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# A preliminary assessment of the building sandstone quarries on the Hopetoun Estates, West Lothian, Scotland

Geology and Landscape Northern Britain Programme

Internal Report IR/06/094





BRITISH GEOLOGICAL SURVEY

GEOLOGY AND LANDSCAPE NORTHERN BRITAIN PROGRAMME

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## *Front cover*

Road bridge over the Union Canal south of Craigton House. The stone masonry is likely to have been sourced locally.

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Maps and diagrams in this book use topography based on Ordnance Survey mapping.

A A McMillan

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## Foreword

This report sets out the observations made at the various quarry sites on the Hopetoun Estates, West Lothian, Scotland and comments on the current status of the quarries and their geological context and summarises knowledge of the historical use of stone from these sources. Based upon this reconnaissance the report offers preliminary opinion on the potential for reopening one or more sandstone quarries and possible options for open new workings.

The report was compiled at the request of Mr A McKinney, Scottish Stone Liaison Group (SSLG), acting for Mr Donald Noble, Factor, Hopetoun Estates.

## Acknowledgements

The Factor, Hopetoun Estates is thanked for permission to access to the quarry sites on the Estate. The author acknowledges assistance of Mr A McKinney (SSLG) in the field reconnaissance, and Mr M A E Browne (BGS) for reviewing the report.

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# 1 Introduction

At the request of Mr A McKinney, Scottish Stone Liaison Group (SSLG), acting on behalf of Mr Donald Noble, Factor Hopetoun Estates, the British Geological Survey (BGS) was invited to visit the Hopetoun Estates, West Lothian with the intention of making a preliminary assessment of some of the former building sandstone quarries of the Estate and offer a statement on future resource potential. Mr A McMillan (BGS) attended an initial meeting with Mr McKinney and Mr Noble at the Hopetoun Estates Office, Newton in December 2005. This was followed up with a series of visits by Mr A McMillan (BGS) and Mr A McKinney (SSLG) on 10 February 2006 and 10 July and 12 July 2006 to the sites of some of the former major quarries on the Estates' property.

This report sets out the observations made at the various quarry sites, comments on the current status of the quarries and their geological context and summarises knowledge of the historical use of stone from these sources. Based upon this reconnaissance the report offers preliminary opinion on the potential for reopening one or more sandstone quarries and possible options for opening new workings.

## 2 Summary of the bedrock geology and structure

### 2.1 STRATIGRAPHY AND LITHOLOGY

Most of the Hopetoun Estate is underlain by strata of the West Lothian Oil-Shale Formation (Browne et al., 1996) of Lower Carboniferous age. The formation is divided into a lower Calders Member and an upper Hopetoun Member (Chisholm et al., 1989). The Hopetoun Member was proposed by Chisholm et al. (1989) to replace the Upper Oil Shale Group of Carruthers et al. (1927). It originates from the best natural sections, which are on the coast near Hopetoun House. The strata are interpreted to be almost all of lacustrine, deltaic and fluvial origin. The lower boundary is defined at the base of the Burdiehouse Limestone (Mitchell and Mykura, 1962) resting on strata of the Calders Member. This distinctive limestone is a lacustrine deposit, commonly 6 m to 9 m thick, containing abundant fossilized ostracod, plant and fish remains. The top of the generally non-cyclic Hopetoun Member is defined at the base of the Hurllet Limestone. This marine limestone forms the base of the marine-dominated cyclic successions of the overlying Lower Limestone Formation (Clackmannan Group).

The Hopetoun Member consists of a sequence of black to grey mudstones, grey siltstones, white, grey and pink sandstones and white to pale-greenish grey calcareous mudstones ('marl') with thin beds of black to grey oil-shales, coals (Hurllet, Two Foot and Houston seams), grey to white, pure to argillaceous limestones and dolostones that comprise the upper part of the West Lothian Oil-Shale Formation. The member includes the Camps, Under Dunnet, Dunnet, Broxburn, Fells, Grey, Mungle, Raeburn and Fraser shales (oil-shales), and the Dunnet and Binny sandstones that were worked in the past for building stone. Of these two sandstone-dominated sequences, it is the Binny Sandstone (first and most extensively wrought at Binny, Uphall) which has yielded the most building stone. The limited number of thin marine beds in the Hopetoun Member include the Dunnet, Raeburn and Fraser Shell Beds (fossiliferous mudstone beds with a marine fauna) and the Under or Gilmerton Bone Bed Limestone. Lacustrine limestones are present such as the Barracks Limestone with the regionally important and thick Burdiehouse Limestone at the base of the member.

