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PLAN FOR THE RESERVATION AND DEVELOPMENT OF GRANULAR MATERIALS IN THE VICINITY OF TUKTOYAKTUK, N.W.T.

Prepared For:

INDIAN AND NORTHERN AFFAIRS CANADA, OTTAWA

Prepared By:

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This project was a joint venture of Hardy BBT Limited, Calgary, Alberta and Avati Associates, Yellowknife, N.W.T.

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Joe Panaktoluk	Tuktoyaktuk CC
Willie Stefansson	Inuvik CC
Vince Steen	Secretary Manager, Hamlet of Tuktoyaktuk
Fred Wolki	Tuktoyaktuk Hunters and Trappers Committee

The following individuals/organizations were also contacted:

Leslie Huget	Senior Land Officer, Lands Division, Municipal and Community Affairs, GNWT, Yellowknife
Kevin McCormick	Habitat Biologist, Canadian Wildlife Service, Yellowknife
Evan Birchard	Esso Resources Canada Limited
James McDougall	Esso Resources Canada Limited
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Brian Rogers	Gulf Canada Resources Limited
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SUMMARY OF RECOMMENDATIONS

This plan was produced as part of the implementation of the Inuvialuit Final Agreement. It recommends a strategy to reserve and develop supplies of sand and gravel on Inuvialuit lands in the vicinity of Tuktoyaktuk, N.W.T. Its goals are the reservation of adequate supplies of sand and gravel for the community's future needs, and the siting and management of these reserves so as to minimize the environmental and social impacts of their development. The plan was developed with members of the Tuktoyaktuk Land Use Planning Working Group and other representatives of the community. It is based on existing scientific and community information, and will be revised at least every 5 years. The plan assesses 12 potential sources of granular material in the Tuktoyaktuk area: Sources 155, 168 and 160/161, which are of primary interest as sources of community supply; Sources 162, 181 and 183 in the vicinity of the community; and Sources 163, 164, 165, 167, 170 and 177, all of which have been proposed as sources of larger-scale supply.

The recommendations of the plan are as follows:

. Granular inventory work in the Tuktoyaktuk area should continue to move towards the establishment of a regionally-integrated system of granular supplies. The goals of this system should be as per Part 2 of this plan. The quantity and quality of materials in all sources considered for development should, as a general principle, be confirmed by a field testing program prior to any vegetative stripping. The environmental impacts of granular development and the number of pits under development at any point in time should be minimized on a regional basis.

- As part of the establishment of such a regional system, Sources 155 and 168 should be reserved and developed for small and medium-scale public community and Inuvialuit projects in the Tuktoyaktuk area (demands of less than approximately 100 000 cubic metres). Larger scale, public and Inuvialuit projects should be granted access to these reserves only if the forecast 20-year demand for the ongoing maintenance and smaller projects in the Tuktoyaktuk area can continue to be met from proven supplies in these sources. The development of Source 155 should be as per the conditions of Section 3.5.2 of this report.

- The quality and quantity of materials in the southern portion of Source 155 should be further confirmed by field investigation. Further field work at Source 168 is not considered a priority at this time.

- The southeast portion of Source 161 should be reserved and made available for residential lot development in Tuktoyaktuk, in accordance with the request of the Hamlet.

- Granular development to serve public community needs in the Tuktoyaktuk area should be confined to the above sources until such time as some of the larger-scale and more speculative projects are implemented in the Tuktoyaktuk area.

- Sources 163, 164, 165, 167, 170, and 177 should be considered potential contributors to the regional system of sources referred to above. Further excavation at these sources should not be permitted until the quality and quantity of materials available are confirmed by field investigation and the environmental impacts and potential contribution of each source to the regional system of supply have been assessed on a regional basis. In the implementation of the regional system, every effort should be made to limit granular development to a series of larger sources, each to supply an area approximately 10 km in radius. It is therefore quite conceivable that only some of the above sources would be developed within the 20-year forecast period of this plan.

- For environmental reasons, further dredging should not be undertaken at Source 162. For similar reasons, Sources 181 and 183 should not be further developed. None of these sources should be considered a priority for field confirmation work at this time.

- Community representatives in Inuvik and Tuktoyaktuk have expressed concerns about the currently-proposed alignment of the Inuvik-Tuktoyaktuk highway, and particularly about its proximity to the Husky Lakes. The ultimate alignment of the highway will have a significant effect on the reservation and development of granular materials throughout the Inuvik-Tuktoyaktuk area. The issue should be addressed by the Mackenzie Delta/Beaufort Sea Land Use Planning Commission and officials of the Highways Planning Division of Indian and Northern Affairs Canada, prior to any reservations of specific sources to service highway construction and maintenance.

- Granular development and environmental protection plans should be produced for all sources ultimately approved for development in the Tuktoyaktuk area. Source 155 should be considered the first priority. The plans should be produced in consultation with local and regulatory representatives (see Appendix A). They should lay out a 5-to-10 year strategy for the orderly development of each source, and should ensure the integration of granular planning and other land use planning initiatives. They should also ensure that each source is developed so as to minimize environmental and visual effects, and maximize the amount of materials recovered from the source. In addition, they should lay out procedures for the proper development and restoration of pits.

- Regulatory bodies and the joint management boards created by the Inuvialuit Final Agreement (e.g. the Fisheries Joint Management Committee) should ensure the integration of their research work with the development of granular sources in the Tuktoyaktuk area.

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INTRODUCTION

In March 1988, as part of the implementation of the Inuvialuit Final Agreement, Indian and Northern Affairs Canada (INAC) contracted Hardy BBT of Calgary, Alberta and Thomas Nesbitt and Associates (now Avati Associates) of Yellowknife, N.W.T. to carry out the present study. The INAC departmental representative for the project was R.J. Gowan, Geotechnical Advisor, Land Management Division.

The terms of reference of the study were:

(1) To determine the potential environmental, cultural, and economic implications of the possible future exploitation of selected granular borrow deposits within and adjacent to Inuvialuit lands

(2) To identify and evaluate other community concerns

(3) To prepare recommendations on the establishment of reserves of granular borrow for public community needs

These objectives were met through the preparation of a plan outlining a strategy for the reservation and development of granular materials around each of the six Inuvialuit communities (Aklavik, Holman, Inuvik, Paulatuk, Sachs Harbour, and Tuktoyaktuk). The Tuktoyaktuk plan is divided into four parts:

Part 1 sets out the scope of the study: why it was undertaken, its objectives, how it was carried out, and how it is intended to be used. It also defines the technical terms used in the plan and outlines the potential impacts of granular development.

Part 2 describes the goals of the plan.

Part 3 presents the factual information upon which the plan is based and assesses different plan options.

Part 4 presents the plan recommendations.

PART 1: SCOPE OF THE STUDY

1.1 REASONS FOR UNDERTAKING THE STUDY

1.1.1 Requirements of the Inuvialuit Final Agreement

With the signing of the Inuvialuit Final Agreement (IFA) and the enactment and proclamation of the Western Arctic (Inuvialuit) Claims Settlement Act in 1984, the Government of Canada granted Inuvialuit title to substantial tracts of land in the vicinity of each of the six Inuvialuit communities. These lands, shown in Figure 1, are commonly known as Inuvialuit 7(1)(a) and 7(1)(b) lands, in reference to the sections of the Final Agreement where their interests are described. They are administered by the Inuvialuit Land Administration (ILA) and the Inuvialuit Land Administration Commission (ILAC).

In the Tuktoyaktuk area, 7(1)(a) lands cover approximately 1790 square kilometres (691 square miles), and directly surround the lands administered by the Hamlet. On these lands, Inuvialuit own both surface and subsurface rights. On 7(1)(b) lands, which cover approximately 26 800 square kilometres (10 348 square miles) in the general vicinity of the community, the Inuvialuit own surface rights only. Granular materials (sand and gravel) are surface resources. The Inuvialuit Final Agreement thus transferred ownership of most of the accessible sources of sand and gravel in the Tuktoyaktuk area, and indeed throughout the Western Arctic region, to the Inuvialuit. Because of this, and because of the general scarcity of suitable sand and gravel throughout the region, the Final Agreement also attached several

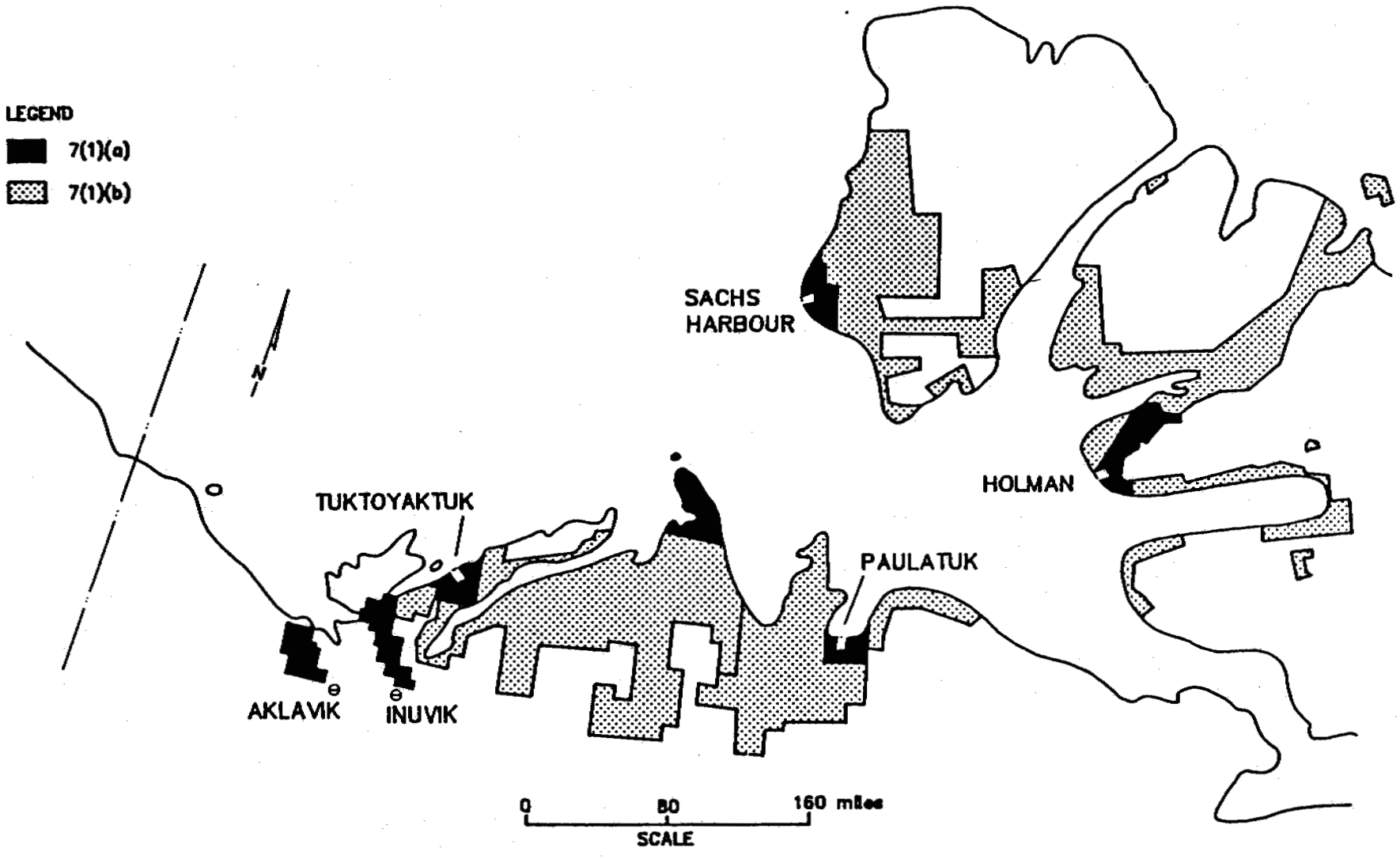

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FIGURE 1. INUVIALUIT LANDS LOCATION PLAN

conditions to Inuvialuit ownership and management of these resources.

