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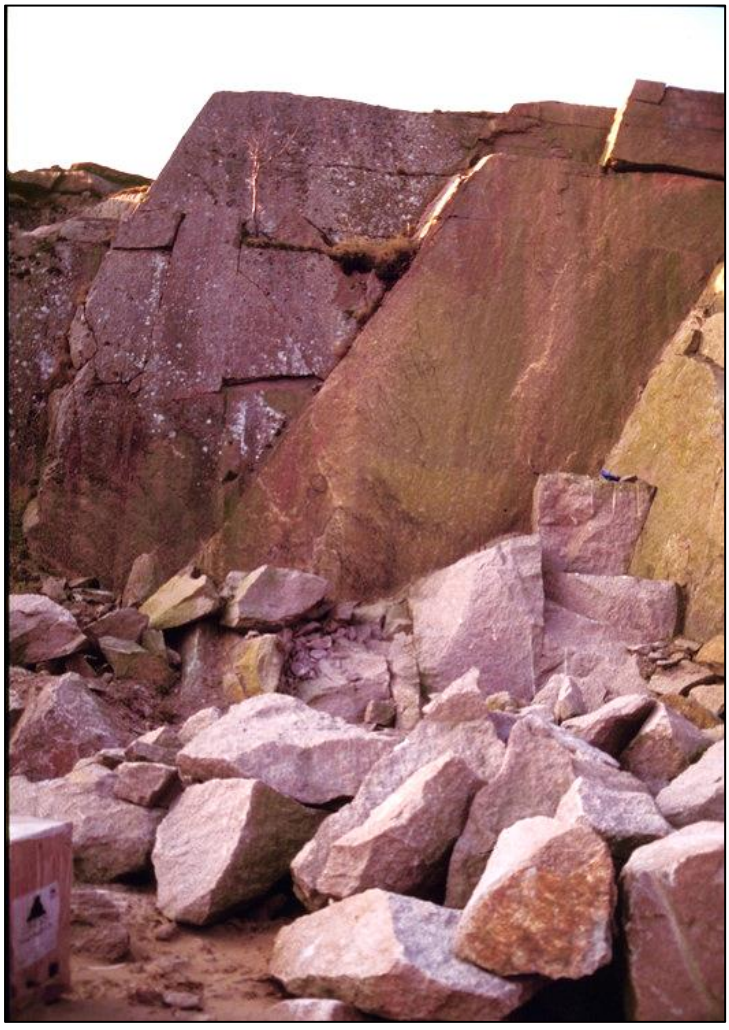
Argyll & Bute Stone Project
Stage 1: Scoping Study

Decarbonisation & Resource Management Programme
Commissioned Report OR/19/060



OR/19/060

BRITISH GEOLOGICAL SURVEY

DECARBONISATION & RESOURCE MANAGEMENT PROGRAMME

COMMISSIONED REPORT OR/19/060

Argyll & Bute Stone Project Stage 1: Scoping Study

Martin R Gillespie and Paul A Everett

Keywords

Report; Argyll and Bute, quarry, building stone, heritage.

Front cover

Tormore quarry (Ross Of Mull Granite) photographed in 1994. The face is c. 10 m high. The largest granite block ever extracted from a UK quarry was reputedly quarried at Tormore for a memorial.

Bibliographical reference

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Contents

FIGURES

TABLES

Executive Summary

This report describes the outcomes of a desktop study to review the building stones that were produced historically in the area administered by Argyll and Bute unitary authority council, and identify those that have the best prospect of commercial success if they were brought back to market today. The project, which was commissioned by Historic Environment Scotland (HES) with Highlands and Islands Enterprise as a funding partner, is the first stage of a larger project seeking to bring about renewed building stone production in Argyll and Bute.

The report contains summary details for 24 building stones that are currently recognised in Argyll and Bute, and 154 quarries that are associated with these stones. A range of information for each stone is provided, including a list of the end-uses to which it might be suited today, an evaluation of its 'heritage value', and an assessment of the commercial environment into which it would be introduced if quarrying was renewed. This information is used to compile a shortlist of the building stones and quarries that are considered to have the most promising market potential, based mainly on the properties and pedigree of each stone, accessibility of the quarries, and the degree to which 'competitor stones' already exist in the market. Our assessment suggests that Furnace Porphyry, Cruachan Granite, Quarry Granite, Ross of Mull Granite, Highland Border Slate and West Highland Slate have the best potential for renewed production.

1 Introduction

During the late 18th and throughout the 19th centuries, tens of thousands of people in Scotland were employed in many hundreds of building stone quarries, producing stone that was used to construct hundreds of thousands of stone buildings in Scotland and beyond. However, the past century has seen a precipitous decline in the industry, and today just a handful of active building stone quarries remain. The industry now employs fewer than two hundred people, and around nine-tenths of the stone used in Scotland is imported. The decline of the building stone industry has coincided with a loss of knowledge and skills relating to stone extraction and use, an increase in the number of traditional buildings needing repair (through ageing and, in many cases, poor maintenance), a gradual reduction in visual consistency within the built environment, and a dilution of settlement character (Gillespie & Tracey, 2016). The threat this situation poses to the long-term health of the traditional built environment in Scotland, and the need to find more sustainable ways of sourcing building stone, are increasingly being recognised by the heritage sector and other stakeholders.

This report describes the outcomes of a desktop-based review of the building stones that were produced historically in the area administered by Argyll and Bute unitary authority council, and the quarries associated with these stones. Only one quarry in this area currently produces building stone, and a key aim of the study was to identify other building stones and quarries in the area that have the best prospect of commercial success should quarrying resume. The study, which was commissioned by Historic Environment Scotland (HES) with Highlands and Islands Enterprise as a funding partner, is the first stage of a larger project that aims to bring about renewed building stone production in Argyll and Bute. The study has been conducted by the BGS Building Stones Team.

A review of relevant quarries and building stones in Argyll and Bute is provided in section 2 of this report, and an assessment of the commercial environment into which any new stone from Argyll and Bute would be introduced (i.e. the strength and nature of potential 'competition' from other UK stones and imported stones) is presented in section 3. The information provided in sections 2 and 3 is used in section 4 to assess the potential for renewed quarrying of Argyll and Bute building stones, and to compile a shortlist of the building stones and quarries that are considered to have the most promising combination of properties, pedigree and market potential. The report concludes with a summary of the main findings.

2 Quarries and building stones in Argyll and Bute

2.1 QUARRIES

Only one quarry (Achnaba) is producing building stone in Argyll and Bute today. With this one exception, all of the building stone quarries are disused and therefore likely to be in a somewhat deteriorated state (e.g. overgrown, debris-filled, flooded, or used for other purposes), and they may lack vehicle access. For this reason, quarries that are active today but produce aggregate rather than building stone have been included in the study. If the stone from any such quarry can be shown to have potential as a building stone, it may be possible to persuade the quarry owner to extract stone block for this purpose, as well as aggregate.

The quarry information presented in this section has been derived from the BGS BritPits database, which currently holds more than 200,000 individual records for mines and quarries in the UK. A wide range of information is stored with each record, including the type of excavation (quarry, pit, mine etc), details of its location, operator and status (active, ceased etc), the type(s) of commodity produced (e.g. sand & gravel, roadstone, coal, building stone, agricultural lime), and the end-use of the product (e.g. crushed rock aggregate, decorative stone, kerbs, setts).

Quarries relevant to this project were identified in the following way.

- All records in BritPits for quarries located within the geographical area administered by Argyll and Bute unitary authority council were downloaded into a Microsoft Excel spreadsheet. The database query identified 2,098 records.
- The full range of end-uses for quarried and mined products that are recorded in BritPits was reviewed, and all those that can be considered a type of 'building stone' end-use or 'aggregate' end-use were identified. Ten end-uses, including 'dimension stone', 'roofing slate' and 'decorative stone', were identified as denoting a type of building stone, and eight end-uses, including 'coated roadstone', 'crushed rock aggregate', and 'constructional fill', were identified as denoting a type of aggregate. The full lists of end-uses considered to denote building stone and aggregate are presented in Appendix 1.
- The 'end-use' of the quarried product recorded for each of the 2,098 records in the spreadsheet was reviewed. Of these:
    - 893 have an end-use that is not relevant to this study (e.g. sand & gravel, coal, agricultural lime), and in 815 cases an end-use is not recorded; these records were not considered further;
    - 140 have a building stone end-use, and these records were taken to be 'building stone' quarries for the purpose of this study;
    - 982 have an aggregate end-use, and these were taken to be 'aggregate' quarries.
- Those aggregate quarries that are recorded as being 'active' (i.e. currently operational, though not necessarily continuously) in BritPits were identified; 14 of the 982 'aggregate' quarries in Argyll and Bute were 'active' at the time of this study.

Details for the 140 building stone quarries and 14 active aggregate quarries that were identified by this process are provided in Table 1 and Table 2, respectively. A description of the contents of each column of data in these tables is presented in Appendix 2. Figures 1–5 show the geographical distribution of the quarries and associated building stones. Address and other details for the quarry operators identified in Table 1 and Table 2 are provided in Appendix 3.

2.2 COMMENTS ON BRITPITS DATA

Information held in BritPits has been compiled by BGS from an exhaustive search of maps and other historical records, and the database is by far the most comprehensive source of quarry information in the UK today. However, the following limitations and considerations should be noted.

- Some (usually very old and/or very small) quarries and excavations are not indicated on maps or otherwise recorded in historical documents, in which case they will not be included in BritPits.
- The end-use to which stone from a quarry was put may not be indicated in the examined historical records, in which case BritPits simply records the end-use as 'not available'. An end-use was not recorded for 815 of the 2,098 records for Argyll and Bute. Some of these quarries are likely to have been used for building stone.
- Over time, two or more closely-spaced quarries can amalgamate, so the number of quarries recorded in a quarry 'cluster' (a group of spatially adjacent quarries) may exceed the number that are actually visible on the ground today. For example, at Furnace on the shore of Loch Fyne, several historical building stone quarries have been subsumed within a single large aggregate quarry. For this and other reasons it can be difficult to derive the true number of historical building stone quarries that there have been in any given area, and how many are still extant today.
- BritPits is updated with information about historical quarries whenever new information is obtained. However, new information about active quarries (which comes from Mineral Planning Authorities) is obtained intermittently, and may be several years old. The information in this report was extracted from BritPits in July 2019.

Table 1 Summary details for historical 'building stone' quarries in Argyll and Bute

BGS ID	BGS NAME	ALTERNATIVE NAME	CLUSTER	SUPER-CLUSTER	BNG REF	EASTING	NORTHING	LOCATION	STATUS	OPERATOR	MPA	HISTORICAL END-USES	BUILDING STONE
215153	Caddleton	Old Marble Quarry	N/A	N/A	NM	178595	715752	Clachan, near Oban	CEASED	Not known	A&B	Building stone	Ardmaddy Bay Marble
88728	Skipness	-	N/A	N/A	NR	188300	658100	Skipness, Kintyre	CEASED	Not known	A&B	Millstones, querns	Beinn Bheula Metasandstone
88891	Ardmore	Bloody Bay	N/A	N/A	NM	147580	758155	near Tobermory	CEASED	Not known	A&B	Building stone	Bloody Bay Sandstone
88886	Bridge of Awe	-	N/A	N/A	NN	203050	729860	Bridge of Awe	CEASED	Not known	A&B	Building stone	Bridge Of Awe Sandstone
142	Bonawe Quarries	-	Bonawe Cluster	N/A	NN	201500	733500	Loch Etive	CEASED	Ennstone Thistle Ltd.	A&B	Building stone; Kerbs, setts; Walling stone	Cruachan Granite
88011	Bonawe Quarries	-		N/A	NN	201535	733420	Loch Etive	CEASED	Breedon Northern		Building stone; Kerbs, setts	
88012	Craig Quarries	Ardchattan Quarries	Craig (Etive) Cluster	N/A	NN	203815	734595	Loch Etive	CEASED	Not known		Building stone; Monumental stone	
88013	Craig Quarries	Ardchattan Quarries		N/A	NN	203830	734690	Loch Etive	CEASED	Not known		Building stone; Monumental stone	
88014	Craig Quarries	Ardchattan Quarries		N/A	NN	203905	734560	Loch Etive	CEASED	Not known		Building stone; Monumental stone	
88015	Craig Point Quarries	-	Craig Point Cluster	N/A	NN	203015	734030	Loch Etive	CEASED	Not known		Building stone	
88016	Craig Point Quarries	-		N/A	NN	203075	734020	Loch Etive	CEASED	Not known		Building stone	
186489	Inverawe	-	N/A	N/A	NN	202010	732643	Taynuilt	CEASED	Not known		Building stone	
13762	Achnaba Quarry	The Cut	N/A	N/A	NR	189195	685785	Lochgilphead	ACTIVE	MacLeod Construction Ltd.	A&B	Building stone; Paving uses; Dimension stone	Dalradian Metamafite
30549	Creggans	-	N/A	N/A	NN	206790	703120	Creggans, Loch Fyne	CEASED	Not known		Building stone	
180660	Esknish Quarry	Aluchga Quarry	N/A	N/A	NR	137336	665013	Ballygrant, Islay	CEASED	C. Morrison		Slate	
30546	St Catherine's	-	N/A	N/A	NN	212360	707255	St Catherines, Loch Fyne	CEASED	Not known		Building stone	
88721	Port a' Gharaidh	Quern	N/A	N/A	NR	163500	647350	Gigha	CEASED	Not known		Millstones, querns	
88722	Port na Cathrach	-	N/A	N/A	NR	162985	648365	Gigha	CEASED	Not known		Millstones, querns	
214439	Lochan Shira Dam Quarry	-	N/A	N/A	NN	215475	720542	Dalmally	CEASED	A. M. Carmichael, Public Works Contractor		Building stone	
88810	Sgeir nam Muc	-	N/A	N/A	NR	197620	695440	Minard, near Inveraray	CEASED	Not known		Millstones, querns	
223858	Doide	-	N/A	N/A	NR	170410	676880	Knapdale	HISTORIC	Not known		Building stone; Monumental stone	
223857	Kilchurn Castle Quarry	-	N/A	N/A	NN	213310	727590	Loch Awe	HISTORIC	Not known		Building stone	
143	Furnace Quarry	-	Furnace Cluster	N/A	NN	202855	700255	Inveraray	ACTIVE	Breedon Northern	A&B	Dimension stone; Constructional fill	Furnace Porphyry
30558	Furnace	-		N/A	NN	202835	700080	Loch Fyne	CEASED	Not known		Building stone	
30559	Furnace Quarry	-		N/A	NN	202690	700075	Loch Fyne	CEASED	Not known		Building stone	
30560	Furnace	-		N/A	NN	202980	700075	Loch Fyne	CEASED	Not known		Building stone	
30561	Furnace	California		N/A	NN	203065	700155	Loch Fyne	CEASED	Not known		Building stone	
30562	Furnace	California		N/A	NN	202985	700135	Loch Fyne	CEASED	Not known		Building stone	
7955	Crarae Quarry	Cumlodden	N/A	N/A	NR	199518	698156	Loch Fyne	CEASED	Crarae Granite Co., Ltd.		Kerbs, setts	

BGS ID	BGS NAME	ALTERNATIVE NAME	CLUSTER	SUPER-CLUSTER	BNG REF	EASTING	NORTHING	LOCATION	STATUS	OPERATOR	MPA	HISTORICAL END-USES	BUILDING STONE
6260	Ardmaleish Point	Bute Quarries	Ardmaleish Cluster	Bute Slate Supercluster	NS	207500	669600	Port Bannatyne, Bute	CEASED	Marquis of Bute	A&B	Slate	Highland Border Slate
48788	Ardmaleish Point	Bute Quarries			NS	207455	669660	Ardmaleish Point, Bute	CEASED	Marquis of Bute		Slate	
48789	Ettrickdale	-	Ettrickdale Cluster		NS	206580	668485	Port Bannatyne, Bute	CEASED	Not known		Slate	
48790	Ettrickdale	-			NS	206470	668445	Port Bannatyne, Bute	CEASED	Not known		Slate	
6348	Hillton	Hilton, Bute Quarries	Hillton Cluster		NS	205845	668455	Port Bannatyne, Bute	CEASED	Marquis of Bute		Slate	
48791	Hillton	Hilton			NS	206000	668390	Port Bannatyne, Bute	CEASED	Marquis of Bute		Slate	
48792	Hillton	Hilton			NS	205725	668275	Port Bannatyne, Bute	CEASED	Marquis of Bute		Slate	
6349	Edinmore	Bute Quarries	N/A		NS	205200	668000	Port Bannatyne, Bute	CEASED	Marquis of Bute		Slate	
48814	Largievrechtan	-	N/A		NS	204275	665015	Largievrechtan, Bute	CEASED	Not known		Slate	
6360	Camstradden	Luss Quarries	Camstradden Cluster	Luss Supercluster	NS	235510	692040	Luss	CEASED	Luss Estates	LL& TTNP	Slate	
30350	Camstraddan	Luss Quarries			NS	235365	691975	Luss	CEASED	Not known		Slate	
30351	Camstraddan	Luss Quarries			NS	235425	691870	Luss	CEASED	Not known		Slate	
30352	Camstraddan Quarries	Luss Quarries			NS	235674	692034	Luss	CEASED	Not known		Slate	
6359	Craig na Goibhre	Luss Quarries	Craig na Goibhre Cluster		NS	235300	692400	Loch Lomond	CEASED	Luss Estates		Slate	
30353	Creag na Goibhre	-			NS	235345	692360	Luss	CEASED	Not known		Slate	
30354	Creag na Goibhre	-			NS	235135	692370	Luss	CEASED	Not known		Slate	
6357	Luss	-	Luss Village Cluster		NS	235625	693060	Loch Lomond	CEASED	Luss Estates		Slate	
30356	Luss	-			NS	235650	692980	Luss	CEASED	Not known		Slate	
30357	Camstraddan Cottage	-			NS	235525	692925	Luss	CEASED	Not known		Slate	
6358	Auchengavin	Luss Quarries	N/A		NS	234895	692730	Loch Lomond	CEASED	Luss Estates		Slate	
30355	Darroch Cottage	-	N/A		NS	235675	692470	Luss	CEASED	Not known		Slate	
88713	Auchamore	-	N/A	N/A	NS	216690	676840	Dunoon	CEASED	Not known	A&B	Roofing slate	
9515	Clynder Quarry	-	N/A	N/A	NS	224435	683582	Clynder, Gare Loch	CEASED	Not known		Building stone	
9258	Inchmarnock Slate Quarries	-	N/A	N/A	NS	202690	659185	Inchmarnock, by Bute	CEASED	Not known		Building stone	
88711	Milton Plantation	-	N/A	N/A	NS	216700	677155	Dunoon	CEASED	Not known		Building stone	
28444	Stroul Burn	-	N/A	N/A	NS	224765	683360	Rosneath, Gare Loch	CEASED	Not known		Slate	
8490	Iona Marble	Iona	N/A	N/A	NM	126860	721830	Iona	CEASED	Iona Marbles Ltd.	A&B	Decorative stone	Iona Marble
214372	Ardentallen Quarries	-	Ardentallan Cluster	N/A	NM	182975	723177	Loch Feochan	CEASED	Not known	A&B	Building stone	Kerrera Sandstone
241742	Ardentallen Quarry	-		N/A	NM	182975	723177	Loch Feochan	CEASED	Not known		Building stone	
241743	Lower Ardentallen Quarry	-		N/A	NM	182701	722805	Loch Feochan	CEASED	Not known		Building stone	
241744	Ardentallen Point Quarries	-		N/A	NM	182975	723177	Loch Feochan	CEASED	Not known		Building stone	
241746	Ardentallen Quarries	-		N/A	NM	182951	723141	Loch Feochan	CEASED	Not known		Building stone	
241747	Ardentallen Quarries	-		N/A	NM	183046	723362	Loch Feochan	CEASED	Not known		Building stone	
241748	Ardentallen Quarries	-		N/A	NM	183080	723361	Loch Feochan	CEASED	Not known		Building stone	
241737	Barrnacarry Bay Quarry	Barnacarry Quarry	N/A	N/A	NM	182701	722805	Loch Feochan	CEASED	Not known		Building stone	
58253	Dunans	Allt a Chaol Ghlinne, Caol-ghleann	N/A	N/A	NS	205395	692705	Caol Ghleann, Cowal	CEASED	Not known	A&B	Building stone	Loch Katrine Metasandstone
88700	Hunter's Quay	Arnadam	N/A	N/A	NS	218200	679260	Hunter's Quay, Dunoon	CEASED	The Hafton Trustees		Building stone	
88677	Achnarossan	-	N/A	N/A	NR	193905	677170	Kilfinan, Loch Fyne	CEASED	Not known		Building stone	