## 2.2 STRUCTURAL AND SEDIMENTOLOGICAL CONTROL ON THE DISTRIBUTION OF THE STRATA

Two important anticlines traverse the Winchburgh and Humbie districts. The axes of these anticlines run from south to north and pitch northwards. One runs from east of Winchburgh [NT 090 750] past Duntarvie Castle [NT 091 765] and to the coast at Hopetoun House [NT 089 790]. The other runs northwards through Humbie [NT 114 755]. The axis of the intervening syncline runs northwards through Niddry Mains [NT 097 750] past Totleywells [NT 099 765] and Westfield [NT 105 768]. The effect of these structures is to bring to rockhead the same stratigraphical units dipping generally west and east about the anticlinal axes. Consequently both the Dunnet Sandstone and Binny Sandstone crop out on both the western and eastern limbs of each anticlinal structure. Faults have also acted to displace of the outcrops of these strata

As these sandstones were laid down in river channels and/or small deltas the original geometry has dictated both the thickness variation of these units and their lateral extents.

## 2.3 IGNEOUS ROCKS

Quartz dolerite has been intruded into the Carboniferous sedimentary strata both as dykes and sills. Notable examples within the Estate boundaries includes the 33 m thick sill which has been quarried at Craighton [NT 0757 7692] east of Craighton House, 2km N of Winchburgh.

# 3 Description of the Quarries

The following quarries (or sites of) were visited:

- Hopetoun Obelisk Quarry [NT094 787] (10/2/06)
- Newton Quarry [NT 0889 7815] and to the west of the Newton road a series of former quarries [NT 0825 7801] (10/2/06)
- Hopetoun White quarries [NT 0735 7735] (10/2/06)
- Duntarvie Castle quarries [including quarries at NT 0898 7686 and NT 091 769] (10/2/06)
- Cockmuir Quarry [NT 0664 7657], noted on the Ordnance Survey 1897 edition of the 6 inch to one mile map as Craighton Quarry (10/7/06)
- Craighton Dolerite quarries [NT 0757 7692] (10/7/06)
- Barnbank Quarry, Craighton [NT 0677 7675] (12/7/06)
- Winchburgh Quarry, also known locally as Paddy Higgins Quarry [NT 0969 7600] (12/7/06)
- Humbie Quarry [NT 1093 7567] (12/7/06)

### 3.1 HOPETOUN OBELISK QUARRY [NT094 787]

The south and east faces of this quarry are still accessible. Recently part of the quarry has been infilled with soil. The sandstones exposed in this quarry belong to the Dunnet Sandstone, Hopetoun Member of the West Lothian Oil-Shale Formation. At the south end [NT 0946 7863], a section was measured. This may be summarised:

Description	Bed thickness (m)
Sandstone, pale brownish grey, fine grained	1.00

Sandstone, off white, fine grained	0.80
Sandstone, pale brownish grey, fine grained	0.50
Sandstone, pale brownish grey, fine grained	0.80
Sandstone, pale brownish grey, fine grained	0.40
Sandstone, fine grained, pale brownish grey, massive, cross-bedded at top, Dip 20 degrees E, strike 150	0.80

On the east wall [NT 0945 7868] the following section was seen:

Description	Bed thickness (m)
Sandstone and siltstone, thinly bedded (high up, not accessed)	c.10.0
Sandstone, pale brownish grey, fine grained	0.20
Sandstone, pale brownish grey, fine grained	0.30
Sandstone, pale brownish grey, fine grained	0.40
Sandstone, pale brownish grey, fine grained, massive to cross bedded when traced round to NE wall	2.40
Sandstone, pale brownish grey, fine grained, massive	2.50
Sandstone, massive (not accessed, seen from a distance in NE corner)	c. 2.50
Dip of the strata undulating but generally at 20 degrees E	

### 3.1.1 Historical use of stone from the Obelisk Quarry

This quarry is known to have supplied Hopetoun House. It was noted as operational in the HM Inspector of Mines List of Quarries (1937). We understand from anecdotal evidence that stone was taken from this quarry for work to Hopetoun House in the 1970s.

### 3.2 NEWTON QUARRY [NT 0889 7815]

At Newton Quarry [NT 0889 7815] and to the west of the Newton road a series of former quarries [NT 0825 7801] worked the Burdiehouse Limestone and Camps Shale of the Calder Member, West Lothian Oil-Shale Formation along strike. At the latter quarries the dip is shallow towards the west. The Dunnet Sandstone may be expected to crop out to the west of these workings. The quarries are still visible, heavily vegetated and exposure is poor. Much evidence of quarrying is also provided by the presence of shale spoil.

#### 3.2.1 Historical use of stone from the Newton Quarry and adjacent quarries

The Burdiehouse Limestone was extensively worked as a source of lime both in mines and quarries around Newton and Hopetoun House (Robertson et al., 1949).