The Agreement regulates the price which can be charged for sand and gravel. It also requires that the Inuvialuit establish and maintain reserves of sand and gravel on Inuvialuit lands. In the establishment of these reserves, the first priority is that adequate supplies of suitable materials be set aside to meet public community needs (IFA, Section 7(27)). These needs include granular requirements for the community's roads and airfields, community arenas, firehalls, and sewage lagoons. Reserves are also to be established, as a second priority, for the private and corporate needs of the Inuvialuit (Section 7(28)). These include projects advocated and owned by the Inuvialuit, for example the proposed Tuktoyaktuk gas gathering system. As a third priority, sand and gravel are to be made available for any project approved by the appropriate government agencies (Section 7(29)). Examples of this sort of granular requirement include pads for oil rigs and rip rap for erosion protection on artificial islands.

This study focuses primarily on the establishment of granular reserves to meet Tuktoyaktuk's public community needs (the first priority above). The Final Agreement requires that the reserves be based upon reasonable 20-year forecasts of the volumes required from Inuvialuit lands. Reserves are to be of an appropriate quantity and quality to meet these forecasts, and are to be within reasonable transport distances of the communities. The demand forecasts upon which the reserves are based are to be

prepared jointly by the Inuvialuit and government. They are to be revised at least every 5 years.

1.1.2 Implementation

In order to implement the above-mentioned requirements of the Final Agreement, the Federal Government established a specific granular materials project as part of the IFA Implementation Program. This project, designated Task 7- Sand and Gravel Inventories, involves a four-phase process developed in consultation with the Territorial Government and the ILA.

(1) An analysis of the projected 20-year demand for sand and gravel and an inventory of potential sources to supply this demand was carried out by EBA Engineering Consultants Ltd. This study, completed in April, 1987, made recommendations on the development of specific sources of supply.

(2) The present study is designed to supplement the EBA information with environmental and socio-economic information, particularly from the community level. It is also designed to develop a plan, with community representatives and other affected parties, for the reservation and future development of granular materials for public community needs in each of the six Inuvialuit communities.

(3) The quality and/or quantity of materials at some of the recommended sources of supply will have to be confirmed by more-detailed site investigations. These investigations will be based on the recommendations of the communities.

(4) In order to assist the Inuvialuit with the preparation and implementation of granular resource development plans which can be managed at the local level, additional studies will be undertaken each year to 1994.

1.2 OBJECTIVES AND METHODS OF THE PRESENT STUDY

The ultimate objectives of the present study were:

(1) The identification of environmental, cultural, and economic concerns, particularly at the community level, associated with local granular resource development

(2) The development of a fair and reasonable plan which could be understood and managed at the local level

(3) The achievement of a consensus among the affected parties

In order to accomplish these ends, workshops of a full day's duration were carried out in each of the six Inuvialuit communities. The workshops were carried out primarily with members of the existing land use planning working group in each community. Because of an overlap in the Inuvik and Tuktoyaktuk areas of interest, a representative of the Inuvik Community Corporation and Hunters and Trappers Committee was invited to participate in the Tuktoyaktuk workshop. Other affected interests were also invited to participate.

The land use planning working groups were established in 1987 to provide each community with an ongoing land use planning capability, and a means of making recommendations on the use of lands surrounding the communities to the Beaufort/Delta Regional Planning Commission and the decision-making bodies at the community level. The Tuktoyaktuk working group includes nominees from the Tuktoyaktuk Community Corporation, the Hunters and Trappers Committee, the Elders, and the Hamlet.

The workshops supplemented the supply/demand information and recommendations produced in Phase 1 of the study (EBA

1987). They also identified potential economic, cultural, and environmental impacts of developing the sites identified in Phase I. The workshops were designed to solicit community concerns and to allow the working groups to use all of this information in a planning context. They were facilitated by Tom Nesbitt, an environmental planning consultant who has worked extensively with the working groups in the past. Technical advice for the workshops was provided by Jim Howell, an environmental consultant and professional geologist.

Unless noted otherwise, the plan detailed in this report represents the consensus of the Tuktoyaktuk Workshop.

1.3 Status and Intended Uses of the Plan

The conclusions of this report have the status of recommendations only. They are recommendations to INAC and the ILA/ILAC, the parties implementing the Inuvialuit Final Agreement and administering Crown and Inuvialuit lands respectively, and to the Hamlet and the GNWT as the administrators of Hamlet and Commissioner's Lands. The results will also be of interest to the various government departments and other granular resource users. Finally, the study can be considered a sectoral plan recommended to the Regional Land Use Planning Commission in the Beaufort/Delta region. As such, the conclusions of the study are subject to changes within the context of the larger planning exercise. Given the community basis of the plan, however, the authors do not expect fundamental changes to it.

1.4 TERMINOLOGY

Several terms describing the kinds of granular materials required by the communities and the confidence of volume estimates are used extensively throughout the plan. These terms are explained in this section.

1.4.1 Classification of Granular Resources

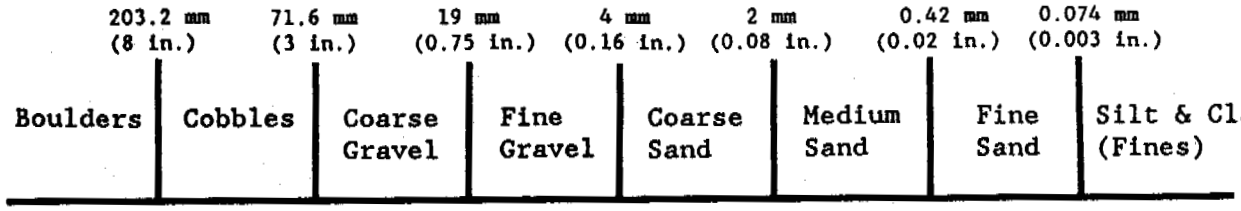
Granular resource supply and demand is discussed in terms of five classes of material:

Class 1 Excellent quality material
Class 2 Good quality material
Class 3 Fair quality material
Class 4 Poor quality material
Class 5 Bedrock, felsenmeer, and talus

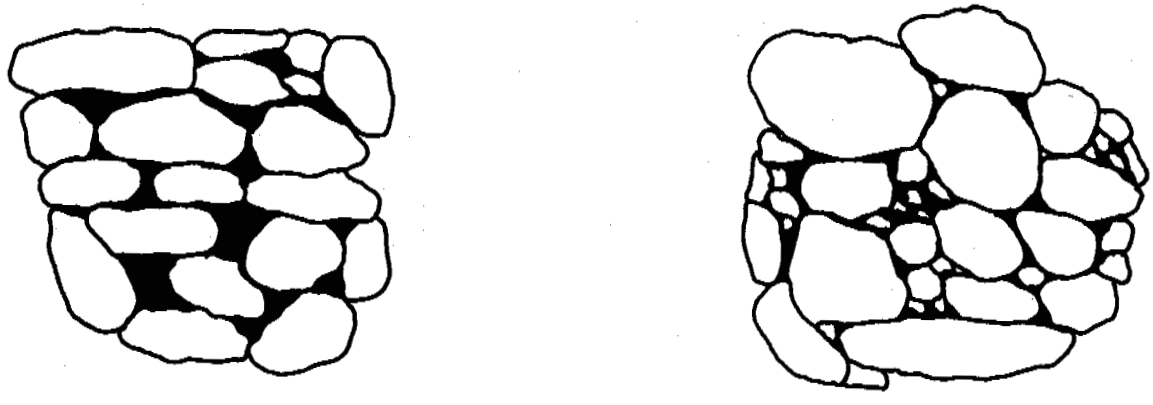
The first four classes are defined in terms of the gradation of the deposit. A brief discussion on gradation is necessary prior to describing these classes in more detail.

1.4.1.1 Gradation

The term gradation refers to the relative size of particles in a deposit. Granular resources can contain particles ranging in size from boulders through clay, as shown in Figure 2. Boulders and cobbles are usually undesirable in a granular deposit. They may be crushed to smaller sizes or discarded as waste. The gravel- and sand-sized particles are the more desirable components of a granular deposit. Silt- and clay-sized particles, also called fines, cannot be seen by the naked eye. These particles



2a. Particle size limits for gravel, sand, and fines. A well-graded granular deposit contains an equal amount of each gravel and sand size.



2b. Poorly-graded materials with all particles the same size or with a lack of certain particle sizes (left drawing) have more voids and are less stable than well-graded materials where the voids are filled by the smaller particle (right drawing).

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FIGURE 2. PARTICLE SIZE AND GRADATION

are undesirable in high proportions because they hold more water which, in the North, results in higher ice contents and a greater likelihood of frost heaving or thaw slumping.

A well-graded granular deposit has an equal amount of each gravel and sand size and little or no fines. Deposits such as this are called "clean". A poorly-graded granular deposit has an excess of some particle sizes and a shortage or lack of others, or has nearly all particles the same size. Poorly-graded deposits can be processed to improve and upgrade their quality. Screening and washing can be used to remove undesirable particle sizes. Boulders and cobbles can be crushed to produce gravel and sand.

The importance of using well-graded materials for pads on which structures will be built is shown in Figure 2. With well-graded materials, the finer particles tend to fit between the coarse ones, reducing the amount of voids or empty spaces to a minimum and forming a strong pad. Pads formed of poorly-graded materials where many voids are present are more likely to shift when the weight of a structure is added.

1.4.1.2 Description of Granular Resource Classes

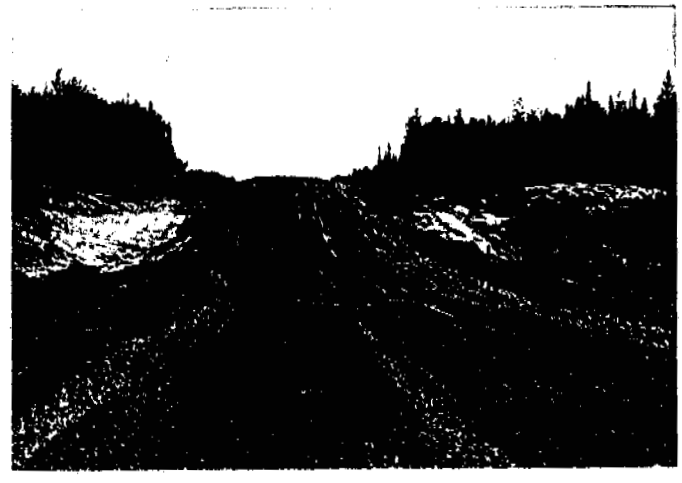
The five granular resource classes are defined below in terms of their gradation and recommended uses. Figures 3 and 4 show photographs of each class and examples of their use.

Class 1. Excellent quality material consisting of clean, well-graded, structurally-sound sands and gravels suitable

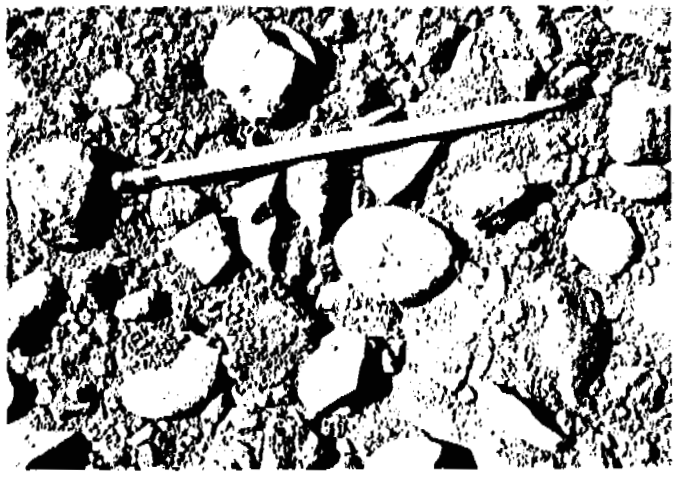
Class 1 - Excellent quality materials; well-graded, no fines.

