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DETAILED AGGREGATE-RESOURCE ASSESSMENT PROJECT, NEWFOUNDLAND AND LABRADOR

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ABSTRACT

This report summarizes the results of the 1989 field program to assess the aggregate-resource potential of (a) the Holyrood quarry area, (b) the Springdale municipal planning area, (c) the Grand Falls region, and (d) the Happy Valley–Goose Bay and Northwest River areas. One hundred and forty-five sand, gravel, till and rock samples were collected and analyzed.

The study was successful in expanding the limits of the Holyrood deposit, and in identifying high-quality aggregate reserves at Springdale and Grand Falls. In the Happy Valley–Goose Bay and Northwest River areas, a number of deposits were identified but their location and small reserves makes development of these deposits for the area unlikely.

INTRODUCTION

The program of aggregate-resource assessment is ongoing. It was initiated in 1982 to undertake a detailed assessment of the aggregate-resource potential in selected areas of the province. The program has focused on areas where municipal plans are being developed or where detailed aggregate information is required to meet a specific need (i.e., aggregates for export). The existing aggregate-resource database (Kirby *et al.*, 1983) defines land-use conflict areas, but it is not adequate in providing detailed information on the aggregate resources, necessary to resolve these problems. Detailed studies, such as this report, should provide the necessary information required to resolve these various land-use conflicts.

The 1989 field program was directed to four areas of the province: Holyrood, Springdale, the Grand Falls area (Figure 1), and the Happy Valley–Goose Bay and Northwest River area (Figure 2).

FIELD PROGRAM

Prior to the field season, all aggregate-resource and surficial data were reviewed and from this review, potential areas for detailed assessment were selected.

The first phase of field work involved driving along all roads and trails to verify and update data on previously sampled deposits and to examine unsampled surficial deposits. Foot traverses were made in areas of potential quarry development and sites were then selected for sampling.

Backhoe test-pits were used, where possible, to determine the extent, quantity and quality of the aggregates sampled. Where a backhoe was not utilized, natural exposure or shallow hand-dug pits, 1- to 2-m deep, were used.

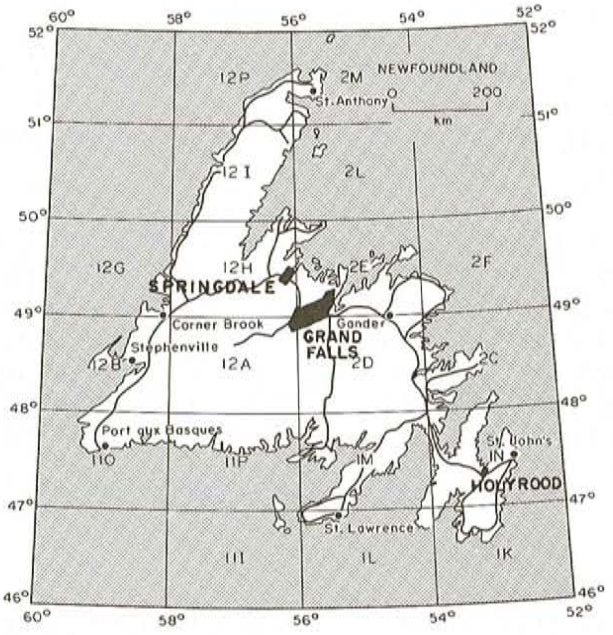

Figure 1. *Study areas for insular Newfoundland.*

Data Analysis and Storage

During the 1989 field program, 145 aggregate and rock samples were collected. Samples of unconsolidated aggregates, containing greater than 8-mm-size material, were sieved through a bank of 4 field sieves (63, 31.5, 16 and 8 mm). A split of the finer than 8-mm fraction were retained for laboratory sieve analysis, which followed the procedure outlined by Kirby *et al.* (1983). A split (about 100 pebbles) of the 16- to 31.5-mm pebble fraction was retained for field lithological and petrographic analysis, following procedures