### 3.3 HOPETOUN WHITE QUARRIES [NT 0735 7735]

The sites of the Hopetoun White quarries [NT 0735 7735] were visited. These quarries which once worked sandstone, the Binny Sandstone (stratigraphically higher than the Dunnet Sandstone in the Hopetoun Member of the West Lothian Oil-Shale Formation), are completely infilled. The geological map indicates that the Binny Sandstone strikes NE from the quarries. There are remnants of shale spoil at surface. Part of the site is now occupied by a specialist riding centre.

#### 3.3.1 Historical use of stone from the Hopetoun White Quarries

These quarries supplied stone to the Hopetoun Estate. According to Carruthers (1927) 'The highest bed [of the Binny Sandstone] was opened out some time ago for estate purposes, where it

is a strong massive rock, but owing to its jointed character it does not form good building stone'. According to McMillan et al. (1999) quarrying can be traced back to 1697. In the early 20<sup>th</sup> century three quarries operated at times; there was little work after 1908.

### 3.4 DUNTARVIE CASTLE QUARRIES

Sites of several former quarries north of Duntarvie Castle [including quarries at NT 0898 7686 and NT 091 769] were visited. These worked stone in the Calders Member of the West Lothian Oil-Shale Formation. The quarries are infilled and now woodland.

#### 3.4.1 Historical use of stone from the Duntarvie Castle Quarries

These quarries are thought to have supplied stone to the Hopetoun Estate.

### 3.5 COCKMUIR QUARRY [NT 0664 7657]

The quarry is a water-filled hole lying to the south of the Union Canal and east of the derelict former Cockmuir Farm. Access to the exposed western quarry face is not possible except by boat but from the east bank, above the water level a section of c. 2.5m of sandstone rests on c. 1.0m thinly bedded sandstone and grey siltstone (Figure 1). The general dip is to the west possibly up to 10 degrees. The quarried strata lie towards the top of the Binny Sandstone which in the Craigton area is over 135 m thick (Carruthers, 1927).



Figure 1. West face of Cockmuir (Craigton) quarry showing thick massive sandstone on thinly bedded sandstone and laminated siltstones. Apparent dip to the west.

### 3.5.1 Historical use of stone from the Cockmuir (Craigton) Quarry

This quarry is thought to have supplied stone to the Hopetoun Estate. There is no indication of a quarry at this site on the OS 6 inch to one mile map of 1856. It is present on the 1897 edition on which it is named Craigton Quarry. It is likely that this quarry and Barnbank Quarry (to the north of the Edinburgh - Glasgow Railway, see section 3.7.1 below) were both referred to the name Craigton. Both quarries had been opened up in the 1890s and it is known that they supplied material for additions to the Surgeons' Hall, Nicolson Street, Edinburgh (1890) and Craigcrook Castle, Craigcrook Road, Edinburgh (1891) (Craig, 1893).

### 3.6 CRAIGTON DOLERITE QUARRIES [NT 0757 7692]

Several quarries were excavated in quartz dolerite to the east of Craigton House. As part of this reconnaissance, the quarries were visited. With the exception of small bodies of sedimentary strata caught up or in the roof of the igneous body, the entire site was underlain by quartz dolerite. This rock was traditionally used for setts and kerbstones but in more recent times was crushed for aggregate.

### 3.7 BARNBANK QUARRY, CRAIGTON [NT 0677 7675]

Lying immediately north of the long rock cutting for the Edinburgh - Glasgow Railway, this quarry is a water-filled hole. The exposed E-W Quarry face at the back of the quarry is up to 10m. It is inaccessible but bed thicknesses of at least two of the sandstone units exceed 2m. South of the railway boundary an E-facing cutting in the sandstones (Figure 2) revealed a succession of beds from base to top of 0.8m, 0.7m, 0.2m, 1.0m, 1.0m. The sandstone is uniformly fine-grained, quartzose, pale yellowish brown (Munsell Rock-Color 10YR 6/2). The strata lie towards the top of the Binny Sandstone (Carruthers, 1927) and dip westwards at up to 10 degrees.



Figure 2. Section in thickly bedded sandstone adjacent to and south of the Edinburgh – Glasgow railway cutting. North of the railway is the site of Barnbank Quarry. Dip c. 10 degrees west

### **3.7.1 Historical use of stone from the Barnbank (Craigton) Quarry**

This quarry is thought to have supplied stone to the Hopetoun Estate. The deep railway cutting was completed in 1842 (Carruthers, 1927) but there is no indication of a quarry to the north of the railway on the Ordnance Survey 6 inch to one mile map of 1856. It is present on the 1897 edition but is not named (see section 3.5.1 above for former uses of this stone: given the size this quarry and its proximity to both the railway and canal it is likely that the stone was used possibly beyond the Estate under the name of Craigton).