Class 1 material used for a pipeline pumping station pad at Norman Wells

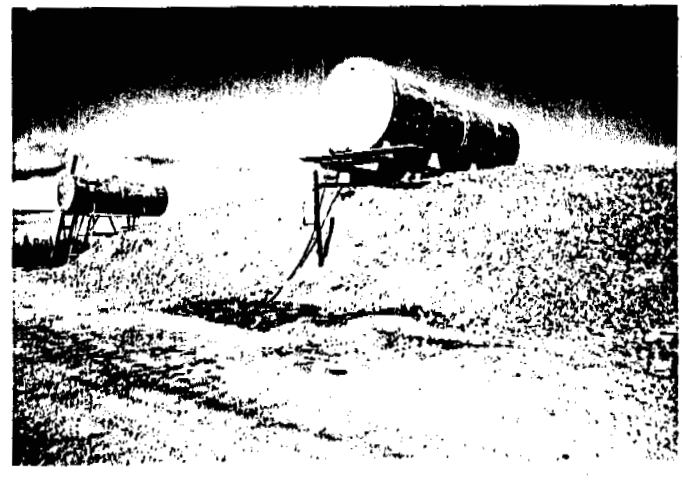
Class 2 - Good quality materials; generally well-graded, some fines



Class 2 material used for surfacing the Mackenzie Highway near Fort Simpson

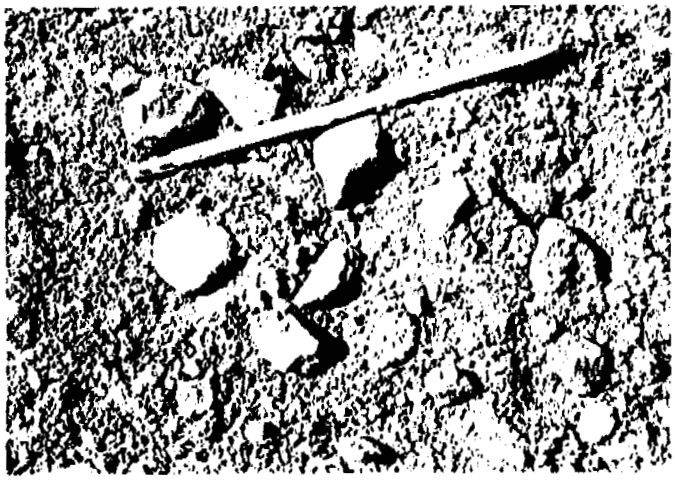


Class 3 - Fair quality materials; poorly-graded with substantial fines

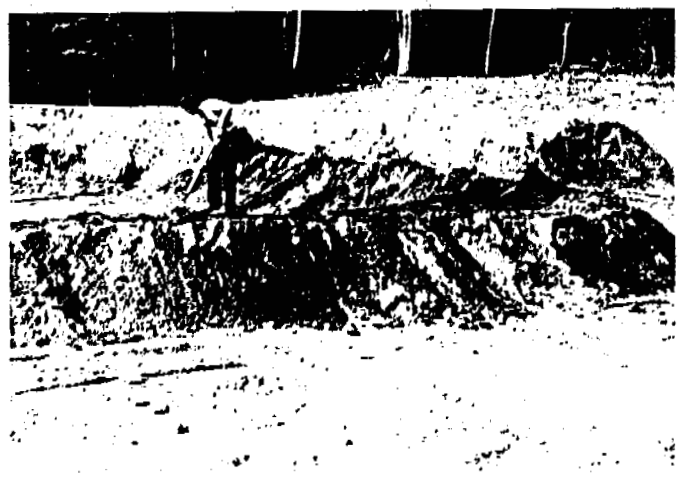


Class 3 material used as a pad for fuel storage tanks

FIGURE 3. CLASS 1, 2, AND 3 GRANULAR MATERIALS

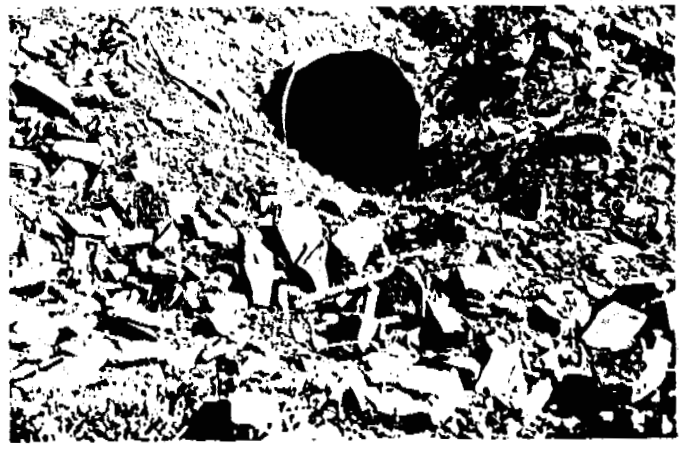


Class 4 - Poor quality materials; poorly-graded with minor gravel and a large proportion of fines

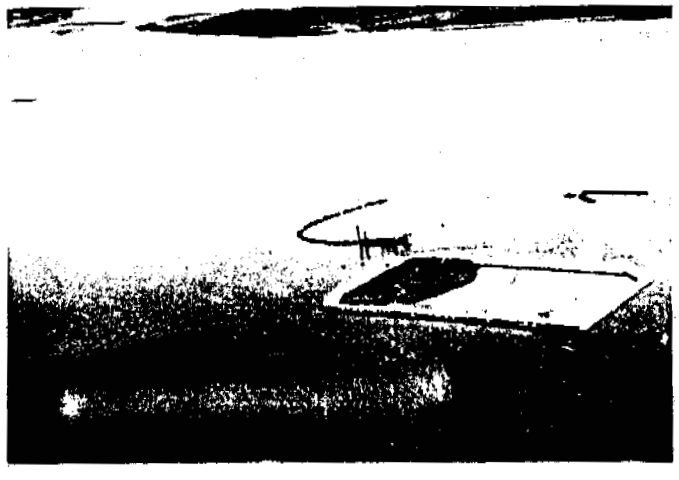


Class 4 material used as a berm around a fuel storage site

Class 5 - Outcropping of bedrock at Holman, N.W.T.



Class 5 material used as rip rap to protect a culvert outlet



Class 5 material used as armour stone around an artificial island in the Mackenzie River at Norman Wells

FIGURE 4. CLASS 4 AND 5 GRANULAR MATERIALS

for use as high-quality surfacing materials, or as asphalt or concrete aggregate, with a minimum of processing.

Class 2. Good quality material generally consisting of well-graded sands and gravels with limited quantities of silt. This material will provide good-quality base and surface-course aggregates or structure-supporting fill. Production of concrete aggregate may be possible with extensive processing, except where weak materials such as shale are present.

Class 3. Fair quality material consisting of poorly-graded sands and gravels with or without substantial silt content. This material will provide fair-quality general fill for roads, foundation pads, or lay-down yards.

Class 4. Poor quality material generally consisting of silty, poorly-graded, fine-grained sand with minor gravel. These deposits may also contain weak particles. These materials are considered suitable for general (non-structural) fill.

Class 5. Bedrock of fair to good quality, felsenmeer (open areas of broken rock), or talus (broken rock at the bottom of a slope). Potentially excellent sources of construction material, ranging from general fill to concrete aggregate or building stone if quarried and crushed. Also includes erosion control materials such as rip-rap or armour stone.

1.4.2 Confidence of Volume Estimates

The volume estimates for the granular material sources identified in the EBA (1987) report are classified as being proven, probable, or prospective.

A proven volume is one whose existence, extent, thickness, and quality is supported by ground truth information such as geotechnical drilling, test-pitting, and/or exposed stratigraphic sections. Usually the thickness of material encountered in a borehole is extrapolated to a radius not exceeding 50 metres around the hole.

A probable volume is one whose existence, extent, thickness, and quality is inferred on the basis of direct and indirect evidence, including topography, landform characteristics, airphoto interpretation, extrapolation of stratigraphy, geophysical data, and limited sampling.

A prospective volume is one whose existence, extent, thickness, and quality is suspected on the basis of limited direct evidence, such as airphoto interpretation and/or general geological considerations.

1.5 IMPLICATIONS OF GRANULAR MATERIAL EXTRACTION

The development of granular resource deposits normally involves three major tasks:

(1) Obtaining access to the deposit.
(2) Development of the deposit.
(3) Reclamation the pit.

Each of these tasks can have economic, cultural, and environmental implications associated with it.

1.5.1 Obtaining Access to the Deposit

The development of access to a source can involve significant economic costs. These costs will have a strong bearing on the cost of materials delivered to the community and on the ultimate feasibility of developing the source.

There are also several potential social and cultural impacts associated with the development of access to a granular source. The development of access, particularly year-round access, can lead to unforseen development activities in an area, and to long-term changes to an area or region which could not be anticipated at the time of the original development. Hunting, fishing, and trapping pressure on an area may increase, visitors to the region may gain access to an area that was previously accessible only to the limited population of the community, and there may be some interference with community activities in the area of the source. On the other hand, road construction may open an area to year-round recreational use by the community, or to possible tourism development benefits on the part of the community.

Environmentally, access road construction can create drainage and erosion problems and habitat destruction if proper construction techniques are not followed. Disturbance to the active layer in permafrost terrain can result in thawing and erosion. If eroded sediments enter

watercourses, fish habitat can be damaged or destroyed. Furthermore, the development of larger access roads could conceivably affect wildlife movements and result in habitat abandonment.

Access road impacts can be minimized by following guidelines presented in the INAC (1984) publication "Land Use Guidelines Access Roads and Trails".

1.5.2 Development of the Deposit

The development of a deposit involves the stripping of vegetation, the removal of overburden, and the extraction of granular materials. The amount of vegetative stripping and overburden removal required to develop a source will play an important role in the costs of development. A thick covering of silts or clays may make the development of the source unfeasible. Similarly, ease of extraction will affect costs. A dry deposit is much cheaper to develop than one with substantial volumes of ice, which may require blasting.

The opening of a pit may destroy important wildlife and fisheries habitat or may interfere with hunting, trapping, or fishing activities. The pit may be located in an area used for recreation by the community or be near enough to such an area that the presence of the pit will impair the aesthetics of the recreational site. As with the opening of an access road, pit development may lead to the discovery of heritage resource sites, but it also offers the opportunity to destroy such sites if their presence is not noted prior to extraction.

Environmentally, pit development offers the potential for drainage and erosion problems, habitat destruction, and wildlife disturbance. Vegetative stripping and overburden removal expose materials to wind and water erosion. The deposition of eroded materials in streams can result in damage to fish habitat. A high ice content in the deposit can result in further erosion and siltation when thawing occurs during extraction. Noise from equipment used during development can disturb wildlife during critical periods such as calving or nesting.

Guidelines to minimize the impacts of development of the deposits are available in the INAC (1982) publication "Environmental Guidelines Pits and Quarries".

1.5.3 Reclaiming the Pit

The costs of pit abandonment and reclamation should be factored into costs of developing a source. Pits which have not been properly restored can be subject to unnecessary longer-term erosion and drainage problems. Pit reclamation can enhance the recreational and habitat capabilities of a site.

Reclamation guidelines for pits and quarries are included in the INAC (1982, 1987) publications "Environmental Guidelines Pits and Quarries" and "Reclamation Guidelines for Northern Canada".

PART 2: PLAN GOALS

The definitions, principles, and goals of the Inuvialuit Final Agreement form the basis of this plan.

Specifically, the goals of this plan are:

(1) To reserve adequate supplies of appropriate quality granular materials for the community's future needs.

(2) To site and manage these reserves within reasonable distance of the community, and so as to ensure that granular development does not interfere with wildlife, archaeological resources, or with people out camping, hunting, fishing, or trapping.

