

Callander Geodiversity Trail



Stories in the Landscape



Stories in the Landscape

This booklet briefly describes the rocks and landforms along the trails around Callander. It complements the Callander Paths leaflet and the Callander Heritage Trail booklet 'Stories in the Stones'.

The place we now call Callander has been shaped by extraordinary forces over millennia. It may be hard to believe nowadays, but where we now stand was once a desert-like region south of the Equator, before continental drift brought the landforms together to create Scotland. A series of Ice Ages have left their mark, from the slow advance of the ice sheets, thousands of metres thick, to the grinding of the glaciers which carved out the glens. The streams and rivers which ran within the ice have left their traces as eskers, most notably near the Roman Camp Hotel, and the last remnant of the retreating glaciers, the Callander Moraine, remains at the east end of the town to tell its story. A major geological feature, a little over 2 km to the north-west of Callander, is the Highland Boundary Fault, a near-vertical fracture that penetrates deep into the Earth's crust, crossing Scotland from coast to coast, from Arran in the south-west to Stonehaven in the north-east, and separating the Grampian Highlands to the north from the Midland Valley to the south.

All of these events have left evidence for us to investigate, and this booklet will show you where some of that evidence is to be found.



To the north of the Fault the rocks are mostly much older than 480 million years: Dalradian rocks consisting mainly of metamorphosed sandstones (psammite) and mudstones (schist and slate) that may be seen at the Falls of Leny. These rocks were laid down as sediments in an ocean called Iapetus in the southern hemisphere, and were subsequently deeply buried, cooked, stewed and much deformed (metamorphosed) under huge pressure by the mountain building process that completely closed the ocean. In the Callander area this process has left the strata steeply dipping and almost at right angles to the horizontal.



On the south side of the Fault, the Midland Valley contains thousands of metres of sedimentary and volcanic rocks which were deposited from about 415 to 400 million years ago (Early Devonian age). Callander at that time was about 30° south of the Equator. In a semi-arid (sometimes desert) environment rivers carried enormous volumes of sediment from eroded mountains and deposited it on alluvial fans* and along river channels and floodplains. As more and more sediment accumulated, the thickening pile became deeply buried and converted to solid rock. The layers of cobbles and boulders became conglomerates. The different layers of conglomerate are given different geological names but locally all are referred to as puddingstone. Sand and mud changed to sandstone and mudstone. The thinly bedded fine-grained sandstones are known as flagstones and have been used for building and paving.





In the past 2.5 million years climate changes have produced a series of ice ages. The two most recent, both in the last 30,000 years, have left a marked impression on the local landscape through deposition of glacial deposits and also by producing landforms of erosion and deposition. One small but locally noteworthy feature is the glacial erratic. When the last ice sheet melted about 12,000 years ago, some of the boulders it had transported were dumped proud at the surface. These stones are called erratics (strangers) when their lithology is different to that of the local rocks. Erratics provide evidence from which it is possible to tell from which direction the ice had come.

** An alluvial fan is a fan- or cone-shaped deposit of silt, sand, gravel, cobbles and boulders, typically found where a ravine draining from highland terrain emerges onto a flatter plain. As a stream's gradient decreases and flow speeds reduce, it first drops the most coarse-grained material and eventually the finest. See also 10a, 24a.*



The Three Bridges

1 Dunmore Fort Puddingstone Crag

This historically important fort is on a prominent hillock of rock. Here the puddingstone (Craig of Monievreckie Conglomerate) seems to have been harder and more resistant to glacial erosion than elsewhere and so forms higher ground.

2 Puddingstone Boulder

Near to the Information Board is a boulder of Craig of Monievreckie Conglomerate, which may have fallen off the Dunmore Crag. This is a puddingstone rich in volcanic fragments. It is made up of rounded cobble- to pebble-sized pieces mainly of lava set in a coarse sandy matrix. Other boulders of puddingstone and small exposures of similar bedrock are in this vicinity.

