Aggregate in Nova Scotia

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Introduction

Aggregate may be defined as any of several hard, inert materials, such as sand, gravel, slag or crushed stone used for mixing with a cementing or bituminous material to form concrete, mortar, plaster or asphalt, or used alone as base coarses, railroad ballast or graded fill. It is a fundamental building material widely used in our industrial society.

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In Nova Scotia the aggregate industry is an integral part of the Province's economy. Within the mining sector, aggregate annually ranks second or third in terms of product value and employment. Annual production (Fig. 1) is currently in the range of 11 Mt with a product value of $50 million requiring a work force of 700 people. The indirect impact of aggregate is much wider with jobs in several other industries being dependent upon these materials. This includes sectors such as concrete production, highway construction and maintenance, trucking, and equipment sales.

The prosperity and growth of the aggregate industry has not been without problems. Intense extraction from the better quality deposits has resulted in resource depletion in some areas. Competition for land use involving such interests as agriculture, recreation and urban centres has often resulted in the loss of resource land. Environmental concerns are also being strongly expressed, the consequence being sterilization of many quality deposits. In spite of a thriving industry, there is justified concern for the future of aggregate mining in the Province.

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Historical Background

The aggregate industry in Nova Scotia has a history dating back several hundred years to the early settlement of the Province. From its humble beginnings using ox carts and sailing ships, the industry has evolved into a high tech operation where Panamax class bulk carriers can be loaded with 70 000 t of aggregate for an international market in 48 hours.

Early European settlers to this coastal region relied on the plentiful beach sand and gravel to satisfy local aggregate needs. Over time it became apparent that some beaches were capable of providing large quantities of superior quality sand and gravel and that a market existed in larger centres. Many of the islands in Mahone Bay were well known for their excellent beach sand deposits, and, in the middle to latter part of the last Century, a flourishing sand trade developed between the Mahone Bay islands and the City of Halifax. Sand was loaded on schooners by hand and shipped to Halifax to make concrete used in many early structures, including the first dry dock at the Halifax shipyard which opened in 1889. This dry dock is still in use today.

In Halifax Harbour, sand and gravel dredging around McNabs Island continued until the mid 1970s. At the height of activity, as many as seven operations produced up to 900 t per day, all for the Halifax-Dartmouth market. These operations consisted of cranes equipped with clamshell buckets for loading scows which were pulled by tugs to Halifax and Dartmouth.

By the 1960s, opposition to beach mining had increased to the point that the Provincial Government took action either to forbid or to control sand and gravel extraction from beaches. In 1975, the Beaches Preservation and Protection Act was proclaimed which effectively halted beach mining. As a result serious concerns were expressed on the part of the supply companies. It was strongly suggested that

closing the beaches would create aggregate shortages and would even put some operations out of business.

The transition to land-based aggregate sources which followed was made easier for the producers through the efforts of the Nova Scotia Department of Mines, which conducted a Province-wide inventory of sand and gravel deposits. A subsequent depletion of the better quality surficial materials in many areas has occurred, the result being that there is a progressive increase in the amount of bedrock quarried and processed in the Province for aggregate. To demonstrate this shift, quarried stone represented 13 per cent of the total aggregate production in 1970, 17 per cent in 1980 and 45 per cent in 1990. Accompanying this shift is the development of a strong aggregate export market supplying several centres on the East Coast of North America. Most recently an interest in offshore marine aggregate has developed, based on the knowledge that there are extensive sand and gravel deposits on the Scotian Shelf. Although this facet of the resource is not currently being mined, there is abundant potential for the future.

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Aggregate Sources

There are three sources of aggregate in Nova Scotia: granular materials, crushed stone and slag. Granular aggregate and crushed stone represent 99 per cent of annual production, however, steel slag has recently entered the market place.

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Granular Aggregate

Granular aggregate occurs as sand and gravel in unconsolidated surficial deposits. Nova Scotia has an abundance of sand and gravel spread throughout the Province, as indicated in Figure 2. Included in this group are ice contact deposits, proglacial deposits, modern stream alluvium, glacial tills, weathered bedrock and marine deposits. The ice contact and proglacial deposits are used extensively as aggregate whereas other materials remain minor contributors to the aggregate budget in the Province. The quality of granular deposits ranges from poor to excellent.

