Part 2.

Geotechnical Discussion of Bedrock Aggregate Potential in Western Halifax Regional Municipality

A Resource Study with the Future in Mind

Given the costs associated with alternative aggregate sources, it is the opinion of the authors that part of the solution to this looming resource dilemma should include creative planning efforts to protect some of the local aggregate potential before it disappears. As a result Nova Scotia Department of Natural Resources initiated this study to re-examine the aggregate resource in the Metro area with a focus on resource development and land use issues. The goal is to evaluate the remaining resource land and determine if there are still aggregate deposits near Metro which can be quarried while minimizing the impact to the community. It is anticipated that the results of this study will permit HRM to continue to realize the overall benefits associated with local sources of stone. The discussion which follows is a summary of the results of the research.

Methodology

This study was conducted in three phases. The preliminary phase was an examination of background information such as geological maps, resource data, the property ownership database and air photos to determine a focus area for the research. This was followed by a field phase to examine the geology and other technical parameters which would affect the placement of a quarry. The initial fieldwork was of a reconnaissance nature over a large area. Once this was completed, specific sites within the study area were outlined which might contain suitable rock and were amenable to surface sampling. Samples were collected from these selected sites to determine if the quality of stone was suitable for construction aggregate. In the final phase of the project the field data and the analytical results were evaluated to determine the suitability of the area for aggregate resource development. For a more comprehensive look at the procedure used to identify potential quarry sites, refer to Appendix 1.

Scope

Based on the selection process outlined above and in Appendix 1, the investigation focused on the fine- to medium-grained granitic rocks of the South Mountain Batholith at the western end of HRM. The decision to study the finer grained granitic rocks is based on the premise that they are appreciably harder, more durable rock types that tend to perform better in aggregate tests than the coarse grained equivalents found in the area (Prime, 2001). There is also a low probability that the granitic rocks will contain chemically reactive rock types or minerals. But probably most important is the 'remoteness' of the area and the low impact that development would have on the community. It is important to note, however, that other areas in the region, not included in this report, may have similar resource potential.

The area covered by this report (Fig. 3) lies to the west of the Stillwater Lake/Upper Tantallon area between eastings 417000 E and 428000 E. It is approximately bounded by the northerly trending Sandy Lake and Big Indian Lake on the east and a line running approximately north from Hubbards on the west. It is bounded on the south by Route 103. The northern boundary is defined by the Halifax County - Hants County line. There are multiple land owners in parts of the study area, but the property that is the main subject of this report is owned by one private land owner.

Regional Geology and Physiography

The study area is located within the physiographic region known as the Southern Uplands