3 Split Erratic of Folded Highland Metamorphic Rock

This attractive minor glacial feature is a boulder over one metre in size of folded metamorphosed sandstone (Southern Highland Group of the Dalradian). Ice transported this stone from somewhere in the Highlands to the west and it has fractured along the folding probably because of weathering and frost action since the end of the last ice age 12,000 years ago.

4 Samson's Stone - Erratic of Highland Metamorphic Rock

This well-known erratic is perched on the hillside above the road. It is a geological curiosity that has probably been seen in passing by a myriad of visitors to the Callander area over hundreds of years. It is a boulder over 3 metres in size made of folded metamorphosed sandstone (Southern Highland Group of the Dalradian) carried by ice from the Highlands in the west.



Callander Crag

5 Puddingstone Crag at Summit Steps

At the top of the path are steps, which pass up through the escarpment formed by the vertical beds of puddingstone on Callander Crag, and allow safe inspection of the rock. The thick hard beds of puddingstone, which were laid down horizontally, have been turned vertical by very powerful earth movements. Geologists call this rock the Callander Craig Conglomerate: it consists of cobble- to pebble-sized pieces of white quartz, lava and other rock types in a coarse sandy matrix.

6 The Queens' Diamond Jubilee Cairn

This location offers a breathtaking panoramic view of geological features. The Highland Boundary Fault runs from the west through Loch Venachar with the Menteith Hills to the south and Ben Ledi to the north. The fault line continues north-eastwards through Glen Artney with the Highland mountains to the north. South of the line are the Braes of Doune and the Ochil Hills in the east, with the lowland hills as far as the Pentland Hills on the southern skyline. Closer at hand are the Torrie drumlins, and the extensive sand and gravel deposits commercially quarried alongside the River Teith. The monument is built of the local Callander Craig Conglomerate.

7 Bedded Flagstone - Old Quarry 50m Down Path

By the path the steeply dipping but more thinly bedded strata show different rock types to the puddingstone. These are sandstone and mudstone (Ruchil Flagstone Formation). The sandstones often split along mica-rich bedding planes and were called flagstones by the old quarrymen. Historically they were quarried for local building and possibly paving stone at the nearby but overgrown small Leny Feus Quarry.



The Lower Woods

8



8

Erratic of Highland Metamorphic Rock

This erratic is presently covered in moss and lichen and the rock cannot easily be seen. Ken Dunn, who was principal Geography teacher at the McLaren High School, first mentioned it in an older version of 'Callander Heritage Trail' written 20-25 years ago. He wrote, "Close inspection shows that markings indicate that it was highly compressed and contorted and is in fact of 'Highland' origin, brought here during the Ice Age". Like items 3 and 4, this rock is metamorphosed sandstone.



9

Puddingstone Quarry at Start of Golf Course Path

The path from Bracklinn Road passes through one of the smaller old quarries where the quartz-pebble-bearing A'Chrannach Conglomerate can be seen. This puddingstone provided much of the local stone used in Callander, for example in Callander Kirk (Item 20). Note that the hard conglomerate is thickly bedded and steeply dipping.

Bracklinn Falls Circuit

10 West Bank of Keltie Water above Bracklinn Falls

10a Vertical Beds

All the strata at the falls are part of the Bracklinn Falls Conglomerate, which includes puddingstone and finer grained strata. Examination of safely accessible rock shows beds of puddingstone, pebbly sandstone, sandstone and some mudstone as well. The beds, the thickest of which are usually of puddingstone, are approximately vertical and at right angles to the river, with the younger strata downstream. The likely environment of deposition is on a major alluvial fan sourced in the Highlands.

10b Sandstone and Gritstone Beds

On the west side of the gorge, at the upstream end, it is usually possible to safely see these beds of sandstone and pebbly sandstone with finer mudstone laminae. The pebbly beds indicate flood flows with high sediment concentrations in the water.