1. **Ice contact deposits** occurred as meltwater channel sediments on, in or under the glacial ice mass. When the ice melted, the deposits remained as part of the landscape in the form of mounds. They include eskers, kames, kame terraces and kame deltas. These deposits are abundant and used extensively throughout the Province.

2. **Proglacial deposits** occurred at the front of the ice mass in shallow, fast flowing, meltwater streams. The deposits which formed are flat lying, well-sorted and of substantial thickness. Where the streams flowed into lakes or marine water, coarse deltaic deposits developed. The deposits are usually well sorted and make good quality aggregate.

3. **Modern stream alluvium** is a product of recent stream deposition and consists of both sand and gravel. For aggregate purposes the group comprises braided streams and alluvial fans. The deposits are confined in both volume and areal extent. Although the quality of the deposits may be excellent, their location close to streams and rivers often makes the deposits inaccessible for environmental reasons.

4. **Glacial tills** or moraines are ice-transported materials which are carried along beneath or in the glacier. With the disintegration of the ice mass they blanketed most of the Province ranging from a veneer to a layer tens of metres in thickness. In general these materials are poorly sorted and used as fill, however, some of the deposits are capable of producing high-quality materials.

5. **Weathered bedrock** occurs as a residuum at the surface of bedrock where conditions permit. Rock types such as conglomerate and granite, which are subject to chemical and mechanical breakdown, can produce an upper zone of gravel-like materials. In many regions, such as Cumberland County, these deposits are quite extensive and up to 6 m in thickness. At present they are used primarily for fill and the building of haulage roads.

6. **Marine deposits** in Nova Scotia include both beach deposits and offshore, continental shelf deposits. Extraction of beach materials is generally prohibited in accordance with the Beaches Preservation and Protection Act of 1975. Extensive, untapped sand and gravel deposits have been mapped offshore Nova Scotia with large portions of these deposits occurring in water depths that would permit mining with established dredging technology. These deposits were formed by reworking processes, including high energy wave action on earlier glacial deposits in a transgressing marine environment. These processes served to clean and sort the tills and destroy soft, deleterious materials, leaving clean sand and gravel deposits ranging in thickness from less than 1 m to 50 m. The distribution of offshore sand and gravels beyond the shallow coastal water zones is shown in Figure 3.

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Crushed Stone

Certain areas of the Province no longer have adequate supplies of granular aggregate and rely upon quarried bedrock to meet their needs. The result is that the annual production of bedrock materials has increased dramatically in recent years (Fig. 4).

Crushed stone consists of consolidated bedrock which has been quarried, crushed, washed and sized for the purpose of producing good quality aggregate. Rock types in the Province suitable for the production of crushed stone are unevenly distributed. In general the bulk of crushed aggregate comes from metasedimentary rocks, intrusives and volcanic rocks. Areas underlain by Late Devonian or younger sedimentary rocks are generally unacceptable for the production of high quality materials.

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Slag

Steel slag is a complex mixture of silicates, ferrites and oxides produced as a by- product of the steelmaking industry. When processes for mineral aggregate it forms a rough, cubical, vesicular material which exhibits durability and high permeability. World wide, steel slag has been used in most aggregate applications including the production of skid resistant asphalts. Heckett Canada Ltd. recently opened the first steel slag aggregate processing facility in the Province at Sydney. The materials are being marketed for the construction of parking lots, roads, berm stabilization and black-top paving.

Other air cooled slags in the Province which may be of interest in the future occur as waste dumps associated with early iron and steel works in Londonderry, Colchester County and Ferrona, Pictou County. At present utilization of these deposits is minimal. Total slag aggregate production represents a small fraction of the total aggregate budget in the Province. However, resource conservation and environmental concerns make utilization of this accessible, nonreactive waste product a desirable goal.

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Uses

Aggregate materials have many applications; however, their primary use is in the construction industry. The most important use in Nova Scotia is in the construction and maintenance of roads and highways, the major consumer being the Nova Scotia Department of Transportation and Communications. Building construction is also important. This includes a variety of concrete products such as foundations, concrete blocks, concrete panels, pipes and other structural products.