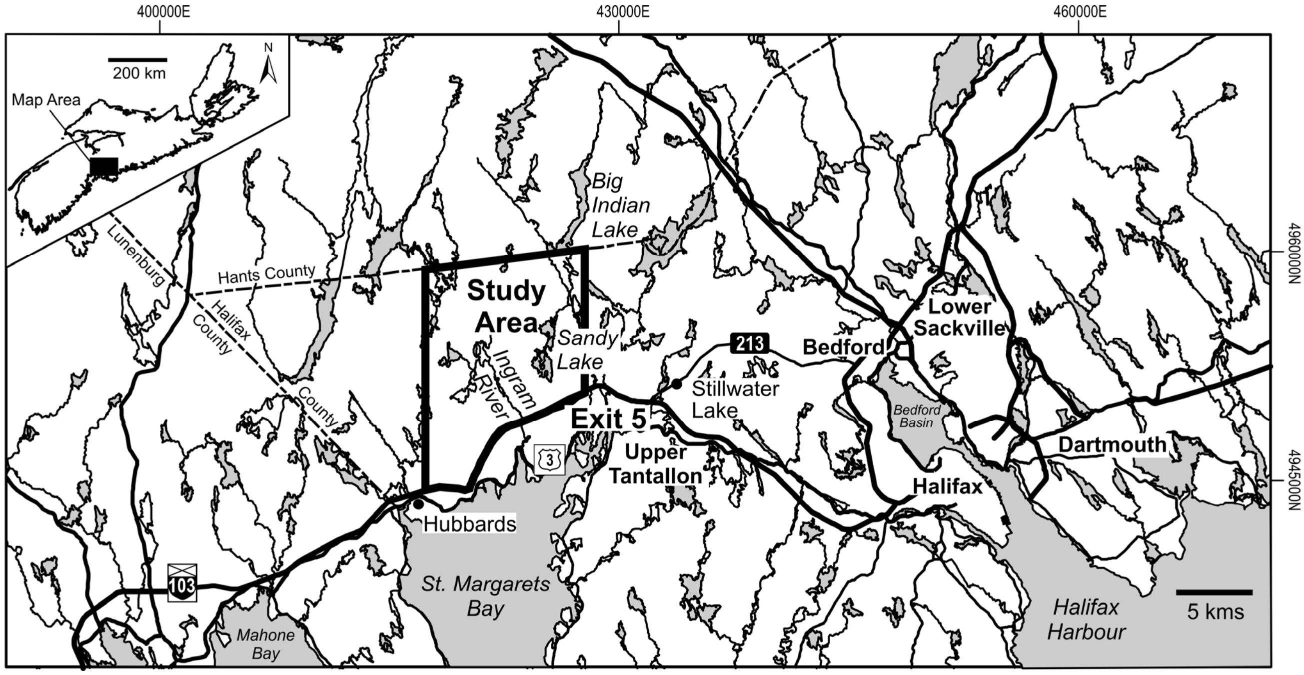

Figure 3. Map showing the study area in relation to the Halifax - Dartmouth metropolitan area.

(Goldthwait, 1924) and lies completely within the South Mountain Batholith, a large granitic body covering much of the western portion of the Meguma Zone. The magma which produced the Batholith was emplaced in several pulses or phases into the sedimentary rocks of the Meguma Group during the Late Devonian. Each phase was characterized by specific minerals and rock types as the molten material cooled to produce rock. The Batholith in the study area consists of several granitic lithologies which include monzogranite, leucogranite and leucomonzogranite (MacDonald *et al.,* 1992). The overlying portion of the Meguma Group country rock, as well as any younger bedrock, which was deposited on top of the granite, were subsequently removed by erosion associated with the wearing down of the Appalachian Mountain Range over hundreds of millions of years.

Disconformably overlying the granitic rocks are the unconsolidated sediments generated over much of the last 100 000 years by Pleistocene glaciation. This comparatively recent, large scale erosional/depositional event significantly modified the landscape during several stages of ice advance. With each successive forward movement of ice, fragments of the bedrock and former surficial materials were incorporated into the glacial ice. When the rock- and sediment-laden ice finally melted, about 12 000 years ago, the landscape which formed was a mosaic of geomorphological features reflecting the dynamic processes of several generations of ice advancement and retreat. In the study area this resulted in scattered areas of scoured bedrock, large areas of thin till (composed of the unsorted rock and soil deposited by glaciers) and areas of thick, hummocky ablation till. As a result of glacial deposition and bedrock related topographic features, the region consists of ridges, stream valleys, hummocky terrain, lakes and other wetlands. A northwest-southeast alignment of bedrock features (ridges, swales, streams and lakes) predominates, with a secondary pattern oriented to the northeast. This is overprinted by glacial land forms which predominantly strike in a general north-south direction. The modern streams, which formed following deglaciation, have modified the glacial deposits on a minor scale, however the land has remained quite constant in the area over the last 12 000 years.

The area is covered by arboreal forests predominated by pine, spruce, balsam fir, hemlock and a mixture of hardwood species. Most recently, the area has been modified by modern forestry management practices. Today, an extensive series of haulage roads permit access to most parts of the region. The study area consists of a patchwork of mature tree stands, clear cuts, tree plantations and naturally regenerating forests in various stages of maturity.

Results

The rocks that are the focus of the study (Fig. 4) are three leucomonzogranite units: the Tantallon Leucomonzogranite (MacDonald and Horne, 1987), the Panuke Lake Leucomonzogranite (Ham and Horne, 1987; Corey, 1987, 1990), and the New Ross Leucomonzogranite (Ham and Horne, 1987; Corey, 1990). The New Ross unit is predominantly fine- to medium-grained, whereas the Panuke Lake and Tantallon units vary from equigranular and fine grained to a porphyritic texture with a small percentage (<5%) of feldspar megacrysts. The Tantallon and Panuke Lake leucomonzogranites are equivalent rock types. The name variation is simply a reflection of field relations recognized during mapping by various authors. A description of the grain size and textural terminology is provided in Appendix 2. A medium grained phase in the Sandy Lake Monzogranite (Corey, 1987) was also examined, but it was not considered to be a primary target at the outset of the research. Based on the geological map descriptions, it was initially suspected that these rocks were coarse grained and less likely to produce high quality construction materials. However, the fieldwork during this study quickly established that the rocks were medium grained in the study area and worth considering for aggregate potential. (Refer to the implications of grain size for aggregate potential in the next paragraph.) Twenty-four samples from different locations were collected and tested for construction aggregate potential. A description of the sample locations and rock types is provided in Appendix 3. The analytical results of the aggregate tests are found in Table 3.

