EBA Engineering Consultants Ltd.

Civil, Geotechnical and Materials Engineers

INUVIALUIT SETTLEMENT SAND AND GRAVEL INVENTORY AND RECOMMENDATIONS FOR DEVELOPMENT

PAULATUK, N.W.T.

PREPARED FOR

INDIAN AND NORTHERN AFFAIRS CANADA

APRIL 1987

D002350

23.

INUVIALUIT SETTLEMENT SAND AND GRAVEL INVENTORY AND RECOMMENDATIONS FOR DEVELOPMENT

PAULATUK

REPORT SUBMITTED TO

INDIAN AND NORTHERN AFFAIRS CANADA

SUBMITTED BY

EBA ENGINEERING CONSULTANTS LTD.

0101-4575

APRIL, 1987

EXECUTIVE SUMMARY

This report presents the results of a study, conducted under the terms of the Inuvialuit Final Agreement, to determine the supply of granular materials and the 20-year demand for granular materials in the community of Paulatuk. Development scenarios and recommendations designed to optimize the utilization of resources for the anticipated demand are presented.

In summary, the 20-year demand for granular materials in the community is nearly 376,000 cubic metres. Most of the demand is for construction of a new airstrip (260,000 cubic metres); maintenance of community facilities requires 86,000 cubic metres while local capital projects consume the remainder (30,000 cubic metres).

Granular materials sufficient to meet the forecast demand are available in the Paulatuk area. The community has a large convenient source of Class 3 (general) granular material located near an all-weather road. Development of this source should continue in the manner that has been established. It is important that a portion of this source be reserved for use on community projects, but the source is extensive and can easily support large projects.

Substantial volumes of higher quality granular material exist several kilometres from the community, across the Hornaday River. However, due to the local availability of granular material, development of these sources is only recommended for construction of the airstrip or other large scale developments.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Background

