

SANDSTONE QUARRIES ALONG THE STRAIT OF GEORGIA* (92F/10; 92G/4W; 92B/13E, 14)

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INTRODUCTION

During the middle to late 1800s sandstone from local quarries was used as chiseled and scabed ashlar (rough-hewn blocks of stone) in construction of prominent buildings in Vancouver, Victoria and other Vancouver Island communities. The use of sandstone was discontinued in the 1920s but many of these historic structures have been designated as heritage buildings. This report documents the current status of abandoned quarries and identifies reserves of stone potentially needed for maintenance of these buildings. Eight sites examined during 1987 (Figure 3-5-1) are described.

All the quarries examined were opened in medium-grained (0.05 to 2 millimetres) Upper Cretaceous Nanaimo Group sandstones (Table 3-5-1). Descriptions are listed by geographical location starting in the north with Denman Island.

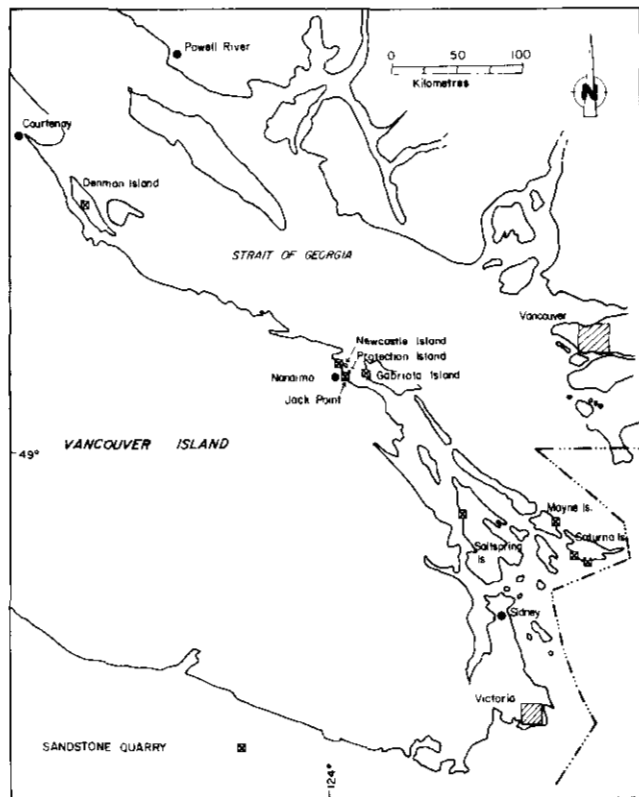


Figure 3-5-1. Location map, sandstone quarries.

Sandstone samples from each quarry were tested by Parks (1917), and the values are within limits set by the American Society For Testing and Materials (ASTM) for sandstone building stone (Table 3-5-2).

TABLE 3-5-1
SANDSTONE QUARRIES ON SOUTHERN VANCOUVER ISLAND AND THE GULF ISLANDS

Quarry	Location	Formation	Description
Denman Island	92F/10	De Courcy Formation	Sandstone, conglomerate, minor siltstone, shale
Jack Point	92G/4W	De Courcy Formation	Sandstone, conglomerate, minor siltstone, shale
Newcastle Island	92G/4W	Extension-Protection Formation	Sandstone, conglomerate, minor siltstone, shale
Gabriola Island	92G/4W	Gabriola Formation	Sandstone, conglomerate, minor siltstone, shale
Saltspring Island	92B/13E	Cedar District Formation	Shale, siltstone, minor sandstone
Mayne Island	92B/14	Gabriola Formation	Sandstone, conglomerate, minor siltstone, shale
Saturna Island	92B/14W	Cedar District Formation	Shale, siltstone, minor sandstone

DENMAN ISLAND QUARRY (92F/10)

An abandoned sandstone quarry (Mineral Inventory 92F-426), located 1.65 kilometres from the British Columbia ferry terminal on Denman Island, produced stone used to construct the Normal School and Drill Hall in Victoria and the Metropolitan Building and Dawson School in Vancouver (Parks, 1917).