All of these rock types are typical granites with slight variations in mineral composition, which should have little bearing on their performance as an aggregate. The important characteristic for this study is grain size. Most of the fine- and medium-grained rocks in the study area have a fairly homogeneous grain size, with local occurrences of highly variable grain size. Coarse grained and porphyritic granites are the chief exceptions to this general observation. Coarse grained granites commonly contain an abundance of feldspar megacrysts and generally have a hypidiomorphic-granular texture, but they were not studied as part of this research, nor are they considered a primary target for aggregate exploration (Prime, 2001). Porphyritic granites, on the other hand, contain large crystals in a fine grained matrix. The porphyritic granites are included here because the phenocrysts are small (<1.5 cm) and the rock should perform reasonably well in aggregate testing. The fine- to medium-grained granites with scattered megacrysts are also included for similar reasons.

Two reference maps accompanying the discussion are located in the back pocket of this report. Figure 5 is a detailed geological map showing the location of the samples. Figure 6 is a digital elevation model (DEM) map illustrating topographic features in relation to the potential aggregate sites, and routes to the nearest aggregate market. Simplified and smaller versions of the maps are found in the body of the report (Figs. 4 and 7).

Resource Assessment Challenges

Before presenting the findings of this study, it is important that the reader has a clear understanding of the relationship between the field methods employed, the geological conditions which exist in the area and the interpretations of this report. The discussion which follows highlights the strengths and weaknesses associated with this field based research. To begin with the fieldwork (the focus of the investigation) relies on bedrock exposure as the main source of information. This presents several challenges when evaluating aggregate potential.

First, there is limited outcrop in this glaciated terrain. In general, the exposed bedrock geology consists of small, scattered outcrops which most likely represent <1% of the land's surface. Refer to the reference geological bedrock maps. If one considers this outcrop in the context of a three dimensional body to a depth where aggregate quarrying might realistically take place, the exposure represents considerably <1% as a volumetric measure. Therefore, the descriptive data and samples may or may not be representative of the geology in the area. For example, an outcrop of competent rock suitable for construction aggregate can occur adjacent to a large area of weathered, friable bedrock which is hidden by overburden. Relying solely on the appearance of the outcrop to

