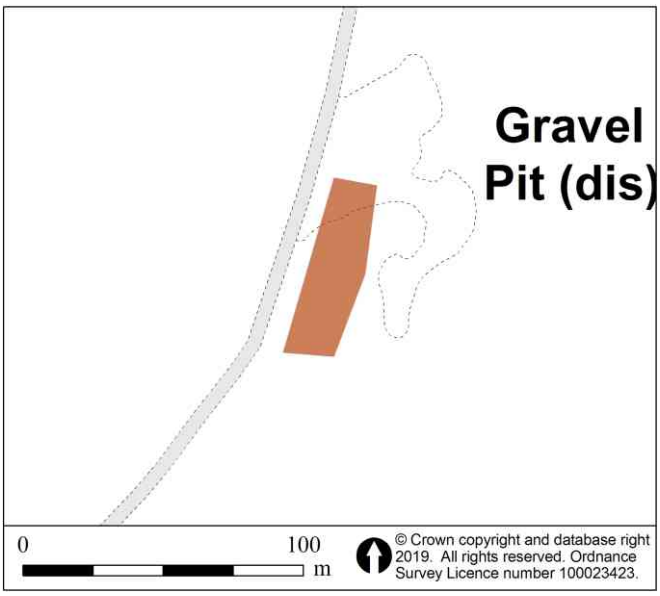
Site Ref: 22

Site Name: Allars Mill, Jedburgh

Area (ha): 0.1

Site Description
Silurian/UORS unconformity

Shown on Map 3



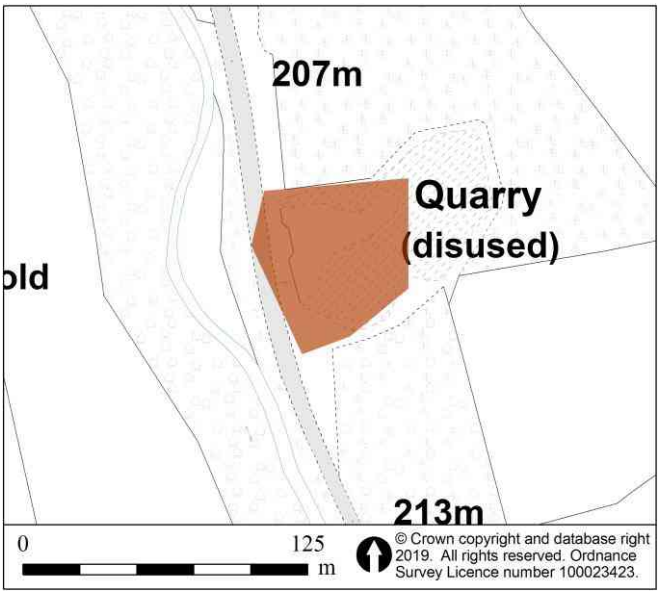
Site Ref: 23

Site Name: Buchtrig Gravel Quarry

Area (ha): 0.1

Site Description
Decomposed Cheviot andesite

Shown on Map 3



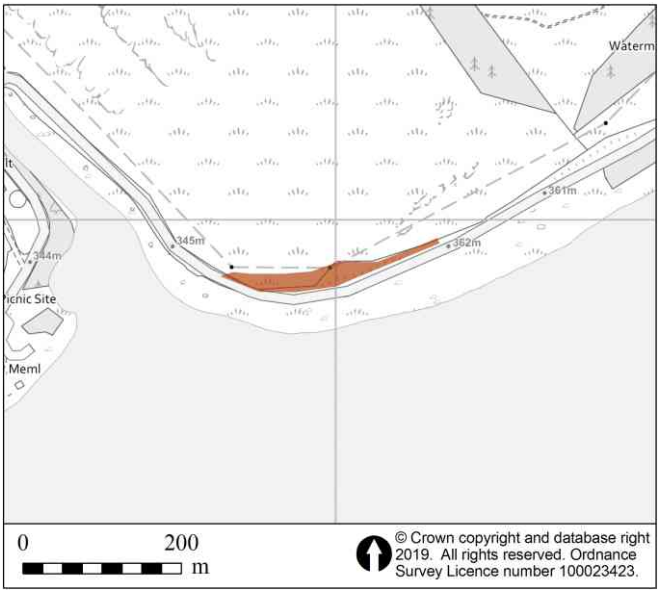
Site Ref: 24

Site Name: Castleweary Quarry

Area (ha): 0.4

Site Description
Gala Group, Silurian