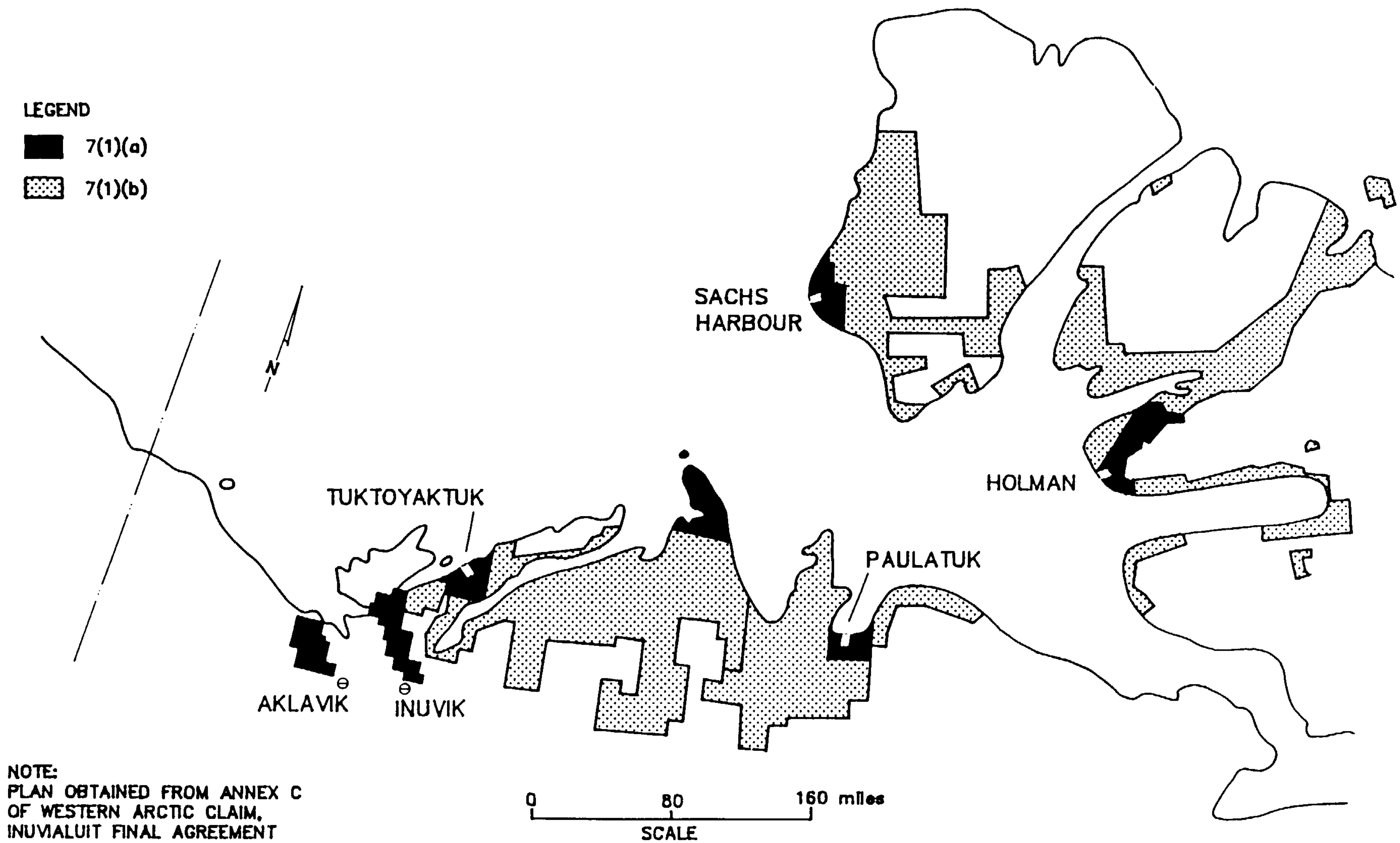
The Inuvialuit Final Agreement provided that Canada grant to the Inuvialuit, fee simple title to a land quantum of 90,650 square kilometres (35,000 square miles) in the Western Arctic Region. The Agreement further specified that the land be sub-divided into two categories, that with mineral rights and that without. For purposes of classification, the two categories have become known as 7(1)(a) and 7(1)(b) lands, respectively. The former includes 12,950 square kilometres (5,000 square miles) of lands; the latter 77,700 square kilometres (30,000 square miles). The 7(1)(a) lands are generally located adjacent to each of the six communities (Aklavik, Holman, Inuvik, Paulatuk, Sachs Harbour and Tuktoyaktuk, Figure 1) considered in the Final Agreement. The 7(1)(b) lands generally surround the 7(1)(a) lands and extend outward from the communities.

The Agreement recognized that most of the proven granular resources of acceptable quality within reasonable distance of the communities were located on Inuvialuit 7(1)(a) lands. In order to ensure that adequate reserves of granular material were maintained at a regulated cost, the Agreement granted control of the 7(1)(a) granular resources to the Inuvialuit, subject to certain provisions.

For purposes of the project described in this report, the provisions concern the supply of, and the demand for, granular resources. Under the terms of the provisions, the Inuvialuit agreed to maintain granular material reserves of appropriate quality sufficient to meet the projected 20-year demand as determined by the Inuvialuit Land Administration [ILA] and appropriate levels of government . The demand for granular materials was to be formed on the basis of estimates of requirements in each community.

In order to ensure that adequate supplies of sand and gravel of appropriate quality remained available within reasonable distance of the communities, the provisions stipulated that the supply of granular materials should be priorized according to end use as determined by the 20-year demand. The first priority was established as the need of the community, the second priority is the need of the Inuvialuit and the third priority is the need of others.

Indian and Northern Affairs Canada [INAC], on behalf of the ILA, has undertaken to develop a granular resources inventory and management plan to fulfill these initial



NOTE:
PLAN OBTAINED FROM ANNEX C OF WESTERN ARCTIC CLAIM, INUVIALUIT FINAL AGREEMENT

EBA Engineering Consultants Ltd.	PROJECT GRANULAR RESOURCES INVENTORY AND MANAGEMENT PLAN
CLIENT INDIAN AND NORTHERN AFFAIRS CANADA	TITLE INUVIALUIT LANDS LOCATION PLAN WESTERN ARCTIC AGREEMENT
DATE 87/02/24 DWN EBR CHKD BAB	JOB NO. 0101-4575 4575-001

obligations. This report presents the resource inventory as it is currently known together with certain development recommendations for the community of Paulatuk.