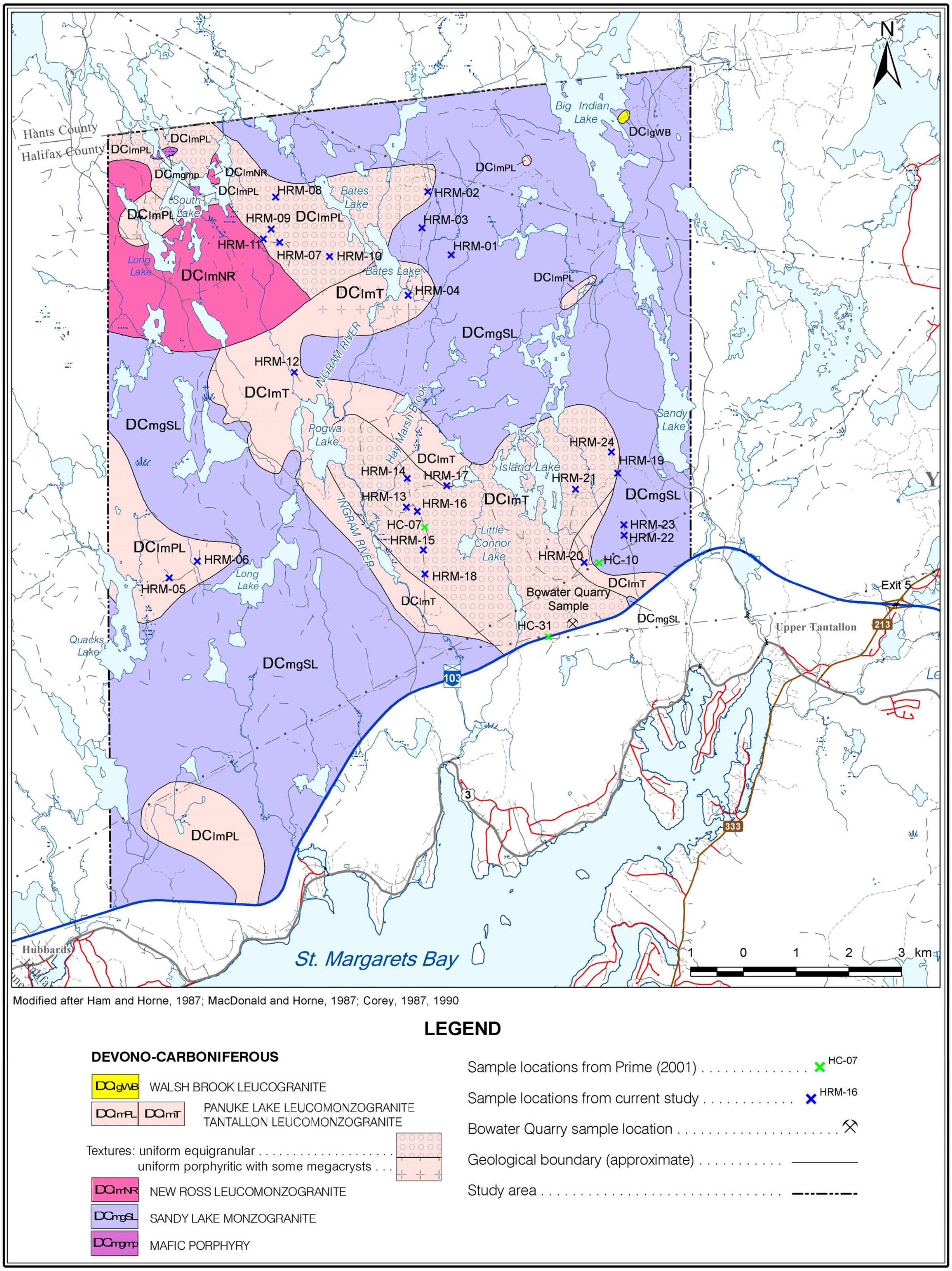

Figure 4. Geological map of the study area showing sample locations. Note that the geology consists entirely of South Mountain Batholith granitic rocks. See Figure 5 (in back pocket) for greater detail.

Table 3. Aggregate test results for samples collected in this study. Note that only those samples labelled with HRM were taken as part of this research.

Sample Number	Reference Locations for Sample Groupings	LA Abrasion Loss %	Absorption %	Bulk Relative Density (SSD)	Petro-graphic Number	Micro-Deval, Loss %
HRM-01	Bates Lake Area	29.7	1.12	2.60	133	7.3
HRM-02		21.8	0.97	2.61	121	6.4
HRM-03		25.3	0.97	2.61	126	7.0
HRM-04		20.3	0.78	2.61	110	5.6
HRM-05		19.9	0.80	2.62	103	6.0
HRM-06		32.2	0.73	2.62	138	8.0
HRM-07	South Lake Area	17.2	0.85	2.62	104	5.8
HRM-08		20.1	0.98	2.61	111	6.3
HRM-09		24.0	1.19	2.61	119	6.4
HRM-10		23.6	1.09	2.61	115	8.1
HRM-11		15.9	0.96	2.61	110	5.2
HRM-12		18.7	0.75	2.63	116	5.3
HRM-13	The Hay Marsh Area	27.7	1.00	2.61	141	8.4
HRM-14		31.1	1.33	2.59	175	10.1
HRM-15		23.9	0.91	2.61	129	6.9
HRM-16		29.0	0.76	2.62	132	7.3
HRM-17		32.0	0.71	2.62	142	7.3
HRM-18		24.0	0.70	2.61	111	5.6
HRM-19	Island Lake Area	20.2	0.99	2.60	142	6.3
HRM-20		26.6	0.82	2.63	132	7.1
HRM-21		21.2	1.01	2.60	132	6.4
HRM-22		17.5	0.81	2.61	128	4.5
HRM-23		18.9	1.03	2.61	136	6.3
HRM-24		26.7	0.84	2.62	128	6.2
Bowater Quarry Hwy 103*		32.0	0.7	2.62	113	-
HC-07**		33.1	0.84	2.586	100.4	-
HC-10**		31.3	1.36	2.55	102.2	-
HC-31**		32.3	0.75	2.595	-	-

Samples HRM-01 to -24 tested by Jacques Whitford Materials Limited, Dartmouth, Nova Scotia, Project No. NSD 17533; February 2003, using methods outlined in Prime (2001).

*Test results from sample of aggregate produced in quarry on Bowater Mersey Paper Company Limited property. Materials were used by Dexter Construction Co. Ltd. in a Nova Scotia Department of Transportation and Public Works highway contract. Refer to Appendix 5 for detailed results.

**Test results from samples taken in previous study (Prime, 2001). Samples tested by Warnock Hersey Professional Services for Technical University of Nova Scotia Aggregate Survey, samples WHPSL # 907, #909, #931; 1990.