Shown on Map 3



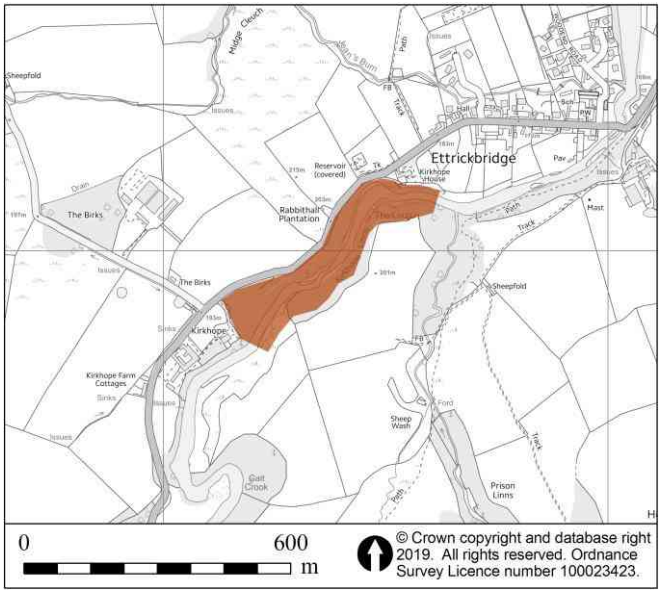
Site Ref: 25

Site Name: Cramalt Road Cutting

Area (ha): 0.5

Site Description
Gala Group, Silurian

Shown on Map 3



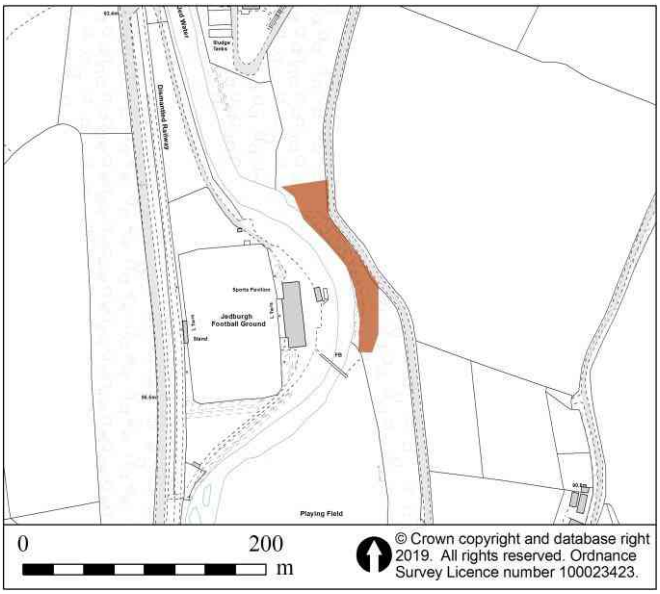
Site Ref: 26

Site Name: Ettrickbridge Gorge

Area (ha): 5.4

Site Description
Moffat Shale Group

Shown on Map 3



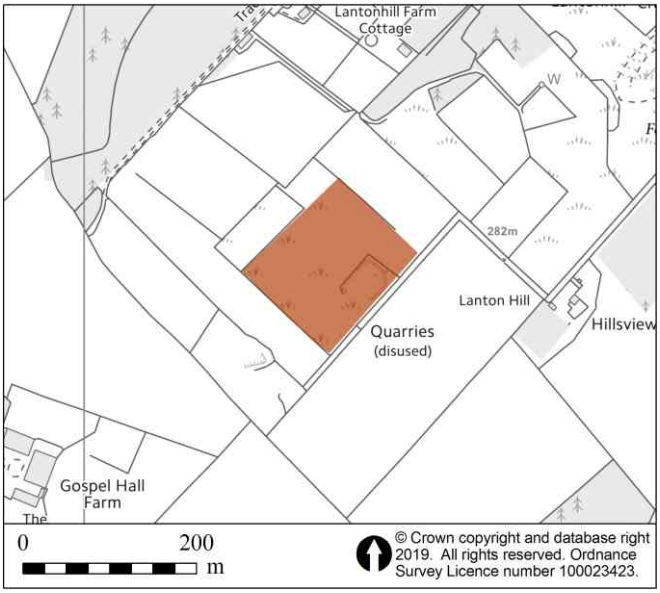
Site Ref: 27

Site Name: Jed Water River Cliff

Area (ha): 0.3

Site Description
Stratheden Group, Upper Devonian