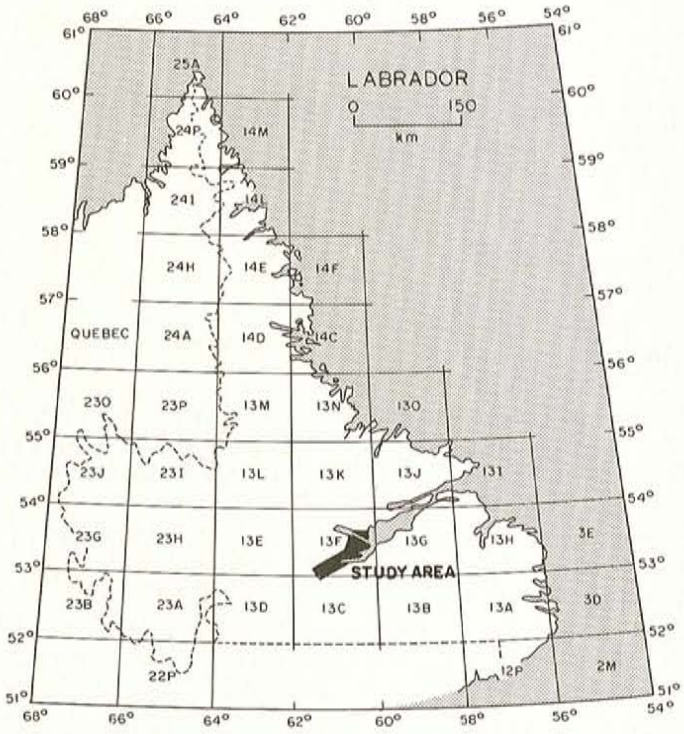

Figure 2. *Study areas for Labrador.*

outlined by Bragg (1986). Data is stored on a microcomputer and available upon request.

In this paper, observations made on deposit quality are based on standards obtained for the Newfoundland Department of Transportation specification book, which are based on ASTM standards for granular materials. The highest petrographic number permitted for use in concrete is 130, whereas asphaltic pavement is 135 (Specifications Book, 1987).

STUDY RESULTS

Holyrood Area

The Holyrood quarry area (Figure 3) is one of the major suppliers of concrete aggregate to the St. John's, Mount Pearl and the eastern Avalon region. A backhoe test-pit program was conducted in the area, east and south of the existing quarries (Figure 3), to determine the quality and extent of reserves to enable proper regulatory protection from conflicting land uses. Seventeen test pits were dug to an average depth of 3.5 m. The average grain-size distribution for the sixteen samples collected was 57.5 percent gravel, 37.6 percent sand and 4.9 percent silt–clay; the average petrographic number is 120. These results are consistent with samples analyzed from the working faces of the existing quarries. Additional work will be undertaken to determine the northern extent of this deposit (Figure 3).

Springdale

A detailed aggregate assessment was undertaken because a review of the municipal plan of the Springdale area was being done. The existing surficial and aggregate data had shown that the Springdale area contains extensive glaciofluvial outwash material, mainly composed of sand and gravel (Figure 4). Due to its flat surface features and well-drained soil, extensive agricultural development has made much of this area unavailable as a source of aggregate material. The aggregate assessment attempted to identify the better quality deposits, within the planning area, so that they could be protected within the municipal plan, to meet the present and future aggregate needs of this area.

The study has shown that there are three usable deposits of sand and gravel within, or partially within, the Springdale municipal planning area. The first is located at Springdale and is a raised glaciomarine delta deposit, 75 m a.s.l., consisting of stratified sand and gravel having an estimated reserve, based on field observations, of 2,500,000 m³ (Deposit I, Figure 4). The average grain-size distribution for six samples collected was 47 percent gravel, 53 percent sand and less than 1 percent silt–clay (having a grain-size range between 37 and 62 percent gravel, 37 and 62 percent sand and less than 1 percent silt–clay); the average petrographic number is 129. The rock types, which make up the pebble fraction, are all intrusive and extrusive rocks. This deposit is used extensively and is the main source of concrete aggregate for the Springdale area.

The second deposit, which is located at Halls Bay, is also a raised glaciomarine delta consisting of stratified sand and gravel (Deposit II, Figure 4). The major part of the deposit falls just outside the planning area, but was included in the study, because the extensive agricultural and cabin development in the area threatened to sterilize the deposit. The average grain-size distribution for nine samples collected was 40 percent gravel, 60 percent sand and less than 1 percent silt–clay; the average petrographic number is 276. The main reason for the relatively high petrographic number is the large amount of highly weathered, undefined rock types and the moderate weathering of the remaining rock types. Further testing would have to be done to determine if this deposit is suitable for concrete or asphaltic pavement, but would likely be more suitable as a source of crushed A- or B-grade road gravels. Estimated reserves based on field observations are in excess of 10,000,000 m³.