10c Ripples

Ripple marks may be seen on a fallen block resting against the west bank gorge wall a little way down from the top end of the falls. In situ ripples would tell us about the direction of transport of the original sediment. This block and many others like it have become detached from the walls over time. In this particular case erosion has largely exploited the bedding planes in the rock. However rock failure is also affected by the presence of two directions of prominent and persistent joints or fractures in the bedded rocks. One is almost vertical and here parallel to the gorge walls, and the other almost horizontal (parallel to the bed of the river) and these combine with the vertical bedding to produce a supply of topple-ready blocks. Few of these large blocks move very far even with the worst flood events.



10d Calcareous Nodules

Calcareous nodules (calcrete soil mediated by vegetation) present in some beds suggest that the climate was semi-arid with wet and dry seasons in which the water table in the sediment rose and fell. This feature fits with the area being about 30° south of the Equator during the formation of these rocks. The finest-grained beds have small load casts and animal trails.

11



11 Puddingstone at Bracklinn Falls

This is the classic viewpoint for the falls. It also shows how the softer sandstones and mudstones (Teith Sandstone Formation) forming the lower part of the gorge have been eroded in the form of a right angle bend with the strata hereabouts running parallel to the walls. This is the perfect spot to recall that, as the last ice age was ending 17,000 to 12,000 years ago, large quantities of glacial meltwaters charged with lots of boulders, cobbles, gravel and sand were mainly responsible for cutting most of the gorge and falls as we see them today. This is evident despite the effects of the 2004 severe flood event that destroyed the previous bridge and shifted some monstrous rock blocks around in the falls. Vertical joints in the puddingstone control erosion of the walls of the slot gorge. With care joints almost parallel to the stream bed may also be seen in this image.



12 Worm Trail Evidence of Life Millions of Years Ago

The finest-grained beds (mudstone and fine grained sandstone) have small load casts looking a bit like elongate blisters. These form where wet sand sinks down into underlying soft mud under the influence of gravity. Careful observation of the red mudstones shows signs of life where small straight or wavy animal trails are preserved. These were made perhaps by worms moving across the soft sediment surface.

13 Glacial Till across River - Seen from East Bank

The glacial till (boulder clay) is in the obvious low cliff in the actively eroding west bank of the Keltie Water. Glacial till is the deposit laid down at the base of glaciers and ice sheets. This unbedded deposit is made up of an unsorted mixture of clay silt, sand, and stones of all sizes up to boulders. Some of the stones may have been carried from far away in the western Highlands, the direction from which the ice was moving. The till at this locality is probably over 20,000 years old and was deposited during the last major glaciation to cover the whole of Scotland in ice. Note the more recent river boulders in the bank top. Further upstream in the river bed there are many large boulders that have been carried downstream when the river was in flood. Seeing these, it is easy to understand why the old bridge at the falls was washed away in the big flood event of 2004!

14



14 Bedded Red Mudstone and Sandstone

The repeated beds of red mudstone and sandstone are like those of Item 7 (Ruchil Flagstone Formation). Many of the sandstone beds are described as flagstones (pavement stone) that may have been laid down in times of flood. The rivers that laid down these sediments may have been braided with confined channels and overbank areas where considerable amounts of mud and silt settled after flood events. Small lakes may also have formed. The mudstones contain small animal trails, rain spot marks and even (difficult to spot) oxidised primitive vascular plant fossils, which look like polished patches no more than 3 cm across. One thing is certain: Callander was largely unvegetated when all the Devonian rocks were formed.

15 Puddingstone Outcrop

This small crag is in puddingstone with quartz pebbles. This is the Callander Craig Conglomerate seen at close quarters without the need to climb the Crag! The steep dip of the bedding is clearly visible. The dip is

the result of massive compressive earth movements that upended the rocks from horizontal to vertical about 400 million years ago at the end of the Lower Devonian time period.

15





16 Puddingstone at Coire Eas na Caillich



16a Below Bridge

Here very steeply dipping puddingstone and sandstone beds (Ruchil Flagstone Formation) may be examined relatively safely at the top end of the gorge when the river is low. The pebbles and cobbles in the coarser beds are of white vein quartz, quartzite and a variety of lava types. The volcanic material in all probability was transported from the north where volcanoes were erupting and then quickly being eroded down by rivers and streams. Some of these lava flows can be seen in the Keltie Water above Braeleny Farm.