SAMPLE DESCRIPTION

Fresh sandstone has a grey tone, is medium grained and generally displays a uniform texture although thin (4 to 5-centimetre) beds of coarse (greater than 2 millimetres) material are present. White to black cherty fragments, up to 3 millimetres across, commonly give the rock a coarse appearance.

Exposed surfaces weather in distinct colours of light to dark yellowish grey. Parks' description of the Normal School in Victoria notes: "Much variation in the colour of individual blocks detracts from the appearance of the building; when a light yellowish block is close to a very dark one the difference is striking".

Thin sections show that fresh angular quartz grains (40 per cent by volume) up to 0.75 millimetre in size are enclosed by a green, cloudy cement, probably chlorite (T. Höy, personal

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement. British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1987, Paper 1988-1.

**TABLE 3-5-2
SANDSTONE QUARRIES ALONG THE STRAIT OF GEORGIA — PHYSICAL PROPERTIES**

Quarry Name	Specific Gravity	Density		Absorption by Weight %		Compressive Strength						Traverse Strength		Shearing Strength	
		lb./ft. ³	kg/m ³	1 hr.	2 hrs.	PSI			MPa			PSI	MPa	PSI	MPa
		Dry	Wet	Freezing	Dry	Wet	Freezing								
Denman Island	2.713	145.45	2330	1.73	2.06	8,551	3,963	2,052	58.96	27.32	14.15	1,128	7.77	846	5.83
Jack Point	2.689	153.36	2457	1.92	2.27	11,276	7,116	5,265	77.75	49.06	36.30	841	5.80	1,053	7.26
Newcastle Island	2.656	152.38	2441	1.09	1.34	14,849	11,874	9,670	102.38	81.87	66.67	1,170	8.07	1,406	9.69
Gabriola Island	2.695	152.34	2440	2.38	2.69	10,589	10,068	7,564	73.01	69.42	52.15	849	5.85	1,054	7.27
Saltspring Island	2.67	157.21	2544	1.40	1.67	27,229	17,800	17,797	187.74	122.73	122.71	2,296	15.83	1,926	13.28
Mayne Island	2.661	149.02	2387	2.73	2.98	16,505	10,869	8,893	113.81	74.94	61.32	892	6.15	1,227	8.46
Saturna Island	2.667	148.31	2376	2.42	2.68	14,800	11,837	11,601	102.04	81.61	79.99	1,212	8.36	1,404	9.68

Physical Requirements — American Society for Testing and Materials (A.S.T.M.)

Sandstone*	N/A	140	2440	20 (max)		2,000 (min)		13.8		300	2.1	N/A	N/A
		(min)								(min)			

* Sandstone (Commercial Definition) — a consolidated sand in which the grains are composed chiefly of quartz or quartz and feldspar, or fragmental (clastic) texture, and with various interstitial bonding materials, including silica, iron oxides, calcite, or clay.

Source: 1984 Annual Book of ASTM Standards.

Physical Tests: Parks (1917).

Conversion Factors: PSI → MPa = # × 6.894757 × 10⁻³.
lb./ft.³ → kg/m³ = # × 1.601846 × 10.