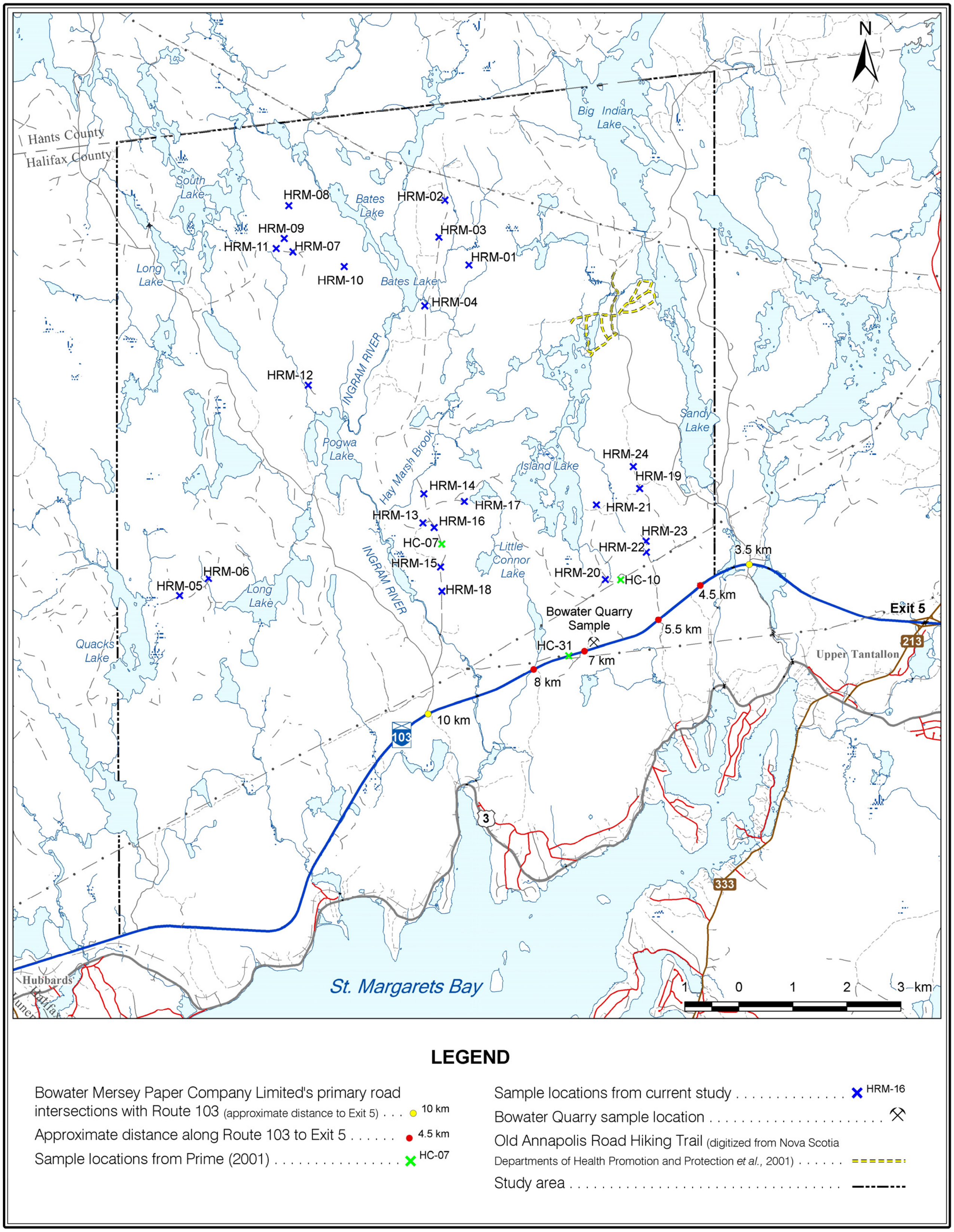

Figure 7. Map showing distances, in the study area, to nearest aggregate market access point at Exit 5, Upper Tantallon. See Figure 6 (in back pocket) for topographic details in the region.

make resource decisions at this hypothetical location could be a costly mistake.

Second, the quality of the outcrop must be considered. Surface weathering is present in almost all of the naturally occurring exposures. Since deglaciation, the bedrock surface has been exposed to precipitation, acid rain, freeze-thaw cycles and the physical and chemical effects of vegetation. There can also be a great deal of variation in the degree of weathering. Usually the fine- to medium-grained rocks exhibit little surface weathering (i.e. a few millimetres). Conversely, coarse grained rock, which is microfractured and altered, can have thick weathered zones (i.e. centimetres in thickness). Some of the surface weathering may even extend deeper than can practically be penetrated using hand tools to access fresh stone. It also can be difficult to visually determine if the sample being taken is in fresh rock (beneath the weathered stone). Man-made exposures (e.g. ditches or road cuts), on the other hand, can be quite fresh at the surface. However, they are still subject to near surface exfoliation fracture systems and related weathering mechanisms. As a result, data from aggregate tests on surface samples may vary significantly from the overall quality of the materials in the deposit.

On the positive side, test results obtained from surface samples can generally be used as a base line for stone quality. Generally one can anticipate better test results for rock obtained from depth using methods such as diamond drilling to extract rock core or test blasting using an air track drill. In other words, a surface sample with marginal test results for construction aggregate may be encouragement that better rock lies beneath.

In summary, fieldwork that relies totally on the examination and sampling of outcrop can lead to erroneous conclusions. Nonetheless, the homogeneity observed by the authors in the granitic rocks of the South Mountain Batholith, coupled with the results of previous geological research (MacDonald *et al.,* 1992), suggests that the likelihood of major problems with the interpretations of these data are low. The geological features that might influence a field study of granitic rocks are illustrated and described in Appendix 4.