1.2 Project Authorization

This study was authorized by Supply and Services Canada [SSC] through Contract No. 25ST.A7134-6-0014, awarded to EBA Engineering Consultants Ltd. [EBA]. The Scientific Advisor for the project was Mr. R. J. Gowan, Geotechnical Advisor for the Northern Renewable Resources Directorate of INAC.

1.3 Project Scope

The project scope, as defined by SSC and INAC in the contract, included the following:

a)Development of granular resource supply models for each of the six communities by examination of all existing reports describing granular material deposits.

b)Development of a granular resource demand model for each community through consultation with private and public sector users.

c)Development of a recommended resource development scenario for each community to ensure reserves are established according to the priorities outlined in the Inuvialuit Final Agreement.

d)Preparation of appropriate development recommendations for those sources with the best development prospects.

The following task was subsequently added to the project through a contract amendment:

e)Development of a geotechnical data base consisting of historic borehole information from the study area.

2.0 EVALUATION OF GRANULAR RESOURCES

2.1 Classification

2.1.1 General

A standard for the classification of granular borrow material does not exist within the study area. The first granular resource inventories in the region, carried out in the early 1970's, classified potential borrow material encountered during exploration according to the Unified Classification System [USC]. However, this general classification proved inadequate because there was no direct reference to the end use of the material.

Several years ago, the Government of the Northwest Territories [GNWT] initiated a classification system whereby potential granular borrow was graded according to its most suitable application. The territorial government's system provided the following five material groups:

- Concrete Aggregate [CA],
- Surfacing Material [SM],
- Base [B],
- Subbase [SB],
- Embankment [E] and
- Rip-Rap.

In 1983, INAC adopted a classification system similar to that presented in the draft Territorial Pits and Quarries Regulations that considered both the USC classification of the material as well as the most suitable end use. This system, modified by INAC, was subsequently adopted in a modified form by INAC and is the basis for all borrow material classification carried out under the current contract.

Materials at prospective borrow sources have been graded into one of the five following classes:

Class 1	Excellent Quality Material,
Class 2	Good Quality Material,
Class 3	Fair Quality Material,
Class 4	Poor Quality Material and
Class 5	Bedrock, Felsenmeer and Talus.

These abbreviated descriptions are elaborated upon in the following subsections of this report.

2.1.2 Class 1

Excellent quality material consisting of clean, well-graded, structurally-sound sands and gravels suitable for use as high quality surfacing materials, or as asphalt or concrete aggregate, with a minimum of processing.

2.1.3 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 deleterious materials are present.

2.1.4 Class 3

Fair quality material consisting generally 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.

2.1.5 Class 4

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

2.1.6 Class 5

Bedrock of fair to good quality, felsenmeer or talus. Potentially excellent sources of construction material, ranging from general fill to concrete aggregate or building stone if quarried and processed. Also includes erosion control materials such as rip-rap or armour stone.

2.1.7 Summary

The five material classes presented above are summarized in Table 1. For reference purposes, the GNWT's classification system has been correlated in the table with the adopted INAC system.

2.2 Inventory

The calculated volumes of the various types of granular materials available at the examined sources have been divided into various certainty levels, as detailed below. These definitions are consistent with those used by INAC.

2.2.1 Proven

A 'proven' volume is one whose occurrence, distribution, 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.

2.2.2 Probable

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

2.2.3 Prospective

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

In the context of this project, the uncertainty associated with prospective volumes of granular material varies with terrain conditions specific to the various communities. For instance, substantial amounts of bedrock are located northwest of the community of Aklavik. Since the bedrock has not been explored in detail, the volume of rock is considered to be prospective. Any exploration would likely result in the prospective volume becoming 'probable' or