16b Cave at River Level

In the gorge immediately above the falls, a cave in the west bank marks the base of a boulder-rich puddingstone (part of the Craig of Monieuvreckie Conglomerate). The puddingstone rests on sandstones (Ruchil Flagstone Formation).

17 The Scout Pool (Coire Eas na Caillich)

17a Waterfall

The main waterfall is formed by very coarse puddingstone (Craig of Monievreckie Conglomerate) composed almost entirely of volcanic debris, from boulder size to sand grains, derived from the Highlands and local volcanoes. On good summer days the pool is much used for swimming and other adventurous water activities and is known locally as the Scout Pool. Recent clearance of trees currently allows a superb view of the waterfall at Coire Eas na Caillich but at a cost of some minor landslides associated with boggy ground at the informal viewpoint area.

17b Rockfall

In the strata (Ruchill Flagstone Formation) just downstream of the waterfall, steeply dipping, thinly bedded sandstone and mudstone have collapsed in an obvious rock fall, demonstrating one more way in which nature degrades gorges.

18 The Red Well - a Chalybeate Spring

Chalybeate mineral spring waters contain salts of iron such as Iron Carbonate that dissolved into them during their passage underground, hence the red coloration. The well was once renowned for its remedial properties, but nowadays drinking the water is not advised.



17a



17b



18

The Glacier Trail *(including the Roman Camp Walk)*

19 St. Kessog's Building

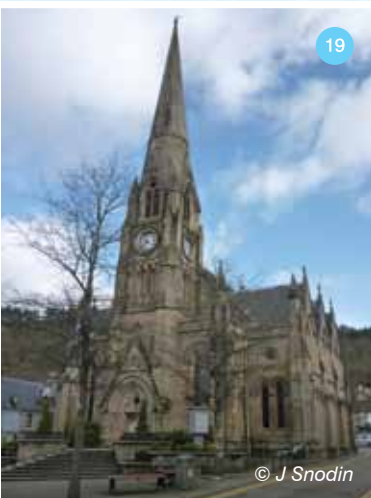
The former Callander Parish Church of St. Kessog was built in 1883. It is constructed in imported Carboniferous blonde (when new or clean) sandstones possibly brought in from the Falkirk or Glasgow areas by train.

20 Callander Kirk

Callander Kirk was built in 1844 as the Free Church, later becoming St. Bride's Church and then Callander Kirk. It is built mainly with local Lower Devonian conglomeratic sandstone and has a pleasing purplish red colour. A quarry from which this stone may have come is at Item 9. The stone used in the detail and in the Italianate belfry top (added in 1861) is blonde Carboniferous sandstone possibly from the Glasgow or Falkirk area.

21 Roman Camp Esker - A Glacial Meltwater Product

This narrow winding ridge is the Roman Camp Esker made of cobbles, gravel and sand that were deposited by a fast flowing stream, possibly inside a tunnel within glacier ice or between ice walls. The ridge was left behind when the glacier retreated. Sometimes, as trees fall, this coarse sediment may be seen entwined in their roots. Across the river another esker is visible. This may be a continuation of the first esker or could be another one formed from a second stream. The glacier is thought to have occupied the Teith valley at Callander about 12,000 years ago during the last ice age, which is known as the Loch Lomond Readvance.



The Glacier Trail *(including the Roman Camp Walk)*

22



22 Callander Terminal Moraine - Seen from Cycle Track

Terminal (end) moraines are ridges of unconsolidated debris deposited at the snout of the glacier. Glaciers act much like a conveyor belt, carrying debris from the top to the bottom where it is deposited in the end moraine. The longer the terminus of the glacier stays in one place the more debris will accumulate. Terminal moraines mark the maximum advance of the glacier. The most accessible view of this landform is from the cycleway with the steep ice contact slope at the wooded bank beyond the field. Unfortunately, bracken and other vegetation make it difficult to appreciate.