(3) To minimize the negative environmental and visual effects of granular development on a regional basis. To minimize the regional effects of pits and access roads. To prevent drainage problems. To ensure that pits are fully restored when depleted.

(4) To ensure that the development of granular materials is well planned and managed so as to ensure that the materials in existing and planned pits are fully used. To ensure the integration of granular planning with other planning initiatives.

(5) To produce a plan that is written in clear and concise terms, so that it can be understood, implemented, and revised at the local level.

PART 3: PRESENTATION AND ASSESSMENT OF RESOURCE INFORMATION

3.1 PHYSICAL SETTING

Tuktoyaktuk is located on the east coast of Kugmallit Bay on the arctic mainland. Granular deposits mapped by EBA (1987) lie within the Tuktoyaktuk Coastlands (Rampton 1988). The locations of the deposits discussed in this report are shown in Figure 5. They occur on Tuktoyaktuk 7(1)(a) and Inuvialuit 7(1)(b) lands.

The terrain around Tuktoyaktuk is low-lying and hilly with approximately 30 percent of the area covered by lakes. Pingos, massive ground ice, and thermokarst are common. Surficial deposits in the area are largely the result of glaciation during the Quaternary Period (the last three million years, approximately). Granular resource sources occur in till, glaciofluvial outwash, ice-contact deposits, lacustrine deposits, and underwater.

Sources 181, 183, and part of 167 occur in till, a mixture of gravel, sand, silt, and clay deposited by glaciers. Parts of Source 155, 160/161, and 163 occur on glaciofluvial outwash plains deposited in front of the glaciers. These deposits consist of sand and gravel, for the most part, with some silt. One-half of the Tuktoyaktuk sources discussed in this plan (Sources 164, 165, 170, 177, and part of 155 and 167) occur in ice-contact deposits. These consist of sands and gravels deposited at the margin of, within, and under the ice. Lacustrine deposits consisting of silt, sand, and some gravel form Source 168 and portions of Source 160, 161 and 163. These deposits

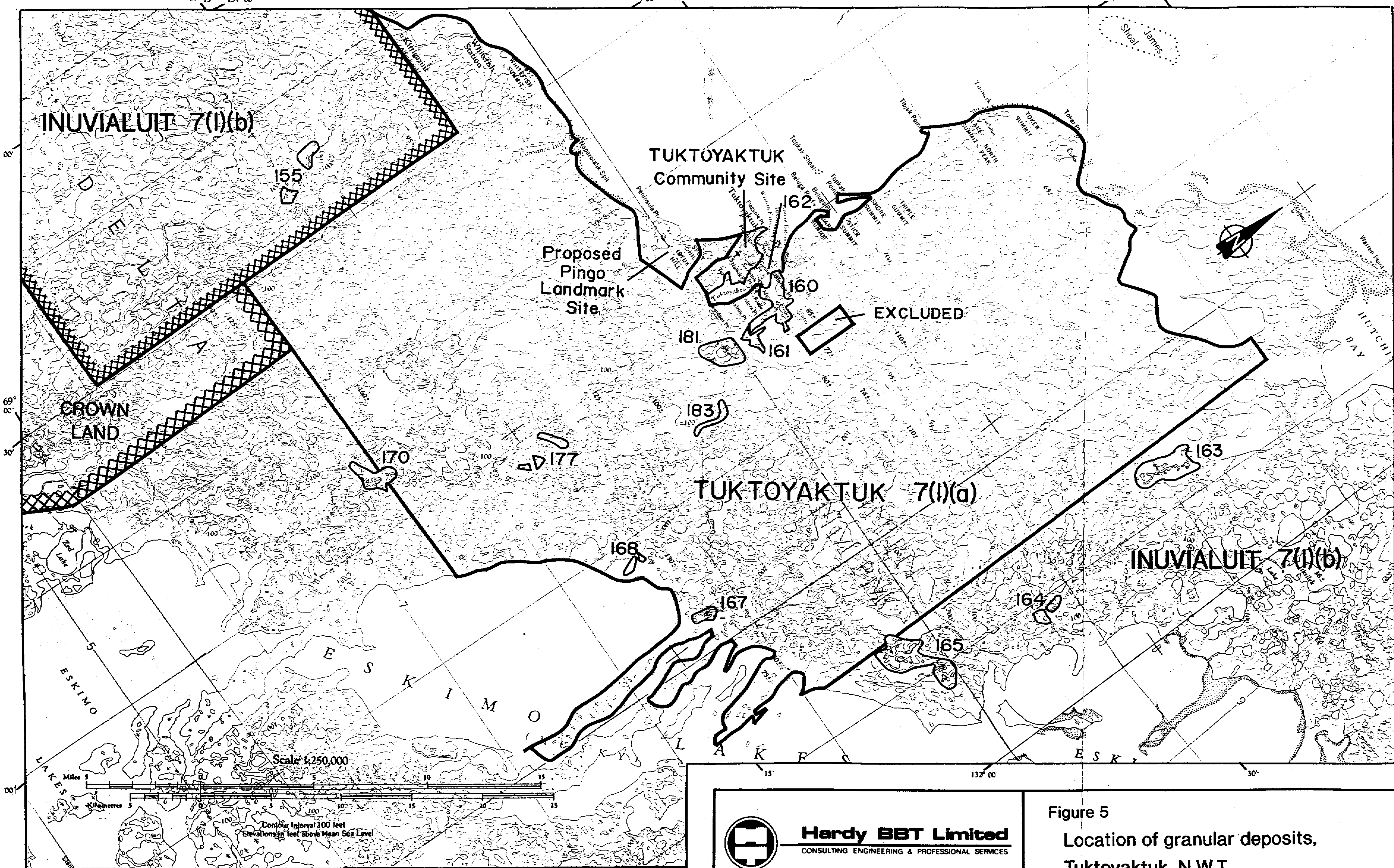


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Figure 5
Location of granular deposits, Tuktoyaktuk, N.W.T.

are all associated with thermokarsting of adjacent ice-contact deposits or moraine. Source 162, consisting of sands and gravels with some silt, is located underwater in Tuktoyaktuk Harbour.

The nature of the materials in the sources is discussed in more detail in the following sections.

3.2 COMMUNITY SETTING

Tuktoyaktuk is situated just east of the Mackenzie River Delta, on Kugmallit Bay in the Beaufort Sea. According to Usher (1976), the people of the Tuktoyaktuk area hunted, fished, and trapped, prior to their settlement in the community as we now know it, around three main focal points: the Tuktoyaktuk - Kittigazuit area, just west of the present community; Cape Bathurst, to the east of Tuktoyaktuk; and an area south of Liverpool Bay, known locally as the Kugaluk-Nadluk area. The orientation of these people was seasonal (as is the present renewable resource orientation of the community), and caribou, beluga, seal, fish, waterfowl, polar bear, small numbers of moose, and several fur bearers were important components of their livelihood. In 1937, the Hudson Bay Co. and the Anglican and Roman Catholic missions established posts at the site of the present community, and during the latter 1930s and 1940s Tuktoyaktuk was one of the regional centres of the fur trade and of the trans-shipment of goods along the Arctic coast. By the mid-1950s, the fur trade was declining and with it, the community's regional importance. In 1955, however, Tuktoyaktuk became the supply and distribution centre for the construction of the DEW Line.

By this time, most families in the area lived in the village itself. In 1970, the community was incorporated as a Hamlet. In 1986, the population of Tuktoyaktuk was 929 (Statistics Canada 1986).

Tuktoyaktuk is now the main base in the Beaufort/Delta region of substantial oil and gas investment. During the mid-to-late 1970s, the community became the focus of the industry's activity in the Beaufort Sea and by the early 1980s, Dome, Esso, and Gulf had each established base camps in Tuktoyaktuk. In recent years, oil and gas activity in the region has fallen substantially. Any re-awakening of the industry's activities in the region could, however, have a significant impact on requirements for granular materials in the Tuktoyaktuk area.

Tuktoyaktuk's economy has witnessed substantial change in the past 15 years, particularly with variations in oil and gas investment in the region. Accurate and up-to-date figures on the relative contribution of different sectors to the overall cash economy are not, however, available. In non-quantitative terms, the community derives its income from oil and gas, shipping, and the transportation businesses; from secondary services, tourism, construction, and renewable resource businesses; from employment with the Hamlet, the Federal and Territorial governments, the school, and the Northwest Territories Power Commission; from Federal and Territorial transfer payments; and from trapping and the imputed value of the country harvest (Lutra and Ruitenbeek 1985). In general, the economy of Tuktoyaktuk is a dynamic one which relies on a diversity of private businesses and wage employment for the income

necessary in a modern community. Like the smaller communities in the region, however, Tuktoyaktuk continues to look to the hunting, fishing, and trapping economy and way of life for a significant proportion of its food, and for many of its cultural and economic values. While the people of Tuktoyaktuk want to diversify and enhance their local economy, they are also concerned that environmental quality and wildlife habitat and populations be preserved.

3.3 NEED FOR GRANULAR MATERIALS (DEMAND)

Figure 6 presents the forecast 20-year demand for granular materials in Tuktoyaktuk, based on the EBA (1987) figures. Of a total forecast demand of approximately 9 million cubic metres over 20 years, approximately 117 000 cubic metres will be required for the maintenance of community facilities, 200 000 cubic metres will be required for local capital projects, and fully 8.6 million cubic metres may be required for large-scale, more-speculative projects.

Community maintenance projects include airfield maintenance (15 000 cubic metres, Class 2), road and general maintenance (100 000 cubic metres, Classes 1 and 3), and yard maintenance (1600 cubic metres, Class 3). The main local capital users, as listed in Figure 6, include shore line protection (60 000 cubic metres, Class 2), erosion control (20 000 cubic metres, Class 5), land development (25 000 cubic metres, Classes 1 and 4), road construction (65 000 cubic metres, Classes 1 and 2), solid waste site (20 000 cubic metres, Class 4), staff housing (4200 cubic metres, Classes 2 and 3), yard development (1500 cubic metres, Classes 2 and 3), a curling rink (1200 cubic