There are many other aggregate products including back fill, road metal, railroad ballast, mortar mix, auto traction sand, abrasives, roofing gravel, silica sand in the production of glass, poultry grit, blasting grit, fracturing sand to enhance oil and gas production in petroleum wells, filter sands for water supply systems, rip rap for breakwater construction and shoreline stabilization and gabion stone for retaining walls.

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Production and Consumption

Most of the aggregate produced in Nova Scotia is consumed here, with less than 10 per cent of total production leaving the Province. Figure 5 shows the transportation pattern for aggregates produced in Nova Scotia, both for local and export markets. Within the Province, all shipments are moved by truck,

while shipments to markets in New Brunswick, Prince Edward Island and Quebec are transported by truck, rail and barge. Shipments to the southern United States are moved in modern, self unloading vessels.

The majority of Nova Scotia aggregate is consumed in our cities and large towns. Halifax-Dartmouth consumes over 3 Mt annually and is the Province's major aggregate consuming centre, followed by Sydney. These materials are used for street and road construction, sewage projects, commercial site preparation, parking lots, residential uses including foundation preparation and drainage, and backfill.

Due to an absence of granular materials, coarse aggregate production in the Halifax- Dartmouth region comes from quarries rimming the metropolitan area. The primary source of these materials is quartzite although a small amount of granite is also produced. All concrete and mortar and some asphalt sand is trucked from outside the metro area from as far away as 115 km (Coldbrook, Kings County).

In Sydney, most of the aggregate production comes from the Meadows Road sand and gravel deposits, and several quarries located west and southwest of Sydney.

In most other regions of the Province, local sand and gravel deposits provide the bulk of aggregate materials. However, new quarries are being developed in regions where these deposits are scarce or of poor quality.

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Export Market

A substantial aggregate export market has developed in the Province in recent years. More than 1.0 Mt of crushed stone and granular materials are exported annually. The exported stone is produced by Construction Aggregates Limited at Auld Cove, Guysborough County, Permanent Concrete Ltd. at Folly Lake, Cumberland County and S. W. Weeks Construction Limited, Barneys River Station, Pictou County. Construction Aggregates Limited established their quarry in 1978, producing in excess of 1.0 Mt of aggregate annually. Over 90 per cent of their production is exported and shipped by bulk ocean carrier to destinations such as Bermuda and several ports in the United States including Savannah, New Orleans and Houston. Major reasons for this success are the tidewater location of the operation and the fact that bulk shipping is a very cost-effective method for transporting the materials. Permanent Concrete Ltd. has both granular and bedrock deposits, exporting their materials by rail to Quebec, New Brunswick and Prince Edward Island. S. W. Weeks Construction Ltd. exports granular materials to Prince Edward Island using trucks and the ferry system.

Consumption of aggregate is steadily increasing in the United States, and this trend should continue. It is becoming more difficult for many of the East Coast centres to meet their needs locally. Consequently they are faced with importing material from the international market. Because of Nova Scotia's maritime location near the U. S. border, it is ideally situated to take advantage of this market.

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Mineral Rights

Under the current Mineral Resources Act, sand, gravel and stone are not Crown minerals. In order to open and operate a sand/gravel pit or a crushed rock quarry, the surface rights for the property must be held by the owner/operator of the quarry or arrangements must be made with the land owner to develop the quarry. Permission to establish an operation must be obtained from the Nova Scotia Department of the Environment. Regulation of health and safety procedures in an operating pit or quarry is the responsibility of the Nova Scotia Department of Labour. (See Mineral Rights, Landowners, and Mineral Exploration, by Nova Scotia Department of Mines and Energy, February 1986.)

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Photo: (Not presently available)

Cover Photo: Construction Aggregates Ltd., Aulds Cove, Guysborough County.

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Figure: (Not presently available)

Figure 1. Annual aggregate production for Nova Scotia.

Figure: (Not presently available)

Figure 2. Major sand and gravel deposits in Nova Scotia.

Figure: (Not presently available)

Figure 3. Distribution of offshore sand and gravel deposits.

Figure: (Not presently available)

Figure 4. Annual production of granular aggregate and crushed stone in Nova Scotia.

Figure: (Not presently available)

Figure 5. Long haul aggregate transportation patterns in Nova Scotia.

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