Shown on Map 3



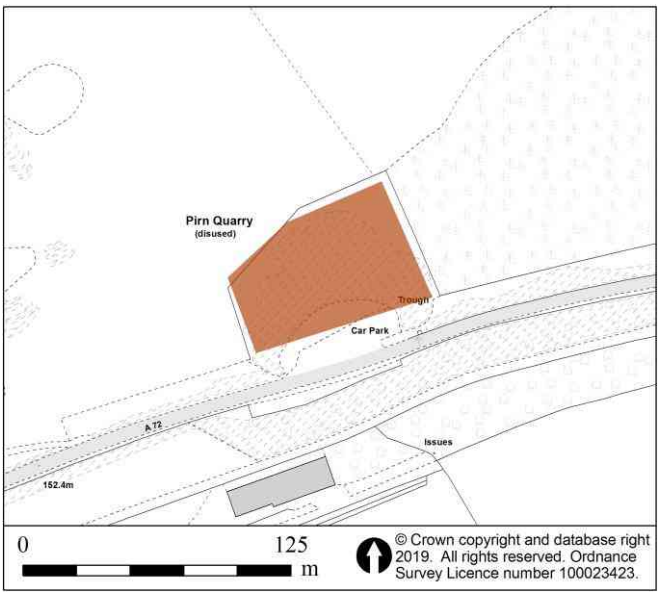
Site Ref: 28

Site Name: Lanton Hill Quarry, Jedburgh

Area (ha): 2

Site Description
Stratheden Group, Upper Devonian

Shown on Map 3



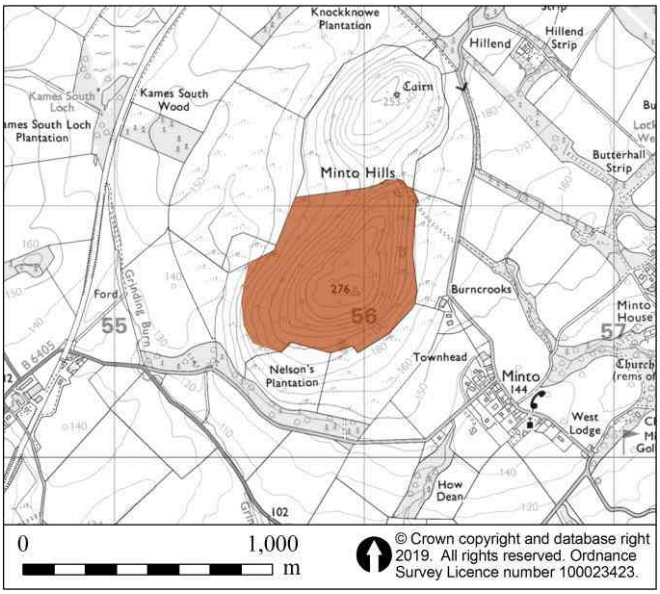
Site Ref: 29

Site Name: Pirn Quarry, Innerleithen

Area (ha): 0.4

Site Description
Gala Group, Silurian

Shown on Map 3



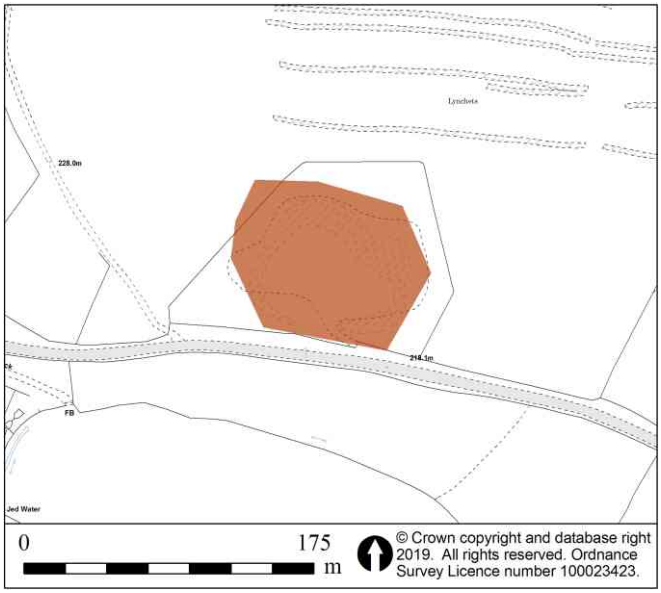
Site Ref: 30

Site Name: South Minto Hill

Area (ha): 37.1

Site Description