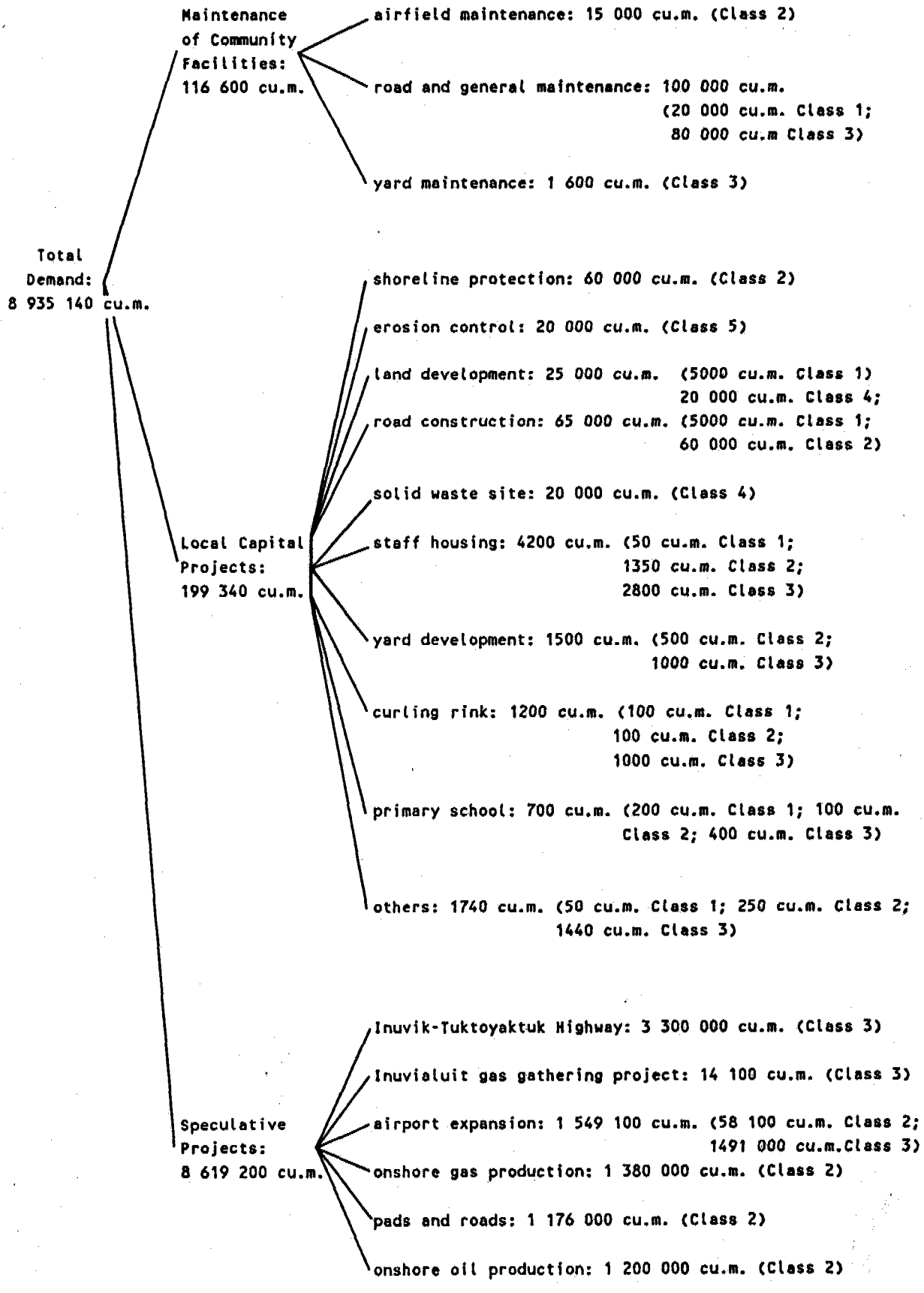

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FIGURE 6.

REQUIRED VOLUMES OF GRANULAR MATERIALS (DEMAND) BY MAIN USERS, TUKTOYAKTUK 1987-2006 (EBA 1987)

metres, Classes 1, 2, and 3), and a primary school (700 cubic metres, Classes 1, 2, and 3).

The more speculative demands incorporated into the forecast include the Tuktoyaktuk portion of the proposed Inuvik-Tuktoyaktuk highway (3 300 000 cubic metres, Class 3), an airport expansion (1 549 000 cubic metres, Classes 2 and 3), the Inuvialuit gas-gathering project (14 100 cubic metres, Class 2), pads and roads associated with oil and gas production (1 176 000 cubic metres, Class 2), and onshore oil production requirements (1 200 000 cubic metres, Class 2).

With the exception of the latter four, most of the foregoing demands are public in nature. The gas-gathering project is an Inuvialuit project. The final three demands are third party in nature. Third party requirements for erosion protection associated with offshore petroleum production facilities in the Beaufort Sea have been accounted for in the Inuvik plan (Nesbitt and Howell 1988), since it is from this area that the required material would have to be excavated.

Tables 1 and 2 focus more specifically on the volumes of different classes of materials that will likely be required from the Tuktoyaktuk region for each five-year period, both with and without the speculative projects.

The preponderance of community demand, excluding speculative projects, will be for Class 2 and 3 materials: approximately 140 000 and 90 000 cubic metres of Class 2 and 3 materials respectively will be required over the next

TABLE 1

REQUIRED VOLUMES OF GRANULAR MATERIALS (DEMAND), IN CUBIC METRES, AND RECOMMENDED SOURCES OF SUPPLY, TUKTOYAKTUK, N.W.T. 1987 - 2006 EXCLUDING SPECULATIVE PROJECTS (FROM EBA 1987)

Class	1987-91	1992-96	1997-2001	2002-06	Totals	Recommended Sources
Class 1	5 400	15 000	5 000	5 000	30 400	- 177, 155 - 168
Class 2	62 300	65 000	5 000	5 000	137 300	- 177, 155
Class 3	27 000	20 400	20 400	20 400	88 200	- 181, 183, 177 or 155
Class 4	0	40 000	0	0	40 000	- 177 or 155
Class 5	0	20 000	0	0	20 000	- I 403 or R 28/29 (Inuvik)
				TOTAL	315 900	

Note: EBA figures used in this table have been rounded to the nearest 100 cu.m.

TABLE 2

REQUIRED VOLUMES OF GRANULAR MATERIALS (DEMAND), IN CUBIC METRES, AND RECOMMENDED SOURCES OF SUPPLY, TUKTOYAKTUK, N.W.T. 1987 - 2006 INCLUDING SPECULATIVE PROJECTS (FROM EBA 1987)

Class	1987-91	1992-96	1997-2001	2002-06	Totals	Recommended Sources
Class 1	5 400	15 000	5 000	5 000	30 400	- 177, 155 - 168
Class 2	62 300	1,979 100	1,905 000	5 000	3,951 400	- 163, 164 or 165 - 177, 155
Class 3	1,741 100	2,911 400	120 400	120 400	4,893 300	- 168, 169, 170, 171, 172, 173, 177, 312, 314 & Parsons Lake - 181, 183, 155
Class 4	0	40 000	0	0	40 000	- 177 or 155
Class 5	0	20 000	0	0	20 000	- I 403 or R 28/29 (Inuvik)
				TOTAL	8,935 100	

Note: EBA figures used in this table have been rounded to the nearest 100 cu.m.

20 years. Substantial demands will also be made at the community level, however, for Class 1, 4, and 5 materials: approximately 30 000 cubic metres of Class 1, 40 000 cubic metres of Class 4, and 20 000 cubic metres of Class 5 materials will be required.

Speculative projects constitute fully 96 percent of the total forecast demand for granular materials from the Tuktoyaktuk region. The speculative demand is exclusively for Class 2 and Class 3 materials. The forecast is that approximately 3 814 000 cubic metres of Class 2 materials and 4 805 000 cubic metres of Class 3 materials will be required for speculative projects from 1987 to 2006.

The present study was not mandated to revise the forecast demand figures. Revisions recommended by workshop participants were, however, noted. Four such revisions were discussed in the Tuktoyaktuk workshop:

(1) The granular requirements of potential pipeline connections with southern Canada do not appear to have been fully incorporated into the speculative forecast figures.

(2) Community representatives suggest that the community's demand may have been underestimated, particularly in the latter 15 years of the 20-year forecast period, both in terms of requirements for general community growth and also for anticipated expansion associated with potential pipeline construction.

(3) The requirements of the proposed Inuvialuit gas-gathering project may also have been underestimated: in addition to the 14 000 cubic metres of Class 3 materials forecast, a further 10 000 to 15 000 cubic metres may be required (Russell Newmark, pers. comm.)

(4) Community representatives also suggest that the materials necessary for onshore oil and gas production and for associated pads and roads may have been over-classed. They agree with the recommendation (EBA 1987) that Class 3 materials be substituted wherever possible in the projected 3 756 000 cubic metres Class 2 demand (Figure 6).

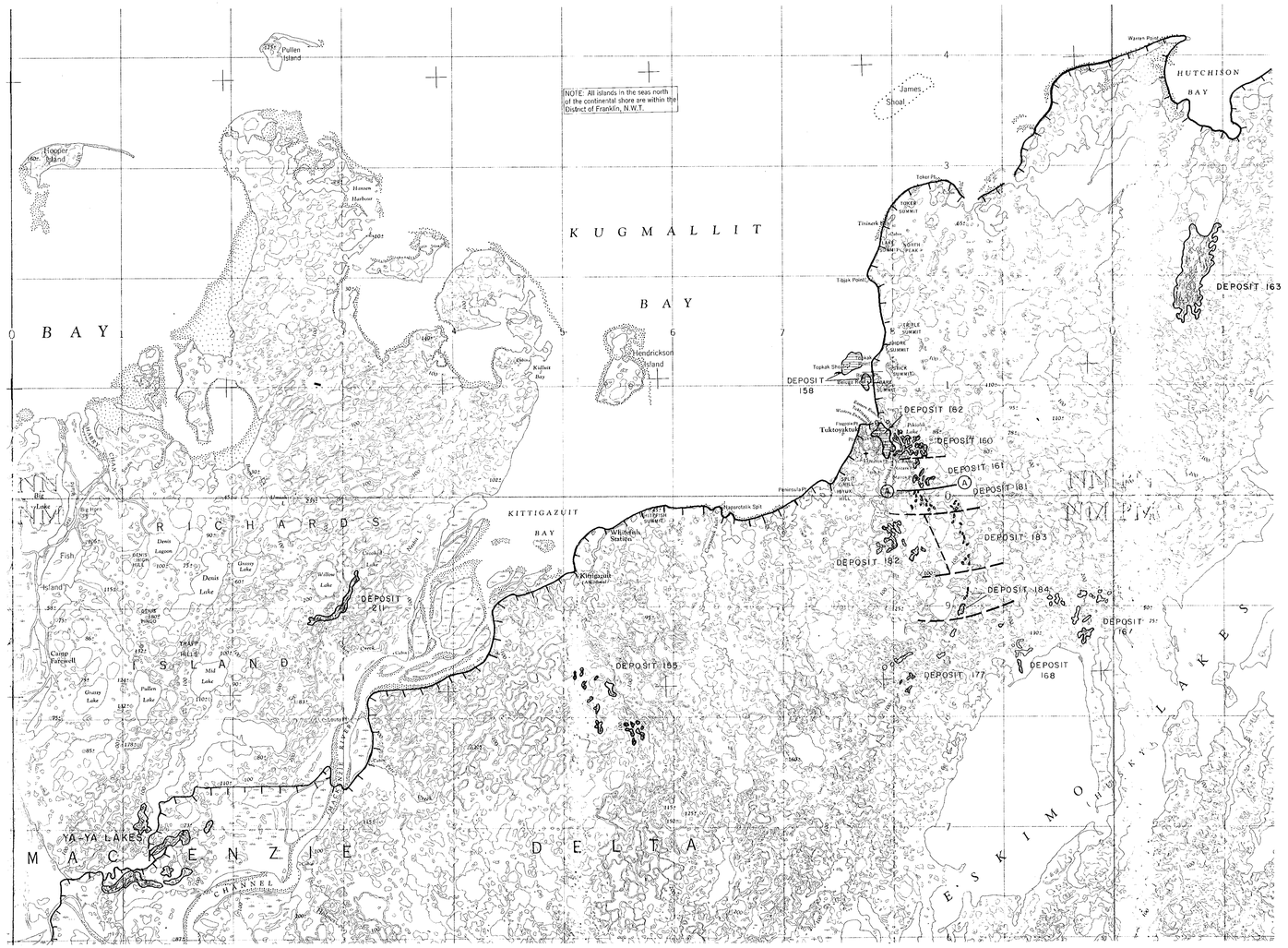
There may thus be some inaccuracies in the forecast demand figures. The Inuvialuit Final Agreement requires, however, that the demand forecasts be revised at least every five years. In this context, the forecast demand (EBA 1987) should be sufficiently accurate for the present purpose of setting aside reserves.

3.4 POTENTIAL SOURCES OF SUPPLY

Granular materials sources in the Tuktoyaktuk area that are discussed in this plan are shown in Figure 5 and described in Table 3. These sources are rated Class 2 or 3, for the most part, with some Class 1 and 4 materials also present.

3.4.1 Class 1 to 4 Materials (Non-Speculative)

EBA (1987) has recommended the investigation of Sources 155 and 177 as general sources of supply for the community's Class 1 to 4 requirements. Source 168 was recommended as a future source of Class 1 supply, and Sources 181 and 183 were recommended as supplementary sources of Class 3 supply. In the event that Class 1 and 2 supplies in the above sources prove insufficient for the community's needs, the use of the Ya-Ya Lakes pit was also recommended. Source 160/161, developed in the past as a nearby source of granular materials for the community's needs, was



NOTE: All islands in the seas north of the continental shore are within the District of Franklin, N.W.T.