BGS ID	BGS NAME	ALTERNATIVE NAME	CLUSTER	SUPER-CLUSTER	BNG REF	EASTING	NORTHING	LOCATION	STATUS	OPERATOR	MPA	HISTORICAL END-USES	BUILDING STONE
88683	Ardmarnock House	-	N/A	N/A	NR	191650	673190	Ardmarnock, Loch Fyne	CEASED	Not known		Building stone	
214440	Lochan Shira Dam Quarry	-	N/A	N/A	NN	215701	720406	Dalmally	CEASED	A. M. Carmichael, Public Works Contractor	A&B	Building stone	Precambrian metasedimentary rocks (undiff)
88667	Ben Cruachan Quarry	-	Ben Cruachan Cluster	N/A	NN	212604	729497	Lochawe	CEASED	Ben Cruachan Granite Quarries Ltd	A&B	Building stone	Quarry Granite
88668	Ben Cruachan Quarry	-		N/A	NN	212445	729464	Lochawe	CEASED			Building stone	
88669	Ben Cruachan Quarry	-		N/A	NN	212075	729416	Lochawe	CEASED			Building stone	
88670	Ben Cruachan Quarry	-		N/A	NN	212393	729239	Lochawe	CEASED			Building stone	
163114	Bull Hole	-	Bull Hole Cluster	N/A	NM	130510	724755	Fionnphort, Mull	CEASED	William Vass	A&B	Building stone	Ross of Mull Granite
163117	Bull Hole Workings	-		N/A	NM	130320	724555	Bull Hole, Mull	CEASED	Not known		Building stone; Monumental stone	
163116	Aridhglas	-	N/A	N/A	NM	132465	723030	Aridhglas, Mull	CEASED	Not known		Building stone	
159794	Camas Tuath	North Bay	N/A	N/A	NM	135218	724238	Ross of Mull	CEASED	Northern Lighthouse Board		Building stone	
159791	Deargphort	Sound of Iona	N/A	N/A	NM	130790	725160	Ross of Mull	CEASED	William Vass		Building stone	
163113	Eilean Dubh	-	N/A	N/A	NM	130405	725240	Fionnphort, Mull	CEASED	William Vass		Building stone	
163115	Rudh nam Buthan	Booth Point	N/A	N/A	NM	136185	722825	Bunessan, Mull	CEASED	Not known		Building stone	
146	Tormore	Ross of Mull, Tor Mor	Tormore Cluster	N/A	NM	130435	723940	Ross of Mull	INACTIVE	Scottish Natural Stones Ltd.		Building stone	
162345	Ross of Mull Quarries	Tormore, Tor Mor		N/A	NM	130405	723990	Ross of Mull	INACTIVE			Building stone	
163118	Prince's Stone	-		N/A	NM	130645	723980	Fionnphort, Mull	CEASED	Not known		Monumental stone	
159806	Erraid	-	N/A	N/A	NM	129787	720426	Erraid, Ross of Mull	CEASED	Northern Lighthouse Board		Building stone	
155467	Carsaig Quarries	-	N/A	N/A	NM	152595	720410	Carsaig, Mull	CEASED	Not known	A&B	Building stone	Scalpay Sandstone
30442	Broom Plantation	-	N/A	N/A	NS	225555	682910	Rosneath	CEASED	Not known	A&B	Building stone	St Ninian Metasandstone
9582	Bullwood	Bull Rock	N/A	N/A	NS	216530	674540	Bullwood, Dunoon	CEASED	E. Cameron		Building stone	
88685	Camsail Wood	Rosneath	N/A	N/A	NS	225760	682380	Rosneath	CEASED	Not known		Building stone	
9511	Blackhill Quarries	-	Blackhill Helensburgh Cluster	N/A	NS	231150	684100	Helensburgh	CEASED	Not known	A&B	Building stone	Stratheden and Inverclyde Sandstone
28436	Blackhill	-		N/A	NS	231035	683900	Helensburgh	CEASED	Not known		Building stone	
28437	Blackhill	-		N/A	NS	231110	683915	Helensburgh	CEASED	Not known		Building stone	
28438	Blackhill	-		N/A	NS	231230	683950	Helensburgh	CEASED	Not known		Building stone	
28439	Blackhill	-		N/A	NS	230995	683810	Helensburgh	CEASED	Not known		Building stone	
28440	Blackhill	-		N/A	NS	231170	683795	Helensburgh	CEASED	Not known		Building stone	
28518	Auchensail	-	N/A	N/A	NS	234250	679770	Geilston, Cardross	CEASED	Not known	A&B	Building stone	Teith Sandstone
88880	Balephetrish	Ballyphetrish, Tiree Marble	N/A	N/A	NM	101390	747340	Tiree	CEASED	Not known	A&B	Decorative stone	Tiree Marble
6265	Cullipool	-	Cullipool Cluster	Luing Supercluster	NM	174150	713705	Cullipool, Luing	CEASED	Not known	A&B	Slate	West Highland Slate
6286	Cullipool No 5	-			NM	173900	713000	Luing	CEASED	Not known		Slate	
6287	Cullipool No 4	-			NM	173950	713250	Luing	CEASED	Not known		Slate	
6288	Cullipool No 3	-			NM	174050	713450	Luing	CEASED	Not known		Slate	
6289	Cullipool No 2	-			NM	174050	713620	Luing	CEASED	Not known		Slate	
6290	Cullipool No 1	-			NM	174105	713680	Luing	CEASED	Not known		Slate	
6292	Toberonochy	-	N/A		NM	174855	708555	Luing	CEASED	Not known		Slate	
6266	Port Mary	-	Port Mary Cluster		NM	174500	714025	Port Mary, Luing	CEASED	Not known		Slate	

BGS ID	BGS NAME	ALTERNATIVE NAME	CLUSTER	SUPER-CLUSTER	BNG REF	EASTING	NORTHING	LOCATION	STATUS	OPERATOR	MPA	HISTORICAL END-USES	BUILDING STONE
163120	Port Mary	-			NM	174585	714120	Port Mary, Luing	CEASED	Not known		Roofing slate	
6262	Rubha na h-Easgainne No 1	Cuan Point	Rubha na h-Easgainne Cluster		NM	174870	714520	Cuan Point, Luing	CEASED	Not known		Slate	
6263	Rubha na h-Easgainne No 2	Cuan Point			NM	174805	714480	Cuan Point, Luing	CEASED	Not known		Slate	
6264	Rubha na h-Easgainne No 3	Cuan Point			NM	174765	714400	Cuan Point, Luing	CEASED	Not known		Slate	
6291	Tir-na-Oig North Quarry	Tir-na-Oig Quarries	Tir-na-Oig Cluster		NM	173330	710310	Luing	CEASED	Not known		Slate	
186493	Tir-na-Oig South Quarry	-			NM	173334	710276	Luing	CEASED	Not known		Slate	
6267	Black Mill Bay	-	Black Mill Bay Cluster		NM	173285	708305	Black Mill Bay, Luing	HISTORIC	Not known		Slate	
6268	Black Mill Bay	-			NM	173305	708315	Black Mill Bay, Luing	HISTORIC	Not known		Slate	
6281	Balvicar No 1	Balvicar	Balvicar Cluster	N/A	NM	176860	716670	Seil	CEASED	Not known		Slate	
6282	Balvicar No 2	Balvicar		N/A	NM	176810	716610	Seil	CEASED	Not known		Slate	
6283	Balvicar No 3 & 4	Balvicar		N/A	NM	176730	716495	Seil	CEASED	Not known		Slate	
6284	Balvicar No 5	Balvicar		N/A	NM	176620	716415	Seil	CEASED	Not known		Slate	
6269	Belnahua Quarries	-	Belnahua Cluster	N/A	NM	171400	712800	Belnahua, by Luing	CEASED	Not known		Slate	
20877	Belnahua South	-		N/A	NM	171470	712650	Belnahua, by Luing	CEASED	Not known		Slate	
6285	Breine Phort	-	Breine Phort Cluster	N/A	NM	175400	716585	Seil	CEASED	Not known		Slate	
186491	Breine Phort Slate Quarries	-		N/A	NM	175352	716501	Seil	CEASED	Not known		Slate	
186492	Breine Phort Slate Quarries	-		N/A	NM	175215	716389	Seil	CEASED	Not known		Slate	
88763	Cairnbaan	Meall Buidhe	Cairnbaan Cluster	N/A	NR	183545	690925	Cairnbaan, Lochgilphead	CEASED	Not known		Building stone	
88764	Cairnbaan	Meall Buidhe		N/A	NR	183495	690865	Cairnbaan, Lochgilphead	CEASED	Not known		Building stone	
6270	Klondyke	Easdale Island	Easdale Island Cluster	N/A	NM	173590	717090	Easdale	CEASED	Not known		Slate	
6273	Easdale East 2	Easdale Island		N/A	NM	174020	716980	Easdale	CEASED	Not known		Slate	
6274	Easdale East 1	Easdale Island		N/A	NM	173980	716900	Easdale	CEASED	Not known		Slate	
6275	Creag Rubha nam Faoileann	Easdale Island		N/A	NM	173500	717000	Easdale	CEASED	Not known		Slate	
6276	Creag an Duin	Easdale Island		N/A	NM	173605	717250	Easdale	CEASED	Not known		Slate	
6277	Craig na h-Uamha	Easdale Island		N/A	NM	173650	717320	Easdale	CEASED	Not known		Slate	
6278	An Toll mar Thuath	Easdale Island		N/A	NM	173510	717175	Easdale	CEASED	Not known		Slate	
6279	An Staca Dubh	Easdale Island		N/A	NM	173465	716915	Easdale	CEASED	Not known		Slate	
6280	An Lub Chlear	Easdale Island		N/A	NM	173490	717130	Easdale	CEASED	Not known		Slate	
6271	Ellenabeich Main	Ellanbeich, Easdale	Ellenabeich Cluster	N/A	NM	174400	717400	Seil	CEASED	Not known		Slate	
6272	Ellenabeich	Ellanbeich, Easdale		N/A	NM	174200	717200	Seil	CEASED	Not known		Slate	
88837	Inverlussa Slate Quarry	Lussa, Ardlussa	Inverlussa Cluster	N/A	NR	164371	686736	Inverlussa, Jura	CEASED	Not known		Roofing slate	
88838	Inverlussa Slate Quarry	Lussa, Ardlussa		N/A	NR	164397	686789	Inverlussa, Jura	CEASED	Not known		Roofing slate	
8973	Drumvargie Cutting	Druim a'Mhargaidh	N/A	N/A	NN	185580	729560	Oban	CEASED	Not known		Building stone; Walling stone	
32233	Tigh a'Mhuilinn Slate Quarry	Tighavullin	N/A	N/A	NR	173025	685515	Tayvallich, Crinan	CEASED	Not known		Slate	
88839	Tarbert	-	Tarbert Cluster	N/A	NR	161390	682015	Tarbert, Jura	CEASED	Not known		Roofing slate	
88840	Tarbert Lodge	-		N/A	NR	161290	681895	Inverlussa, Jura	CEASED	Not known		Roofing slate	
241745	Ardentallen Slate Quarries	-	N/A	N/A	NM	182941	722916	Ardentallen, Loch Feochan	CEASED	Not known		Slate	

Table 2 Summary details for active aggregate quarries in Argyll and Bute

BGS ID	BGS NAME	ALTERNATIVE NAME	BNG REF	EASTING	NORTHING	LOCATION	OPERATOR NAME	MPA	HISTORICAL END-USES	BUILDING STONE
13766	Ambrisbeg Quarry	Ambrisbeg	NS	206805	659510	Ambrisbeg, Bute	Ambrisbeg Ltd	A&B	Crushed rock aggregate; Subbase	Clyde Plateau Volcanic Rock
88010	Bonawe Quarries	-	NN	202205	733770	Loch Etive	Breedon Northern	A&B	Coated roadstone; Roadstone; Concrete aggregate	Cruachan Granite
16420	Gigha Quarry	-	NR	164215	648380	Gigha	Gigha Trading Ltd.	A&B	Crushed rock aggregate	Dalradian Metamafite
13762	Achnaba Quarry	The Cut	NR	189195	685785	Lochgilphead	MacLeod Construction Ltd.	A&B	Crushed rock aggregate	
143	Furnace Quarry	-	NN	202855	700255	Inveraray	Breedon Northern	A&B	Coated roadstone; Crushed rock aggregate; Concrete aggregate; Constructional fill	Furnace Porphyry
145	Pennygown Quarry	-	NM	160678	743115	Mull	John MacLachlan Quarries Ltd.	A&B	Ready mixed concrete; Crushed rock aggregate	Intrusions & extrusions, Atlantean Orogeny (undiff)
27195	Clachan Quarry	-	NN	220000	714155	Cairndow, Loch Fyne	Bonnar Sand & Gravel Co., Ltd.	A&B	Crushed rock aggregate	Intrusions & extrusions, Caledonian & Acadian orogenies (undiff)
187332	Dunbeg Borrow Pit	-	NM	187666	733669	Dunstaffnage, near Oban	TSL Contractors Ltd.	A&B	Crushed rock aggregate	Kerrera Sandstone
13761	Barrachander Quarry	-	NN	202730	726450	Glen Nant, by Taynuilt	Barrachander Quarry	A&B	Crushed rock aggregate	Lorn Plateau Volcanic Rock
147	Upper Soroba Quarry	-	NM	186595	728235	Oban	John MacLachlan Quarries Ltd.	A&B	Ready mixed concrete; Crushed rock aggregate	
148	Ballygrant Quarry	-	NR	139550	665875	Ballygrant, Islay	Dunlossit Estate	A&B	Roadstone	Precambrian metasedimentary rocks (undiff)
13763	Benderloch Quarry	Culcharron Farm	NM	190830	739515	Benderloch	Breedon Northern	A&B	Ready mixed concrete	
149	Calliburn Quarry	-	NR	171730	625455	Campbeltown	McFadyens Contractors (Campbeltown) Ltd.	A&B	Crushed rock aggregate; Armourstone; Roadstone	
16419	Clachan Quarry	-	NR	176450	657890	Kintyre	George McNaughton & Son	A&B	Crushed rock aggregate	

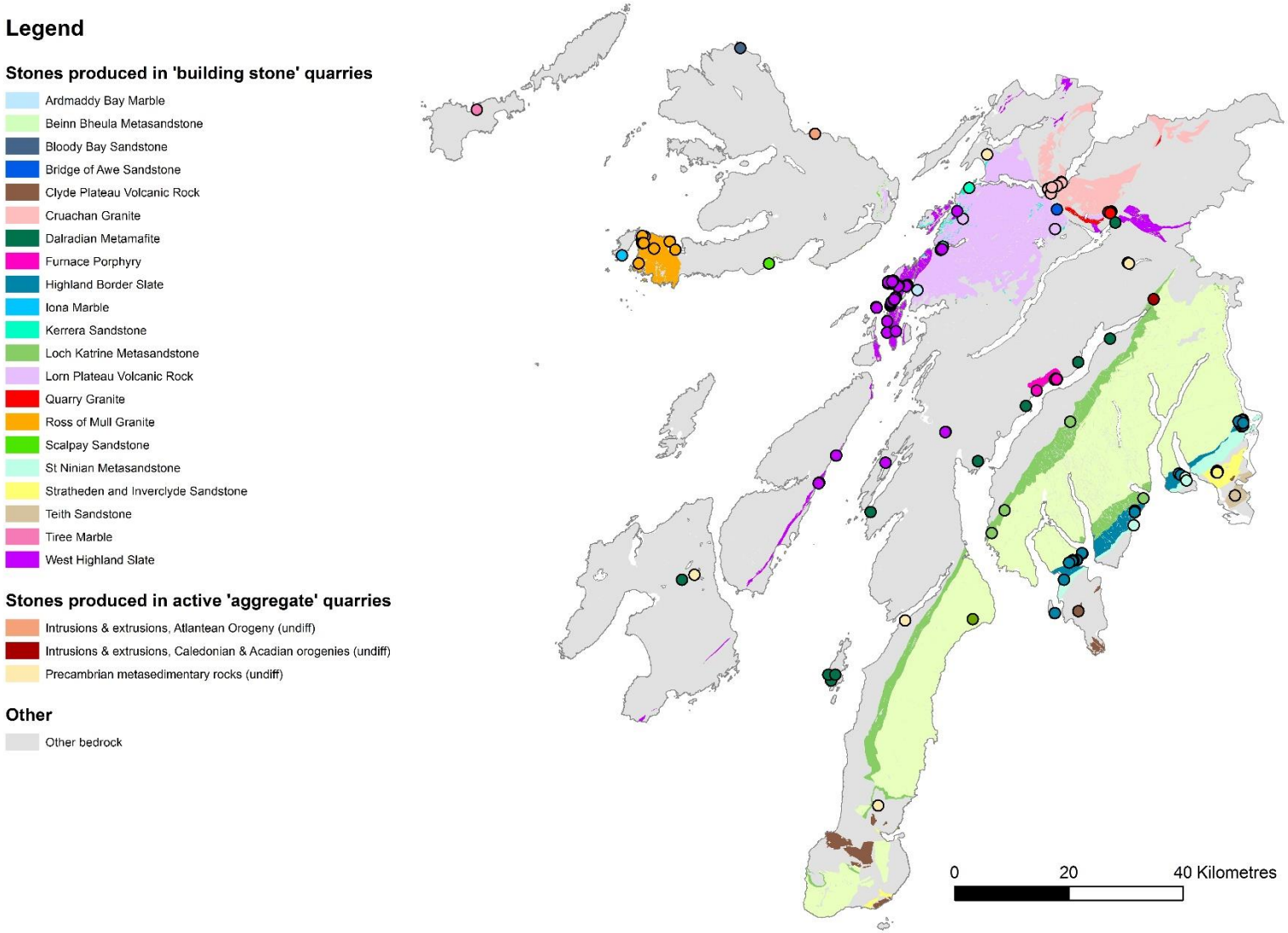

Figure 1 Geographical distribution of building stones and quarries referred to in this report

Map shows area administered by Argyll and Bute unitary authority council. Circles represent quarry locations; circle colour denotes type of stone quarried – see Legend. Some building stone polygons are not visible at this scale– see Figures 2-5.