TABLE 1 GRANULAR MATERIAL TYPES

MATERIAL DESCRIPTION	CLASS	POTENTIAL APPLICATIONS
Excellent quality material consisting of clean, well-graded, structurally-sound sands and gravel suitable for use as high-quality (e.g., runway or roof) surfacing materials, or as asphalt or concrete aggregate, with a minimum of processing.	1	Concrete Aggregate (CA), Surfacing Material (SM)
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 aggregates may be possible with extensive processing, except where deleterious materials are present.	2	Concrete Aggregate (CA), Surfacing Material (SM)
Fair quality material consisting generally of poorly-graded sands and gravels with or without substantial silt content. This material will provide fair quality general fill for roads, flexible foundation pads, or lay-down yards.	3	Base (B), Subbase (SB), Embankment (E)
Poor quality material generally consisting of silty, poorly-graded, fine-grained sand, with minor gravel. May also contain weak particles and deleterious materials and are considered suitable only for marginal, general (non-structural) fills.	4	Subbase (SB), Embankment (E)
Bedrock of fair to good quality, felsenmeer, or talus. Potentially excellent sources of construction material, ranging from general fill to concrete aggregate or building stone if quarried and processed. Also includes erosion control materials such as rip-rap or armour stone.	5	Rip-rap, or if processed properly, equivalent to Class 1 or any other class of material.

'proven'. The situation is very different in the vicinity of Tuktoyaktuk, where granular materials are scarce and landforms are poorly defined. Features that contain 'prospective' volumes of material are often found during detailed investigation to contain little or no useable granular material.

3.0 SUPPLY OF GRANULAR RESOURCES

3.1 General

The amount of information available on the borrow sources in the vicinity of each community varies greatly. This is due in part to the historic level of activity in and around each community, but predominately to the relative supply of acceptable quality borrow within reasonable distance of the community.

Communities whose growth has not been significantly affected by northern petroleum exploration (ie. Holman, Paulatuk and Sachs Harbour) have little formal information regarding the location, size and quality of appropriate borrow sources. As the granular materials demand in general is modest and wholly generated by the community, there is little incentive to undertake borrow material studies provided adequate quantities for current needs exist adjacent to the community. The quality of the borrow materials may not meet desirable standards but this is usually offset by the convenient location. If the borrow performs poorly once in place, it is a simple matter to obtain more material and improve the deteriorating areas.

Communities whose recent growth can be partially attributed to northern petroleum exploration (Inuvik and Tuktoyaktuk) have greater requirements for granular resources. These requirements usually impact both the quality and quantity of borrow materials . Industrial developments usually require large volumes of higher quality material.

The extent of identification and investigation of granular material sources has depended upon local demand. Minimal information is available pertaining to borrow reserves in the vicinity of Holman, Paulatuk and Sachs Harbour. Transport Canada has conducted airphoto studies for the area adjacent to each community, but the results have not been confirmed by field evaluations. Information pertaining to borrow resources for Inuvik and Aklavik is available , however, extensive exploration work has not been undertaken because developed sources have been sufficient to meet the demands.

Tuktoyaktuk is a unique situation with respect to supply of granular materials Although Tuktoyaktuk has grown substantially over the past 10 years and petroleum resource activities have put unusual demands on granular material resources, semi-continuous granular resource exploration activities have generally failed to prove large deposits of quality material within a reasonable distance of the community.

The supply of granular resources for the six western Arctic communities was determined summarizing existing data from site investigations, airphoto interpretation and field reconnaissance of prospective sources. These estimates were made by combining the areal extent of the sources (aerial photography and field measurements) with the stratigraphy determined from test pits and boreholes within the source.

The accuracy of the estimates may not accurately reflect the true situation as detail is lacking for certain sources. Some sources have no ground truthing or very few boreholes and test pits and the depth to which the investigations were completed was often insufficient to reasonably represent the extent of the individual materials within a source. Testing of samples for moisture content or grain size analysis was not necessarily carried out consistently and so designation of a certain class of material to a particular source may be based only upon visual soil description.

Source-by-source descriptions and estimated material volumes are located in the Supply appendix. The following section describes the supply of granular resources situated on or near 7(1)(a) and 7(1)(b) lands adjacent to the community of Paulatuk.

3.2 Paulatuk

3.2.1 General

Paulatuk is located where the Hornaday River discharges into Pauley Bay off the Amundsen Gulf. The highlands situated approximately 15 km south of the community are covered by morainal tills and older glaciofluvial deposits, while at lower elevations along the coast, glaciolacustrine and glaciomarine terraces and bottom sediments have accumulated. More recent deltaic, fluvial terrace and channel deposits are located along the Hornaday River. A few talus fans are located up to 25 km southwest of the community. Paulatuk currently obtains granular materials from a glaciofluvial delta located a few kilometres south of the community.