LEGEND

- Deposits investigated during this study and/or previously, and considered favourable
- Offshore deposits investigated previously considered favourable
- Deposits investigated during this study and considered unsuitable
- Deposits identified during this study but not ground-truthed
- Inuvialuit lands
- (A)—(A) Demarcation line agreed upon during Phase I, development of granular deposits south of this line allowed:

Scale 1:250,000 Échelle

Miles 5 0 5 10

Kilometres 5 0 5 10 15

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COMMUNITY GRANULAR MANAGEMENT PLAN
TUKTOYAKUK N.W.T.

POTENTIAL BORROW SOURCES FOR COMMUNITY SUPPLY

DATE Nov./86 DWN YK CHKD. NM APPD AH

CG 14096 PLATE 1

TABLE 3

GRANULAR MATERIAL SOURCES - TUKTOYAKTUK
(FROM EBA 1987 Unless Noted Otherwise)

Source No.	Location	Estimated Volume	Access	Comments
155	32 km southwest of Tuktoyaktuk	1 160 000 m^3 Class 3 (probable) 2 600 000 m^3 Class 3 (prospective)	Tundra/ice road in winter	330 000 m^3 Class 2, 531 000 m^3 Class 3, 42 000 m^3 Class 4 (proven - Hardy BBT Limited 1987a) on Inuvialuit 7(1)(b) lands
160/ 161	East side of Tuktoyaktuk Harbour	128 000 m^3 Class 2 (probable) 622 000 m^3 Class 3 (probable)	Tundra/ice road in winter; barge to stockpiles in summer	
162	Northern half of Tuktoyaktuk Harbour - underwater	70 000 m^3 Class 1 (probable), 1 050 000 m^3 Class 1 (prospective); 285 000 m^3 Class 3 (probable), 4 275 000 m^3 Class 3 (prospective)	Tundra/ice road in winter; barge in summer	
163	35 km northwest of Tuktoyaktuk	10 million m^3 Class 3 (probable), 150 million m^3 Class 3 (prospective)	Tundra/ice road in winter	

TABLE 3 (Continued)

GRANULAR MATERIAL SOURCES - TUKTOYAKTUK
(FROM EBA 1987 Unless Noted Otherwise)

Source No.	Location	Estimated Volume	Access	Comments
164	35 km east of Tuktoyaktuk	534 000 m^3 Class 2, (probable), 890 000 m^3 Class 2, (prospective), 1 068 000 m^3 Class 3 (probable), 1 780 000 m^3 Class 3 (prospective)	Tundra/ice road in winter	
165	32 km southeast of Tuktoyaktuk	85 000 m^3 Class 2, (probable) 1.3 million m^3 Class 2 (prospective)	Tundra/ice road in winter	
167	27 km southeast of Tuktoyaktuk	220 000 m^3 Class 2 (probable), 880 000 m^3 Class 2 (prospective); 220 000 m^3 Class 3 (probable), 880 000 m^3 Class 3 (prospective)	Tundra/ice road in winter	
168	25 km southeast of Tuktoyaktuk	70 000 m^3 Class 1 (proven), 280 000 m^3 Class 3 (proven) 530 000 m^3 Class 3 (probable)	Tundra/ice road in winter	
170	32 km south of Tuktoyaktuk	61 000 m^3 Class 1 (probable) 458 000 m^3 Class 1 (prospective) 549 000 m^3 Class 3 (probable) 4 122 000 m^3 Class 3 (prospective)	Tundra/ice road in winter	

TABLE 3 (Continued)

GRANULAR MATERIAL SOURCES - TUKTOYAKTUK
(FROM EBA 1987 Unless Noted Otherwise)

Source No.	Location	Estimated Volume	Access	Comments
177	22 km south of Tuktoyaktuk	317 000 m^3 Class 1 (probable) 634 000 m^3 Class 1 (prospective) 317 000 m^3 Class 2 (probable) 634 000 m^3 Class 2 (prospective) 317 000 m^3 Class 3 (probable) 634 000 m^3 Class 3 (prospective)	Tundra/ice road in winter	
181	8 to 12 km southeast of Tuktoyaktuk	260 000 m^3 Class 3 (proven)	Tundra/ice road in winter	
183	12 to 17 km southeast of Tuktoyaktuk	118 500 m^3 Class 3 (proven)	Tundra/ice road in winter	
Ya-Ya Lakes	85 km southwest of Tuktoyaktuk	7.5 million m^3 Class 2 (proven) 8.8 million m^3 Class 2 (probable)	Tundra/ice road in winter	On Inuvialuit 7(1)(b) lands

recommended for abandonment and reclamation in response to community concerns. It was, however, recommended that any quality materials exposed during reclamation be used.

Hardy BBT Limited (1986a, 1986b, 1987a, 1987b, 1988), in a granular management plan commissioned by the Government of the Northwest Territories for Tuktoyaktuk, recommended the northern portion of Source 155 as the prime source of granular materials for the community. Realizing that this source could not meet all of the community's projected needs for lower-classed materials, they recommended Source 177 as an alternative source. Hardy BBT suggested that additional drilling in the area of Source 155 may prove more material.

Source 155 is located near Kittigazuit Creek, approximately 47 km southwest of Tuktoyaktuk, on Inuvialuit 7(1)(b) lands (Figure 5). It is only accessible by winter ice road. Sources 181, 183, 177, and 168 are located on Inuvialuit 7(1)(a) lands, approximately 8, 12, 22, and 25 km south of Tuktoyaktuk respectively. Until an all-weather road to these sources is developed, their excavation would require the yearly construction of winter access roads as well. The Ya-Ya Lakes pit is located primarily on Inuvialuit 7(1)(b) lands, approximately 85 km southwest of Tuktoyaktuk, and is accessible to Tuktoyaktuk via the Tuktoyaktuk-Inuvik winter ice road. Source 160/161 is located on Inuvialuit 7(1)(a) lands, on the east side of Tuktoyaktuk harbour.

Current information on the volumes of material in the recommended sources is as follows: Source 155, recently

investigated by Hardy BBT Limited (1987a) has proven volumes of 330 000 cubic metres Class 2, 531 000 cubic metres Class 3, and 42 000 cubic metres Class 4 materials. Source 168 is reported by EBA (1987) to have a proven volume of 70 000 cubic metres of Class 1 material, and proven and probable volumes of 280 000 and 530 000 cubic metres respectively of Class 3 material. Sources 181 and 183 are reported to have proven volumes of 260 000 and 118 500 cubic metres respectively of Class 3 material. Source 177 is reported to contain probable volumes of 317 000 cubic metres of each Class 1, 2, and 3 materials. The Ya-Ya Lakes pit was originally predicted to contain a volume of 8.8 million cubic metres of Class 2 material. It has, however, been extensively developed, and more current estimates are unavailable. Source 160/161 was originally assessed as having a probable volume of 128 000 cubic metres of Class 2 and 622 000 cubic metres of Class 3 material. It was also extensively developed prior to the community-requested suspension of activities. The remaining volumes are currently unknown.

Community representatives in Tuktoyaktuk are generally skeptical of supply information which has not been corroborated by field investigation. Development permits have been issued for probable sources of granular material in the Tuktoyaktuk area in the past, only to find, on excavation, that some sources consisted largely of ice (Vince Steen, pers. comm.). Field verification of some of the above sources will therefore be necessary. Community representatives suggest, for example, that Source 177 may be less promising than supposed. While the source has not been extensively explored, excavations to date suggest that

it may consist primarily of Class 3 and/or Class 4 materials. Similarly, community information suggests that Sources 181 and 183 may be very shallow. Several shallow pits might thus have to be excavated in order to recover any substantial volume of Class 3 material from these sources. On the other hand, Source 160/161 still contains Class 3 material, and community representatives now believe that some part of the source should be made available for residential lot development in the Hamlet.

In summary, Tuktoyaktuk's non-speculative, 20-year requirements for Class 1, 2, 3, and 4 materials are approximately 31 000, 138 000, 90 000 and 40 000 cubic metres of these materials respectively (Table 1). Current information suggests that the sources preferred by the community (sources 155, 168, and 160/161) should be adequate to meet the community's 20-year requirements and that sources 177, 181, and 183 should not be needed.

3.4.2 Class 5 Requirements (Non-Speculative)

There are no Class 5 sources in the Tuktoyaktuk area. EBA (1987) recommended the use of Sources R 28/29 or I 403 in the Inuvik area to supply these needs. Irrespective of which of these sources is ultimately used, they will have more than enough material to meet Tuktoyaktuk's comparatively modest requirements. Sources R 28/29 and I 403 have proven volumes of Class 5 material of 20 million and 2 million cubic feet respectively. Tuktoyaktuk's Class 5 requirement is only approximately 20 000 cubic metres over 20 years.

3.4.3 Class 2 Materials (Speculative)

Tuktoyaktuk's more speculative Class 2 requirements consist of approximately 3.75 million cubic metres of granular material for onshore oil and gas projects, and approximately 60 000 cubic metres for airport expansion (Figure 6).

EBA (1987) recommended the use of Sources 163, 164, and 165 to supply the 3.75 million cubic metre oil and gas requirement. These sources are situated on Inuvialuit lands, between 32 and 35 km east of Tuktoyaktuk. Their development would require the yearly construction of winter access roads. The community recommends that sources 167, 177, and 170 be considered also as potential sources of industrial supply. Source 177 had been described earlier. Source 167 is located on Inuvialuit 7(1)(a) lands, approximately 27 km southeast of Tuktoyaktuk. Source 170 is located on Inuvialuit 7(1)(a) and (b) lands, approximately 32 km south of the Hamlet. As with Source 177, the development of Sources 167 and 170 would require the yearly construction of winter access roads.

Because the required quantity of Class 2 material does not exist in the Tuktoyaktuk area, except in the Ya-Ya Lakes pits, EBA recommended some substitution of Class 3 material for Class 2 requirements. Sources 163, 164, 165, 167, and 170 contain total probable and prospective volumes of Class 2 material of 839 000 and 3 070 000 cubic metres respectively. Class 3 probable and prospective volumes at these sources are 11 837 000 and 156 782 000 cubic metres respectively. Source 170 contains probable and prospective

volumes of 61 000 and 458 000 cubic metres respectively of Class 1 material.

Sources 163, 164, 165, 167, 177, and 170 thus appear promising as potential sources of supply for the oil and gas industry's substantial onshore requirements for granular material in the Tuktoyaktuk area.

EBA recommended that the community's 60 000 cubic metre Class 2 requirement for airport expansion be supplied from Source 177. This source has been described above. Community representatives suggest that Source 168 might also be used to supply the required 60 000 cubic metres of Class 2 material necessary for airport expansion.

3.4.4 Class 3 Material (Speculative)

EBA (1987) has recommended that Class 3 materials required for the construction of the Tuktoyaktuk portion of the Inuvik-Tuktoyaktuk highway (3.3 million cubic metres) be obtained from sources along the proposed alignment (Sources 168, 169, 170, 171, 172, 173, 177, 312, 314, and Parson's Lake). The alignment is close to a straight line route and is thus one of the shortest construction options available. As will be described in Section 3.5, however, community representatives are strongly opposed to this alignment because of its proximity to the Husky Lakes. Until the issue of the alignment of the highway is resolved, there is little value in discussing available supplies and the reservation of sources that are specific to a particular route.

Tuktoyaktuk's Class 3 requirement for airport expansion is approximately 1.5 million cubic metres. EBA recommended that this requirement be dredged from Tuktoyaktuk Harbour (Source 162). As will be described in Section 3.5, community representatives are opposed to the use of dredged material for airport expansion. They suggest the investigation of Source 177, or, failing that, of Source 167. Source 177 has been described above. Its probable volume of Class 1, 2, and 3 materials is approximately 950 000 cubic metres. The prospective volume of these materials in Source 177 is 1.9 million cubic metres. The source may thus be able to supply or make a significant contribution to the project. Source 167, described earlier, is also promising.