23 Callander Terminal Moraine in Drumdhu Wood

In Drumdhu Wood the full topographical shape of the terminal moraine feature is easily appreciated: a very asymmetric ridge with a steep westerly flank. Follow this path southwards to observe the steep western ice contact slope. This is the point where the last glacier started to retreat.

23

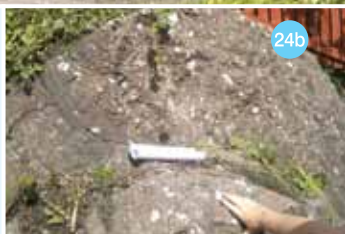
© M Hawkins



The Glacier Trail *(including the Roman Camp Walk)*



24 Puddingstone at Original Stationmaster's House



24a House above Rock

Here at the site of Callander's first station and below the old stationmaster's house, there is an easily accessible rock exposure of the typical Callander puddingstone as used in many local buildings. It is full of poorly rounded pebbles, most obviously of white quartz brought by fast flowing rivers along an alluvial fan from somewhere to the north within the Highlands.

24b Rock below House - Similar to Local Building Stone

In close view, sub-angular to rounded pebbles of vein quartz are evident in the A'Chrannach Conglomerate. There is a lot of sandy matrix, suggesting that fast-flowing flood water laid down this rock and that it was heavily charged with unsorted sediment.

Acknowledgements



CALLANDER COMMUNITY DEVELOPMENT TRUST

This booklet was written by Mike Browne, in association with and produced by Callander's Countryside, an associated organisation of Callander Community Development Trust.

www.callandercdt.org.uk

CCDT is a charity registered in Scotland - Charity No: SC 034462



Mike Browne is a member of Stirling and Clackmannan RIGS Group, a committee of the Edinburgh Geological Society. Local Geodiversity Site is now the appropriate term used for RIGS planning purposes.

www.edinburghgeolsoc.org

EGS is a charity registered in Scotland - Charity No: SC 008011

The booklet has received support from the following organisations.

Map supplied by Forestry Commission Scotland and modified by Loch Lomond & the Trossachs National Park Authority.



All photographs are by Mike Browne unless otherwise indicated.

Funding for this booklet has been received from Stirling Council, Cemex, Friends of Loch Lomond & The Trossachs and Stirling and Clackmannan RIGS Group.