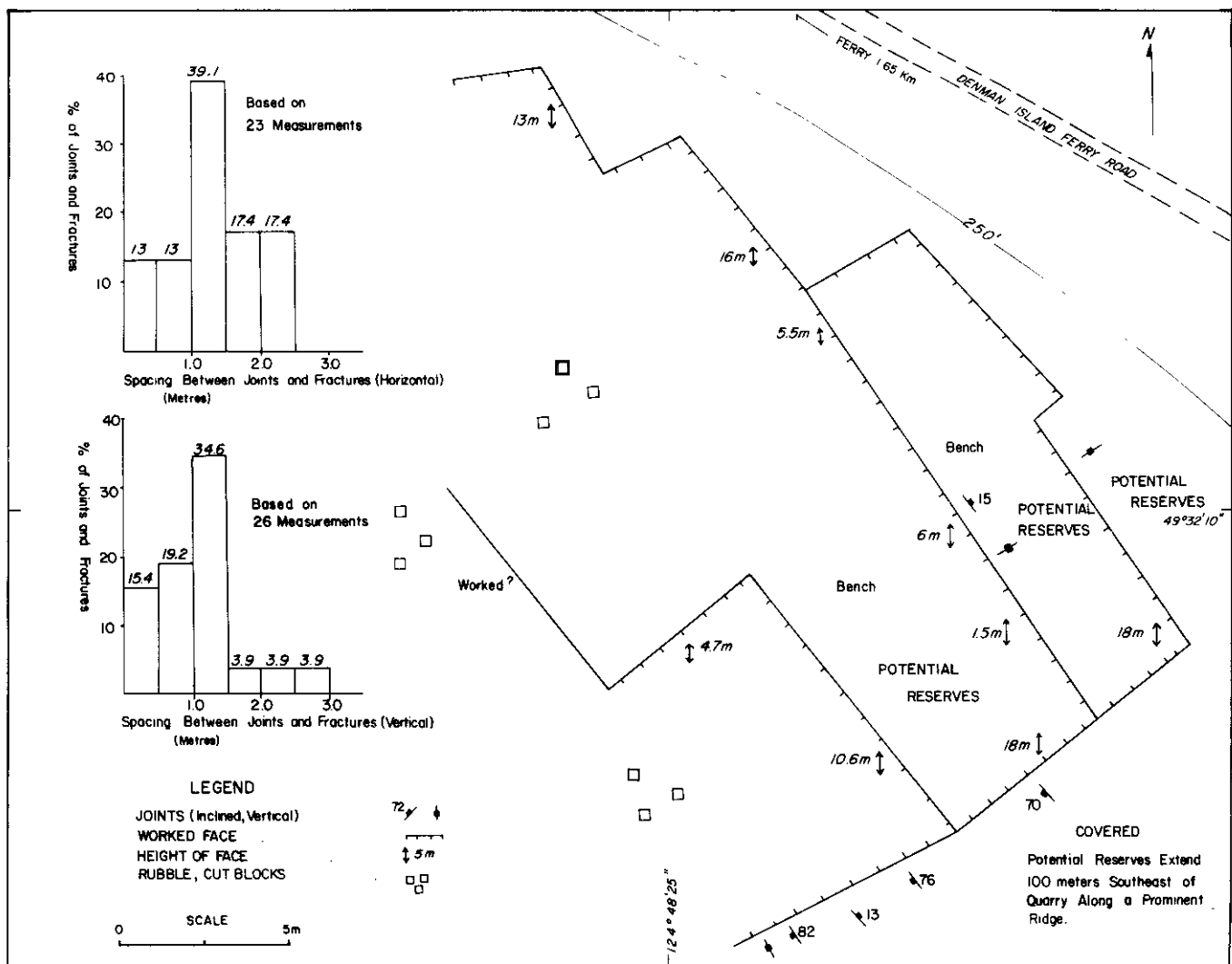


Figure 3-5-2. Denman Island sandstone quarry (92F/10).

communication, 1987). Sericite comprises 50 per cent of the rock and accessory minerals include plagioclase, biotite and an unidentified isotropic mineral.

QUARRY DEVELOPMENT AND STRUCTURE

The quarry, approximately 26 metres long and 17 metres wide, was developed in three benches along prominent joints striking northwest and dipping steeply southwest (Figure 3-5-2). Other irregular northwest-striking joints dip moderately northeast while well-developed northeast joints at the middle and upper benches, dip vertically.

Spacing between vertical joints and fractures varies from 0.4 to 20.3 metres with most spaced approximately 1.5 metres apart. Horizontal joints are regularly spaced, averaging between 1.5 and 2.0 metres apart. Beds strike northwest and dip 10 to 15 degrees east.

On the upper bench the rock contains concretions of medium-grained sandstone, 50-centimetre bands of pebbles, and rounded cherty pebbles up to 7 centimetres long which have a distinct north-south orientation. The stone in the middle bench is similar in appearance and it represents one distinct bed.

The lower bed is 9 metres thick, is dark grey in colour, and has a uniform texture and occasional shaly partings. It is intensely fractured and would not produce large blocks. Bedding is poorly defined.