All of the sources discussed in the following sub-sections have been identified through airphoto interpretation.

3.2.2 Class 1

Presently there are no proven, probable or prospective volumes of Class 1 material in any of the 20 sources identified in the Paulatuk area. Only an airphoto interpretation study has been carried out for this community and a detailed borrow investigation may reveal more information.

3.2.3 Class 2

Figure 5 shows that the prospective volume of Class 2 material in the Paulatuk region is approximately 9,700,000 cubic metres. There are nine sources of which seven appear to have good quality material. These seven are close to the community with the furthest source only 20 km away (Table 12). Only airphoto interpretation has been carried out, thus detailed field investigations will be necessary to quantify potential and proven volumes.

3.2.4 Class 3

Airphoto evaluation of potential sources at Paulatuk has indicated the prospective volume of Class 3 material is 15,700,000 cubic metres (Figure 5). The sources with substantial volumes of Class 3 material are close to the community but for most of the areas direct access is questionable and the quality of the sources appears to be less than ideal (Table 13). Source 87-P-23 however, is closest to the community (2.5 km) and has a potential volume of 2,200,000 cubic metres.

3.2.5 Class 4

Four sources in the Paulatuk region are considered to have substantial volumes of Class 4 material (Table 14). Three of these sources are of poor to marginal quality and access is difficult. Source 87-P-22 is close to the community (1 km), but is of low volume (250,000 cubic metres) and only fair quality.

3.2.6 Class 5

There are no explicit sources of Class 5 material within the Paulatuk study region, but boulders may be obtainable from Source 87-P-13.