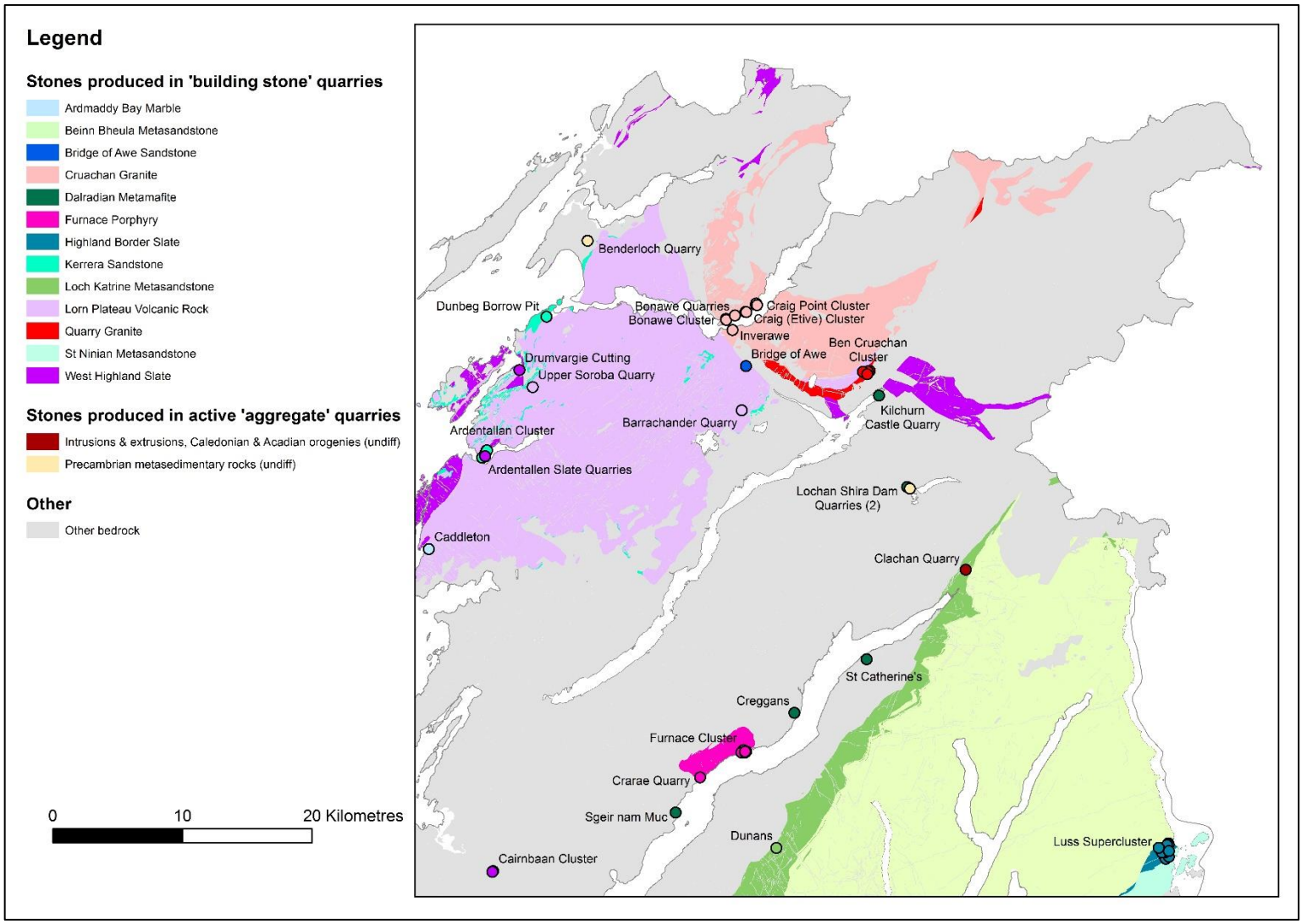

Figure 2 Geographical distribution of building stones and quarries in NE Argyll and Bute

Circles represent quarry locations; circle colour denotes type of stone quarried – see Legend.

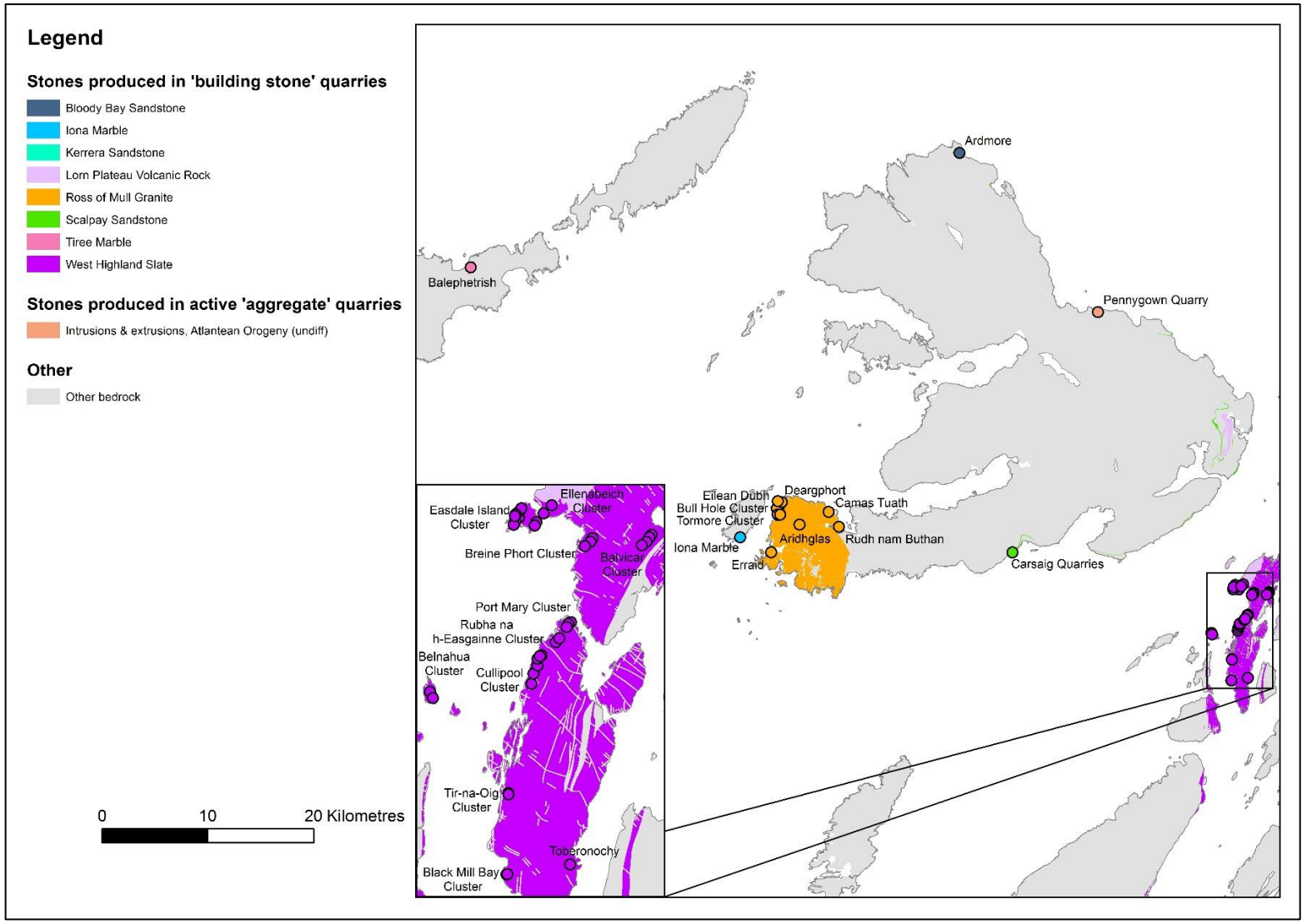

Figure 3 Geographical distribution of building stones and quarries in NW Argyll and Bute

Circles represent quarry locations; circle colour denotes type of stone quarried – see Legend.

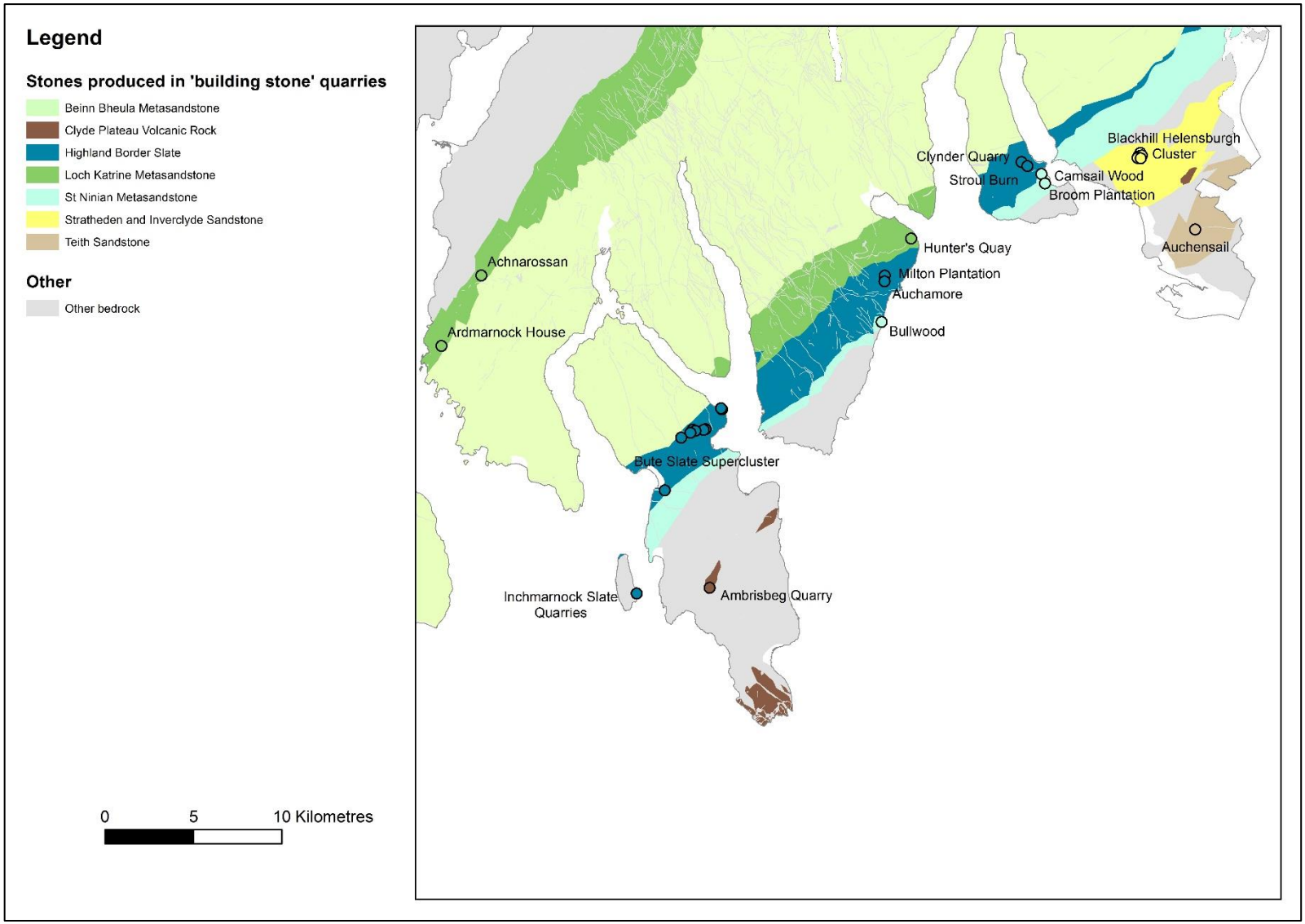

Figure 4 Geographical distribution of building stones and quarries in SE Argyll and Bute

Circles represent quarry locations; circle colour denotes type of stone quarried – see Legend.

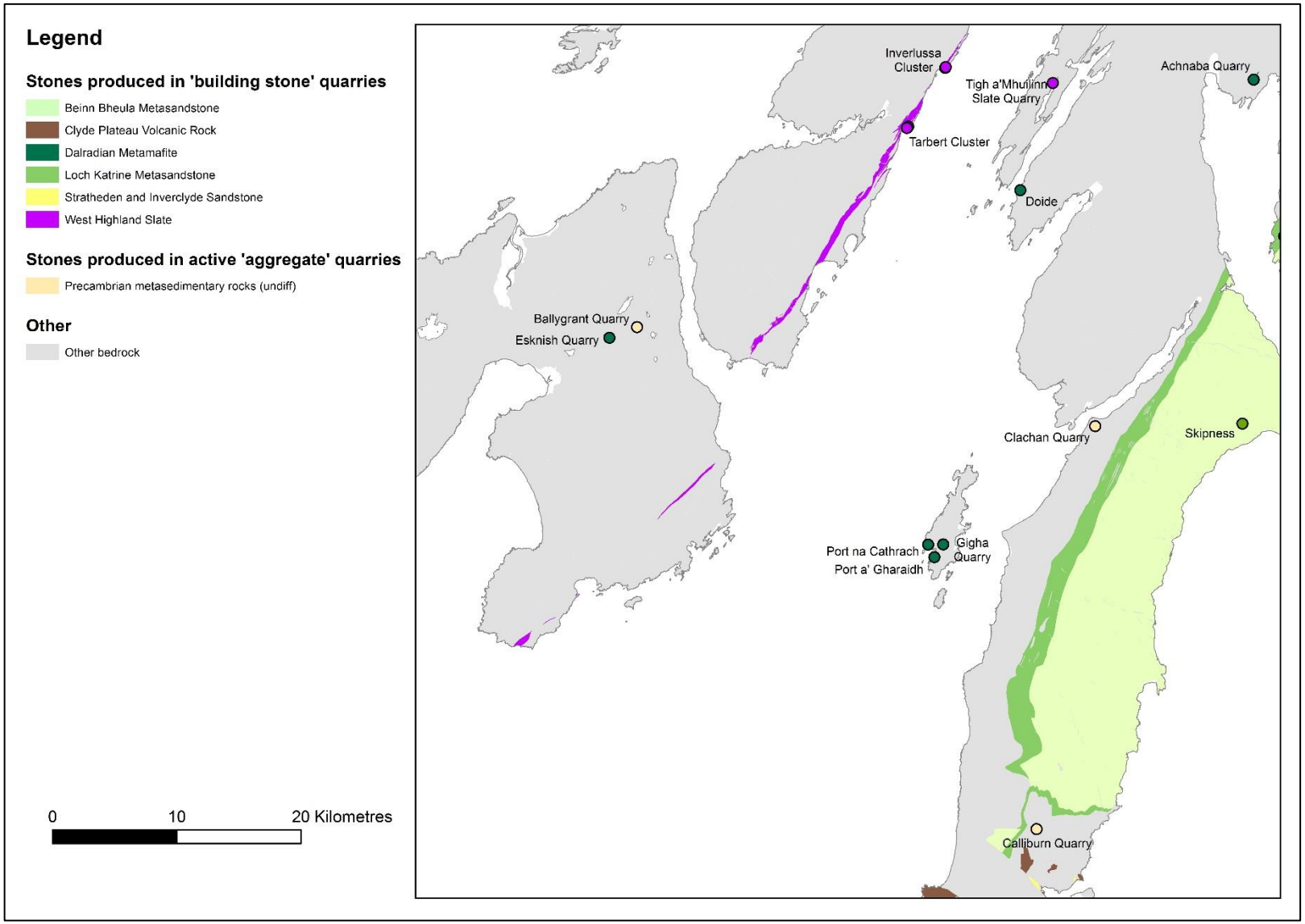

Figure 5 Geographical distribution of building stones and quarries in SW Argyll and Bute

Circles represent quarry locations; circle colour denotes type of stone quarried – see Legend.