The third deposit is located approximately 1 km from the Springdale Junction (Deposit III, Figure 4). Where exposed, the deposit is mainly comprised of stratified sand and gravel, although a 2.5-m exposure of medium sand and scattered pebbles was sampled in a quarry located in this deposit. The average grain-size distribution for 5 samples collected from this deposit shows 39 percent gravel, 60 percent sand and 1 percent silt–clay; the average petrographic number is 274. Although all the rock types present are igneous, the main reason for the relatively high petrographic number is the moderate weathering of the feldspar-rich

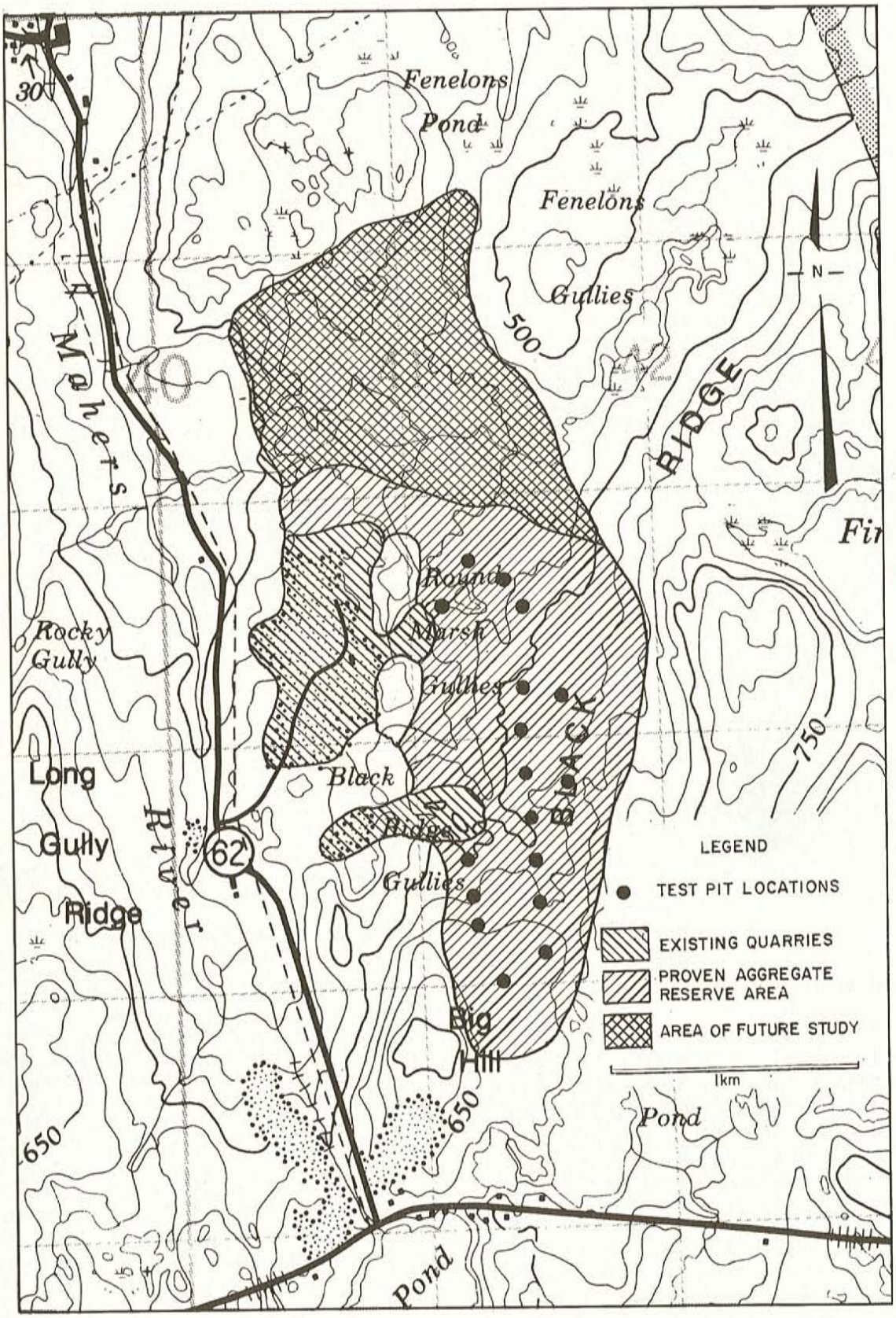

Figure 3. *Holyrood study area.*

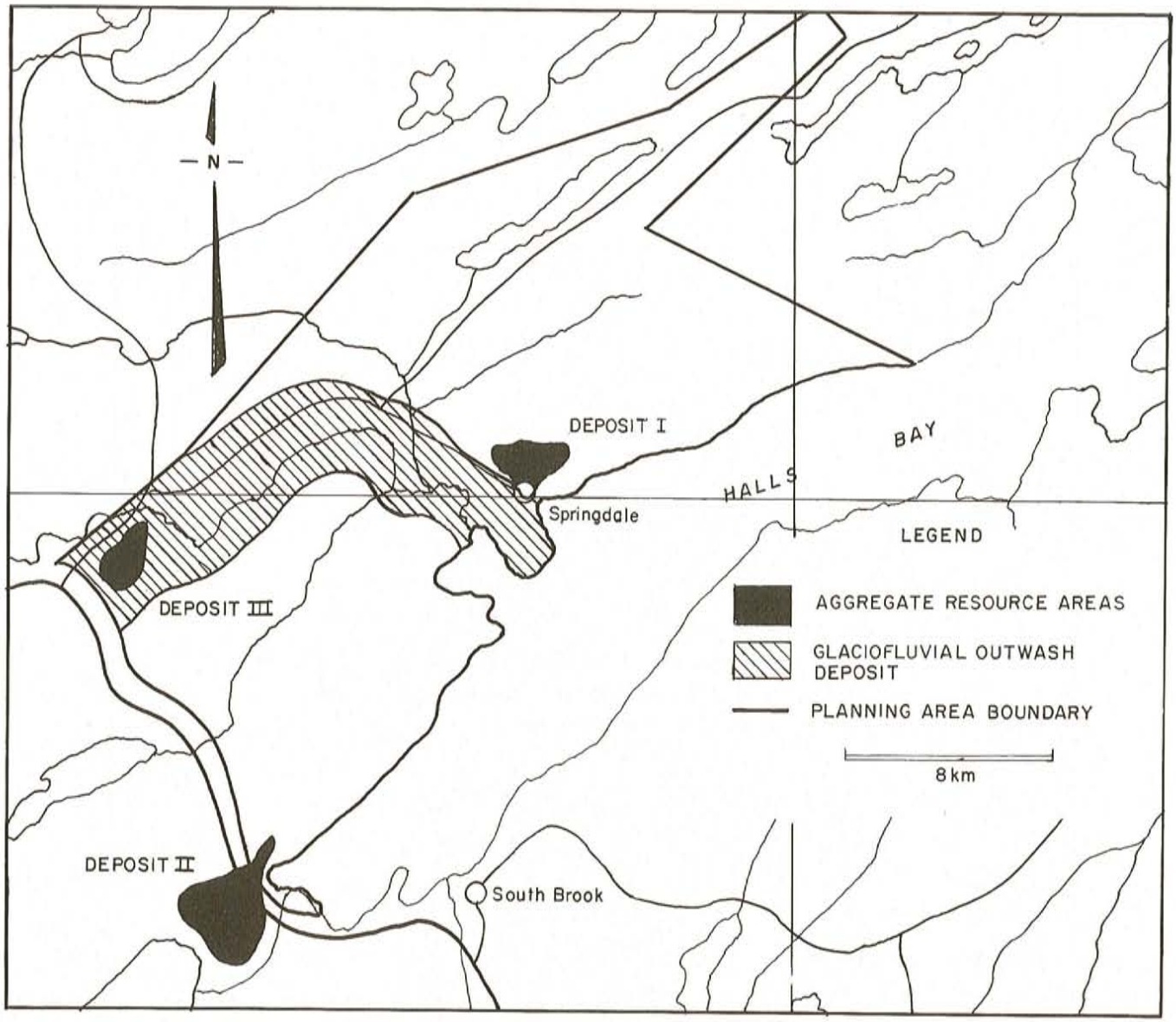

Figure 4. *Proposed aggregate-reserve areas within the Springdale municipal planning area.*

granites and the presence of a number of highly weathered rock types.

Tills, where observed, were commonly confined to a thin veneer over bedrock. The grain-size distribution for many of these tills averaged 29 percent gravel, 53 percent sand and 18 percent silt–clay. Where till samples were taken, immediately adjacent to glaciofluvial deposits, the tills were more sandy having an average grain-size distribution of 62 percent gravel, 33 percent sand and 5 percent silt–clay. The petrographic numbers of the tills range between 200 and 500 and are mainly dependent on the amount of undefined, highly weathered pebbles in each sample. The high silt content of many of these tills and the poor petrographic quality of these materials make them unsuitable as sources of crushed aggregate materials, and may only be useful as sources of fill material.