Vent agglomerate

Shown on Map 3



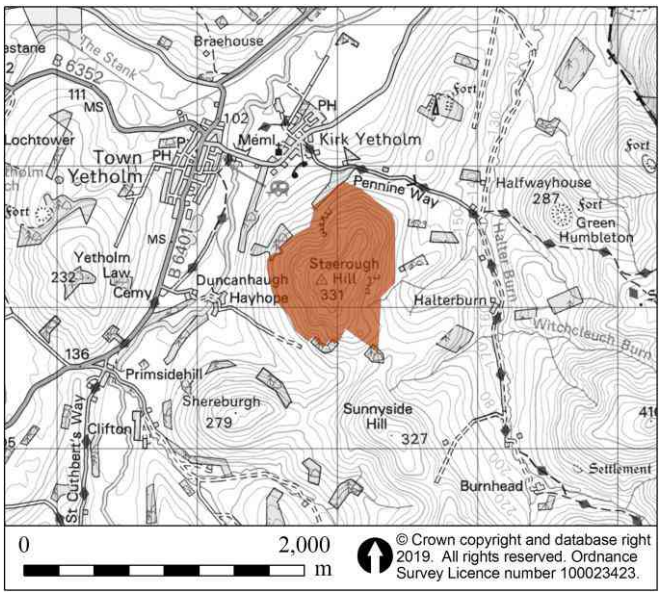
Site Ref: 31

Site Name: Southdean Quarry, Chesters

Area (ha): 0.9

Site Description
Nepheline basanite plug

Shown on Map 3



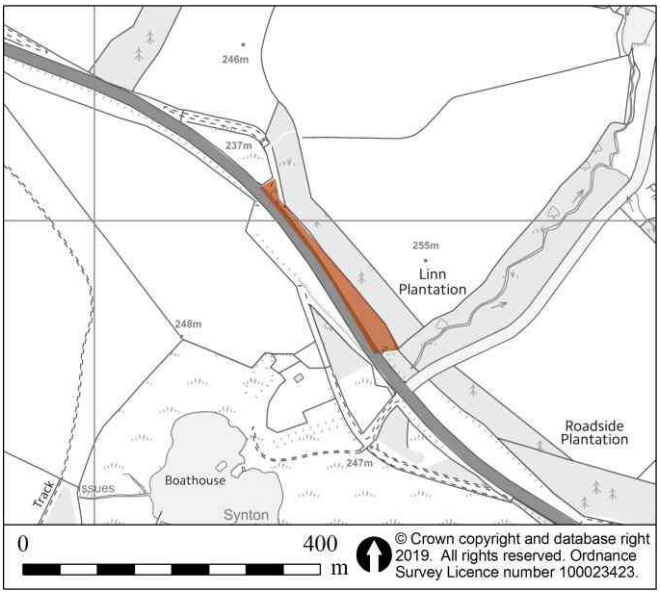
Site Ref: 32

Site Name: Staerough Hill, Yetholm

Area (ha): 74.2

Site Description
Andesite with pitchstone sills

Shown on Map 3



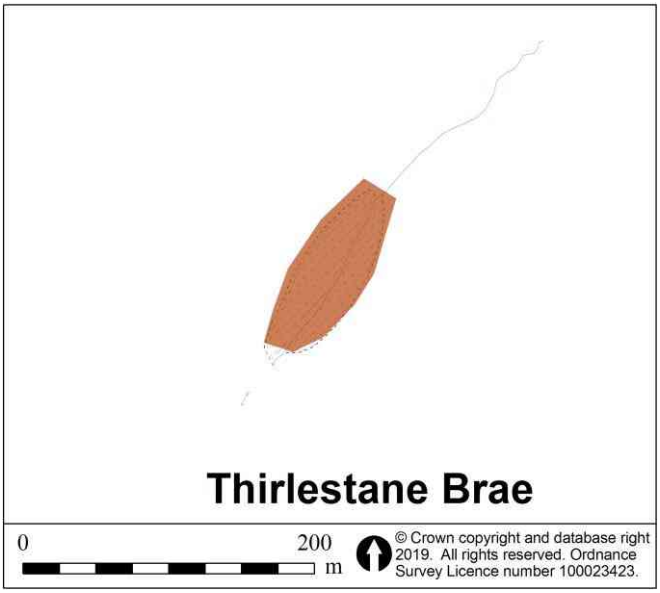
Site Ref: 33

Site Name: Synton Mossend Cutting

Area (ha): 0.5