Blocks left on site measure 1.5 by 1.6 by 2.9 metres but Parks described blocks "25 feet by 12 feet" (7.6 by 3.6 metres) successfully removed from the middle bench. Blocks left on site are in good condition although pitting and occasional peeling were observed.

RESERVES

Potential reserves of sandstone extend 100 metres south-east of the developed site along a well-defined ridge 20 to 25 metres high. Quarry development north of the upper bench is restricted by the road to the Denman Island ferry dock; outcrop is covered to the south and east.

JACK POINT QUARRY (PORTAGE QUARRY) (92G/4W)

This sandstone quarry (Mineral Inventory 92G-049), located east of Nanaimo harbour on Jack Point, produced building stone used to construct the Nanaimo Post Office (Parks, 1917).

SAMPLE DESCRIPTION

Sandstone ranges from medium to dark blue-grey in colour and is the coarsest of eight sandstones examined, with an average grain size between 1 and 2 millimetres. Cherty pebbles (up to 2 centimetres) and large sand concretions (up to 1.4 metres in diameter) disrupt an otherwise uniform texture.

Buildings constructed of Jack Point sandstone were not examined, but exposed stone at the site remains fresh, giving an indication of its durability and weathering characteristics.

In thin section angular to subangular quartz grains between 0.25 and 1.5 millimetres in size are seen to comprise 50 per cent of the rock. A cloudy green chlorite cement is visible between grains of orthoclase which are often partially altered to sericite. Other constituent minerals include plagioclase, biotite and an unidentified isotropic mineral.

QUARRY DEVELOPMENT AND STRUCTURE

The Jack Point quarry described by Parks was 46 metres long and located 6 metres above sea level. He described the jointing as: "not very distinct, but there seems to be an ill-defined set striking with the face and dipping 70 degrees towards the harbour".

Recent excavation on Jack Point has removed a large volume of sandstone (probably for fill, but the final destination and use of the stone is not known) and exposed a face 520 metres long and 5 to 7 metres high (Figure 3-5-3). Distinct sets of joints are exposed, with the main set striking northeast and dipping steeply northwest. Irregular west-northwest-striking joints dip steeply to the northeast. A subhorizontal joint set strikes parallel to the worked face and dips moderately east.

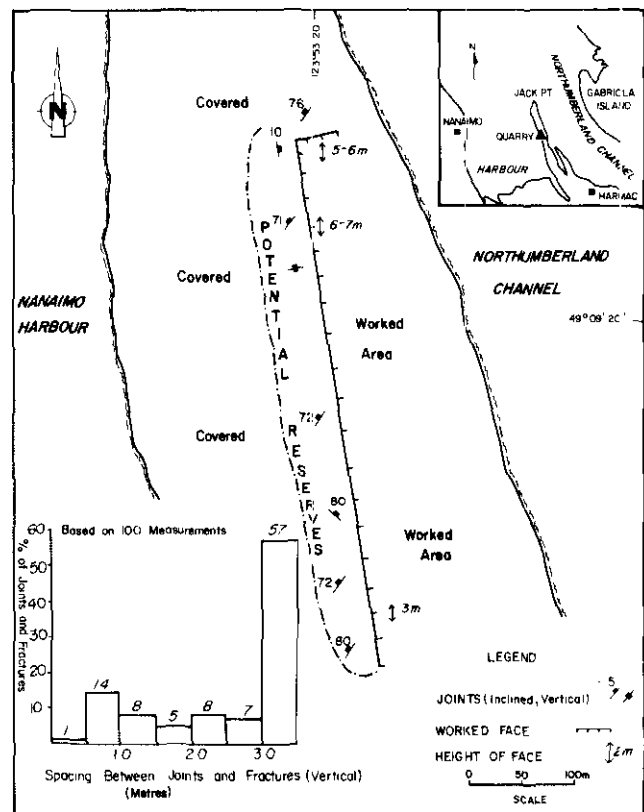


Figure 3-5-3. Jack Point sandstone quarry (92G/4W).