2.3 BUILDING STONES

Details for all the 'building stones' listed in Table 1 and Table 2 are provided in Table 3. The contents of each column in Table 3 are described below.

2.3.1 Building stone

This column contains the building stone name.

The term 'building stone' is used here to refer to any stone that has been used as a building material or in decorative features and artefacts. BGS has previously identified and named all the building stones in Scotland, as part of a BGS-HES co-funded project to develop a *Building Stone Database for Scotland* (BSDS). The names in this column are consistent with those in the BSDS. Details for all the 200 building stones that are currently recognised in Scotland can be found via the online portal to the BSDS.

Each building stone is defined according to the geological unit from which it is sourced; for example, the building stone *Teith Sandstone* is sourced from a bedrock unit called Teith Sandstone Formation, and the building stone *Ross of Mull Granite* is sourced from a bedrock unit called Ross of Mull Granite Pluton. In reality, any given building stone has been sourced from only a very small part of its host bedrock unit (i.e. from one or more quarries), but the full area within which more of the same stone *may* occur is defined by the full geographical extent of the outcrop of the source bedrock unit. A *Building Stone Map for Scotland*, indicating the areas within which the different building stones of Scotland may occur, is incorporated within the BSDS. The map is based on BGS geological maps that show the full geographical extent of all the bedrock units in Scotland. Figures 1–5 have been derived from the *Building Stone Map for Scotland*.

Not all bedrock units have been used for building stone. Those that have not are referred to using terms that indicate their character and origin, and the fact that they encompass multiple bedrock units. For example, the term *Intrusions and extrusions, Atlantean Orogeny (undiff.)* encompasses within one 'undifferentiated unit' all of the igneous bedrock units (intrusions and extrusions) that formed due to geological forces associated with opening of the Atlantic Ocean (Atlantean Orogeny). Several such terms are relevant to this study because some of the active aggregate quarries in Argyll and Bute are sited on bedrock units that have not been used for building stone. All such terms conclude with the word 'undiff.', which distinguishes them from building stones.

Twenty-four 'stones' are included in Table 3. Of these, twenty-one are building stones that are defined in the BSDS and three are not. The twenty-four stones can be grouped into the following rock types.

- Slates (2): Highland Border Slate, West Highland Slate
- Marbles (3): Ardmaddy Bay Marble, Iona Marble, Tiree Marble
- Granites (3): Cruachan Granite, Quarry Granite, Ross of Mull Granite
- Porphyry (1): Furnace Porphyry
- Whin (dark, fine-grained igneous rocks) (4): Clyde Plateau Volcanic Rock, Lorn Plateau Volcanic Rock, Intrusions & extrusions, Atlantean Orogeny (undiff.), Intrusions & extrusions, Caledonian & Acadian orogenies (undiff.).
- Metamorphosed whin (1): Dalradian Metamafite
- Sandstones (6): Bloody Bay Sandstone, Bridge Of Awe Sandstone, Kerrera Sandstone, Scalpay Sandstone, Stratheden and Inverclyde Sandstone, Teith Sandstone
- Metasandstones (4): Beinn Bheula Metasandstone, Loch Katrine Metasandstone, St Ninian Metasandstone, Precambrian metasedimentary rocks (undiff.).

Figures 1–5 show the spatial distribution of building stones within Argyll and Bute.

2.3.2 Stone character

This column contains a brief summary of the key geological characteristics of each stone.

The description relates primarily to the distinctive, intrinsic geological properties (rock type, colour, texture and so on) of the stone. In preparing the descriptions, we have where possible examined stone samples obtained from the relevant quarries within Argyll and Bute. Where this was not possible, we have examined stone samples from elsewhere in the host bedrock unit and/or have obtained information from a publication. The source of the information is indicated in the description using asterisks, as follows. * = description based on one or more BGS samples from relevant quarries. ** = description based on one or more BGS samples from elsewhere in the host bedrock unit (i.e. BGS has no samples from relevant quarries). *** = Description based on published information.

Fourteen of the stones in Table 3 crop out entirely, or very largely, within Argyll and Bute. The other ten also crop out in other parts of Scotland.

2.3.3 Key properties

This column contains a list of the geological properties of the stone that determine its suitability for a range of building stone end-uses.

For the purposes of this exercise, eight key properties – 'durable', 'hard to split', 'easy to split', 'easy to saw', 'impermeable', 'shapeable (coarse detail)' and 'shapeable (fine detail)' – have been identified; a brief description of each is presented in Appendix 1. Key properties have been assigned to each stone subjectively, based on the description provided in the 'Stone character' column, and a general geological understanding of the rock type. Properties such as compressive strength and water absorption are not considered because they require a geotechnical test.

2.3.4 Potential end-uses

This column contains a list of end-uses to which the building stone may be suited, based on its key properties.

For the purposes of this exercise, eight potential end-uses – kerbs, setts, paving slabs, cladding, masonry, monuments, decorative items, and roofing – have been identified; a brief description of each is presented in Appendix 1. The end-uses to which different building stones have been put traditionally correlate very closely with the stone properties. For example, only stones that can easily be split thinly in one direction have been used for roofing, and only stones that can be carved or polished to produce a smooth finish and fine detail tend to have been used for decorative items. The list of *potential* end-uses identified for each building stone in Table 3 is therefore based on the list of key properties for that stone, as indicated in Appendix 1. Thus, for example, a potential end-use as 'kerbs' is recorded for all stones to which the key properties 'durable', 'hard to split' and 'impermeable' have been assigned.

In some cases, the relationship between stone properties and end-uses is obvious, but in others it is less so; for example, many different types of stone with many different properties have been used in the past to form masonry, often due to lack of local alternatives. For the purposes of this exercise, we have identified only one 'key property' for masonry ('shapeable - coarse detail'), on the basis that it would be too expensive now to prepare stone that is not readily 'shapeable' into masonry blocks; however, this may not apply in every case. Thus, while the list of potential end-uses assigned to each building stone includes all those that stem from its key properties, the list for each stone might be extended to include other end-uses in particular circumstances.

The geotechnical properties of the stones have not been considered, but appropriate geotechnical tests to determine if a stone meets the modern requirements of a particular end-use would need to be carried out prior to renewed quarrying.

Table 3 Summary details for the building stones of Argyll and Bute

BUILDING STONE	STONE CHARACTER	KEY PROPERTIES	POTENTIAL END-USES	HERITAGE VALUE
Ardmaddy Bay Marble	Reddish brown and grey (variegated), coarse-grained, texturally heterogeneous, crystalline metamorphic rock (metamorphosed limestone / marble) (* & ***).	Hard to split, Easy to saw, Impermeable, Shapeable (fine detail)	Decorative	Moderate. A visually distinctive stone sourced from a single quarry between 1745 and 1751, and used mainly to make decorative features like altars and fireplaces that were used locally and regionally. The bedrock unit from which this building stone is sourced occurs only in Argyll and Bute.
Beinn Bheula Metasandstone	Light to dark grey and thinly colour banded (mm-scale bands), crystalline metamorphic rock (metamorphosed sandstone), sometimes folded on the hand-sample scale, with a metamorphic foliation; flaggy partings, and veins or blobs of white quartz, are developed locally (**).	Durable, Easy to split (where flaggy), Impermeable, Shapeable (coarse detail) (where flaggy)	Paving slabs (where flaggy), Masonry (where flaggy)	Moderate. Stone from the only identified building stone quarry was used to make millstones and quern stones, which may have been used regionally. Stone sourced from elsewhere in the outcrop was probably used locally, mainly for masonry. The stone was used to form most of the masonry (walling and lintels) in Skipness Castle. The bedrock unit from which this building stone is sourced occurs almost entirely within Argyll and Bute.
Bloody Bay Sandstone	Dull reddish brown, medium-grained, granular sedimentary rock (sandstone), uniform at the hand sample scale, moderately cohesive, with 'high' permeability (*).	Easy to saw, Shapeable (coarse detail)	Cladding, Masonry	Low. A reddish brown but otherwise visually unexceptional sandstone sourced from a single quarry and used locally. The quarry was opened to provide stone for nearby Rubha nan Gall lighthouse; the stone was used in several structures, including a wall beside the path to the lighthouse, the causeway to the lighthouse, and its foundations. The bedrock unit from which this building stone is sourced occurs only in Argyll and Bute, but similar stone may occur in Ardnamurchan.
Bridge Of Awe Sandstone	Pink (or reddish) to grey, coarse-grained and locally gritty, granular sedimentary rock (sandstone), uniform at the hand- sample scale, moderately friable, with 'moderate' permeability (* & ***).	Easy to saw, Shapeable (coarse detail)	Cladding, Masonry	Low. A pink but otherwise visually unexceptional sandstone sourced from a single quarry and used locally and possibly regionally, probably mainly to form masonry. The stone was used to form dressings at Fraoch Eilean Castle [situated on an island in Loch Awe] and later at Kilchurn Castle on Loch Awe. The bedrock unit from which this building stone is sourced occurs only in Argyll and Bute, but similar stone occurs in parts of the Central Belt.
Clyde Plateau Volcanic Rock	Dark grey to dark greenish-grey and occasionally reddish-brown, fine-grained crystalline igneous rock (basaltic-rock and andesitic-rock), with phenocrysts and amygdales up to cm-scale developed locally (**).	Durable (in places), Hard to split, Impermeable	Kerbs, Setts (good-quality whin only)	Not applicable: BGS has no record that this stone has been used for building.
Cruachan Granite	Medium grey, medium- and coarse-grained, even-textured, crystalline igneous rock ('granite'), with a 'salt and pepper' visual character at the hand sample scale given by crystals of black biotite scattered in pale quartz and feldspar (*).	Durable, Hard to split, Impermeable, Shapeable (fine detail)	Kerbs, Setts, Monuments, Decorative	Moderate. A visually unexceptional 'grey granite', produced from multiple quarries and used locally, regionally and nationally, mainly to form masonry and paving. At least one quarry of the Bonawe Cluster was producing setts in 1987. The bedrock unit from which this building stone is sourced occurs almost entirely within Argyll and Bute.
Dalradian Metamafite	Greenish grey, fine- to medium, even-textured (though porphyritic or fragmental locally), crystalline metamorphic rock (metamorphosed igneous rock), with a weak to moderate metamorphic foliation producing a weakly flaggy character locally (* & **). Likely to be quite variable in different quarries and outcrops.	Durable, Hard to split, Impermeable, Shapeable (coarse detail) (where flaggy)	Kerbs, Setts, Masonry (where flaggy)	Moderate. A greenish grey (and therefore quite unusual) stone, historically produced from multiple quarries and probably varying somewhat in character from quarry to quarry. Used locally and regionally for many purposes, including masonry, roofing, decorative artefacts and millstones. Numerous medieval crosses and tombstones are formed of slabs of Dalradian Metamafite from the quarries at Doide on Loch Sween. The bedrock unit from which this building stone is sourced occurs widely outside Argyll and Bute.

BUILDING STONE	STONE CHARACTER	KEY PROPERTIES	POTENTIAL END-USES	HERITAGE VALUE
Furnace Porphyry	Light grey or pinkish brown, crystalline igneous rock (porphyritic rhyolite), with large, white and black crystals set in a groundmass of very small crystals (*).	Durable, Hard to split, Impermeable, Shapeable (fine detail)	Kerbs, Setts, Monuments, Decorative	High. A visually distinctive 'porphyry' that has been used locally, regionally and nationally, mainly to form paving and to a lesser extent masonry (e.g. structures in Inveraray, including Duke's Tower, the Parish Church, and the sea wall). The bedrock unit from which this building stone is sourced occurs only in Argyll and Bute.
Highland Border Slate	Dull green to medium grey, crystalline metamorphic rock (metamorphosed mudstone / slate) that yields thick roofing slates with matt, moderately rough surfaces and a 'ribboned' character (*).	Durable, Easy to split, Impermeable	Roofing	Very high. Yields distinctive roofing slates with a unique combination of geological and man-made features that cannot be reproduced by any other slate. Used locally and regionally on numerous structures, mainly for roofing but also for masonry. The bedrock unit from which this building stone is sourced occurs mainly outside Argyll and Bute.
Intrusions & extrusions, Atlantean Orogeny (undiff.)	Mainly very dark grey, very-fine-grained, even-textured crystalline igneous rock (basaltic-rock), but the category includes lavas and intrusions of varying size, so rock character will vary considerably. (**, ***).	Durable, Hard to split, Impermeable	Kerbs, Setts (good-quality whin only)	Not applicable: BGS has no record that this stone has been used for building.
Intrusions & extrusions, Caledonian & Acadian orogenies (undiff.)	A single sample is very dark grey, fine- to medium-grained, even-textured crystalline igneous rock (lamprophyre) (**), but the rock character will vary in different quarries and outcrops.	Durable, Hard to split, Impermeable	Kerbs, Setts (good-quality stone only)	Not applicable: BGS has no record that this stone has been used for building.
Iona Marble	White, green and orange, fine- to medium-grained, texturally heterogeneous crystalline metamorphic rock (carbonate-replaced igneous rock) (*).	Hard to split, Easy to saw, Impermeable, Shapeable (fine detail)	Decorative	Moderate. A visually distinctive stone sourced from a single quarry and used locally and regionally mainly to make decorative artefacts, in particular altars and other interior features of churches. Examples include the old altar of Iona Cathedral, the reconstructed Iona Cathedral, Westminster Cathedral, and St. Ann's Parish Church in Murrayfield, Edinburgh. The bedrock unit from which this building stone is sourced occurs only in Argyll and Bute.
Kerrera Sandstone	Grey, greenish grey or purplish grey, coarse-grained, granular sedimentary rock (sandstone), uniform at the hand-sample scale, strongly cohesive with low permeability (** & ***).	Hard to split, Easy to saw, Shapeable (coarse detail)	Cladding, Masonry	Low. A relatively unusual colour range for sandstone produced from one notable cluster of quarries and used locally and regionally, mainly to form masonry. The stone was used in the construction of the Caledonian Canal. The bedrock unit from which this building stone is sourced occurs only within Argyll and Bute.
Loch Katrine Metasandstone	Green to grey, fine-grained but locally gritty, crystalline metamorphic rock (metamorphosed volcaniclastic sandstone), with a metamorphic foliation producing a weakly flaggy character locally (**). Likely to be moderately variable in different quarries and outcrops.	Durable, Hard to split (except where flaggy), Impermeable	Kerbs, Setts (good-quality stone only)	Moderate. A green to grey (and therefore quite unusual) stone, produced from a cluster of quarries near Tarbert in Kintyre (Peach et al., 1911; these quarries are not yet in BritPits) and from several other widely spaced quarries in Argyll and Bute; the stone probably varies somewhat in character across the outcrop. Probably used locally, mainly for masonry. The bedrock unit from which this building stone is sourced occurs mainly within Argyll and Bute.
Lorn Plateau Volcanic Rock	Purplish-brown, fine-grained crystalline igneous rock (basaltic-rock and andesitic-rock), with pale crystals or rock fragments of varying size and colour (**); character likely to be variable in the unit as a whole, but may be essentially consistent at any one locality.	Durable, Hard to split, Impermeable	Kerbs, Setts (good-quality whin only)	Not applicable: BGS has no record that this stone has been used for building.

BUILDING STONE	STONE CHARACTER	KEY PROPERTIES	POTENTIAL END-USES	HERITAGE VALUE
Precambrian metasedimentary rocks (undiff)	Grey, fine- and locally medium-grained, even-textured, crystalline metamorphic rock (metamorphosed sandstone), which is weakly foliated and folded locally; pyrite is a feature of all examined samples (**).	Durable, Hard to split (except where flaggy), Impermeable	Kerbs, Setts (good-quality, non-flaggy stone only), Masonry (where flaggy)	Low. Used in the construction of a dam and other buildings associated with the Glen Shira Hydro-electric project. The bedrock unit from which this building stone is sourced occurs widely outside Argyll and Bute.
Quarry Granite	Mid grey, coarse-grained, even-textured, crystalline igneous rock ('granite') with patches of black crystals set in more abundant light grey to white crystals (*).	Durable, Hard to split, Impermeable, Shapeable (fine detail)	Kerbs, Setts?, Monuments, Decorative	Low. A visually unexceptional 'grey granite', produced from a single cluster of quarries and probably used locally and regionally, mainly to form masonry. Used in construction of the Connel Ferry Bridge, and possibly for 'ornamental purposes'. The bedrock unit from which this building stone is sourced occurs only within Argyll and Bute.
Ross of Mull Granite	Medium greyish pink, coarse-grained, even-textured, crystalline igneous rock (granite) (*).	Durable, Hard to split, Impermeable, Shapeable (fine detail) (in parts)	Kerbs, Monuments, Decorative	High. A visually distinctive 'red granite' produced from multiple quarries within a small geographical area and used locally, regionally, nationally and internationally, mainly to form masonry (in particular for piers and quays). Some of the quarries could produce larger blocks of stone than any other British quarry. Built sites incorporating Ross Of Mull Granite include several important Scottish lighthouses, several bridges, viaducts and monuments in London, and Liverpool docks. The bedrock unit from which this building stone is sourced occurs only within Argyll and Bute.
Scalpay Sandstone	Very light grey (often with a yellowish or greenish tinge), medium-grained, granular sedimentary rock (sandstone), moderately friable, uniform or faintly laminated at the hand sample scale, and with 'high' water absorption (* & ***).	Easy to saw, Shapeable (coarse detail)	Cladding, Masonry	Low. A light coloured and therefore moderately unusual sandstone that was used locally and regionally, probably mainly to form masonry. Used in the construction of Ardchattan Priory (Argyll) and St Clement's Church on Harris. The bedrock unit from which this building stone is sourced also occurs outside Argyll and Bute.
St Ninian Metasandstone	Dark grey, fine- and medium-grained, crystalline metamorphic rock (metamorphosed sandstone), with a locally 'gritty' character (where rounded, coarse grains of quartz are abundant) and a weak metamorphic foliation (* & **).	Durable, Hard to split, Impermeable	Kerbs, Setts (good-quality stone only)	Low. The gritty character is unusual but the stone is too dark to be visually distinctive. Probably used locally, mainly for masonry. The bedrock unit from which this building stone is sourced occurs almost entirely within Argyll and Bute.
Stratheden and Inverclyde Sandstone	Light buff to brownish orange, medium- to fine-grained, granular sedimentary rock (sandstone), strongly cohesive, laminated to uniform at the hand-sample scale, and with 'low' to 'high' water absorption (**).	Easy to saw, Shapeable (coarse detail)	Cladding, Masonry	High. In Argyll and Bute, this stone is a visually unexceptional sandstone that was sourced from a single cluster of quarries near Helensburgh. It is the main building stone used in Helensburgh, and was used there mainly for masonry. Most of the outcrop of this stone lies outside Argyll and Bute, in the Central Belt and Scottish Borders, where it is of somewhat variable but unexceptional character and has been used locally and regionally in numerous structures (including Dryburgh Abbey, Thirlestane Castle, Dunbar Castle, Jedburgh Abbey and Melrose Abbey), mainly to form masonry.
Teith Sandstone	Grey, greyish brown and purplish brown, very-fine- to medium-grained, granular sedimentary rock (sandstone), moderately to strongly cohesive, uniform at the hand sample scale (but weakly flaggy in places), and with 'low' to 'moderate' water absorption (**).	Easy to saw, Shapeable (coarse detail)	Cladding, Masonry	High. In Argyll and Bute, this stone is probably grey to purplish brown (and therefore moderately unusual), and was sourced from a single quarry midway between Helensburgh and Dumbarton. Little is known of how and where the stone was used, but it may be the main building stone in Geilston and Cardross, and was probably used mainly for masonry. Most of the outcrop of this stone lies outside Argyll and Bute, in a swathe of ground parallel to and just south of the Highland Border. It was sourced from clusters of quarries near Blairgowrie and Gartocharn, and from several localities in between, and was probably used locally and possibly regionally, mainly for masonry. Possibly the main building stone in Blairgowrie.