General Discussion of Rock Descriptions and Laboratory Test Results

The field examination of the fine- to medium-grained to porphyritic granitic rocks in the study area indicates that they generally have a solid, durable appearance. Joint spacing is commonly moderately to closely spaced (approximately 0.5-1 m). A visual inspection of the weathered, mineral alteration zones adjacent to the joint fractures suggests that they are generally narrow, confined to a few millimetres of thickness away from the fracture faces. Shearing and pervasive surface weathering are locally observed, but do not appear to be common. Alteration (predominantly producing the iron mineral hematite) is common in the rock mass, giving the rock a buff to pale brown to pinkish colour. Locally, where the hematite is more concentrated, the rock is reddish brown. At the rare locations where the rocks are a maroon red, they are commonly accompanied by shearing and a higher degree of alteration. Pods of hematite are scattered in some of the rocks. The joint fracture faces commonly contain iron minerals (hematite and limonite) and less commonly manganese. In general, these iron minerals would make the rock somewhat softer where it is encountered on fracture planes. It should not compromise the overall quality of the rock, however, even though iron minerals can be an indicator of other alteration minerals in the rock. Sulphides were rarely observed in the outcrop. Cordierite, a soft mineral, occurs as scattered mineral grains (<5%) throughout these rocks. Much of the cordierite has been altered to pinite (MacDonald *et al*., 1992), which is a soft mineral. This is observed on surface exposures and along fracture planes where minerals have been completely weathered away to produce pea sized vugs or cavities, giving the rock a pock-marked appearance. Although these soft minerals can be problematic, their scattered nature in the rock suggests that their effect on stone quality should be minor.

The samples collected in the study area were tested for LA Abrasion Loss, Absorption, Bulk Relative Density, Petrographic Number (PN) and Micro-Deval Loss. An examination of the laboratory test results in Table 3 suggests that the fine- to medium-grained rocks should be capable of producing high quality construction stone. Using LA Abrasion Loss of 25% and Petrographic Number (PN) of 135 as maximum numbers for high quality stone, the majority of the rock samples collected (LA Abrasion = 67% of the samples; PN = 75% of the samples) will meet the standards for high quality aggregate. (For a discussion of the tests employed in this study, refer to Prime, 2001.) Most of the other samples are marginally higher than the allowable limits identified above. By increasing the cut off for the LA Abrasion Loss to 30% and the Petrographic Number to PN=140, 87% of the samples meet the LA Abrasion requirements and 83% for the PN. Using a very conservative upper limit of 15% for the Micro-Deval test, all of the samples in the study were well within the allowable limits for highway materials. The only sample which seemed to perform poorly in the tests was HRM -14 (LA Abrasion = 31.1 and PN = 175). Based on field observations of the rock at this location, the high Petrographic Number may reflect a softness in the stone attributable to a higher concentration of alteration minerals. As discussed in Appendix 4, the influences of surface weathering agents on the samples would have at least some impact on the outcome of the tests. If samples of similar composition and properties could have been obtained at a depth of a few metres (i.e. typical of working quarries) somewhat 'fresher' rock accompanied by at least a marginal improvement in their performance as an aggregate would be expected.

In summary, the fine- to medium-grained granites of the study area generally will meet or exceed specifications for high quality construction aggregate. This conclusion is consistent with the findings of Prime (2001) examining similar rocks on a regional scale. Three of these samples (HC-07, HC-10 and HC-31 in Table 3, Fig. 5 (in back pocket)) were taken in the previous study (Prime, 2001). Test results for a quarry opened in 1996 for a highway contract on Route 103 (Bowater Quarry sample in Table 3, Fig. 5 (in back pocket) and Appendix 5) indicate that the materials were satisfactory for the production of asphalt mix (LA Abrasion Loss = 32%; PN = 113). This is significant because the data confirm that the fine- to medium-grained granitic rocks of Late Devonian age in western Nova Scotia will pass the specifications required for construction aggregate. The quality of the stone only appears to be compromised when, (1) there is shearing or closely-spaced fracturing, (2) the rock is highly altered, or (3) deep weathering profiles are present. Any coarse grained, megacrystic rock encountered in the monzogranite unit should be examined with caution in terms of aggregate potential. Although it may pass for construction aggregate, the probability of deleterious weaknesses in the rock increases significantly. The fine- to medium-grained granitic rocks with large megacrysts of feldspar should not create quality problems for aggregate. Typically the megacrysts represent <5% of the rock and are surrounded by a finer grained matrix of durable, fine grained aplite. Porphyritic granitic rocks with phenocrysts (mostly <1.5 cm in size) should also be suitable for construction aggregate for similar reasons.