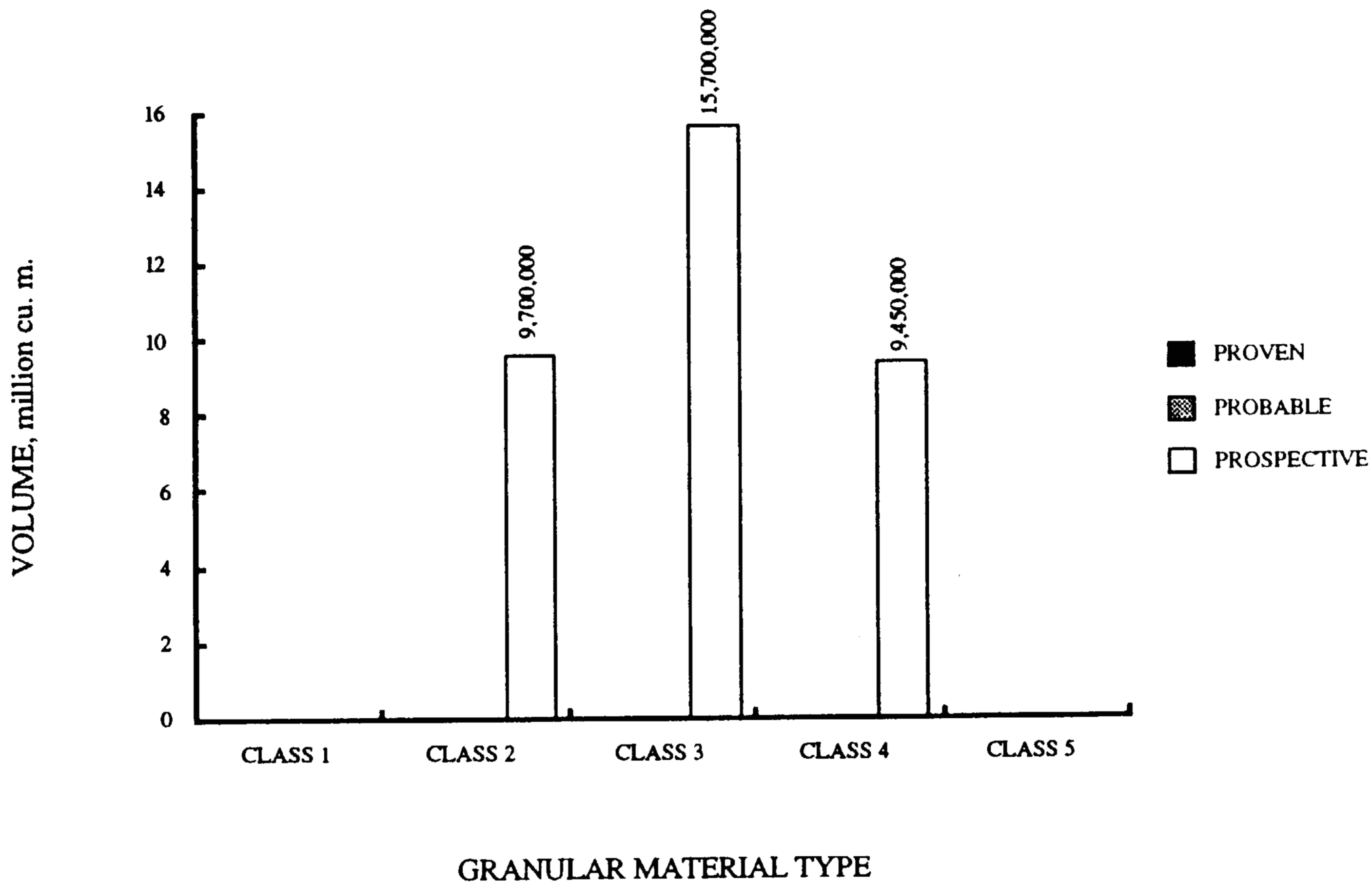


FIGURE 5 SUPPLY OF GRANULAR RESOURCES-PAULATUK

TABLE 12 DISTANCE TO CLASS 2 GRANULAR RESOURCES-
PAULATUK

SOURCE	DISTANCE (km)	PROVEN (cu. m.)	PROBABLE (cu. m.)	PROSPECTIVE (cu. m.)	CONSIDERATIONS
87-P-10	9.2			700,000	Marginal quality
87-P-12	10			1,200,000	Source with highest potential
87-P-13	11.5			2,500,000	Possible boulders
87-P-15	15.5			300,000	Good quality
87-P-4	16			500,000	Marginal quality
87-P-16	17.2			1,500,000	Good quality
87-P-17	19			500,000	Good quality
87-P-3	20			1,300,000	Good source, indirect haul
87-P-19	20			1,200,000	Good quality

TABLE 13 DISTANCE TO CLASS 3 GRANULAR RESOURCES-PAULATUK

SOURCE	DISTANCE (km)	PROVEN (cu. m.)	PROBABLE (cu. m.)	PROSPECTIVE (cu. m.)	CONSIDERATIONS
87-P-23	2.5			2,200,000	Highest potential close source
87-P-11	7			1,500,000	Potentially wet in summer
87-P-21	11			1,000,000	Difficult access, questionable quality
87-P-14	14			1,600,000	Possible over-sized material
87-P-20	15			700,000	Small, indirect haul route
87-P-2	16.5			700,000	Small, questionable quality
87-P-1	17			8,000,000	Coastal access possible

TABLE 14 DISTANCE TO CLASS 4 GRANULAR RESOURCES-PAULATUK

SOURCE	DISTANCE (km)	PROVEN (cu. m.)	PROBABLE (cu. m.)	PROSPECTIVE (cu. m.)	CONSIDERATIONS
87-P-22	1			250,000	Good source of fair quality material
87-P-9	12			5,000,000	Difficult access, marginal quality
87-P-6	17			1,200,000	Poor accessibility, poor quality
87-P-7	25			3,000,000	Poor quality

4.0 DEMAND FOR GRANULAR RESOURCES

4.1 General

The purpose of the demand model was to determine the requirements for granular materials within the study area for a period encompassing the next 20 years. The needs of the model required that a substantial amount of specific information be obtained. This information consisted of descriptions of proposed types of projects and end users of the granular material, as well as material type and volume requirements.

The first step in compilation of the demand model was the identification of individuals and groups likely to have granular material demands or, alternatively, be concerned with the use of granular materials in general. A list of potential respondents was prepared by identifying the various departments in all levels of government involved with civil-oriented community projects and by forming a list of contractors residing or prominent in each community. A questionnaire was then assembled and distributed.