BUILDING STONE	STONE CHARACTER	KEY PROPERTIES	POTENTIAL END-USES	HERITAGE VALUE
Tiree Marble	Pink, fine-grained, even-textured, crystalline metamorphic rock (carbonate-replaced igneous rock) with scattered, large, dark green crystals set in a pink, fine-grained groundmass (*).	Hard to split, Easy to saw, Impermeable, Shapeable (fine detail)	Decorative	Moderate. A visually distinctive stone sourced from a single quarry on Tiree and used locally and regionally to make decorative artefacts. The bedrock unit from which this building stone is sourced occurs only within Argyll and Bute.
West Highland Slate	Dark grey, very fine-grained, crystalline metamorphic rock (metamorphosed mudstone / slate) that yields moderately thick roofing slates with matt, moderately smooth, crenulated, pyrite-bearing surfaces and an occasionally 'ribboned' character (*).	Durable, Easy to split, Impermeable	Roofing	Very high. Yields distinctive roofing slates with a unique combination of geological and man-made features that cannot be reproduced by any other slate. Used locally, regionally, nationally and internationally on numerous structures, mainly for roofing but also for masonry. The bedrock unit from which this building stone is sourced occurs mainly within Argyll and Bute.

2.3.5 Heritage value

This column records a 'Heritage Value' (HV) for the building stone, expressed simply as 'low', 'moderate', 'high' or 'very high', with a summary of additional relevant information.

Understanding how significant a building stone is in the context of Scotland's built environment (i.e. its 'heritage value') could be important in deciding whether to bring the stone back to market. However, judging the heritage value of a building stone is not straightforward, and we are aware of only one instance where a methodology has been designed for this purpose (Inglis-Woolcock, 2016[1]).

For the purposes of this study, a method suggested by BGS in a proposal to HES entitled "*Scoping Studies - Work Package 1. Review established approaches to, and the rationale for, assigning a heritage status to building stones*" has been used to calculate the heritage value of the building stones of Argyll and Bute. The method is quantitative rather than qualitative; in other words, it relies on assigning numerical values to a range of criteria to produce an objective outcome. By contrast, a qualitative approach might rely on expert judgment, which would yield a subjective outcome. Among the strengths of a quantitative approach are consistency and transparency, but its weaknesses include lack of flexibility and nuance.

The method takes into account the following criteria.

- The cultural value or significance of structures in which the stone has been used.
- The number of structures in which the stone has been used.
- The geographical distribution of structures in which the stone has been used.

Each criterion is divided into several classes, and numerical values are assigned to each class as illustrated in Appendix 4. The values used to determine the heritage value of the building stones of Argyll and Bute are shown in Table 4.

Threshold scores, which allow 'heritage value' to be expressed using a simple set of terms ('low', 'moderate' etc), were set as follows.

Score	'Heritage Value'
1–50	Low
51–100	Moderate
101–300	High
>300	Very high

On this basis, six Argyll and Bute building stones are of 'low' heritage value, seven others are 'moderate', four are 'high' and just two are 'very high'. The five stones originating from aggregate quarries are deemed to have no heritage value, as they have not previously been used as building stone.

Clearly, different criteria, classes and/or assigned numerical values would produce different 'scores', and different threshold scores could be set. However, we consider it unlikely that any such changes would substantively alter the outcome; for example, it seems unlikely that any method would assign Bridge of Awe Sandstone a higher heritage value than West Highland Slate.

[1] In that report, individual stones and quarries were assigned a 'Heritage Value Indicator' ranging from 1 to 10, based on a subjective assessment of a range of factors broadly similar to those used in this study.

Table 4 Calculation of 'heritage values' for the building stones of Argyll and Bute

BUILDING STONE	CULTURAL VALUE						NUMBER	DISTRIBUTION	TOTAL
	A	B	C	D	E	Sum			
Ardmaddy Bay Marble	0	2	0	50	0	52	10	10	72
Beinn Bheula Metasandstone	0	2	0	50	0	52	10	2	64
Bloody Bay Sandstone	0	2	0	0	0	2	10	2	14
Bridge Of Awe Sandstone	0	2	0	0	0	2	10	2	14
Clyde Plateau Volcanic Rock	0	0	0	0	0	0	0	0	0
Cruachan Granite	0	10	0	0	0	10	10	50	70
Dalradian Metamafite	0	10	0	50	0	60	10	10	80
Furnace Porphyry	0	10	0	0	50	60	10	50	120
Highland Border Slate	50	50	0	50	50	200	100	10	310
Intrusions & extrusions, Atlantean Orogeny (undiff)	0	0	0	0	0	0	0	0	0
Intrusions & extrusions, Caledonian & Acadian orogenies (undiff)	0	0	0	0	0	0	0	0	0
Iona Marble	0	2	0	50	0	52	10	10	72
Kerrera Sandstone	0	2	0	0	0	2	10	10	22
Loch Katrine Metasandstone	0	10	0	0	50	60	10	2	72
Lorn Plateau Volcanic Rock	0	0	0	0	0	0	0	0	0
Precambrian metasedimentary rocks (undiff)	0	0	0	0	0	0	0	0	0
Quarry Granite	0	10	0	0	0	10	10	2	22
Ross of Mull Granite	0	50	0	0	50	100	10	100	210
Scalpay Sandstone	0	10	0	0	0	10	10	10	30
St Ninian Metasandstone	0	2	0	0	0	2	10	2	14
Stratheden and Inverclyde Sandstone	0	10	0	0	50	60	50	10	120
Teith Sandstone	0	10	0	0	50	60	50	10	120
Tiree Marble	0	2	0	50	0	52	10	10	72
West Highland Slate	50	100	0	50	0	200	100	100	400

Details of the classes used to divide each criterion, and the numerical values (‘scores’) assigned to each class, are provided in Appendix 4.

3 Review of commercially available stones

3.1 INTRODUCTION

The aim of this section of the report is to consider the extent to which commercially available stones might compete with any Argyll and Bute stone that was brought back to market. As the Argyll and Bute stones are not commercially available, and there are no published geotechnical data, the only means of comparing them with commercially available stones is through a visual comparison. The range of building stones (from the UK and overseas) that are commercially available within the UK has been reviewed, primary through a trawl of company websites and brochures. Details for any stones considered closely similar in appearance to one of the Argyll and Bute stones described in Table 3 have been compiled in Appendix 5.

The following points should be borne in mind when considering the information in this section and in Appendix 5.

- The comparison is based on visual character only. However, visual similarity is a subjective criterion, and is contextual. For example, when all building stones are considered together, it could be said that all grey granites are closely similar, whereas if only grey granites are compared with each other the relatively subtle differences between them become clear. For the purposes of this exercise, only stones of the same rock type that are visually closely similar (similar in both colour and texture, at a range of scales) to an Argyll and Bute stone are considered to be a potential 'competitor'.
- Most of the comparisons were made using hand samples of Argyll and Bute stones (held in the BGS Collection of UK Building Stones) and photographs (in websites and brochures) of the commercially available stones. While photographs are helpful, they are less informative and less reliable than a direct comparison of physical specimens (such as hand samples). Different types of finish (rough, sawn, polished etc), and the scale of observation can also significantly alter the visual appearance of stone.
- The trade names under which stones are advertised are often geologically incorrect; for example, many stones advertised as 'granite' or 'marble' are actually some other rock type and will not necessarily have the geological properties of true granite or marble. However, in most cases a geologist can identify the correct rock type from a photograph on a website.
- The information in Appendix 5 is not exhaustive; for some types of stone (e.g. red and grey granite), there are multiple potential competitors, and details for only a subset of these are provided.

3.2 RESULTS

3.2.1 Slates

Roofing slate originating from many countries, including England, Wales, Spain, Brazil, Argentina, the U.S.A., Canada, China and Italy, can be obtained in Scotland. Moreover, each country tends to produce multiple 'types' of slate (of varying colour and texture), and each type tends to be sold in a range of dimensions and finishes. Thus, the range of commercially available roofing slates is large, and comparing them using photographs can be difficult because many are dark and textural features can be subtle. This review of commercially available slates has shown that nearly all are too regular and 'clean' to be considered a good match for Scottish slates. Furthermore, none are as thick or have the surface texture of typical Highland Border slates, and none are supplied in the range of sizes that would allow the 'diminishing courses' style of traditional Scottish roofs to be replicated.

No commercially available slates were identified that are closely similar in character to Highland Border Slate, and only one slate (from Spain) could be considered a potential competitor to West

Highland Slate (though even this lacks some of the characteristic features of West Highland Slate and could not reproduce the 'diminishing courses' style of traditional Scottish roofs.

No slate is produced commercially in Scotland.

3.2.2 Marbles

Marble from many countries, including Italy, France, Greece, Belgium, Portugal, Turkey, Egypt, Namibia, Pakistan, India, China and Brazil, can now be obtained in Scotland. Marbles display a very wide range of colour and texture combinations, and virtually every occurrence of variegated marble is visually distinct. This review of commercially available marbles has revealed none that are closely similar to the three Argyll and Bute marbles.

Only two marbles – Ledmore Marble and Skye Marble – are produced commercially in Scotland; both are sold mainly as aggregate, and neither is closely similar to any of the Argyll and Bute marbles.

3.2.3 Granites

Granite from many countries, including Spain, Portugal, Italy, Finland, England, the U.S.A., South Africa, India and China, can now be obtained in Scotland. Much of it is provided as polished slab aimed at the decorative stone market, but granite that has been pre-formed into setts, kerbs and other paving units is also widely available. Commercially available stones that are visually similar and could be considered potential competitors can be identified for all three of the Argyll and Bute granites (details in Appendix 5).

3.2.4 Porphyry

Several examples of imported porphyry – igneous rock with scattered, large crystals (known to geologists as 'phenocrysts') set in a fine matrix – can be obtained in Scotland, but none are sufficiently visually similar to Furnace Porphyry to be considered a potential competitor.

3.2.5 Whin (dark, fine-grained igneous rocks)

The term 'whin' traditionally has been used to refer to dark grey, fine-grained igneous rock with the composition of basalt or andesite. Such rock occurs as both extrusions (lava flows) and intrusions (dykes and sills). Three of the stones currently quarried for aggregate in Argyll and Bute (Clyde Plateau Volcanic Rock, Lorn Plateau Volcanic Rock, and Intrusions and extrusions, Atlantean Orogeny (undiff)) consist mainly of whin sourced from thick piles of basalt and andesite lava, in places cut by dykes and sills of similar rock.

Whin, processed into kerbs, setts and other forms, is sold commercially in Scotland by Tradstocks Ltd., and this would be the main competitor for rocks of this type produced in Argyll and Bute.

3.2.6 Metamorphosed whin (metamafite)

One of the Argyll and Bute building stones – Dalradian Metamafite – consists of 'whin' (i.e. basalt and andesite) that has been metamorphosed; unlike non-metamorphosed whin, it is greenish and has a metamorphic foliation. Dalradian Metamafite is being produced at the only active quarry currently producing building stone in Argyll and Bute (Achnaba Quarry). This review of commercially available building stones has revealed none that could be considered a competitor to the Dalradian Metamafite currently being produced at Achnaba Quarry.

3.2.7 Sandstones

England is the main source of the building stone sandstones used in Scotland today, and numerous (probably > 100) varieties are available, with a very broad range of character. Around ten Scottish sandstones and a few from Wales are also produced commercially, but relatively few are imported into the UK. Commercially available stones that are visually similar, and could be considered

potential competitors, can be identified for all six of the Argyll and Bute sandstones. In two cases (Kerrera Sandstone and Teith Sandstone), a Scottish sandstone (Dunaverig Sandstone) is the main 'competitor', and in two other cases (Scalpay Sandstone and Stratheden and Inverclyde Sandstone) the competitor is a sandstone quarried in England by a company based in Scotland (Hazeldean Sandstone). In the remaining two cases (Bloody Bay Sandstone and Bridge of Awe Sandstone), the main competitors are sandstones from England (and Wales in the case of the former).

3.2.8 Metasandstones

Sandstone that has been metamorphosed to a similar extent as the Argyll & Bute metasandstones (such that a metamorphic foliation and a locally fissile or flaggy character is developed) is relatively rare in global terms, and such stones generally are not made commercially available as building stones because they tend not to be either aesthetically pleasing or suited to popular end-uses. This review of commercially available building stones has revealed none that are closely similar to any of the Argyll and Bute metasandstones.

No metasandstone is currently produced commercially in Scotland for use as building stone.

3.2.9 Price

The price charged for commercially available stone is an important consideration in judging the potential competitiveness of a new stone brought to market. Meaningful information about the price of commercially available stone proved difficult to obtain. The following approximate prices are based on discussions with a quarry operator and rare details on company websites. The information should be considered a very rough guide only.

- £2,000 / m^3 for sawn six-sided blocks (e.g. ashlar) made from UK stone.
- £1,200-£1,300 / m^3 for 'landscape products' (setts, paving, kerbs etc) made from UK stone.
- £600 / m^3 for 'landscape products' (setts, paving, kerbs etc) imported to the UK.

4 Potential to renew production of Argyll and Bute building stones

A brief assessment of the potential for bringing each of the Argyll and Bute building stones back to market, based on information presented earlier in this report and additional information about the status of disused quarries, is presented in Table 5. In the following summary, information about 'heritage value' and potential 'competitors' comes from Table 3 and Appendix 5, respectively.

- The two slates – Highland Border Slate and West Highland Slate – have the highest heritage value amongst all the Argyll and Bute building stones, and virtually no direct competition amongst commercially available materials; as such, there should be a ready demand in Scotland for newly quarried slate. However, Walsh (2002), in considering a revival in the production of both stones, concluded that the most promising quarries were not located in Argyll and Bute.
- Each of the three marbles that were produced in Argyll and Bute have 'moderate' heritage value, and there appear to be no visually similar stones amongst currently available marbles. On this basis, a small potential market for each stone might be found. However, the resource in each case is probably very limited, and quarry access is variable: two of the sources are on islands, and one of these has no road access. Furthermore, the decorative stone market is very crowded and competitive. On this basis, none of the Argyll and Bute marbles could be considered a promising candidate for renewed production.
- Several good-quality granites, including 'red' (Ross of Mull) and 'grey' (Cruachan and Quarry) variants, were produced historically as building stone in Argyll and Bute. The heritage value of these stones ranges from 'high' to 'low', but *potentially* they all could compete in today's marketplace. The greatest demand is likely to be for 'landscape products' (primarily kerbs and setts) and slabs for decorative use. However, only Cruachan Granite has a significant pedigree in producing kerbs and setts. Quarry Granite is (as far as we know) untested in this regard, and much of the Ross of Mull Granite that was quarried historically was considered unsuited to the production of kerbs and setts due to the absence of a 'grain' (preferred direction of splitting) in the stone. However, it is not clear if this latter factor would still be regarded as a drawback when applying modern means of stone splitting. Both the 'landscape products' and decorative stone markets for granite are very crowded and competitive; on this basis, it is unclear if any of the Argyll and Bute granites could be considered a promising candidate for renewed production. Ross of Mull Granite has a reputation for producing the largest intact blocks of any British granite, and this might make it attractive for use in monuments.
- Furnace Porphyry has 'high' heritage value and no direct competitors. The stone also has a pedigree in producing setts and kerbs, and its distinctive visual character may make it attractive as a decorative stone. On this basis, Furnace Porphyry could be considered a promising candidate for renewed production.
- Whin (Clyde Plateau Volcanic Rock, Lorn Plateau Volcanic Rock, Intrusions and extrusions, Atlantean Orogeny) has been (and still is) sourced from several quarries in Argyll and Bute, and some of this stone may be amenable to use as kerbs and setts. However, whin kerbs and setts are already produced commercially elsewhere in Scotland, so the stone in Argyll and Bute is not considered a candidate for renewed production.
- Dalradian Metamafite, which historically was produced from at least ten quarries in Argyll and Bute, has 'moderate' heritage value and no direct competitors amongst imported stones. However, the stone is currently quarried for building stone at Achnaba Quarry, so other quarries in Argyll and Bute are not considered to be candidates for renewed production.