Finally, between 14 000 and 30 000 cubic metres of Class 3 material are required for the development of the Inuvialuit gas-gathering project. EBA recommended the use of sources 177, 169, 181, and 183 to fulfill this requirement. Most of these sources have described earlier. Source 169 is located 16 km southeast of Tuktoyaktuk, on Tuktoyaktuk 7(1)(a) lands. It contains probable volumes of Class 1 and 3 materials of 204 000 and 306 000 cubic metres, respectively, and prospective volumes of Class 1 and 3 materials of 306 000 and 459 000 cubic metres respectively. Community concerns with sources 181 and 183 will be discussed below (Section 3.5.5). Community representatives suggest the use of Source 177, and failing that, of lower quality portions of sources 167 or of 168, described above.

3.5 ASSESSMENT OF POTENTIAL SOURCES OF SUPPLY

3.5.1 Introduction

The reservation and development of granular sources in the Tuktoyaktuk area is an issue of some concern to the community. As noted earlier, permits have been issued for the excavation of unproven sources in the past, only to find that some probable or prospective sources consisted largely of ice. This had led to the surface excavation of a relatively large number of unproductive pits in the area which are very slow to recover, and which the community considers an environmental and aesthetic problem. The development of an excessive number of small, scalped pits may also have been aided by a failure to plan the development of granular resources on a regional basis, and by past permitting practices. The community is now concerned that environmental considerations be given a greater weight in the Tuktoyaktuk area. It is recommending that an integrated system of pits be developed which will minimize environmental impacts and restrict the number of pits under development on a regional basis.

The development of a regionally integrated system of granular materials supply will require a better information base than exists at present. This assessment will attempt to aid in the development of such a system by indicating where further work might best be concentrated.

3.5.2 Source 155 (Kittigazuit Creek)

In the spring of 1988, Gruben's Transport Ltd. began developing Source 155. Approximately 15 000 cubic metres were excavated. While further work is necessary to prove materials in the southern portion of the source, Site 155 holds promise as the community's primary source of supply. The source is located, however, very close to the headwaters of Kittigazuit Creek. Furthermore, access to the source follows an ice road along Kittigazuit Creek for most of the creek's length (15 km), before turning inland for 4 to 8 km to approach the source from its landward side.

Kittigazuit Creek flows from its headwaters north into Kugmallit Bay, on the Beaufort Sea. It is important to local people, particularly from Inuvik, because of its fishing, camping, and archaeological and cultural significance. Kittigazuit (at the mouth of the Creek) was one of the traditional areas around which people in the area camped before the establishment of Tuktoyaktuk, and it is still used extensively for whaling and fishing in the summer months, primarily by Inuvik residents. The Inuvik Hunters and Trappers Committee has thus expressed some concern with the development of this source. A representative of the Inuvik Community Corporation and the Hunters and Trappers Committee was therefore brought to the Tuktoyaktuk workshop, and excavations at Source 155 were inspected.

Source 155 is being developed so as to maintain a buffer zone between the developed area and drainage into

Kittigazuit Creek. While an environmental evaluation by Cockney (1988) initially recommended against the development of the site, the consensus of the Tuktoyaktuk and Inuvik workshops (Nesbitt and Howell 1988), at which the issue was discussed, was that the environmental and social impacts of development of the source should be acceptable, provided that the following conditions are met:

(1) A long-term development/environmental protection plan should be produced for the source, demonstrating that the fish populations and fish habitat will not be affected by the source's development. Representatives of the two communities and of the regulatory authorities should work together in the development of this plan (see Appendix A).

(2) All excavation and transport work should be undertaken in the winter, and must ensure that the buffer zone between the developed area and drainage into Kittigazuit Creek is maintained.

(3) The site should be regularly monitored by the ILA, together with the two communities' Hunters and Trappers Committees.

Hardy BBT (1988) included a development and restoration plan for the northern portion of Source 155 as part of their community granular management plan for Tuktoyaktuk. The plan included recommendations regarding timing of excavation, buffer zones between excavations and water bodies, progressive development, overburden and massive ice handling, contouring, and revegetation.

Tuktoyaktuk representatives consider material from Source 155 to be acceptably priced at between $16 and $20 per cubic yard. The consensus of the workshops was that the

source should be reserved and developed for small- and medium-scale public community and Inuvialuit projects in the Tuktoyaktuk area (demands of less than approximately 100 000 cubic metres).

3.5.3 Source 168

Source 168 is the other primary source of interest to the community. Because of its greater access costs, however, the price of materials produced from Source 168 is comparable to the price from Source 155 only at higher extraction rates (at least 30 000 to 40 000 cubic metres per season). Source 168 will thus be more suitable for the medium-volume requirements of the community.

Source 168 is within 1 km of the Husky Lakes, an area used extensively for fishing, trapping, and camping by Tuktoyaktuk residents. Although close to the Husky Lakes, the source is not considered particularly sensitive. The consensus of the Tuktoyaktuk workshop was that Source 168 has been sufficiently explored and is sufficiently important that it should now be reserved and developed for the future use of the community and the Inuvialuit. Provided that a development/ environmental protection plan is produced for the source, that all excavation is regularly monitored for compliance, that access roads to the source are kept as far as possible from the Husky Lakes trail, and that access is during the winter only, the environmental and social impacts of the development of this source should be acceptable.

3.5.4 Source 160/161

On the basis of the fact that Source 160/161 was then considered "off-limits" by the community, EBA (1987) recommended that the source be considered abandoned and that the land be reclaimed. They also recommended recovery of any quality materials encountered during reclamation.

In 1985, Source 160/161 was closed to further development by the Tuktoyaktuk Community Corporation. Excavations at the source were considered a possible source of drainage and/or contamination of Kudluk Lake, the community's primary source of water. There were also concerns that granular development in the general area west of the harbour was resulting in too many cleared areas, and that water quality in Water Creek (a creek from which many people privately gather drinking water in the summer months) might be affected.

The Hamlet has recently approached the Community Corporation with a request that the southeast portion of Source 161 be made available for local residential lot development. This area has already been cleared, and it is considered sufficiently far from Kudluk Lake that the community's water supply will not be affected. Development within 600 feet of Water Creek is also now prohibited (Vince Steen, pers. comm.). Furthermore, at a cost of approximately $10 per cubic yard from Source 161 versus up to $20 from Source 155, residential house pads can be constructed for approximately $300 using material from Source 161 versus $600 from Source 155. After considering

the above factors, the Community Corporation has approved the Hamlet's request. (Joey Carpenter, pers. comm.).

3.5.5 Sources 181 and 183

Community experience suggests that Sources 181 and 183 are relatively shallow in depth. Several pits would have to be excavated and a relatively large surface area disturbed to recover any significant quantity of material from these sources. As suggested earlier, the community wishes to eliminate the development of small pits in the Tuktoyaktuk area, and to minimize the number of pits under development on a regional basis. The community is therefore opposed to the reservation and development of Sources 181 and 183 on environmental grounds. Further exploration and development of these sources is also considered unnecessary at this time, given the reliability of Sources 155 and 168.

3.5.6 Sources 162 (Tuktoyaktuk Harbour), 177, and 167

EBA (1987) has recommended that dredged sediments in Tuktoyaktuk Harbour (Source 162) be used for airport expansion south of Tuktoyaktuk. The community is opposed to such a plan on environmental grounds.

Several fish camps surround Tuktoyaktuk Harbour, and broad whitefish, inconnu, and blue herring are taken by gill net during the open-water season. These camps and the fishing resources of Tuktoyaktuk Harbour are of considerable social and cultural importance to the community. Some local people feel quite strongly, however, that dredging activities in the harbour in the early 1980s had a

significant negative impact on the harbour's fishing resources. Community representatives have therefore recommended that further investigation and development of Source 162 not be undertaken, and that Sources 177 and 167 be investigated as potential sources of supply of the 1.5 million cubic metres of Class 3 material that will be needed for airport expansion.

Like Source 168, Source 167 is relatively close to the Husky Lakes, an area of high social and cultural importance to Tuktoyaktuk. Sources 167 and 177 are not, however, considered particularly sensitive, either on environmental or social/cultural grounds.

The consensus of the workshop was that the reservation and development of Sources 167 and 177 not be approved until such time as a better information base is available for them; that an exploratory drilling program should now be undertaken at the two sources to confirm the quantity and quality of materials available; and that the sources should subsequently be assessed on a regional basis to ascertain their suitability for reservation and development as part of a regional system of granular supplies. The conditions attached to the development of Source 167 should be similar to those stated earlier for Source 168.

3.5.7 Sources 163, 164, 165, and 170

EBA (1987) has recommended that Sources 163, 164, and 165 be used to supply the requirements of onshore oil and gas development in the Tuktoyaktuk area. As noted earlier, the

forecast 20-year demand is 3.75 million cubic metres of Class 2 and 3 material.

The community is not fundamentally opposed to the development of Sources 163, 164, and 165. Some concern has been expressed in the past with drainage and possible stream contamination at Source 163. Similarly, there is some concern with possible interference with traditional activities in the vicinity of Sources 164 and 165, given their proximity to the Husky Lakes: community representatives want to ensure that the development of Sources 164 and 165 does not interfere with nearby local fishing lakes, with creeks draining into the Husky Lakes, or with the trail from Tuktoyaktuk to the Lakes. The consensus of the workshop, however, was that the effect of development at these sources can be reduced to an acceptable level with proper planning.

The community has recommended that Sources 167, 177, and 170 also be considered as potential sources of industrial supply. Sources 167 and 177 have been assessed above. Source 170 is approximately 8 km from the Husky Lakes. It is not otherwise, however, considered to be in an environmentally or socially sensitive area.

The general consensus of the workshop was that further exploratory drilling should be undertaken at Sources 163, 164, 165, and 170 (as well as at Sources 167 and 177). Further excavation at these sources should not be permitted until their potential contribution to a regional system of granular sources has been assessed. If it contains sizeable quantities of suitable granular material, the

community would prefer that Source 167 be developed prior to Sources 164 and 165. In the development of the regionally-integrated system of granular sources, the community would prefer that every effort be made to permit development only at a series of larger sources, each to supply an area approximately 10 km in radius. While the sequence of development is likely to be influenced by the siting of industrial facilities, it is quite conceivable that only some of the above sources would be developed within the 20-year forecast period of this plan.

3.5.8 Inuvik-Tuktoyaktuk Highway Alignment Sources

EBA (1987) has recommended that granular material for the construction of the Inuvik-Tuktoyaktuk Highway be obtained from sources along the proposed alignment (Sources 168, 169, 170, 171, 172, 173, 177, 312, 314, and Parsons Lake). Many community representatives are fundamentally opposed to this alignment. They have also recommended against any assessment of the proposed sources, for fear that the assessment might be interpreted as a tacit approval of the alignment.

The proposed alignment of the highway passes very close to the Husky Lakes. The Lakes are an inland sea of high environmental and social/cultural importance to Tuktoyaktuk, which is afforded a special level of protection under the Inuvialuit Final Agreement (Section 8(1)). They are used for fishing from mid-winter (January/February) onward, and particularly in spring (April and May), when a large part of the community leaves the settlement to camp for a month or more in their

vicinity. Some hunting of geese also takes place throughout the area in spring, and trapping and caribou hunting are pursued in winter. The Husky Lakes are equally important, however, as a kind of haven for the community as a whole, where many people go to get away from the pressures of modern life and to renew their contact with the natural world.

The proposed routing of the highway would allow greater public access to the Lakes. Community representatives have noted concerns with potentially greater fishing pressure on the Lakes, with the potential reductions in fishing resources, and (perhaps most importantly) with the potential for disruption of local fishing, camping, and hunting activities in their vicinity. Many community representatives would prefer that consideration be given to routing the Inuvik-Tuktoyaktuk highway further to the west.