Site Description
Gala Group, Silurian

Shown on Map 3



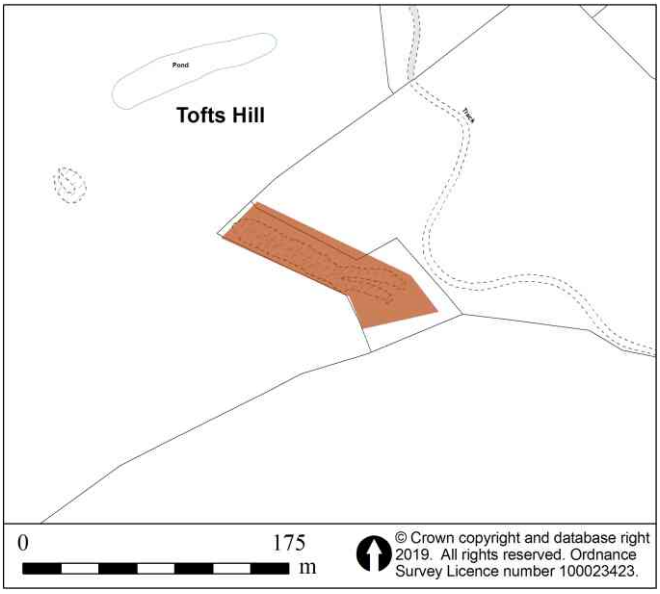
Site Ref: 34

Site Name: Thirlestane Score

Area (ha): 0.5

Site Description
Moffat Shale Group

Shown on Map 3



Site Ref: 35

Site Name: Tofts Hill Quarry, Kirkton

Area (ha): 0.4

Site Description
Acklington Dyke, Palaeogene

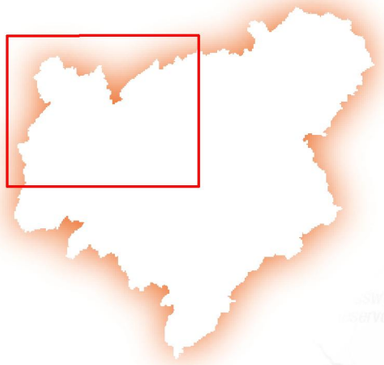
Shown on Map 3

LOCAL GEODIVERSITY SITES TECHNICAL NOTE

APPENDIX 4: LOCAL GEODIVERSITY SITES (SCOTTISH BORDERS CONTEXT)