Potential bedrock aggregates in the area are either from sedimentary or volcanic bedrock sources. The sedimentary rocks are confined to the southern part of the planning area and consist of sandstones and conglomerates (Bragg, 1985). Where hard and fresh, the sandstone units make good sources of aggregate. The conglomerates are less desirable because they continue to breakdown over time, due to the relatively weak internal cement bonding of the individual pebble components (Bragg, 1985). The volcanic rocks are exposed generally north of Indian Brook and mainly comprise pyroclastic and metavolcanic rocks (Kean, 1984). These fine-grained, extrusive rocks are excellent sources of crushed material, but require testing if they are to be used in concrete, because of the possibility of alkali reactivity.

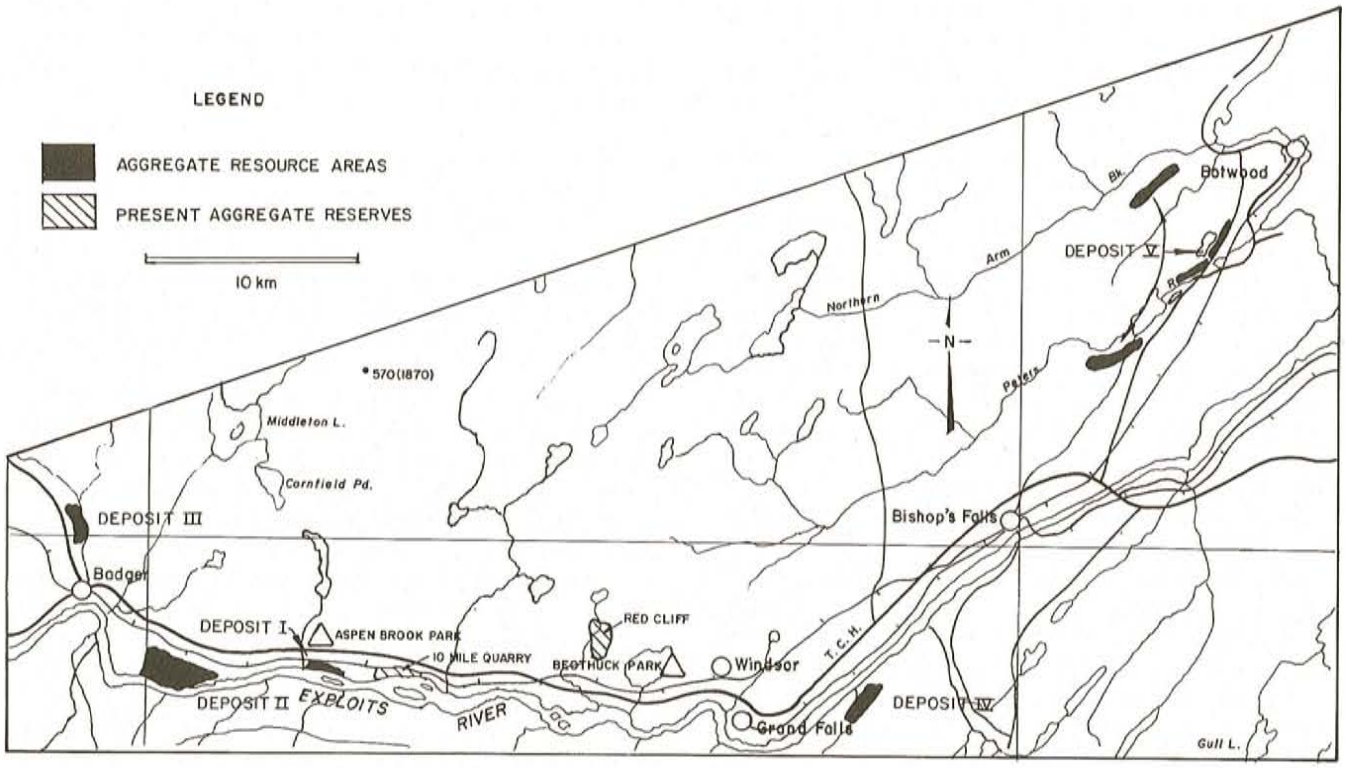

Figure 5. *Aggregate-resource areas within the Grand Falls study area.*

Grand Falls Area

This study was undertaken in an attempt to identify sources of high-quality sands and gravel within a 30-km radius of Grand Falls. Grand Falls is rapidly depleting its main sources of sand and gravel at Red Cliff and 10-mile quarry (Figure 5). As these two sources near exhaustion, new sources of aggregate are required to meet the growing demands of the region. In 1982, aggregate-assessment studies identified a number of sources within close proximity to Grand Falls, but environmental concerns and private land ownership makes development of these deposits highly unlikely (Kirby, 1983).