Until the issue of the alignment is resolved, there is little practical value in assessing the potential impacts of developing the proposed sources. These sources would not necessarily be required for a more westerly alignment. Nor would it be an effective use of resources to carry out a geotechnical program to confirm specific sources for highway construction until the alignment issue is resolved.

3.6 COMPARATIVE ASSESSMENT OF SOURCES

A comparative assessment of the granular resource sites near Tuktoyaktuk is summarized in Table 4 and discussed below.

TABLE 4

PREFERRED GRANULAR RESOURCE SOURCES
TUKTOYAKTUK

Source	Use	Environmental and Aesthetic Considerations	Wildlife and Social-Cultural Considerations	Economic Considerations	Comments	Ranking	
						Significance of Impacts	Acceptability of Development
155	Class 1 to 4 needs (non-speculative)	Potential sedimentation of Kittizazuit Creek and subsequent damage to fish populations.	Kittizazuit Creek important for fishing, whaling, and camping, and for its archaeological and cultural significance.	32-km winter road required; economic importance of fishing and whaling activities.	Workshop participants recommend the reservation of this source for small - and medium-scale public and Inuvialuit projects.	Potentially significant	Acceptable providing mitigative measures in place.
160/161	Class 2 and 3 needs (non-speculative)	Sedimentation and contamination of Kudluk Lake - community's main water supply; potential deterioration of water quality in Water Creek.	Too many cleared areas west of Tuktoyaktuk Harbour.	Low costs of development because of location near community.	Closed to development in 1985. Hamlet requested southeast portion of Source 161 be open for residential lot development. Gravel from the source could be used for house pads. Approval given to this request because area is far enough away from water sources.	Potentially significant	Acceptable if buffer between development and water sources maintained.
162 Tuk Harbour	Class 2 and 3 needs (speculative)	Potential sedimentation of Tuktoyaktuk Harbour and subsequent damage to fish populations.	Fishing camps and fishing resources of Tuktoyaktuk Harbour are of considerable social and cultural importance to the community.	Economic importance of fishing and whaling activities.	Workshop participants recommend further investigation of developing Source 162 not be undertaken.	Significant	Unacceptable
163,164, 165	Class 2 and 3 needs (speculative)	Potential stream contamination at Source 163.	Potential interference with traditional fishing, trapping and camping activities near Husky Lakes and the trail to Husky Lakes if Sources 164 or 165 developed.	32 to 35-km winter ice road required; economic importance of trapping and fishing activities.	Impacts can be reduced to an acceptable level with proper planning.	Potentially significant	Acceptable, provided mitigative measures in place.

TABLE 4 (Continued)

PREFERRED GRANULAR RESOURCE SOURCES
TUKTOYAKTUK

Source	Use	Environmental and Aesthetic Considerations	Wildlife and Social-Cultural Considerations	Economic Considerations	Comments	Ranking	
						Significance of Impacts	Acceptability of Development
167	Class 3 needs (speculative)	Potential sedimentation and contamination of Husky Lakes.	Potential interference with traditional fishing, trapping, and camping activities near Husky Lakes.	27-km winter road required; economic importance of trapping and fishing activities.	Confirmation of quality and quantity of material required; development should be as part of a regional granular materials plan; development/environmental protection plan is required; access roads must be removed from Husky Lakes trail; access must be restricted to winter; excavation must be regularly monitored.	Potentially significant	Acceptable if conditions under "comments" are met.
168	Class 1 to 4 needs	Potential for sedimentation and contamination of Husky Lakes.	Potential interference with traditional fishing, trapping, and camping activities near Husky Lakes.	25-km winter road required a greater portion of which is on tundra than with the winter road to Source 155; economic importance of trapping and fishing activities.	Development/reclamation plan should be produced for this source; access roads must be away from Husky Lakes trail; access must be restricted to winter; excavation must be regularly monitored. Source should be reserved for future use of the community.	Potentially significant	Acceptable if conditions under "comments" are met.
170	Class 2 and 3 needs (speculative)	None identified	8-km from Husky Lakes; potential interference with traditional fishing, trapping, and camping activities in the area.	32-km winter road required; economic importance of trapping and fishing activities.	Confirmation of quality and quantity of material required; development should be part of a regional granular materials plan.	Insignificant	Acceptable if confirmed and part of regional plan.

TABLE 4 (Continued)

PREFERRED GRANULAR RESOURCE SOURCES
TUKTOYAKTUK

Source	Use	Environmental and Aesthetic Considerations	Wildlife and Social-Cultural Considerations	Economic Considerations	Comments	Ranking	
						Significance of Impacts	Acceptability of Development
177	Class 3 needs (speculative)	None identified	None identified	22-km winter road required.	Confirmation of quality and quantity of material required; development should be part of a regional granular materials plan.	Insignificant	Acceptable if confirmed and part of regional plan.
181/183	Class 3 needs	Deposits are shallow, therefore, several pits would be required and a large area disturbed.	Increased number of small pits in Tuktoyaktuk area.	8 to 17-km winter road required.	Community is opposed to development of these pits.	Significant	Unacceptable
312, 314 and Parsons Lake	Inuvik-Tuktoyaktuk highway needs	Not discussed	Potential interference with traditional fishing, trapping, and camping activities near the Husky Lakes area.	Not discussed	Not discussed at the workshop since the community is fundamentally opposed to the proposed highway routing along the Husky Lakes.	-	-
Ya-Ya Lakes	Class 1 and 2 needs	Existing pit; massive ice present.	Existing pit; none identified.	85-km winter road required.	Not discussed at workshop; Pits are the preferred source of higher quality materials for Inuvik. Quantities are such that use by Tuktoyaktuk would not effect Inuvik use.	Insignificant	Acceptable

The development of most sources was deemed acceptable by the workshop participants provided certain stipulations are met. These include developing a regional granular materials plan to minimize the number of pits opened to meet speculative needs of the petroleum industry, and the production and implementation of development and environmental protection plans for the sources. Two sources were deemed unacceptable for development: Source 162, in Tuktoyaktuk Harbour, would interfere with fishing activities in the harbour if developed and Source 181/183 would result in a disturbance of large areal extent because of the shallowness of the deposits.

PART 4: RECOMMENDATIONS

(1) Granular inventory work in the Tuktoyaktuk area should continue to move towards the establishment of a regionally-integrated system of granular supplies. The goals of this system should be as per Part 2 of this plan. The quantity and quality of materials in all sources considered for development should, as a general principle, be confirmed by a field testing program prior to any vegetative stripping. The environmental impacts of granular development and the number of pits under development at any point in time should be minimized on a regional basis.

(2) As part of the establishment of such a regional system, Sources 155 and 168 should be reserved and developed for small- and medium-scale public community and Inuvialuit projects in the Tuktoyaktuk area (demands of less than approximately 100 000 cubic metres). Larger-scale, public and Inuvialuit projects should be granted access to these reserves only if the forecast 20-year demand for the ongoing maintenance and smaller projects in the Tuktoyaktuk area can continue to be met from proven supplies in these sources. The development of Source 155 should be as per the conditions of Section 3.5.2 of this report.

(3) The quality and quantity of materials in the southern portion of Source 155 should be further confirmed by field investigation. Further field work at Source 168 is not considered a priority at this time.

(4) The southeast portion of Source 161 should be reserved and made available for residential lot development in Tuktoyaktuk, in accordance with the request of the Hamlet.

(5) Granular development to serve public community needs in the Tuktoyaktuk area should be confined to the above sources until such time as some of the larger-scale and more speculative projects are implemented in the Tuktoyaktuk area.

(6) Sources 163, 164, 165, 167, 170, and 177 should be considered potential contributors to the regional system of sources referred to above. Further excavation at these sources should not be permitted until the quality and quantity of materials available are confirmed by field investigation, and the environmental impacts and potential contribution of each sources to the regional system of supply have been assessed on a regional basis. In the implementation of the regional system, every effort should be made to limit granular development to a series of larger sources, each to supply an area approximately 10 km in radius. It is therefore quite conceivable that only some of the above sources would be developed within the 20-year forecast period of this plan.

(7) For environmental reasons, further dredging should not be undertaken at Source 162. For similar reasons, Sources 181 and 183 should not be further developed. None of these sources should be considered a priority for field confirmation work at this time.

(8) Community representatives in Inuvik and Tuktoyaktuk have expressed concerns about the currently-proposed alignment of the Inuvik-Tuktoyaktuk highway, and particularly about its proximity to the Husky Lakes. The ultimate alignment of the highway will have a significant effect on the reservation and development of granular materials throughout the Inuvik-Tuktoyaktuk area. The issue should be addressed by the Mackenzie Delta/Beaufort Sea Land Planning Commission and officials of the Highways Planning Division of Indian and Northern Affairs Canada, prior to any reservations of specific sources to service highway construction and maintenance.

(9) Granular development and environmental protection plans should be produced for all sources ultimately approved for development in the Tuktoyaktuk area. Source 155 should be considered the first priority. The plans should be produced in consultation with local and regulatory representatives (see Appendix A). They should lay out a 5-to-10 year strategy for the orderly development of each source, and should ensure the integration of granular planning and other land use planning initiatives. They should also ensure that each source is developed so as to minimize environmental and visual effects, and maximize the

amount of materials recovered from the source. In addition, they should lay out procedures for the proper development and restoration of pits.

(10) Regulatory bodies and the joint management boards created by the Inuvialuit Final Agreement (e.g. the Fisheries Joint Management Committee) should ensure the integration of their research work with the development of granular sources in the Tuktoyaktuk area.

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APPENDIX A

LETTER FROM NANCY WITHERSPOON, HABITAT MANAGEMENT BIOLOGIST, WESTERN ARCTIC AREA, FISHERIES AND OCEANS CANADA

Government of Canada / Gouvernement du Canada
Fisheries and Oceans / Pêches et Océans

May 29, 1988

Your file / Votre référence

Our file / Notre référence

Fisheries & Oceans
Western Arctic Area
Box 1871
Inuvik, NWT
X0E 0T0

Mr. Tom Nesbitt
Thomas Nesbitt and Associates
5210 Lundquist Road
Yellowknife, NWT
X1A 3G2

GRAVEL EXTRACTION IN THE WESTERN ARCTIC AREA

Dear Tom:

We have looked at existing and potential sites for gravel extraction in our area and provide the following comments related to the fisheries resources:

1. Gravel extraction near creeks or lakes should be conducted so that:
   a) silt is not released into the water body
   b) bank disturbances are minimized as are changes to the shape and direction of the watercourse
   c) that watercourses are not dammed as a result of the activity
   d) pounding along side watercourses does not take place
   e) spawning gravels are not removed on creek or river bottoms
   f) refuse does not enter water bodies
   g) winter and summer road construction to the sites are constructed to minimize disruptions to water bodies as outlined above
   h) any summer operations near water bodies should be conducted outside fish migratory or spawning periods if they are conflicting

2. Underwater gravel extractions should be conducted giving consideration to;
   a) type of equipment used for extraction
   b) timing of migration and spawning of species in the area
   c) utilizing of the areas by fish for feeding or rearing

Specific sites identified that have fisheries concerns include:

1. Aklavik area sites 455 and 467

.../2

2. Tuk area sites 155, 160, 162 and 158

3. Inuvik area sites 2.45, 2.44, 2.43,314, R28 and R29

4. Sachs Harbour sites 9, 10 and 11

5. Paulatuk sites 14 to 19

All sites could be reviewed in detail as they come up for development.

I hope this will assist you in producing your report and if you have any questions don't hesitate to contact me or Richard Barnes at (403)979-3314.

Yours truly,

Nancy Witherspoon
Habitat Management
Biologist
Western Arctic Area

cc: D.V. Gillman
B. Wong
J. Stein
R. Barnes