Local Geodiversity Sites
Map 1

Scottish Borders Council

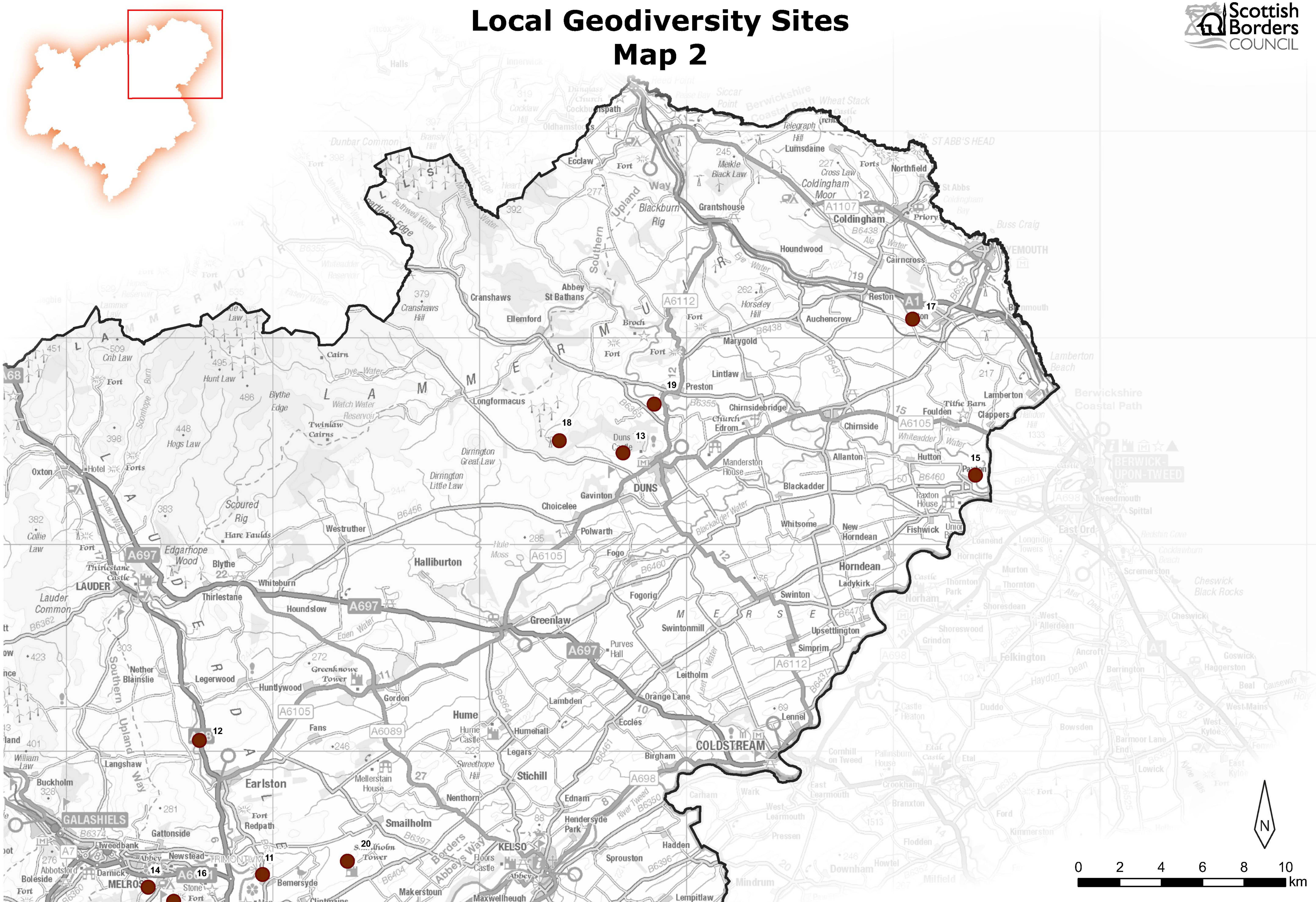


1 Blyth Bridge
2 Glenlood Hill
3 Leadburn
4 Castlecraig
5 Halmyre Mains
6 Carnos
7 Romannobridge
8 Carnos
9 Mountbenger
10 Dewar
29 Walkerburn

N

0 2 4 6 8 10 km

Local Geodiversity Sites
Map 2



Local Geodiversity Sites
Map 3