Subdivision of the Study Area Based on Resource Assessment and Development Considerations

Most of the samples from the study area (Table 3, Fig. 5, in back pocket) can be divided into four general areas: Bates Lake, South Lake, The Hay Marsh and Island Lake. The clustering of the samples into these groupings largely reflects where the outcrops occur in the targeted rock types and accessibility for sampling. The geological and aggregate resource maps indicate that there are undoubtedly other locations in the study area which have aggregate potential. Unfortunately, areas lacking bedrock exposure could not be examined because they would require expensive methods of investigation beyond the means of this study such as trenching or diamond drilling. The following discussion of the four areas is based on field observations, geotechnical data and other site considerations. No attempt was made to rank the sites based on their significance or opportunity.

South Lake Area (Samples HRM-07 to -11)

The South Lake area potential (Table 3, Appendix 3, Fig. 4 and Fig. 5, in back pocket) consists of leucomonzogranite which varies from fine grained to porphyritic granite with minor amounts of megacrystic feldspar (<5%). In outcrop the rock appears solid and competent, however the joint spacing is commonly quite close (approximately 5-50 cm in places). Based solely on the aggregate test data, this area has the best characteristics for aggregate quarrying. All of the samples (n=5) will meet the highest standards of aggregate specifications (LA Abrasion ranges from 15.9-24.0%; PN ranges from 104-119), with some of the samples passing by a wide margin. The consistency of the test results for the samples is also significant in terms of the resource potential for the area.

Some of the megacrysts and phenocrysts of feldspar in the rock may affect aggregate quality (Prime, 2001). However, they seem to represent a minor component of the rock and occur in a matrix of fine grained granite. This would suggest that they should have minimal negative impact on the performance of the stone as an aggregate. It is unknown if weathering zones associated with the closely-spaced fractures would have negative implications for quarrying. However, the samples were collected at locations where the joints were quite closely spaced, suggesting that alteration along joints should not be a concern.

A visual inspection of the area during the field investigation revealed an abundance of outcrop, probably indicating a thin overburden. This would be beneficial in terms of low stripping costs for quarrying.

Probably, the factor which would most negatively impact on the site for quarrying would be the distance to the highway (Fig. 6, in back pocket, Fig. 7). At approximately 10 km in a straight line from Route 103, this location would be the farthest from the aggregate market. Using existing roads to access the site it would be considerably farther. The approximate distance to the Upper Tantallon interchange (Exit 5) using access roads found in the area would be at least 22 km. If a new road could be constructed to straighten and shorten the access distance to the highway, the total distance to the interchange could be reduced to approximately 17 km. (This distance assumes that there are no engineering or access impediments constraining a road which intersects with Route 103 at the indicated point. There may be reasons that this could not be done at this arbitrary point, which would result in a longer haul distance.) The haulage distance of this location or the costs of constructing a new access road may mean that it is not a competitive location at the present time. However, as the urban area expands over the coming decades, the value of this site may increase.

The Island Lake Area (Samples HRM-19 to -24)

The Island Lake area (Table 3, Appendix 3, Fig. 5, in back pocket) consists of fine- to medium-grained, minor coarse grained leucomonzogranite and medium- to coarse-grained monzogranite. Based on the field examination, laboratory results and distance considerations, this area appears to be the best candidate for quarrying. The performance of the samples in the aggregate tests is reasonably good for LA Abrasion Loss (ranges from 17.5%-26.7%) and Petrographic Number (ranges from 128-142). Outcrop exposure is very limited which may be an indicator of thicker overburden. However, a general lack of ablation till mounds in the area, where the samples were taken, suggests that overburden depths may be acceptable for quarrying. The most favourable characteristic of the area is its location. It is approximately 2-3 km from Route 103 and a total distance of 7-10 km from the Exit 5 Route 103 interchange. This area is the closest location to the market place identified in this study. The authors suggest that the land area to the east and southeast of Island Lake would be the best target for additional work. One potential land use concern associated with this site is the Old Annapolis Road Hiking Trail to the north (Figs. 5 and 6, in back pocket, Fig. 7). Although a quarry could be sited kilometres to the south of this recreational land, it will undoubtedly become an issue. An alternative area to consider would be the area directly south of Island Lake. However, the reader is cautioned that thick ablation tills were observed in some locations. Poor stripping ratios associated with deep overburden could make the economics of the site less appealing.

A possible concern in the area is the mixture of rock types and the potential of significant grain size variation in the monzogranite. Previous research (Prime, 2001) indicated that coarse grain size can negatively impact on aggregate quality. Although the leucomonzogranite is predominantly fine- to medium-grained (minor coarse grained), the monzogranite can be coarse grained and megacrystic. The potential of encountering coarse grained rock makes the monzogranite less favourable as a target than the leucomonzogranite. On the positive side, the monzogranite rock observed in the area during the field work was predominantly medium grained. The leucomonzogranite should be the primary focus of exploration in this area, however the monzogranite should also be considered as having resource potential.