Vertical joints are widely spaced with 85 per cent more than 1 metre apart and nearly 60 per cent spaced over 3 metres apart. The greatest distance measured between two sets of vertical joints was 25 metres. Bedding along the west shore of the point strikes northwest and dips 10 to 15 degrees southeast. Individual beds range from 1.6 to 3 metres thick and are continuous.

RESERVES

Reserves of sandstone similar in appearance to stone described extend 40 to 50 metres west of the worked face.

NEWCASTLE ISLAND (92G/4W)

The Newcastle Island sandstone quarry (Mineral Inventory 92G-022) was the first quarry developed in the region (Parks, 1917). It provided building stone used to construct the San Francisco Mint (1873), the British Columbia Penitentiary (1875), Esquimalt Graving Dock (1880), Lord Nelson School in Vancouver (1911) and Christ Church Cathedral in Victoria (1955). This important quarry is located on the west shore of Newcastle Island, opposite Pimbury Point, and lies within the Newcastle Island Provincial Park.

SAMPLE DESCRIPTION

Medium-grained sandstone displays a uniform texture, has an attractive light grey tone and a speckled salt-and-pepper appearance. Occasional lenses of coal up to 5 by 20 centimetres in size lie parallel to bedding and concretions of coarse sandstone are common.

Christ Church Cathedral, constructed using Newcastle Island sandstone, is darker than fresh outcrop suggesting the stone darkens on exposure. Examination of the quarry face and buildings indicates pitting and peeling take place on exposed surfaces.

Thin sections show 50 to 60 per cent of the rock is comprised of closely packed, fresh, angular to subangular quartz grains, commonly 0.5 millimetre in size, with interstitial orthoclase, plagioclase and biotite. In many instances orthoclase is altered to sericite and occasional microfractures cut grain boundaries.

QUARRY DEVELOPMENT AND STRUCTURE

The worked face is 73 metres in length and has a height of 2 to 6 metres (Figure 3-5-4).

Bedding strikes northwest and dips gently southwest toward Newcastle Island Passage. A prominent set of joints strikes north-northeast and dips steeply east.

Over 85 per cent of joints and fractures measured are spaced more than 100 centimetres apart with 57 per cent greater than 300 centimetres apart.

RESERVES

Reserves of light grey sandstone lie northeast of the quarry. Measurements of joint and fracture density suggest blocks greater than 3 by 3 by 3 metres are available.

GABRIOLA ISLAND (92G/4W)

Building stone from a sandstone quarry (Mineral Inventory 92G-021), located on the west coast of Gabriola Island just south of Descanso Bay, was used to construct the main Post Office in Victoria, the Federal Life Building (Williams Building) and the Dunsmuir Street Roman Catholic Church in Vancouver (Parks, 1917). Blocks 1.4 metres across by 1.5 metres deep were quarried for use as grindstones in pulp mills.