### **3.8 WINCHBURGH QUARRY [NT 0969 7600]**

Winchburgh Quarry, also known locally as Paddy Higgins Quarry is now the site of the Hopetoun Fisheries pond. Spoil from the ground to the northeast of the quarry. No strata were observed. We have no record of the use of stone from this quarry.

### **3.9 HUMBIE QUARRY [NT 1093 7567]**

This quarry is an extensive excavation, now water-filled. From the east bank a section the strata can be traced in an arc from north to west. A massive white sandstone bed in the order of 4 to 5 m thick can be seen at the northern end of the quarry. It is overlain by some 5m of thinner sandstone beds which appear to be laminated and cross-bedded. The dip is undulating is apparently eastwards. Southwards along the quarry face, the sandstones appear to be jointed, some units are obviously cross bedded. The strata lie towards the top of the Binny Sandstone (Carruthers, 1927).



Figure 3 North end of Humbie Quarry. Thickly bedded, massive sandstone overlain by medium to thin bedded sandstone and laminated siltstone. Dip undulatory and is to the east at this location.

### **3.9.1 Historical use of stone from the Humbie Quarry**

This quarry was a major source of building sandstone. It produced three colours of stone, white, grey and light brown. Smith (1835) note the stone 'is very little laminated'. The quarry was abandoned in 1868 being unable to compete with other quarries (Bremner, 1869). The white stone was most highly regarded and was used for the front part and portico of the Surgeons' Hall (1829-32) and the Dugald Stewart Mounment, Calton Hill, Edinburgh (1831). The grey stone was used for dressings of rubble buildings and for step and platts (Smith, 1835). Other examples of the use of Humbie stone in Edinburgh are given in McMillan et al. (1999). Hunt (1859) notes that Humbie stone was used in the Royal Exchange, Glasgow.

## **4 Options for assessment of resources**

### **4.1 DUNNET SANDSTONE**

The exposures at Hopetoun Obelisk Quarry demonstrate useful information about sandstone bed thickness. Samples were collected for thin sectioning. The thickest beds are deepest and generally dip at 20 degrees eastwards. Any further excavation of the east wall will therefore require stripping of increasing amounts of overburden. Further resources of these thicker beds within the Dunnet Sandstone may be present along strike to the south, south of Obelisk Cottage, but the lateral continuity and thickness variation of these sandstone beds is not known. If, as is likely they were laid down as river channel and deltaic sands, their distribution may be localised.

Some effort should be made to retain access to this quarry, should like-for-like repair work be required for estate buildings.

## 4.2 BINNY SANDSTONE

Binny Sandstone was formerly worked at a number of quarries on Hopetoun Estates, the sites of which lie both north and south of the M9 motorway. With the exception of Humbie Quarry, quarry sites visited lying north of the M9 Motorway did not reveal any bedrock exposures. Humbie Quarry together with quarries south of the M9 Motorway at Cockmuir (Craigton), and Barnbank (Craigton) all exhibited exposed faces in the quarried sandstone. Historically all three quarries were important not only for supply to the Estate but also to nearby towns and the City of Edinburgh.

Demand for supply of sandstones from the Binny Sandstone is likely to increase during the 21<sup>st</sup> century in response to increasing requirements to repair historic buildings. None of the quarries offers much potential to be reopened. All are water-filled. The best options are to consider adjacent green field sites which lie along the strike of the beds. A planned programme of drilling focussed either along strike or immediately down-dip of the existing quarries could be considered. As part of the planning, a drilling prognosis will require an assessment of existing borehole records and geological maps. This should provide a 3D model of the geological structure which may show the distribution of strata assigned to the Binny Sandstone and likely overburden (bedrock and superficial deposits). Targeted drilling, possibly preceded by shallow geophysical survey could then proceed.

As part of any proposed evaluation of the resource the following factors should be considered:

- Bed thickness and lateral continuity
- Joint pattern and spacings or other disturbance to beds (e.g. effects on the stone of nearby igneous intrusive rocks)
- Texture, mineralogy and colour characteristics and variations in representative samples from quarries and from borehole core (BGS already holds a number of samples from quarries in the Binny Sandstone and these could be analysed as part of the assessment. Petrographical analysis of the sandstones is routinely carried out by the BGS following standard procedures, BS EN 12407:2000)
- Overburden thickness and material characteristics.

In the development of plans to exploitation of the stone resources consideration should be given to environmental impact assessment, access to quarries, transport and necessary quarry plant required on site or elsewhere.

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Most of the references listed below are held in the Library of the British Geological Survey at Keyworth, Nottingham. Copies of the references may be purchased from the Library subject to the current copyright legislation.

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