Table 5 Prospects for bringing Argyll and Bute building stones back to market

BUILDING STONE	SUPPORTING INFORMATION AND EVALUATION OF PROSPECTS
Ardmaddy Bay Marble	A visually distinctive marble with no direct competitors and 'moderate' heritage value. The stone was quarried at a single location, from a small outcrop; no other outcrops of the building stone are known. The resource is likely to be small and may be largely exhausted. The site of the disused quarry is accessible via an unpaved vehicle track but appears vegetated and may be partly infilled. On this basis, renewed quarrying of this building stone on anything other than a very small scale seems unlikely.
Beinn Bheula Metasandstone	A visually unexceptional, locally flaggy metasandstone, with no direct competitors and 'moderate' heritage value. Only one quarry is known to have produced building stone (for millstones and querns); the quarry is small, overgrown and in remote moorland with no vehicle access. Renewed quarrying of this building stone at the original quarry therefore seems very unlikely.
Bloody Bay Sandstone	A reddish brown but otherwise visually unexceptional sandstone, with at least two potential competitors and 'low' heritage value. According to Lee and Bailey (1925) (see Appendix 6), the stone was quarried at a single location, from a sandstone bed that is said to be 16 metres thick, 200 metres long, and comprised of "good freestone", and the site is "sheltered, and can be safely approached by small vessels in ordinary weather". No other outcrops of this building stone are known in Argyll and Bute, though the same formation may crop out in Ardnamurchan. The disused quarry is sited in coastal cliffs, but is not shown on modern OS maps and is not marked by an obvious topographic feature on aerial photographs. The site has no vehicle access, though an unpaved forestry track passes within 200 metres. On this basis, renewed quarrying of this building stone seems unlikely.
Bridge Of Awe Sandstone	A pink but otherwise visually unexceptional sandstone, with at least one potential competitor and 'low' heritage value. The stone was quarried at a single location, from a small outcrop; no other outcrops of the building stone are known. The quarry site can be accessed by an unpaved track, but the quarry is not shown on modern OS maps, is not discernible on aerial photographs, and is not obvious on the ground. On this basis, renewed quarrying of this building stone on anything other than a very small scale seems unlikely.
Cruachan Granite	A visually unexceptional grey granite, with several potential competitors and 'moderate' heritage value. The stone was worked for building stone in at least eight quarries, none of which is active today. Unpaved vehicle tracks provide access to all eight quarries. Of the eight quarries: one (BGS site ID 88013) is not depicted on the modern OS map and is not discernible in aerial photographs; one (BGS site 88011) is given over to aggregate processing; four (sites 88014, 88015, 1001224 and 1001226) are partly debris-filled and overgrown but retain visible worked faces in aerial photographs; and one (186489) is somewhat overgrown and used for storage but retains well-defined and apparently accessible quarry faces. None of these disused building stone quarries need be ruled out on current evidence. One quarry in the Cruachan Granite (88010, Bonawe Quarries) is worked for aggregate today; this large quarry, which has several well-defined benches and fresh, accessible worked faces, may also offer potential for quarrying building stone.
Dalradian Metamafite	A greenish grey (and therefore quite unusual) building stone, that has 'moderate' heritage value and is currently produced as building stone at one quarry (Achnaba Quarry) in Argyll and Bute. It is also currently being produced as aggregate at Gigha Quarry. The stone occurs in multiple outcrops both within and outside Argyll and Bute, and its character in different outcrops may vary. The stone historically was worked for building stone in at least nine widely scattered quarries within Argyll and Bute. St Catherine's quarry appears to have vehicular access but is overgrown and is not shown on the current OS map. Creggans quarry appears to have vehicular access, is overgrown and marked as disused on the OS map, but worked faces and spoil may be discernible on aerial photographs. Port a' Gharaidh quarry (Gigha) is identified as an historic 'quern quarry' on the OS map, and appears to have visible worked faces, but is separated from the nearest track by c. 300 m of rough ground. Port na Cathrach quarry (Gigha) appears to have visible worked faces but is not shown on the OS map and is separated from the nearest track by c. 450 m of rough ground. Sgeir nam Muc quarry is identified as an historic 'quern quarry' on the OS map, but is overgrown and separated from the nearest track by c. 140 m of forest. Esknish Quarry is overgrown and next to a farmhouse, but has visible worked faces, is shown on the OS map, and a track provides access to the site. Lochan Shira Dam Quarry is

BUILDING STONE	SUPPORTING INFORMATION AND EVALUATION OF PROSPECTS
	shown on the OS map, has visible worked faces and a track provides access to the site. Kilchurn Castle Quarry has visible worked faces but is small, adjacent to Kilchurn Castle, and c. 700 m from the nearest road. Doide quarry has visible worked faces but is not shown on the OS map; the quarry is historically important, and is separated from the nearest road by c. 300 m of rough ground. On this basis, renewed quarrying of this building stone may be possible at several sites, with St Catherine's and Creggans quarries perhaps being the most promising of the disused quarries, and Gigha Quarry offering the advantages of an active site, should the stone there prove suitable. However, Achnaba Quarry is active and currently producing Dalradian Metamafite for use as building stone.
Furnace Porphyry	A visually distinctive 'porphyry', with no direct competitors and 'high' heritage value. The stone has been quarried for building stone from at least seven quarries. Six of these form a 'cluster', beside the village of Furnace. Four quarries in the cluster have now been subsumed within a large active aggregate quarry. Two others are disused and partly overgrown, but still accessible; site 30559 ('Furnace Quarry') appears to be occupied by a large building, and site 30562 ('Furnace' or 'California') may be used for aggregate processing. Crarae Quarry (the other disused building stone quarry) is large and apparently has vehicular access, but appears to be partly debris-filled and overgrown on aerial photographs. The active aggregate quarry at Furnace would appear to offer the best potential for renewed quarrying of building stone, perhaps in a part of the site that is not actively being quarried (e.g. disused quarry site 30562). The disused Crarae quarry may also be worthy of further examination.
Highland Border Slate	Dull green to medium grey slate, with no direct competitors and 'very high' heritage value. The stone has been quarried for building stone in at least twenty-six quarries within Argyll and Bute, and numerous other quarries outside Argyll and Bute. None of these quarries is active today. Having reviewed all the Highland Border Slate quarries, Walsh (2002) concluded that those at Craiglea and Aberfoyle (both outside Argyll and Bute) were the most promising in terms of possible revival (based on a range of criteria including slate quality, size of resource and accessibility). Of the quarries within Argyll and Bute, Walsh (2002) focussed on those on Bute and at Luss, presumably as they are the most substantial. The quarries on Bute (Edinmore, Hilton and Ardmaleish) were described collectively as still comprising a 'medium' resource (10^6–10^7 m^3) but producing slate of very variable quality; Edinmore and Ardmaleish were described as accessible but Hilton was considered 'not accessible'. Auchengavin quarry at Luss was described as having a 'limited to medium' resource (10^5–10^7 m^3), producing slate of 'medium' quality (based on its weathering characteristics), and being 'reasonably accessible'. On this basis, Auchengavin quarry (site 6358) may offer the best potential for renewed quarrying of a modest amount of Highland Border Slate, but some of the quarries on Bute may also merit further examination.
Iona Marble	A visually distinctive marble, with no direct competitors and 'moderate' heritage value. The stone was quarried at a single location, from a small outcrop. Two other small outcrops of the building stone in north-west Iona are shown on BGS maps (and therefore in the BSDS), but it is unlikely that stone with the character of Iona Marble occurs in these localities; furthermore, both are in coastal locations that are not accessible by road. The quarry site is in remote ground with no road access. The quarry is not shown on modern OS maps, but the site is visible on aerial photographs. The following comment was made in Bailey and Anderson (1925): "Most of the available material is now probably exhausted. A certain amount of rock is, however, left intact at the seaward end, and although the industry could never be developed on a large scale, it would be possible, without deepening the old quarries, to meet a limited demand for several years." On this basis, renewed quarrying of this building stone on anything other than a very small scale seems unlikely.
Kerrera Sandstone	A sandstone with a relatively unusual colour range but which is otherwise visually unexceptional, with at least two potential competitors (one of which is a Scottish sandstone) and 'low' heritage value. The stone was quarried for building stone from at least eight quarries. Seven of these form a cluster on the north side of Loch Feochan; an unpaved vehicle track provides reasonable access to most of these, but the following comment made in Lee and Bailey (1925) applies to at least two of the quarries: "The quarries are now flooded, and as they pass below sea-level they would not be easily worked".

BUILDING STONE	SUPPORTING INFORMATION AND EVALUATION OF PROSPECTS
	Several other quarries in the cluster are overgrown but apparently not flooded. One other quarry on the south side of Loch Feochan appears to be overgrown and has no vehicle access.
Loch Katrine Metasandstone	A green to grey (and therefore quite unusual) metasandstone, with no direct competitors and 'moderate' heritage value. The stone was quarried for building stone from several quarries around Tarbert and from at least four others further northeast in Argyll and Bute. The Tarbert quarries are not shown on modern OS maps and are not visible on aerial photographs. The Ardmarnock House and Dunans quarries are not shown on modern OS maps and are not visible on aerial photographs. Achnarossan quarry is not shown on modern OS maps, but a small overgrown pit with farm-track access near the recorded quarry site is visible on aerial photographs. Hunter's Quay quarry (north of Dunoon) is shown on the OS map but is thickly wooded and not visible in aerial photographs. On this basis, the Hunter's Quay and Achnarossan quarries may warrant further investigation.
Precambrian metasedimentary rocks (undiff)	Grey (though almost certainly variable) metasandstone with no direct competitors and 'low' heritage value. Only one quarry in Argyll and Bute (Lochan Shira Dam Quarry) is known to have worked this stone for building purposes; the quarry is small, overgrown and in remote moorland but can be accessed by an unpaved vehicle track. Given the low heritage value and limited range of potential end-uses, renewed quarrying of this building stone at the original quarry seems unlikely.
Quarry Granite	A visually unexceptional 'grey granite', with several potential competitors and 'low' heritage value. The stone was produced from a cluster of four quarries that are disused but can be accessed to varying degrees by an unpaved vehicle track. Three are long-abandoned and substantially overgrown, and one (site 88669) is flooded; site 88670 has no visible access track, while sites 88668 and 88669 have short lengths of overgrown access track. The other quarry (site 88667), the largest of the four, can be accessed directly by a good quality track and, while most of its worked faces are partly overgrown, one face looks clean and may have been worked relatively recently.
Ross of Mull Granite	A visually distinctive 'red granite' with several competitors and 'high' heritage value. The stone was worked for building stone from at least eleven quarries that lie within a restricted geographical area. All the quarries are disused and only four have road access. Two adjacent quarries with vehicle access - Tormore quarry (site 146) and Ross of Mull Quarries (site 162345) - have been worked for aggregate relatively recently (though they are currently inactive), and these may be the most promising sites to consider for renewed building stone extraction. Bailey and Anderson (1925; see Appendix 6) suggested very large blocks could be extracted from the Ross of Mull granite, but the stone generally was not suitable for setts and only locally (Erraid and Camas Tuath quarries) suitable for polishing.
Scalpay Sandstone	A light grey and therefore moderately unusual sandstone, with at least one potential competitor (produced by a company based in Scotland) and 'low' heritage value. The stone was quarried for building stone at just one locality, a thick sandstone bed exposed in a coastal cliff and adjacent intertidal exposures at a site c. 1.5 km southwest of Carsaig Bay, on Mull. The nearest road is at Carsaig Pier, nearly two km away. The following comment is from Albornoz et al. (2015): ".. sourcing new stone from Carsaig quarry would be challenging for a number of reasons: the quarry site has no vehicle access and can only be reached by foot or by boat; there are no detached, sizeable blocks of suitable stone at the quarry site, so any new stone would probably have to be quarried from exposed bedrock (probably by excavating into the cliff face); the site is within an SSSI, so Scottish Natural Heritage would need to grant permission to extract stone." Scalpay Sandstone crops out in several other localities on Mull: in a discontinuous band in the steep ground enclosing Carsaig Bay; beneath the harbour in Tobermory; and in discontinuous bands near Loch Don; however, BGS has no record of quarrying in these outcrops.
St Ninian Metasandstone	A dark grey metasandstone, with no direct competitors and 'low' heritage value. The stone was quarried for building stone from at least three quarries. Broom Plantation quarry, on the south edge of Rosneath, is depicted as a small excavation on the current OS map, but on aerial photographs the site is thickly wooded and a quarry is not discernible. The quarry at Camsail Wood (c. 0.5 km south of Rosneath) is relatively large (covering an area of

BUILDING STONE	SUPPORTING INFORMATION AND EVALUATION OF PROSPECTS
	ground at least c. 250 m long), and on aerial photographs appears partly overgrown and partly spoil-filled; however, the quarry has been active at some point in recent years (for an unknown purpose), and its status today is not clear. Aerial photographs of Bullwood quarry reveal large, clean rock faces, but the quarry floor is now occupied by a wastewater treatment works, which presumably would preclude further quarrying. On this basis, Camsail Wood quarry may merit further investigation.
Stratheden and Inverclyde Sandstone	Light buff to brownish orange sandstone, with at least one potential competitor (produced by a company based in Scotland) and 'high' heritage value. The stone crops out quite extensively in southern Scotland, and has been sourced from more than forty quarries there. In Argyll and Bute, the stone was sourced from a single cluster of quarries near Helensburgh (Blackhill Helensburgh Cluster). The current OS map shows no record of the quarries, and aerial photographs reveal that the entire site has been infilled and is now grassed over. On this basis, renewed quarrying of this building stone within Argyll and Bute seems highly unlikely.
Teith Sandstone	Grey, greyish brown and purplish brown sandstone, with at least two potential competitors (including one Scottish stone, produced from Dunaverig quarry) and 'high' heritage value. Most of the outcrop of this stone lies outside Argyll and Bute, in central Scotland, where it has been sourced from at least a dozen quarries. Within Argyll and Bute, the stone was sourced from a single quarry located between Helensburgh and Dumbarton. The disused quarry is shown on the current OS map, and aerial photographs reveal an extensive (c. 150 m-long), overgrown and partly spoil-filled pit next to a road. This quarry might merit further investigation. However, Dunaverig quarry near Callander is active and currently producing Teith Sandstone for use as building stone.
Tiree Marble	A visually distinctive marble with no direct competitors and 'moderate' heritage value. The stone was quarried at a single location, from a small outcrop; no other outcrops of similar rock are known. The quarry is not shown on modern OS maps, but is visible in aerial photographs; the site is overgrown but has road access. Renewed quarrying of this building stone on anything other than a very small scale seems unlikely.
West Highland Slate	Dark grey slate, with perhaps one direct competitor (Spanish ‘Cupa’ slate) and 'very high' heritage value. The stone has been quarried for building stone in at least forty-five quarries within Argyll and Bute, and others (in the Ballachulish area) outside Argyll and Bute. None of these quarries is active today. Within Argyll and Bute, Walsh (2002) proposed that the Breine Phort quarry on Seil be selected for further investigation, due to its reasonably good access and low environmental sensitivity. However, Walsh noted that "further work would need to be done to determine the quality of the slate" and that "no quarry is ideal for further investigation as a possible source of Easdale slate ... resources in quarries with the best quality slate are exhausted and Breine Phort is proposed as a compromise between quality and resource". Walsh also suggested further consideration could be given to Toberonochy quarry on Luing ("there is good quality slate in this area and it is worth exploiting if sufficient reserves can be found and the environmental problems overcome"), Port Mary quarry on Luing ("it may be worth looking at this quarry in more detail given the good location"), and Cullipool No.3 quarry on Luing ("possibility for small-scale development within the confines of the Quarry No 3").

- Four of the sandstones (Kerrera, Scalpay, Stratheden and Inverclyde, and Teith) would potentially compete with stones that are currently produced in Scotland, so are not considered further. Two other sandstones (Bloody Bay and Bridge of Awe) would potentially compete with stones currently produced in England and Wales. Two sandstones (Bloody Bay and Scalpay) were sourced from quarries that would now be very difficult to access, and one (Stratheden and Inverclyde) was sourced from quarries that have been infilled. On this basis, none of the historic building stone sandstones from Argyll and Bute could be considered a promising candidate for renewed production.
- Several metasandstones that were historically produced in Argyll and Bute have 'moderate' or 'low' heritage value, and no direct competitors. However, they are visually unexceptional building stones and their key properties are not widely sought after; as such, their potential market is probably limited to supplying stone for repairs and new-build structures that are 'in-keeping' with local structures in the areas where they have traditionally been used.

Table 6 provides summary details for those stones considered to have the best potential for renewed production.

Table 6 Summary details for stones with the best potential for renewed production

STONE	QUARRY SOURCE(S)	POTENTIAL END-USES	COMMENTS
Furnace Porphyry	Furnace Quarry (site 143); Crarae Quarry (site 7955)	Kerbs; Setts; Monuments; Decorative	The stone is assigned 'high' heritage value and historically was used mainly to make setts. The stone is visually distinctive and has no direct competitors in terms of visual character. Furnace Quarry is active, so may provide a relatively easy means of obtaining block.
Cruachan Granite	Bonawe Quarries (site 88010)	Kerbs; Setts; Monuments; Decorative	The stone is assigned 'moderate' heritage value and has a pedigree in being used as setts. However, the stone is not visually distinctive and there are several potential competitors. Bonawe quarry is active, so may provide a relatively easy means of obtaining block.
Quarry Granite	Ben Cruachan Quarry (site 88667)	Kerbs; Setts; Monuments; Decorative	The stone is assigned 'low' heritage value, but should be a good-quality building stone with several potential end-uses. However, the stone is not visually distinctive and there are several potential competitors. Ben Cruachan Quarry is easily accessible and appears to have been worked relatively recently.
Ross Of Mull Granite	Tormore (site 146)	Kerbs; Monuments; Decorative	The stone is assigned 'high' heritage value and has been widely used in monuments and for decorative uses. However, there are several potential competitors. Tormore quarry is accessible, capable of producing unusually large blocks, and appears to have been worked relatively recently.
Highland Border Slate	Auchengavin (site 6358)	Roofing slate	The stone is assigned 'very high' heritage value and has no direct competitors, so there is likely to be a demand in Scotland. However, Walsh (2002) identified quarries outside Argyll and Bute as having greater potential. The resource at Auchengavin may be limited and its location within a National Park may be problematic.
West Highland Slate	Breine Phort (site 6285); Toberonochy (site 6292); Port Mary (site 6266); Cullipool No.3 (site 6288)	Roofing slate	The stone is assigned 'very high' heritage value and has just one potential competitor, so there is likely to be a demand in Scotland. However, Walsh (2002) identified quarries outside Argyll and Bute as having greater potential. A significant resource may still be accessible at Breine Phort.