The Hay Marsh Area (Samples HRM-13 to -18)

The Hay Marsh area (Table 3, Appendix 3, Fig. 4, Fig. 5, in back pocket) consists primarily of medium grained leucomonzogranite rocks. It appears to be a compromise between location and geotechnical characteristics. Although the test results are generally not as promising as the other three areas, the location is reasonably good. The LA Abrasion Loss ranges from 23.9%-32.0% and the Petrographic Number varies from 111-175. The anomalously high Petrographic Number for HRM-14 (previously discussed) may be caused by a high degree of alteration resulting in the presence of soft minerals. Many of the other test results for these samples were marginally high, however this may reflect the effects of near surface weathering. Thick ablation tills lie immediately to the south of the sample area, however the topography in the sample area may be indicative of overburden which is of an acceptable thickness. The authors suggest that the topographic high (Fig. 6, in back pocket) to the west and northwest of Little Connor Lake and south of HRM-14 would be the best spot for further exploration. One concern, based on field observations and the geology map of MacDonald and Horne (1987), may be the increased probability of encountering deleterious alteration minerals and shearing in this area. The reader is also cautioned that there is an arsenic showing to the northeast of the area and a uranium occurrence to the southwest (MacDonald and Horne, 1987; Fig. 5, in back pocket). Although problems with this type of mineralization in the target area are remote, any exploration program should include an awareness that deleterious metals, which could be harmful to human health or the environment, could be encountered.

A positive attribute for the area is its proximal location to the highway (Fig. 6, in back pocket, and Fig. 7). Using existing access roads, the area is approximately 13 km from the Hammonds Plains (Exit 5) interchange. If a more direct access road to Route 103 were constructed, the distance could be reduced to approximately 10-11 km.

Bates Lake Area (Samples HRM-01 to -04)

The Bates Lake area (Table 3, Appendix 3, Fig. 4 and Fig. 5, in back pocket) lies to the east of the South Lake area. It consists of fine- to medium-grained monzogranite and leucomonzogranite, although the authors could not distinguish between the two rock types in the field. According to the geological map (Corey, 1987), samples HRM-02 and HRM-04 were taken from the leucomonzogranite and HRM-01 and HRM-03, from the monzogranite. The samples tested indicate that the stone has good mechanical properties capable of producing high quality aggregate. With the exception of the LA Abrasion Loss for HRM-01 (Loss = 29.7%), all of the samples meet or exceed the standards for high quality construction aggregate. The LA Abrasion Loss test for the samples ranged from 20.3%- 29.7% and the Petrographic Number test varied from PN=110-133.

One possible difficulty with evaluating the aggregate potential in this area is the presence of more than one rock type. Provided that both rock types have similar grain size, previous research (Prime, 2001) suggested that these mineralogically similar rocks should perform alike in the aggregate tests. However, if coarse grained, megacrystic monzogranite is encountered in the area, the quality of the rock as a source of aggregate would most likely diminish and it is less certain that it would pass materials specifications. Therefore, potential grain size variations in the monzogranite make it more difficult to generalize about its aggregate potential, but field observations do suggest that the medium grain size predominates in the monzogranite in this area. Provided that medium grained monzogranite with a low content of phenocrysts or megacrysts is present in an area sufficiently large to quarry, it should be as competent for aggregate as the leucomonzogranite. (The authors acknowledge that the presence of coarse grained stone in a portion of an aggregate deposit may not be a significant problem. Perhaps it could be selectively mined for those products that do not require top quality materials.) The leucomonzogranite generally makes a better choice for aggregate, primarily because of its consistent grain size.

The area to the south of the power transmission line and west of the northward-trending woods access road (Fig. 6, in back pocket) would be a good location to begin exploration. The overburden thickness in the area is unknown, but the authors speculate that it should be in the order of a few metres or less.

Although the rocks of the Bates Lake area appear technically suited to aggregate extraction, its location is its main drawback (Fig. 6, in back pocket and Fig. 7). Using the existing access road, the distance to Route 103 would be approximately 8-10 km for a total distance to Exit 5, Hammonds Plains connector of 18 km. An examination of the topographic maps indicates that a more direct route to the highway, by constructing a new access road, would have minimal effect on reducing the distance.

Summary of Site Assessments

Although the four localities were not ranked in terms of their suitability for quarrying, one area clearly has an advantage over the others based on proximity to market (Fig. 6, in back pocket, and Fig. 7). The Island Lake area not only exhibits good technical attributes, but is the nearest location to Exit 5, Route 103. At a distance of 7-10 km from Exit 5, the site would be competitive with existing quarries which now serve areas to the west of Halifax.