The questionnaire was designed to determine the need for various quantities of selected types of granular materials and to indicate the end use of the material. The questionnaire recipient was also asked to indicate, if possible, the likely or preferred source of the granular materials for each project or material type. In an attempt to quantify the rate of granular material demand, information was requested to be submitted in four data blocks, each five years in length.

Shortly after submission of the questionnaires, two EBA representatives, Messrs. D. Hayley, P. Eng., and J. Carss, P. Eng., visited each project community, as well as Yellowknife and Cambridge Bay, to meet with recipients of the questionnaires and other representatives of the local community to discuss their specific requirements for granular materials. This not only provided direct contact with most of the users and regulators of granular materials but also permitted the EBA representatives to become familiar with local conditions regarding granular resources.

Recipients of the questionnaire who were not visited were contacted by telephone, where possible, to ensure that all possible input was obtained and to clarify any questions or ambiguities that developed regarding the information sought by the questionnaire. The data collected was then assembled into a computerized data base to facilitate data handling and interpretation.

A large number of the respondents defined material quality in terms other than those in the INAC classification system that was outlined in the questionnaire. Table 1 presents the current interpretation of these various classes of required materials in light of the INAC classification system.

The process of data assimilation indicated that a project requiring granular materials could best be described as belonging to one of three categories: planned capital projects, speculative projects and maintenance. While the demand generated by all three project categories may be somewhat speculative, the 'speculative' projects category specifically refers to large scale projects that may or may not occur within the next 20 years. These projects usually involve a political decision and require a substantial committment of both funding and granular materials and typically involve projects such as airstrips, lengthy highways and construction of infrastructure for the production of oil and gas.

The total demand for granular materials in all of the Western Arctic communities is graphically presented in Figure 8. The total demand for granular materials for the years 1987 to 2007 has been estimated at 17.4 million cubic metres. Ninety-two percent of the demand (16 million cubic metres) is for projects that have been described as speculative, five percent of the demand (0.8 million cubic metres) has been indicated for planned capital projects and three percent of the demand (0.6 million cubic metres) has been designated for maintenance. Most of the demand is created by the various levels of government, with expansion of private industry requiring only three percent of the non-speculative capital project demand.

Despite the attempt of the questionnaire to determine the 20-year demand in 5-year blocks, most data received did not contain any specific 5-year information for non-speculative capital projects beyond 1991. The reasons for this occurrence appear to be two-fold: first, the Territorial Government uses an annually up-dated 5-year plan for budgeting capital expenditures; and second, most of the communities will acquire their basic facilities (ie. schools, nursing stations, government offices, etc.) within the next five years.

Projects designated as speculative appear to require 38 percent of the designated 16 million cubic metres within the next five years and 62 percent thereafter. This break-down is likely as speculative as the projects themselves, since it predominately reflects the desire for the project to occur in the near future. In contrast to the public/private split