5 Summary

The main findings and conclusions of this study can be summarised as follows.

- The BGS BritPits database contains details for 140 quarries with a 'building stone' end-use and 14 currently active 'aggregate' quarries within the area administered by Argyll and Bute unitary authority council.
- Twenty-one building stones originate from these quarries. They include two slates, three marbles, three granites, one porphyry, two stones that can broadly be characterised as 'whin' (dark grey, fine-grained igneous rock), one metamorphosed 'whin' (metamafite), six sandstones, and three metasandstones. Three other stones that are not currently recognised as building stones are produced at active aggregate quarries; these include one metasandstone, one 'whin', and one igneous rock whose character has not been determined.
- The range of 'key properties' (i.e. those properties considered to be significant in determining which end-use[s] a stone might be suited to) displayed by each stone has been determined through an assessment of relevant BGS samples and a general geological understanding of each rock type. For the purposes of this exercise, eight key properties were identified: 'durable', 'hard to split', 'easy to split', 'easy to saw', 'impermeable', 'shapeable (coarse detail)' and 'shapeable (fine detail). Properties requiring a geotechnical test (e.g. compressive strength and water absorption) were not considered.
- The range of end-uses to which each stone might be suited was determined from the set of key properties assigned to it. In general: slates are potentially suited to roofing; marbles are potentially suited to decorative uses; granites and porphyry are potentially suited to the production of kerbs and setts, and to monuments and decorative uses; whin is potentially suited to the production of kerbs and setts, where it is of good quality; metamafite is potentially suited to the production of kerbs and setts where it is of good quality, and masonry where it is flaggy; sandstones are potentially suited to the production of cladding and masonry; and metasandstones are potentially suited to the production of paving slabs and masonry where they are flaggy, and kerbs and setts where they are of suitable quality.
- A 'heritage value' for each stone has been calculated using a method suggested by BGS in an earlier proposal to HES. The method is quantitative and takes into account the cultural value or significance of structures in which the stone has been used, the number of structures in which it has been used, and the geographical distribution of structures in which it has been used. Threshold values were set so that numerical totals for heritage value can be expressed using the terms 'low', 'moderate', 'high' and 'very high'. On this basis, six Argyll and Bute building stones are of 'low' heritage value, seven others are 'moderate', four are 'high' and just two are 'very high'. The five stones that come from aggregate quarries are deemed to have no heritage value, as they have not previously been used as building stone (as far as we are aware). Different criteria, classes and/or assigned numerical values would produce different 'scores', and different threshold values could be set, but it is considered unlikely that any such changes would substantively alter the outcome.
- A review of commercially available stones has shown that all of the granite, sandstone and whin building stones from Argyll and Bute would have at least one potential 'competitor' (i.e. a commercially available stone that is visually closely similar to it), if they were brought back to market. By contrast, no potential direct competitors were identified for the marble, porphyry, and metasandstone building stones of Argyll and Bute.
- Furnace Porphyry, Cruachan Granite, Quarry Granite, Ross of Mull Granite, Highland Border Slate and West Highland Slate are considered to have the best potential for renewed production, taking into account factors such as heritage value, potential end-uses, and access to suitable quarries.

Appendix 1 Dictionaries

The terms in the following tables have been used in tables and text throughout this report.

End-use classes used to identify building stone quarries

CLASS	DESCRIPTION
Building stone	Natural stone, crude, riven or cut, for use in buildings and monuments
Decorative stone	Natural stone processed for decoration or production of small artefacts or ornaments
Dimension stone	Natural stone, cut or sawn to specific dimensions for use in construction work
Kerbs, setts	Natural stone, dressed for use as kerbs and setts
Millstones, querns	Stone cut for use as grinding stones, usually gritty sandstone, but finer-grained rocks may be used for materials other than corn.
Monumental stone	Natural stone, riven or cut, for use in monuments
Paving uses	Natural stone, cut or riven for paving uses
Roofing slate	Cleaved slate for use in roofing
Slate	Cleaved slate used for roofing, cladding or decorative purposes
Walling stone	Stone used for dry stone or bonded walls (including ‘drystane dyking’ and hedging stones)

End-use classes used to identify aggregate quarries

CLASS	DESCRIPTION
Coated roadstone	A road material consisting of graded aggregates coated with tar, bitumen or asphalt. Aggregate may be sold from a quarry for coating at a remote site. May be termed 'pitching'
Ready mixed concrete	Concrete made on quarry site
Crushed rock aggregate	Crushed rock for general aggregate use
Subbase	Crushed rock used as lower layers of road material
Armourstone	Large natural stone blocks used for coastal defences, etc.
Roadstone	Material used in road construction, whether bound or unbound, i.e. coated and uncoated; may be termed 'road metal, 'subbase'
Concrete aggregate	Sand, gravel and crushed rock suitable for use as coarse and fine aggregates in concrete
Constructional fill	Unbound aggregate used to provide bulk in civil engineering works (Ballast)

Key properties

CLASS	DESCRIPTION
durable	strongly cohesive, resistant to decay, dissolution and abrasion
hard to split	no propensity to part along a preferred plane of weakness
easy to split	has a propensity to part along a preferred plane of weakness
easy to saw	causes relatively little wear to blades when sawn into slabs
impermeable	watertight
shapeable (coarse detail)	can be formed into building blocks relatively easily
shapeable (fine detail)	produces a high quality finish when carved or polished

Potential end-uses

CLASS	DESCRIPTION	KEY PROPERTIES
kerbs	kerb stones, channels	durable, hard to split, impermeable
setts	setts, cobbles, cubes	durable, hard to split, impermeable
paving slabs	paving slabs, flags / flagstones	durable, easy to split, impermeable
cladding	cladding panels	easy to saw
masonry	ashlar, dressings, rubble	shapeable (coarse detail)
monuments	statues, gravestones, memorials, fountains	durable, shapeable (fine detail)
decorative items	worktops, facings, altars, fireplaces, artefacts / ornaments	shapeable (fine detail)
roofing	roofing slates	durable, easy to split, impermeable

Appendix 2 Column contents in Table 1 and Table 2

COLUMN HEADING	DESCRIPTION OF CONTENTS
BGS ID	The unique identifier assigned to a quarry in BritPits.
BGS Name	The primary name assigned to a quarry in BritPits.
Alternative name	Other name(s) by which a quarry is known, in BritPits.
Cluster	The name of the cluster to which a quarry is linked in the BSDS*.
Supercluster	The name of the supercluster to which a quarry or cluster is linked in the BSDS.
BNG Ref	The two-letter British National Grid identifier of the 100 x 100 kilometre square in which the quarry is located, as recorded in BritPits.
Easting	The easting co-ordinates of the quarry (British National Grid), as recorded in BritPits.
Northing	The northing co-ordinates of the quarry (British National Grid), as recorded in BritPits.
Location	The name of the nearest settlement or geographical feature.
Status	The quarry status, as recorded in BritPits. Active = Site which, at date of entry, was actively extracting mineral products. Inactive = Site which, at date of entry, was not extracting minerals, but which still has a valid planning permission to do so, and can restart at any time. May be considered 'Mothballed' by operator. May be considered to have 'Active' or 'Dormant' planning permission by the Mineral Planning Authority. Historic = Historic mineral workings, usually historic building stone sites, where not currently active and the location is not known for certain. These sites usually predate the Ordnance Survey mapping. Ceased = Site which, at date of entry, had ceased to extract minerals. May be considered as 'Closed' by operator. May be considered to have 'Active', 'Dormant' or 'Expired' planning permissions by the Mineral Planning Authority.
Operator	The name of the current or last quarry operator, where known, as recorded in BritPits.
MPA	The name of the Mineral Planning Authority for the quarry: A&B = Argyll and Bute unitary authority council; LL&TTNP = Loch Lomond & The Trossachs National Park Authority.
Historical End-uses	The end uses of the building stone extracted from the quarry, as recorded in BritPits. The information held in BritPits was obtained from a range of records, including reports, books and geological field slips.
Building Stone	The name of the building stone produced at the quarry, as recorded in the BSDS.

* Building Stone Database for Scotland

Appendix 3 Contact details for quarry operators listed in Table 1 and Table 2

OPERATOR	ADDRESS	TELEPHONE	EMAIL
A. M. Carmichael, Public Works Contractor	94 George Street, Edinburgh	not known	not known
Ambrisbeg Ltd	The Quarry, Kingarth, Isle of Bute	01700 831215	ambrisbeg@btconnect,com
Barrachander Quarry	Taynuilt, Argyll	01866 833 355	barrachander@gmail.com
Ben Cruachan Granite Quarries Ltd	Lochawe, Argyllshire	not known	not known
Bonnar Sand & Gravel Co., Ltd.	Clachan Quarry, Clachan, Cairndow, Argyll	01499 600268/9	bsgco@btinternet.com
Breedon Northern	Ethiebeaton Quarry, Kingennie, Monifieth	01382 537600	enquiries.northern@breedon group.com
Crarae Granite Co., Ltd.	Crarae, Furnace, Inveraray, Argyllshire	not known	not known
Dunlossit Estate	Knocklearach Farm, Ballygrant, Isle of Islay	01496 840652	not known
E. Cameron	241 Argyll Street, Dunoon, Argyllshire	not known	not known
Ennstone Thistle Ltd.	Ennstone House, Ethiebeaton Quarry, Kingennie, Monifieth, Angus	01382 537600	info@ennstonethistle.co.uk
George McNaughton & Son	20 Kilmory Industrial Estate, Lochgilphead, Argyllshire	01546 602389	not known
Gigha Trading Ltd.	Gigha Hotel, Isle of Gigha, Argyllshire	01583 505244	gtl@gigha.org.uk
Iona Marbles Ltd.	53 Victoria Street, Westminster, London	not known	not known
John MacLachlan Quarries Ltd.	Torran Gorm Industrial Estate, Oban, Argyll	01631 566370	not known
Luss Estates	Estate Office, Luss, Alexandria, Dunbartonshire	not known	not known
MacLeod Construction Ltd.	Kilmory Industrial Estate, Lochgilphead, Argyllshire	01546 602989	sales@mkmacleod.co.uk
Marquis of Bute	Mount Stuart, Rothesay, Isle of Bute	not known	not known
McFadyens Contractors (Campbeltown) Ltd.	Glebe Street, Campbeltown, Argyllshire	01586 552961	info@mcfadyenscontractors.co.uk
Northern Lighthouse Board	84 George Street, Edinburgh	0131 473 3100	enquiries@nlb.org.uk
Scottish Natural Stones Ltd.	Wallace House, Whitehouse Road, Stirling	01506 874 222	info@scottishnaturalstones.co.uk
The Hafton Trustees	Dunoon, Argyllshire	not known	not known
TSL Contractors Ltd.	Craignure, Isle of Mull, Argyllshire	01680 812 475	not known
William Vass	Bunessan, Isle of Mull, Argyllshire	not known	not known

Appendix 4 Criteria, classes & scores used in heritage values for building stones

Cultural value or significance of structures in which the stone has been used		
Class	**Score**	**Comment**
A - UNESCO World Heritage Site	50	The score for Class B depends on the number of structures, as follows: <10 = 2; 11-100 = 10; 101-1,000 = 50; >1,000 = 100.
B - Scheduled Monument / Listed Building / HES PiC / NTS property	2-100	
C - Distinctive vernacular structures (e.g. tenements)	50	
D - Structures requiring a particular geological attribute or character (e.g. roofing slate, paving slab, decorative artefact)	50	
E - Structures in which the stone makes a significant visual contribution to 'sense of place'	50	

Number of structures in which the stone has been used		
Class	**Score**	**Comment**
<10	2	In most cases, this is based on an estimate.
10-1,000	10	
1,001-10,000	50	
>10,000	100	

Geographical distribution of structures in which the stone has been used		
Class	**Score**	**Comment**
Local	2	In most cases, this is based on recorded information.
Regional	10	
National	50	
International	100	

Appendix 5 Summary details for potential ‘competitor’ stones

See section 3 for details.

ARGYLL AND BUTE STONES	POTENTIAL COMPETITOR STONES					
	Trade name	**Supplier(s)**	**Country of origin**	**Visual & geological character**	**Form in which supplied**	**Weblink**
Ardmaddy Bay Marble	None					
Beinn Bheula Metasandstone	None					
Bloody Bay Sandstone	Callow Hill Sandstone	Black Mountain Quarries	Wales	Purplish brown, fine to medium, uniform sandstone	Rough block, sawn block	www.blackmountainquarries.co.uk
	Red Hollington Sandstone	Staffordshire Stone UK Ltd	England	Dull orangish brown, fine to medium, uniform to bedded sandstone	Rough block, sawn block	http://www.staffordshire-stone.co.uk/
Bridge of Awe Sandstone	Bridestone (or Cloudside) Gritstone	Bridestone & Brydges Ltd	England	Light brownish pink, medium to coarse, uniform sandstone	Rough block, sawn block	http://www.bridestoneandbrydges.co.uk/
Clyde Plateau Volcanic Rock	Scottish Whin	Tradstocks Ltd	Scotland	Dark grey (sometimes pink-tinged), medium-grained, even-textured whin (dolerite)	Kerbs, Setts and more	http://www.tradstocks.co.uk/
Cruachan Granite	Bianco Sardo Granite	Imperial Marble	Italy	Grey, coarse, even-textured granite	Tiles up to 600 x 600 mm	http://www.imperial-marble.co.uk/granite-tiles/bianco-sardo/
	Bianco Diamante	Surrey Marble and Granite	Spain	Grey, coarse, even-textured granite (weak igneous fabric)	Large (metre-scale) polished slabs.	https://www.surreymarbleandgranite.co.uk/product/granite-bianco-diamante/
		The Marble and Granite Centre				https://www.themarbleandgranitecentre.co.uk/BlockResult/42/Granite_Bianco_Diamante_Grey_Polished
	Fine grey granite; Grey granite; Speckled grey granite; Silver Grey Granite; Fine Grain Granite	Stoneyard	Portugal	Grey, medium and coarse, even-textured granite (some is weakly porphyritic)	Kerbs and setts in a range of sizes, with 'natural cropped finish'	https://www.stoneyard.co.uk/product-category/natural-finish-granite-setts/
		Granite Setts UK				https://www.stoneyard.co.uk/product-category/natural-finish-granite-setts/
	Talila Grey Granite	Beltrami and many others	China	Grey, coarse, even-textured granite	Polished slab and more	https://www.beltrami.co.uk/en/pro/granite-95/material/talila-grey-3924/finishing/polished-8765

ARGYLL AND BUTE STONES	POTENTIAL COMPETITOR STONES					
	Trade name	**Supplier(s)**	**Country of origin**	**Visual & geological character**	**Form in which supplied**	**Weblink**
Dalradian Metamafite	Green Schist	MacLeod Construction	Scotland	greyish green, medium to coarse, foliated and even-textured metamorphosed basaltic rock	Rough block	https://www.mkmacleod.co.uk/quarries/
	Blue Whin (from Achnaba Quarry)	Tradstocks Ltd			Rough block, sawn block	http://www.tradstocks.co.uk/
Furnace Porphyry	None					
Highland Border Slate	None					
Intrusions & extrusions, Atlantean Orogeny (undiff)	Scottish Whin	Tradstocks Ltd	Scotland	Dark grey (sometimes pink-tinged), medium-grained, even-textured whin (dolerite)	Kerbs, Setts and more	http://www.tradstocks.co.uk/
Intrusions & extrusions, Caledonian & Acadian orogenies (undiff)	Not known; the character of the quarried stone was not determined					
Iona Marble	None					
Kerrera Sandstone	Dunaverig Sandstone	Tradstocks Ltd	Scotland	Purplish grey to brownish grey, very fine to fine, uniform sandstone	Rough block, sawn block	http://www.tradstocks.co.uk/
	Pennant Sandstone	Forest of Dean Stone Firms Ltd	England and Wales	Green, grey, purple and blue, fine to medium, uniform sandstone	Rough block, sawn block	https://www.fodstone.co.uk/
Loch Katrine Metasandstone	None					
Lorn Plateau Volcanic Rock	None					
Precambrian metasedimentary rocks (undiff)	None					
Quarry Granite	Fine grey granite; Dark grey granite; Grey granite	Stoneyard	Portugal	Grey, medium, even-textured granite	Kerbing blocks in 100x20x10; 100x20x20; 100x30x20; 100x30x30cm	https://www.stoneyard.co.uk/product/fine-grey-granite-kerbing/
					Setts in a range of sizes, with 'natural cropped finish'	https://www.stoneyard.co.uk/product/fine-grey-granite-setts-in-natural-cropped-finish/

ARGYLL AND BUTE STONES	POTENTIAL COMPETITOR STONES					
	Trade name	**Supplier(s)**	**Country of origin**	**Visual & geological character**	**Form in which supplied**	**Weblink**
Ross of Mull Granite	Balmoral Red; Rosa Balmoral	Blyth Marble	Finland	Reddish, coarse, even-textured granite	20 mm and 30 mm slabs for worktops, internal and external cladding, sills, tiles.	http://www.blythmarble.com/product/balmoral-red-20mm/
		Imperial Marble			Large (metre-scale) polished slabs.	http://www.imperial-marble.co.uk/granite-slabs/rosa-balmoral/
					Tiles up to 600 x 600 mm.	
		The Marble and Granite Centre			Large (metre-scale) polished slabs.	https://www.themarbleandgranitecentre.co.uk/BlockResult/39/Granite_Balmoral_Red_CG_Red_Polished
	N/A	Stoneyard	Portugal	Pink, coarse, even-textured granite	Setts in a range of sizes, with 'natural cropped finish'	https://www.stoneyard.co.uk/product/brown-granite-setts-in-natural-cropped-finish/
	Rosa Porrino, Pink Porrino, Porinho Rosa, Rosa Angelina, Rosa Atlantico, Rosa Porina, Rosa Porinho, Rosso Porinho, Spanish Pink and others	MKW Surfaces	Spain	Pink, coarse, even-textured granite	Rough block, sawn block, polished, in a range of sizes	https://www.mkwsurfaces.co.uk/rosa-porrino/
		International Granites				https://igranites.com/rosa_porrino.html
		Levantina				https://www.levantina.com/en/product/granite/ranges-and-colours/pink-granite/rosa-porrino
		Stone Contact				https://www.stonecontact.com/rosa-porrino/s2599
Scalpay Sandstone	Hazeldean Sandstone	Hutton Stone Ltd	England (quarry site) Scotland (supplier base)	White to light grey, with buff and pink tones, fine to medium, uniform sandstone	Rough block, sawn block	https://www.huttonstone.co.uk/
St Ninian Metasandstone	None					

ARGYLL AND BUTE STONES	POTENTIAL COMPETITOR STONES					
	Trade name	**Supplier(s)**	**Country of origin**	**Visual & geological character**	**Form in which supplied**	**Weblink**
Stratheden and Inverclyde Sandstone	Hazeldean Sandstone	Hutton Stone Ltd	England (quarry site) Scotland (supplier base)	White to light grey, with buff and pink tones, fine to medium, uniform sandstone	Rough block, sawn block	https://www.huttonstone.co.uk/
Teith Sandstone	Dunaverig Sandstone	Tradstocks Ltd	Scotland	Purplish grey to brownish grey, very fine to fine, uniform sandstone	Rough block, sawn block	http://www.tradstocks.co.uk/
	Pennant Sandstone	Forest of Dean Stone Firms Ltd	England and Wales	Green, grey, purple and blue, fine to medium, uniform sandstone	Rough block, sawn block	https://www.fodstone.co.uk/
Tiree Marble	None					
West Highland Slate	Cupa	Cupa Pizarras	Spain	Dark grey to black natural slates Some varieties contain 'non rusting metallic particles and thin laminations'.	Available in two surface finishes ('smooth' and 'riven'), several sizes (up to 75 x 50 cm) and thicknesses (up to 9 mm), and a range of formats (rectangular, square etc).	https://www.cupapizarras.com/uk/

Appendix 6 Relevant information from BGS memoirs

Most BGS geological maps are accompanied by a 'memoir', which contains a detailed written account of the geology within the map area. Each memoir includes a short chapter on 'Economics' or 'Economic Geology', which usually contains brief information about the building stones that were produced historically in the area, and their source quarries. Relevant sections of text from the memoirs covering Argyll and Bute are presented below.