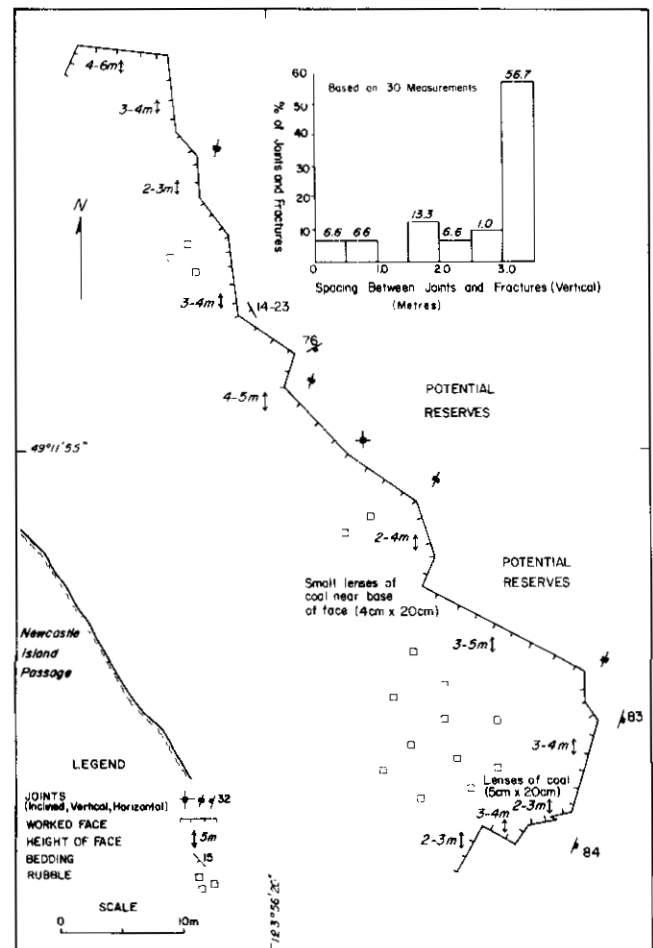


Figure 3-5-4. Newcastle Island sandstone quarry (92G/4W).

SAMPLE DESCRIPTION

The sandstone is medium grained, displays an even texture and a light to medium brown tone similar to Saturna Island sandstone. Small angular quartz crystals and blades of biotite (up to 3 millimetres) speckle the rock. Occasionally coarse concretions (up to 60 by 90 centimetres in size) and pebbles (up to 4 centimetres) disrupt the continuity of the bedding.

The stone darkens on weathered surfaces (Victoria Post Office) but remains solid and "fresh".

As seen in thin section, quartz grains range from 0.25 to 1.5 millimetres in size, are angular and comprise 70 per cent of the rock. Other minerals include orthoclase, plagioclase and biotite. Alteration of feldspar to sericite is pronounced, giving these grains a cloudy appearance.

QUARRY DEVELOPMENT AND STRUCTURE

The quarry has a length of 45 metres with worked faces between 2 and 15 metres high developed parallel to north-east-striking joints (Figure 3-5-5).

Vertical joints are widely spaced with 90 per cent greater than a metre apart and 50 per cent more than 3 metres apart. Flat-lying bedding planes, which define individual beds, are regularly spaced between 2 and 14 metres apart.

Beds dip 10 to 15 degrees northeast and strike northwest.