The major part of the current survey in this area was confined to the west of Grand Falls. Three sites were identified as having potential for development (Figure 5). The first deposit is located about 17 km west of Grand Falls (Deposit I, Figure 5), and is composed of a pebble–cobble gravel having a grain-size distribution ranging from between 55 and 68 percent gravel, 32 and 44 percent sand and less than 1 percent silt–clay. The presence of highly weathered shale and undefined rock types results in an average petrographic number of 180 for this deposit. Testing would have to be conducted to determine the effects of these highly weathered rock types on the quality of the aggregates used in asphaltic pavement or concrete.

The second deposit (Deposit II) is located about 23 km west of Grand Falls. The area consists of a number of interfluves grading into a glaciofluvial terrace. Nine hand-dug pits were dug in the interfluve area and the analysis of the samples collected gave an average grain-size distribution of 67 percent gravel, 32 percent sand and 1 percent silt–clay. The presence of highly weathered shale and undefined rock types results in an average petrographic number of 186 for this deposit. Before the aggregate is used in asphaltic pavement or concrete, testing needs to be conducted, to determine the effects of the undesirable rock types. No sampling was conducted in the terrace area. Subsequent to the assessment in the area, a local aggregate producer conducted extensive backhoe testpitting, which verified the presence of high-quality sand and gravel in both the terrace and ridged area.

The third deposit (Deposit III) is located just north of Badger (Figure 5) and consists of stratified sand and gravel. The average grain-size distribution for eleven samples collected is 44 percent gravel, 54 percent sand and 2 percent silt–clay; the average petrographic number is 203. The relatively high petrographic number is due mainly to the presence of moderately weathered siltstone clasts and the presence of highly weathered undefined rock types. Further testing will have to be done to determine the suitability of this deposit as a source of asphaltic pavement or concrete aggregate. Much of this resource area has been sterilized due to private land ownership in this area; estimated reserves are in excess of 300,000 m^3.

There are two areas of study east of Grand Falls, one on the south side of the Exploits River, and the other, an esker complex in the Botwood area. The deposit south of the Exploits River (Deposit IV) is a stratified pebble–cobble gravel

deposit. The average grain-size distribution for four samples collected is 68 percent gravel, 31 percent sand and less than 1 percent silt–clay; the average petrographic number is 190. The high petrographic number is mainly the result of the presence of highly weathered shale and undefined rock types. Since the study was completed, this deposit has been heavily utilized and is now nearing exhaustion. The esker complex near Botwood (Deposit V), although extensive, is of poor quality as a source for concrete or asphaltic pavement. The eskers are 30- to 32-m high and are composed of stratified sand and gravel, having an average grain-size distribution of 39 percent gravel, 56 percent sand and 5 percent silt–clay; the average petrographic number is 308. The poor petrographic characteristics of the deposit are mainly due to the presence of moderately weathered micaceous sandstones. The presence of mica renders this deposit unsuitable as a source of concrete or asphaltic pavement aggregate due to its high susceptibility to mechanical and chemical weathering.

Tills in the Grand Falls area are generally sandy although, locally, silt–clay contents reach 16 percent. The average grain-size distribution for 40 till samples collected throughout the area is 57 percent gravel, 37 percent sand, 6 percent silt–clay; the average petrographic number is 238. The relatively high petrographic number is the result of highly weathered undefined rock types.

The main bedrock units exposed within the study area are slate, siltstone, greywacke, sandstone and felsic volcanics (Bragg, 1985). Slate is generally a poor source of aggregate material, because of its low tensile strength and cleavage. The remainder of the bedrock types exposed in the area are generally good sources of aggregate material, provided they are fresh and not highly altered.