From Bailey and Anderson (1925): *The Geology of Staffa, Iona, and Western Mull*

Ross of Mull Granite

* The total land area of the Ross of Mull granite is about 20 square miles. The rock varies in colour from pale to deep red, and does not show prominent feldspar phenocrysts.

* It is generally stated that the wide intervals between the joint planes of this granite enable larger blocks to be obtained from it than from any other in Britain. Blocks 18 ft. x 3 ft. have been shipped to America; but an attempt to get a still larger monolith, to be erected in London as a memorial to the Price Consort, proved unsuccessful.

* There are usually two sets of very steep or vertical joints, almost at right angles to one another. Their directions are often nearly north and south, and east and west. Gently inclined joints are also often well developed.

* The principal quarries all lie within Sheet 43: the most important was the Tòrr Mòr Quarry, half a mile north-north-east of Fionphort on the Sound of Iona. Two smaller quarries were worked on the Sound at Dearg Phort. One of these was on a small island named Eilean Dubh na Ciste, and the other was close to this on the mainland. The name Black Island Quarry appears to have been applied to both. Perhaps the oldest quarry is the one on the north side of the Ross, east of North Bay, or Camas Tuath. This was opened to supply stone for Skerryvore Lighthouse; it became known as the North Bay Quarry, and was largely worked. Another, known as Booth Point Quarry, was situated on Bunessan Bay (Loch na Lathaich), east of Ardfenaig House. The only other quarry of any significance appears to have been the one on the island of Erraid.

* A large part of the material quarried was used for piers and quays, e.g. Liverpool Docks. There was at one time a considerable export to America. The granite was also used for ornamental purposes, and for the frontage of shops and offices. For this the whole of the rock was not equally suitable. The stone from the Erraid and North Bay Quarries is said to have been capable of taking a higher polish than the rest, which, as a whole, is not a 'polishing' material. Neither is it suitable for the production of setts, possibly owing to a general absence of 'reed' or direction of cleavage, though a vertical direction of cleavage running north-east and south-west is mentioned in connection with this granite,[2] and a certain quantity of setts was actually produced.

The refuse of the quarries was, in some cases, ground down for granolithic work and for the rough-casting of walls.

[2] John McCormick, 'The Island of Mull', 1923, p.177.

* The quarries were last wrought on any large scale by the Shap Granite Company, and the material was taken by sea and rail to the polishing works at Shap, in Westmorland. The rock is for the most part free from cover and in a very sound condition. The location of the different quarries seems to have been fixed by their proximity to natural harbours, the Tòrr Mòr Quarry, for instance, being near the sheltered anchorage known as the 'Bull Hole', between the Ross and Eilean nam Ban. In this respect, the Ross of Mull granite appears to be as favourably situated as any in Britain.

* The following is a list of some of the instances of different types of construction in which Ross of Mull granite is known to have been used:-

Skerryvore Lighthouse and Ardnamurchan Lighthouse. North Bay Quarry.
Dubh Artach Lighthouse. Erraid Quarry.
Hysker Lighthouse. Tòrr Mòr Quarry.
Iona Cathedral. The older part of this cathedral and the nunnery are mainly constructed of granite and flags, which are interbuilt without much dressing, but according to a definite plan. The pillars and facings are of sandstone. The granite is Ross of Mull granite, which might have been got from local boulders. In reconstructing the cathedral, the contractors followed the style of the original, and granite was obtained from the mainland Black Island Quarry.
Blackfriars Bridge, London. Tòrr Mòr Quarry. The large columns are built of stones 8 ft. in diameter, which were turned by a Shap lathe[3].
Westminster Bridge and Holborn Viaduct, London.
Foundation of Albert Memorial, London. Tòrr Mòr Quarry.

Flagstones

* Metamorphic flagstones have been quarried on a small scale in the Ross of Mull for roofing and flooring the recently restored Iona Cathedral. Two notes on this subject may be quoted from Dr Clough. The first was published in the Explanation of Sheet 35 (1911), and deals with a locality on the south coast. "Wishes have been expressed (1909) to use the spangled flaggy mica schists of the Moine Series for roofing slates for the restored Iona Cathedral in lieu of the black slates at present used. A peculiar beauty does indeed attach to these spangled schists, but it would be very difficult to get even a moderate supply without going to great expense, for sufficiently thin beds are but sparsely scattered in different positions in the series. Prospecting for the flags has recently been carried on, on the coast about 300 yards west-south-west of Dun a' Ghaird [Dùn nan Geàrd], but it has not been followed up by quarrying. Indications of former workings are said to be visible in this locality."

* The second note is dated 1910, and refers to a locality on the north coast, a quarter of a mile west of the pier, half a mile west-north-west of Bunessan. It runs: "Scars slightly quarried for new parts of Iona Cathedral, especially, it is said, for flooring.

Iona Marble

"Tradition asserts that this stone was used for the old altar of Iona Cathedral, and it seems probable that its existence was known of in early times. It is stated, we know not on what authority, that the marble was largely quarried during the sixteenth and seventeenth centuries, and it was certainly used as an ornamental stone before 1693. After having been neglected for a while, the quarries were opened up, at some expense, by the then Duke of Argyll, about 1790, but the adventure was short-lived. No stone was apparently worked for the next fifty years, and perhaps nothing was done till about 1907, when the quarries were restarted by a Glasgow syndicate. They were last worked by a London firm named Iona Marbles Ltd., but they have been idle since before the war.

[3] G.F. Harris, 'Granite and Our Granite Industries,' 1888, pp. 94, 120.

The stone is a serpentinous marble, owing its peculiar beauty to the streaking and mottling of the white calcareous portions of the rock by yellowish-green serpentine. This mineral is not uniformly distributed, and in many of the blocks which are produced from the quarry it is almost absent. Thin veins of a white fibrous material cut through the rock, and must have somewhat interfered with the quarrying.

The marble forms a nearly vertical band, which, in the most recently worked part of its outcrop, near the sea, is about 20 ft. in thickness. Farther inland, where the section is now obscured, it may have been 30 ft. thick, and one record mentions 40 ft. The distance through which the band has been followed is probably not much over 100 yds., and it would be unsafe to assume that it extends farther inland. Most of the available material is now probably exhausted. A certain amount of rock is, however, left intact at the seaward end, and although the industry could never be developed on a large scale, it would be possible, without deepening the old quarries, to meet a limited demand for several years.

The material was lowered directly from the latest quarry, by means of a crane, into vessels alongside; but, owing to the absence of shelter, this means of shipment must have been rather precarious.

The marble has been mainly employed for interior work in churches. It was so used in the reconstruction of Iona Cathedral. Westminster Cathedral and St. Ann's Parish Church, Murrayfield, Edinburgh, afford further examples of its use.

From Lee and Bailey (1925): *The Pre-Tertiary Geology of Mull, Loch Aline, and Oban*

Ross of Mull Granite
The account given is identical to the one in Bailey and Anderson (1925) – see above.

Sandstone
Lower Old Red Sandstone, Lorne (Sheet 44). A grey massive false-bedded freestone occurs at the base of the group at Ardentallan Point, Loch Feochan. Its thickness is about 25 ft., and it was quarried along the outcrop for building-stone used in the construction of the Caledonian Canal. The quarries are now flooded, and as they pass below sea-level they would not be easily worked.

What is probably the same sandstone has been quarried in a small faulted outcrop on the shore of Barnacarry Bay, a mile farther west.

Otherwise, little use has been made of the Lower Old Red Sandstone. The most promising exposures are in Kerrera, especially near the south coast, where they are sufficiently indicated in Fig.6 (p. 39).

Triassic Sandstone (Sheet 44). A coarse felspathic grit, 35 ft. thick, has been quarried a little east of the Boat House, near the Head of Loch Aline. It is often pebbly and stained with haematite. Its dip is 20º.

Triassic sandstone has also been quarried at Inninmore Bay, a quarter of a mile west of the western boundary fault of the Coal Measures.

Middle Lias Sandstone (Scalpa Beds-Sheet 44). According to tradition, the old sandstone quarries, shown by a note on the Map near the Nuns' Pass, west of Carsaig, supplied freestone used in the ecclesiastical buildings of Iona. The sandstone averages about 200 ft. in thickness, and might easily be worked again, if shipping were more easy.

The following is a list of exposures of the same sandstone in the eastern corner of Mull which might perhaps meet a local demand, should such arise. The available thickness sometimes reaches 100 ft.:-

Cliff parallel with coast between Port Donain and Port nam Marbh.
On both sides of Loch Don Anticline, north of Gualachaolish Farm.
On west side of Loch Don Anticline, in Gleann Rainich: (1) between path and stream west of Cnoc na Moine; and (2) in stream north-west of south end of Loch a' Ghleannain.
Along Abhuinn Lirein, a quarter of a mile above Oakbank House.
Pier, Duart Bay.

Bloody Bay Sandstone (Sheet 51). A red sandstone occurs in the sea-cliff a quarter of a mile south-east of Ardmore Farm (p. 114). It is about 50 ft. thick, and can be traced for some 200 yds. The site is sheltered, and can be safely approached by small vessels in ordinary weather. The quality of the freestone is good, and it has stood the weather well where employed in the wall of a path leading to Rudha nan Gall Lighthouse (Sheet 52).

Roofing Slates and Flags

Black Slates (Sheet 44). Black carbonaceous slates with pyrites extend through the Oban district, frequently showing from under a cover of Lower Old Red Sandstone sediments and lavas. The slates belong to the same group as has been extensively quarried in the islands of Easdale, Seil, Luing, and Belnahua of Sheet 36. In the present are, the slates generally show a minute crinkling of their cleavage except near the southern margin of the map. The following small abandoned quarries have been noted (including two in Sheet 45, added for the sake of completeness) :-

North end of Eilean Mor, 31/2 miles N.N.E. of Oban (Sheet 45).
Quarry Road, ½ mile S.E. of Oban Station (Sheet 45).
Port an t-Sruthain, Kerrera, near S. end of Sound.
Ardentallan House, and N.E. of Ardentallan Point, Loch Feochan.
Clachan Sound, near N. entrance of sound, and again near S. margin of Sheet 44 (both shores).
N. of Ardencaple House, Seil; and also ¾ mile S.S.E. of same.

Micaceous Flags (Sheets 35 and 43).

The account given is identical to the one in Bailey and Anderson (1925) – see above.

From Gunn et al. (1897): *The Geology of Cowal including the part of Argyllshire between the Clyde and Loch Fine*

Some of the old slate quarries in the Dunoon Phyllite are elsewhere mentioned, pp. 30, 32 **. None of these are now worked, as they cannot compete with the slates imported from other districts. The cheapness of freight at the present day has brought into such close proximity and rivalry districts which are geographically far apart, that only those best fitted for their respective products and industries can retain even the local market.

To state this is almost a truism, but still we were hardly prepared for the great extent to which some of the local products have consequently fallen into neglect. …

A clay, apparently formed from a crushed decomposed lamprophyre, occurs in a line of fault 5/8 mile east of Socach (141), and was formerly known locally as a good pottery clay (see p. 109).

The sheet of felsite near St Catherine's has been quarried, both for road metal and field dykes, a little below the road near the top of the "h" of "Tighe Claddich" (133), and on the hill 1/3 mile south-east of the "s" of St Catherine's.

The granite has not been quarried anywhere. The nearest part of it is 3 miles from the head of Loch Fine. Some varieties would probably serve well for ornamental purposes, being rather like the Shap Fell granite of Westmorland, but with even larger porphyritic feldspars.

The north-west outcrop of epidiorite at St Catherine's has been largely quarried, and is said to have supplied most of the stone used in building Inveraray Castle. The rock is evidently liable to vary in character a good deal, both structurally and in chemical composition. The more schistose and fissile parts are not so suited for building purposes. The microscopical characters of the variety preferred are described on p. 64. The rock is called by Mr Teall a tremolite-chlorite-rock. It is said in the neighbourhood that the new quarry, close to the road leading south-east from the side of the inn, did not furnish such good stone as the old quarry in the garden on the west side of the ruined chapel of St Catherine's. Besides these quarries, there are others at the back of the raised beach south and south-west of the old chapel. The stone has a great local reputation. It is soft and easy to cut, but yet offers great resistance to atmospheric weathering. Many of the bridges in the neighbourhood are built of a rather schistose variety of it, or some similar stone, and the depths of the names cut into them, and the dates added, show how easy the stone is to cut and how long it retains tool marks. These varieties remind one somewhat of the stone of which the old crosses of Iona and Kilchoman (Islay) have been formed.

The somewhat similar epidiorite bands near Creggans (141), have been worked for building stone near the west end of the wood, and in some older quarries further inland. There are also small quarries for general purposes in the epidiorites south of Kilfinan (181).

Small quarries for road metal are not unfrequently opened out in schist outcrops which happen to be conveniently situated at the road side. One third of a mile N.N.W. of Inveronich an albite schist has been extensively quarried, partly for this purpose and partly for building stone.

The more massive schists, quartzose or pebble beds, or the green beds, are generally used for building purposes in the schist area. Some of the latter may tool with comparative facility, but with the other rocks mentioned it is hard to prepare even an approximately smooth face, and so the outsides of buildings are usually covered with cement or fine concrete, and subsequently painted. For the same reason imported freestone is used for window sills, door lintels, etc. Most of the stone used in building Dunans Castle (162), was procured from a tough pebbly green bed in the north-west banks of Dunans burn ½ mile south-west of Caol-ghleann. It is said to have given great satisfaction. The building stone chiefly used in Dunoon comes from a quarry in a massive portion of the Bull Rock greywacke schist, a little north of the Bull Rock. There are various large quarries of pebbly schist within the phyllite series near the town. One of these lies near the "d" of "Castle Crawford", another in the wood ¼ mile north of the first "o" of "Dunoon", another just north-east of the same letter "o", another 1/10 mile south of the "y" of "Trinity". Of these four, the second one was the only one in active work at the time the Survey was being carried on. In the south-west part of Cowal the more gritty schists have been quarried for building purposes in several places, but not on a large scale; among the more important, are those of Ardlamont west of Point Farm, and between Corra and Craig Cottage, at Acharosson, north-east of Auchanaskioch, Kilbride, Auchagoyl, 400 yards north of Ardmarnock House, Tighnabruaich, etc.

The red sandstone near Inellan and Toward is generally too full of bits of schist and other rock to make good building stone, particularly as these bits are not firmly cemented in. It has been quarried close to Toward Church, together with a basalt dyke, and we think also at the back of the raised beach near Chapel Hall.

** From p 32

The phyllites are not now quarried for slates, but some bands were worked in former times: e.g. at the edge of the 100 foot beach by the first "o" of "Dunoon" (town), in the deep ravine of the burn ¼ mile W.S.W of this letter, at the burn side a little over 1/6 mile E.S.E. of Corlarach, and on the hillside ¼ mile north-east of Corlarach. None of these workings are on a large scale, perhaps not even so large as the old quarries in the phyllite on the south-east side of the Bull Rock greywacke. The colours of the phyllites so used are dark grey, black, and purple. There are many other quarries within the phyllite series, particularly in the close neighbourhood of Dunoon, but the rock quarried is pebbly schist in most cases, and is used for building stone.

From Paterson et al. (1990): ***Geology of the Greenock district***

Slate

Slate was worked at one time in two small quarries on the hillside west of Clynder. The slate waste from one quarry is used from time to time for making up forestry roads. The slate is rather inconsistent in quality and cannot be considered as a resource.

Sandstone

Within the district there are several sandstone beds which have been used for building stone. None of the original quarries is still in use but many of them could be reopened for small quantities of stone. Bright red or carmine sandstone from the Stratheden Group near Renton [386 791], Bonhill [398 787] and Dumbarton [388 760] was used locally for houses and churches. The Kinnesswood Formation provided a pale red to grey freestone near Helensburgh [311 840, 313 830] and at Dumbarton [391 753]. White sandstone of the Clyde Sandstone Formation was worked for local housing in Gourock, Greenock and Port Glasgow. There are several disused quarries along the cliff forming the inland margin of the raised beach platform west of Gourock [222 768 to 235 773]. There were also quarries on Gourock Golf Course [225 763], in Shielhill Glen [235 722], at Everton [219 761] and near Port Glasgow [398 747].

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British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: https://envirolib.apps.nerc.ac.uk/olibcgi.

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