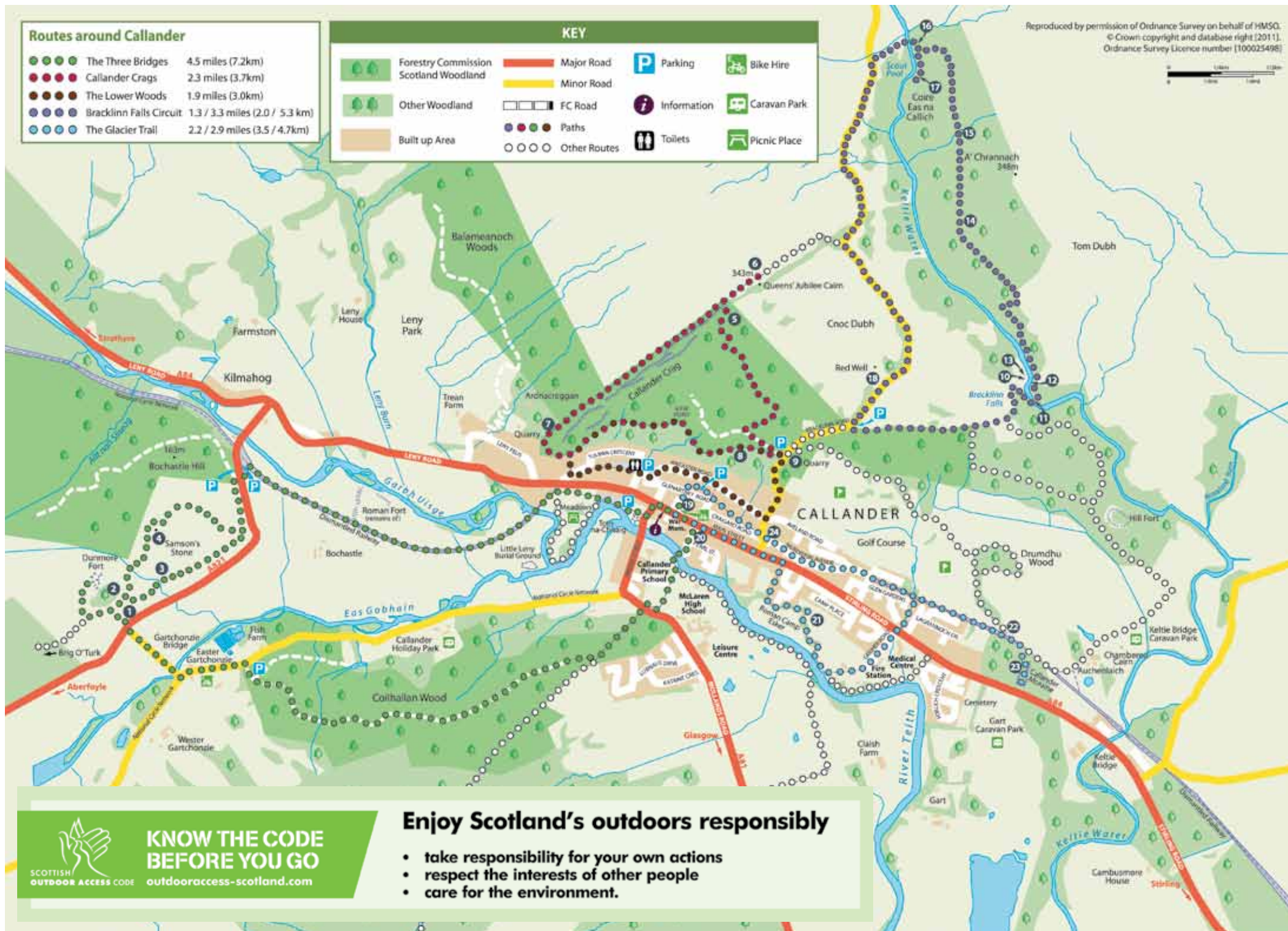
Routes around Callander

	The Three Bridges	4.5 miles (7.2km)
	Callander Crag	2.3 miles (3.7km)
	The Lower Woods	1.9 miles (3.0km)
	Bracklinn Falls Circuit	1.3 / 3.3 miles (2.0 / 5.3 km)
	The Glacier Trail	2.2 / 2.9 miles (3.5 / 4.7km)

KEY

	Forestry Commission Scotland Woodland		Major Road		Parking		Bike Hire
	Other Woodland		Minor Road		Information		Caravan Park
	Built up Area		FC Road		Toilets		Picnic Place
			Paths		Other Routes		

Reproduced by permission of Ordnance Survey on behalf of HMSO.
© Crown copyright and database right (2011).
Ordnance Survey Licence number (100025498)



SCOTTISH
OUTDOOR ACCESS CODE

**KNOW THE CODE
BEFORE YOU GO**

outdooraccess-scotland.com

Enjoy Scotland's outdoors responsibly

- take responsibility for your own actions
- respect the interests of other people
- care for the environment.

Further Information

Design by The Write People Tel: 01 786 445022



**Loch Lomond & The Trossachs
National Park** (Callander Office)
52-54 Main Street, Callander FK17 8BD
Tel: 01389 722600
Email: info@lochlomond-trossachs.org
www.lochlomond-trossachs.org

VisitScotland Information Centre
52-54 Main Street,
Callander FK17 8BD
Tel: 01877 330342
Email: callander@visitscotland.com
www.visitscottishheartlands.com



© M Hawkins