Happy Valley–Goose Bay, North West River Area

An aggregate-resource survey was undertaken in the Happy Valley–Goose Bay and North West River municipal planning areas in 1986 (Kirby, 1987). This survey failed to locate any significant deposits of sand and gravel. In 1988, a backhoe testpitting program was conducted by the Department of Mines in the Birchy Hill area of North West River (Kirby, 1989), but failed to locate any aggregate suitable for use in concrete or asphaltic pavements. This leaves Sunday Hill as the only readily available source of high-quality aggregates in the region.

This present study was conducted within a 50-km radius of Happy Valley–Goose Bay (Figure 6). The first phase of this study involved backhoe testpitting in the Goose River area. A total of 22 test pits were dug to an average depth of 3.4 m and the majority of these testpits intersected silty sand lenses, but 7 pits intersected 1 to 2 m of pebble gravel, overlain by 1 to 1.5 m of silty sand (Deposit I, Figure 6). In all but one pit, the gravel samples were below the water table. The average grain-size distribution for five gravel samples collected from these pits was 46 percent gravel, 53 percent sand and 1 percent silt–clay, having an average petrographic number of 125. Due to the proximity of this deposit to the Goose River (within 50 m), and the fact that much of the deposit is below water table, it is unlikely that this deposit could be developed as a source of aggregates for the Happy Valley–Goose Bay area.

Deposit II was located at the edge of an abandoned quarry (Figure 6), and is composed of a pebble–cobble gravel, having an average grain-size distribution from four samples of 69 percent gravel, 31 percent sand and <1 percent silt–clay, and an average petrographic number of 115. Because the showing was overlain by 10 m of fine sand and was below the water table, an estimate of reserves could not be made.

The third deposit (Deposit III) is located about 40 km west of Goose Bay along the banks of Peters River. This deposit is a glaciofluvial terrace composed of a pebble–cobble gravel. The average grain-size distribution (for 15 samples collected) is 64 percent gravel, 34 percent sand and 2 percent silt–clay, having an average petrographic number of 112. When washed, this material would make an excellent source of concrete aggregate, however, there are two problems, which will hinder the development of this resource. First, the deposit is located 40 km west of Goose Bay over a gravel road, which would make transportation costs so high as to make the deposit uneconomic; and second, the majority of the deposit is located across Peters River, which would mean the construction of a 30- to 40-m-long bridge, capable of handling heavy trucks and withstand the spring ice-breakup.

Deposits IV and V are located 35 and 42 km, respectively, west of Happy Valley–Goose Bay on the Churchill Falls Road. Deposit IV is composed of a 1- to 3-m veneer of gravel over bedrock that is confined to a thin band just above the postglacial fluvial terraces of the Churchill River Valley and above the till exposure. The average grain-size distribution for five samples collected from this deposit is 62 percent gravel, 38 percent sand and <1 percent silt–clay; the average petrographic number is 126. Although reserves are small, the material is an excellent source of concrete or asphaltic pavement aggregate. Deposit V is composed of stratified sand and gravel having an average grain-size distribution for 5 samples of 86 percent gravel, 14 percent sand and <1 percent silt–clay; the average petrographic number of 100. Again, this deposit is an excellent source of aggregate for both concrete or asphaltic pavement production. Development of these deposits is unlikely because excessive haulage distance and small size would make them uneconomical, and existing cabin developments on these deposits have sterilized much of these deposits.

Tills within the study area are very poor for any type of aggregate use with silt–clay contents ranging between 16 to 26 percent.

The bedrock geology of the area is dominated by rocks of the North West River anorthositic intrusive suite and rocks of the Dome Mountain intrusive suite (Wardle and Ash, 1986). Monzonite, anorthosite and granitoid rocks are the dominant rock types exposed. For the most part, these rocks are