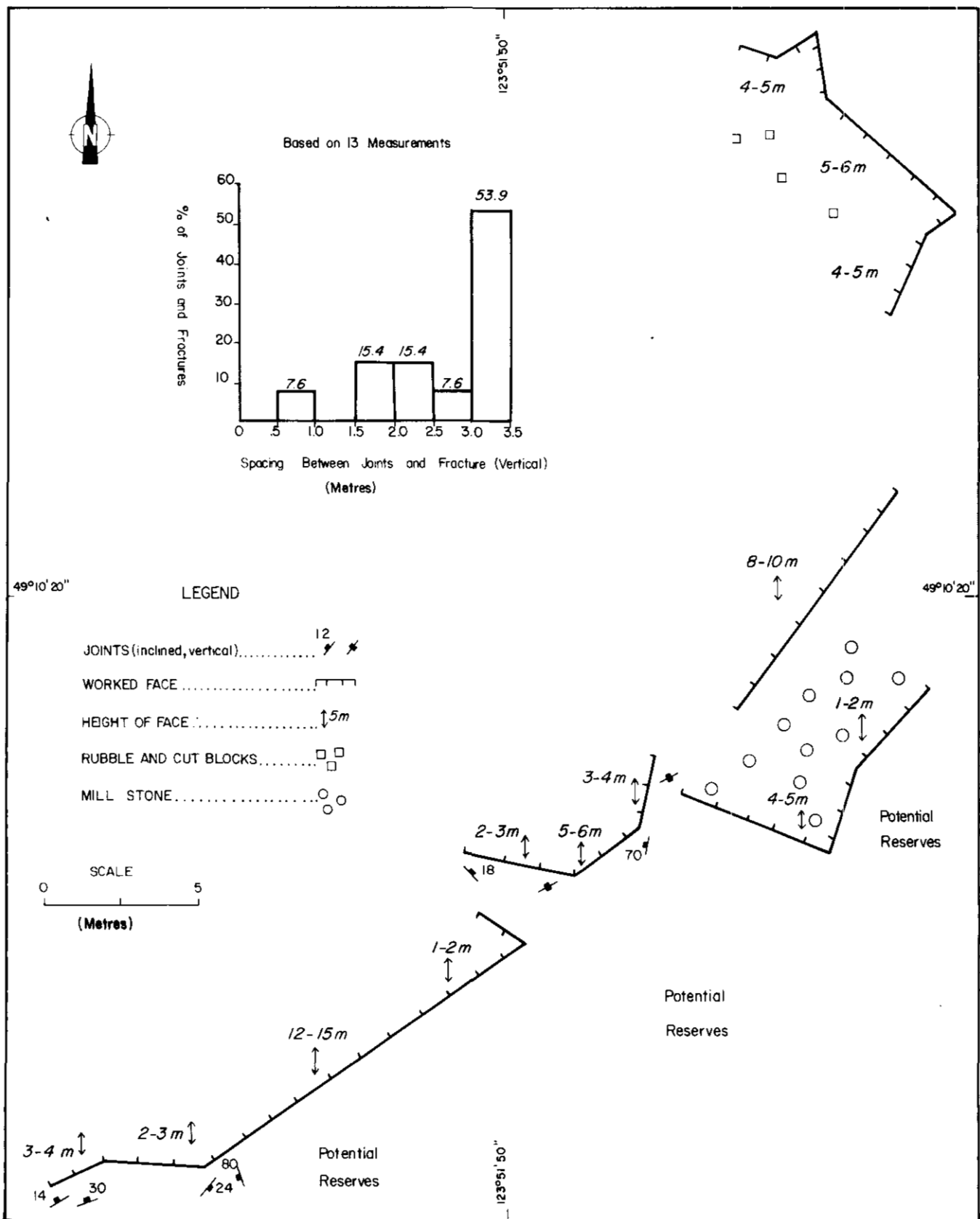


Figure 3-5-5. Gabriola Island sandstone quarry (92G/4W).

RESERVES

Potential reserves of quarriable stone extend 20 metres southeast of the worked face; beyond this distance heavy forest cover prevents detailed examination.

SALTSPRING ISLAND (92B/13E)

Sandstone from a small quarry opened parallel to the north shore of Booth Bay on Saltspring Island (Mineral Inventory 92B-072) was used to construct a part of the main Victoria Post Office (Parks, 1917).

SAMPLE DESCRIPTION

The stone is medium grained, displays a uniform texture and a moderate light to dark brown colour. Exposed faces darken and according to Parks "the weathering properties of the stone as indicated by this building (Victoria Post Office) are not of a high order, as so much disintegration had occurred in a few years that re-facing was resorted to in order to make the structure presentable". An examination of the post office suggests the original stone was replaced by more weather-resistant Gabriola sandstone, but this has not been confirmed.

At the quarry, thin lenses of coal and shale partings are common along joint and bedding planes.

Thin sections show that fresh angular quartz grains, up to 1 millimetre in size, occupy 50 per cent of the volume. Orthoclase is altered to sericite and forms nearly 40 per cent of the interstitial minerals. Other, largely unaltered minerals include plagioclase and biotite.

QUARRY DEVELOPMENT AND STRUCTURE

The worked face extends intermittently for 150 metres along a vertical bedding plane and is cut by steeply dipping north-northwesterly striking joints (Figure 3-5-6). Vertical joints are widely spaced (up to 16 metres) while flat-lying joints (bedding planes) are regularly spaced 2 to 4 metres apart.

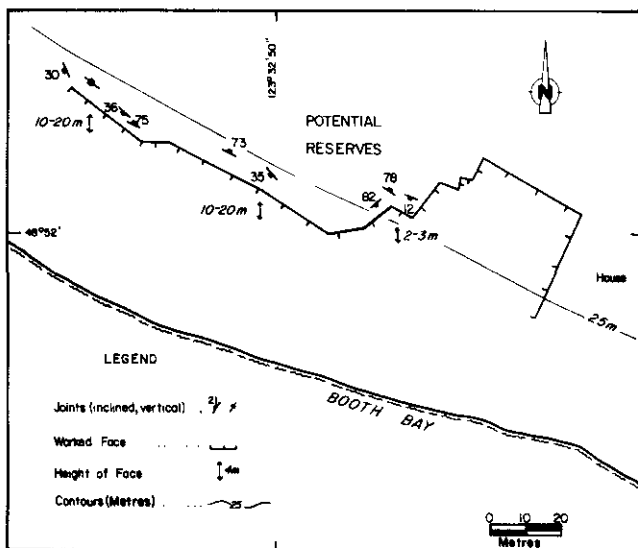


Figure 3-5-6. Saltspring Island sandstone quarry (92B/13E).

RESERVES

Potential reserves of sandstone extend 20 metres north and east of the worked face although a developed residential lot immediately east of the quarry will restrict expansion.

Block size will be restricted by flat-lying joints and by shaly partings along bedding planes.

MAYNE ISLAND (92B/14)

This small sandstone quarry (Mineral Inventory 92B-071) was developed along the north shore of Campbell Bay on Mayne Island, approximately half the distance to Edith Point. The stone was used "in Postal Station C at the corner of Main and 15th streets in Vancouver" (Parks, 1917).

SAMPLE DESCRIPTION

The sandstone has a light to medium brown tone, is medium grained and has a fresh uniform texture. Exposed surfaces weather yellow-brown and variations in colour extend along the quarry face depending on exposure. Parks, in describing the post office, commented "This building presents a very fair appearance, but there is considerable variation in colour of different blocks". This statement supports recent observations of the quarry's exposed face. While there are colour variations along individual beds, the stone maintains a solid, "fresh" appearance and does not display pitting or peeling.

In thin section quartz grains are seen to be angular and up to 1.75 millimetres in diameter, although they are commonly between 0.25 and 0.75 millimetre. Interstitial minerals include orthoclase (often altered to sericite), plagioclase and biotite. Individual grains do not appear to be well cemented and a few of the quartz, orthoclase and feldspar grains are cut by microfractures.

QUARRY DEVELOPMENT AND STRUCTURE

Located on tidewater, the abandoned quarry (Figure 3-5-7) is 34 metres long by 3 to 4 metres high, and was developed

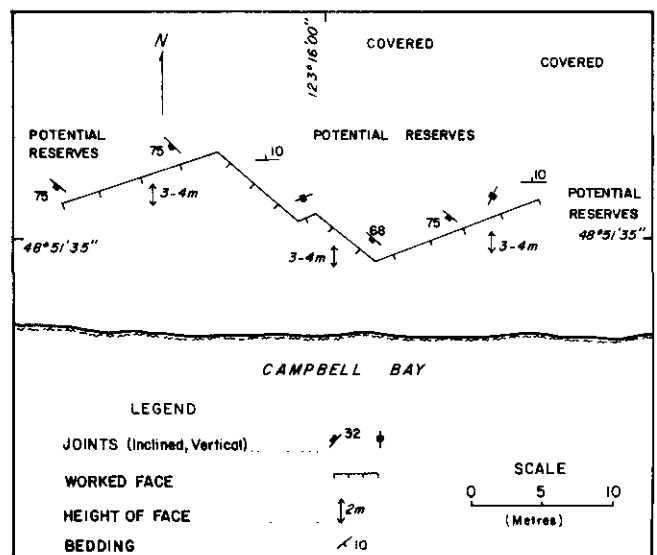


Figure 3-5-7. Mayne Island sandstone quarry (92B/14).



Plate 3-5-1. The old Victoria Public Library (Carnegie Library), designated a heritage building, was constructed using Saturna Island sandstone.

cient quantities of stone remain to complete any necessary repairs or maintenance on heritage buildings located in the Lower Mainland or on Vancouver Island.

- (2) Due to slight differences in colour, grain size, texture and weathering properties, the stone from one quarry cannot be replaced by rock from another source. The quarries which produced material for historically significant buildings should therefore be preserved.
- (3) Inclusion of the Newcastle Island quarry in a Provincial Park and the close proximity of the Saltspring Island quarry to a residential subdivision will restrict their future development and access.
- (4) The Saltspring Island sandstone breaks down with exposure and in at least one instance has had to be replaced.

ACKNOWLEDGMENTS

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