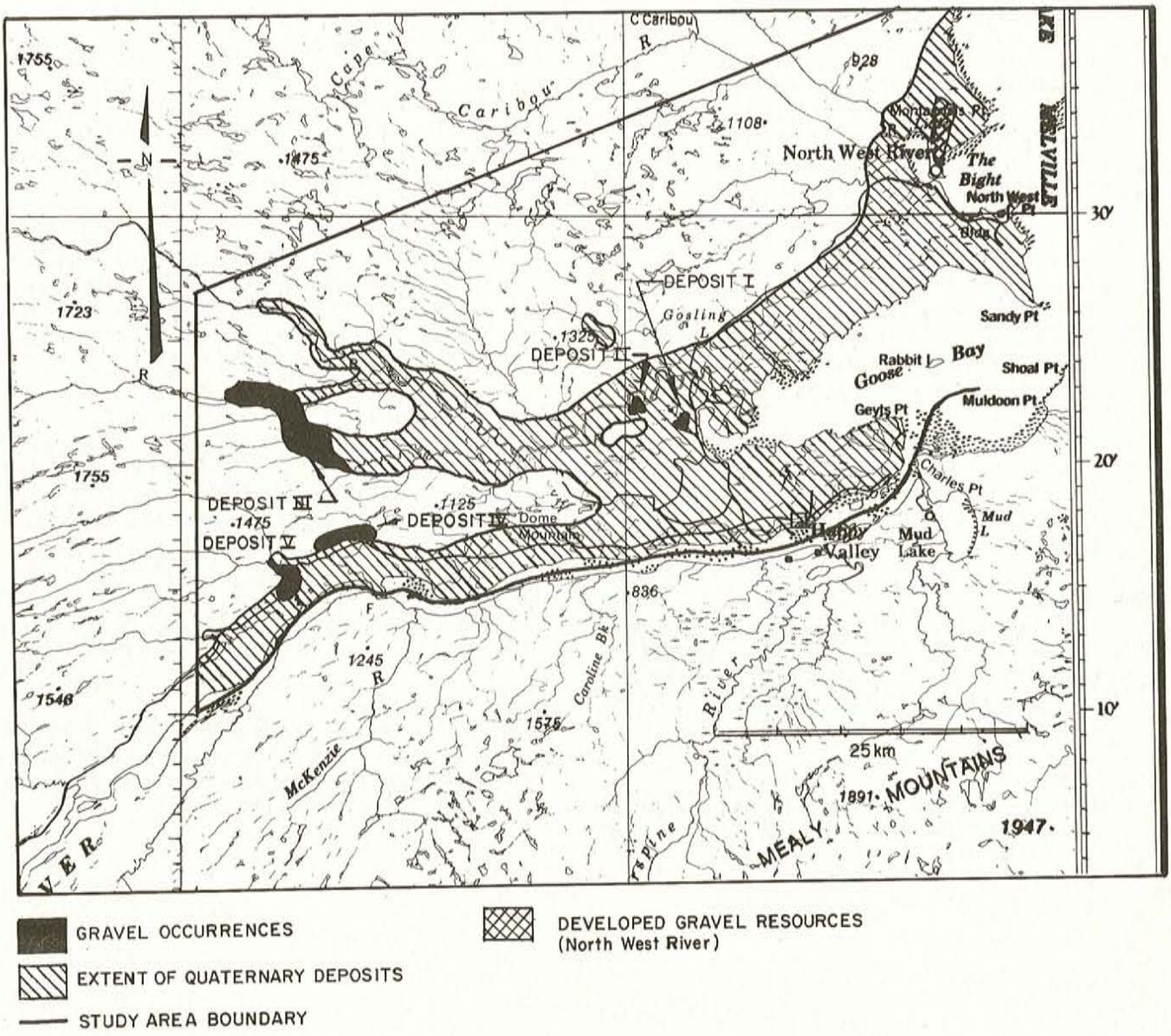

Figure 6. *Gravel resources within the Happy Valley–Goose Bay area.*

excellent sources of crushed material for use in asphaltic pavement and crushed road gravel. Before use as a source of concrete aggregate, further testing is recommended (e.g., for alkali reactivity).

SUMMARY

During the 1989 field season, 145 aggregate samples were collected and analyzed. The results are as follows:

(1) Holyrood–A backhoe testpitting program in the Holyrood quarry area has verified the continuation of a high-quality aggregate reserve to the east of the existing quarries. Future assessments will continue the survey northward, to determine the extent and quality of the deposit in that direction;

(2) Springdale–Three areas were identified within the Springdale municipal area as containing aggregate reserves suitable to meet the aggregate needs of the area. The results of the survey will be forwarded to the Department of Municipal and Provincial Affairs for inclusion into the municipal plan being prepared for the area;

(3) Grand Falls–Work in the Grand Falls area was successful in identifying an area of high-aggregate potential, capable of supplying high-quality aggregates to the Grand Falls and area market, and

(4) Happy Valley–Goose Bay–The survey identified a number of potential aggregate sources, but groundwater problems, land-use conflicts and distance from the market, combined with poor road conditions, make it unlikely that any of these sources can be economically exploited at present.

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