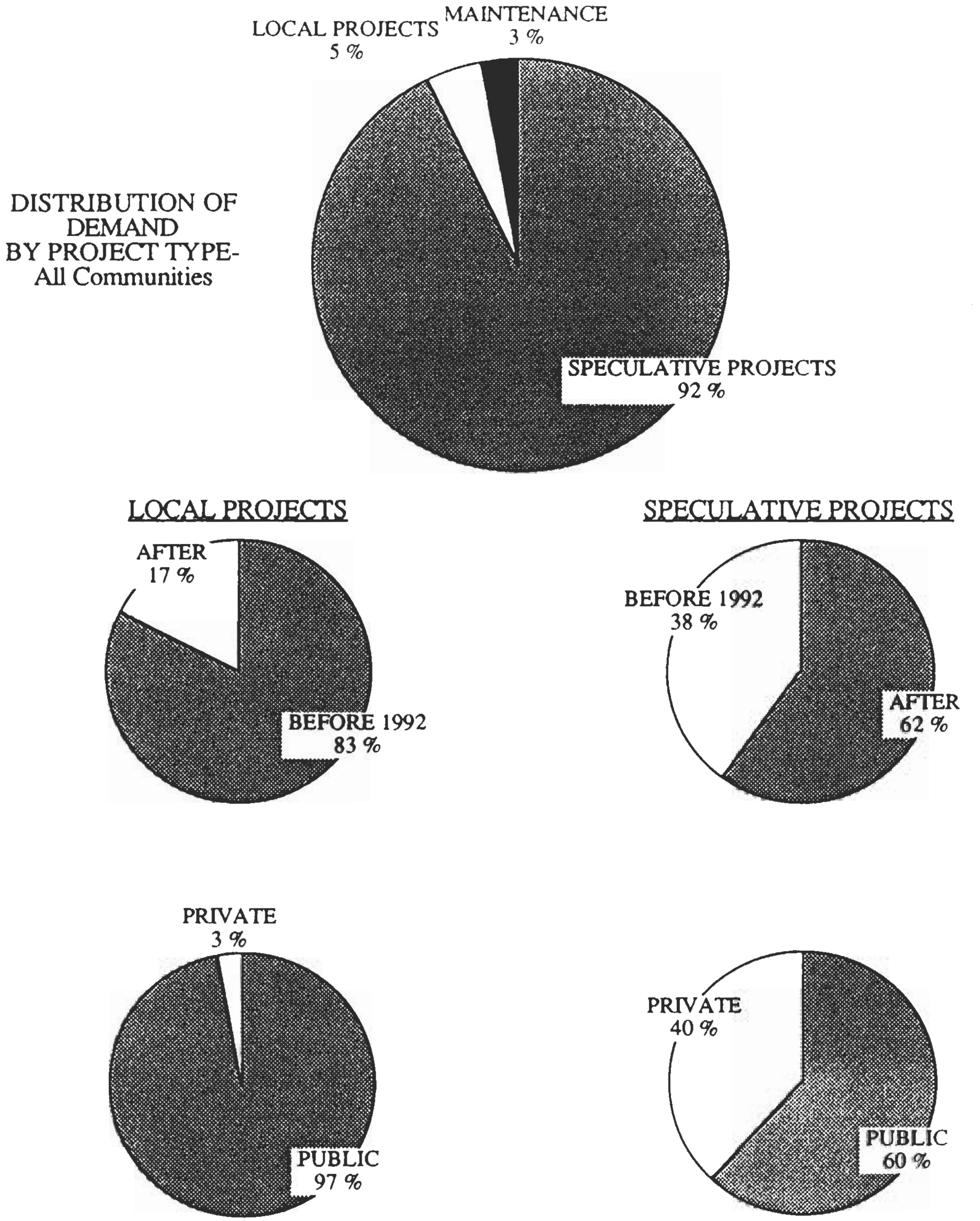


FIGURE 8 GRANULAR RESOURCES DEMAND SUMMARY-
ALL COMMUNITIES

on local capital projects, private industry envisages requiring 40 percent (6.9 million cubic metres) of the total speculative demand.

The following subsections present and discuss the demand data collected. Granular material requirements for the projects identified within the area of the community are presented and summarized in the Demand appendix. Figures presenting the required volume of each class of material for Paulatuk are contained in the following text.

4.2 Paulatuk

4.2.1 General

Paulatuk is a hamlet that is preparing for significant growth over the next five years. It currently has less-than modern facilities and its population is experiencing substantial growth in response to the general slow-down in northern resource exploration activities to the west. A significant number of people are now moving to Paulatuk from Tuktoyaktuk and the community is attempting to up-grade public facilities in order to accommodate the projected population increase. All of the projects identified through the study are of a public nature. Local capital projects are expected to require 289,900 cubic metres of granular materials within the next five years and 210 cubic metres thereafter. Maintenance activities are expected to consume 86,000 cubic metres of material over the next 20 years.

Most of the demand (260,000 cubic metres) is required for construction of a new airstrip. The current airstrip is located adjacent to the community and is susceptible to severe and unpredictable winds. This project is understood to be in the planning stages and has therefore not been included in the speculative category. A benefit related to airstrip relocation is the opportunity to use the old airstrip for subdivision purposes.

The demand for each class of granular material for capital projects over the next twenty years is summarized in Figure 17; the cumulative demand is presented in Figure 18.

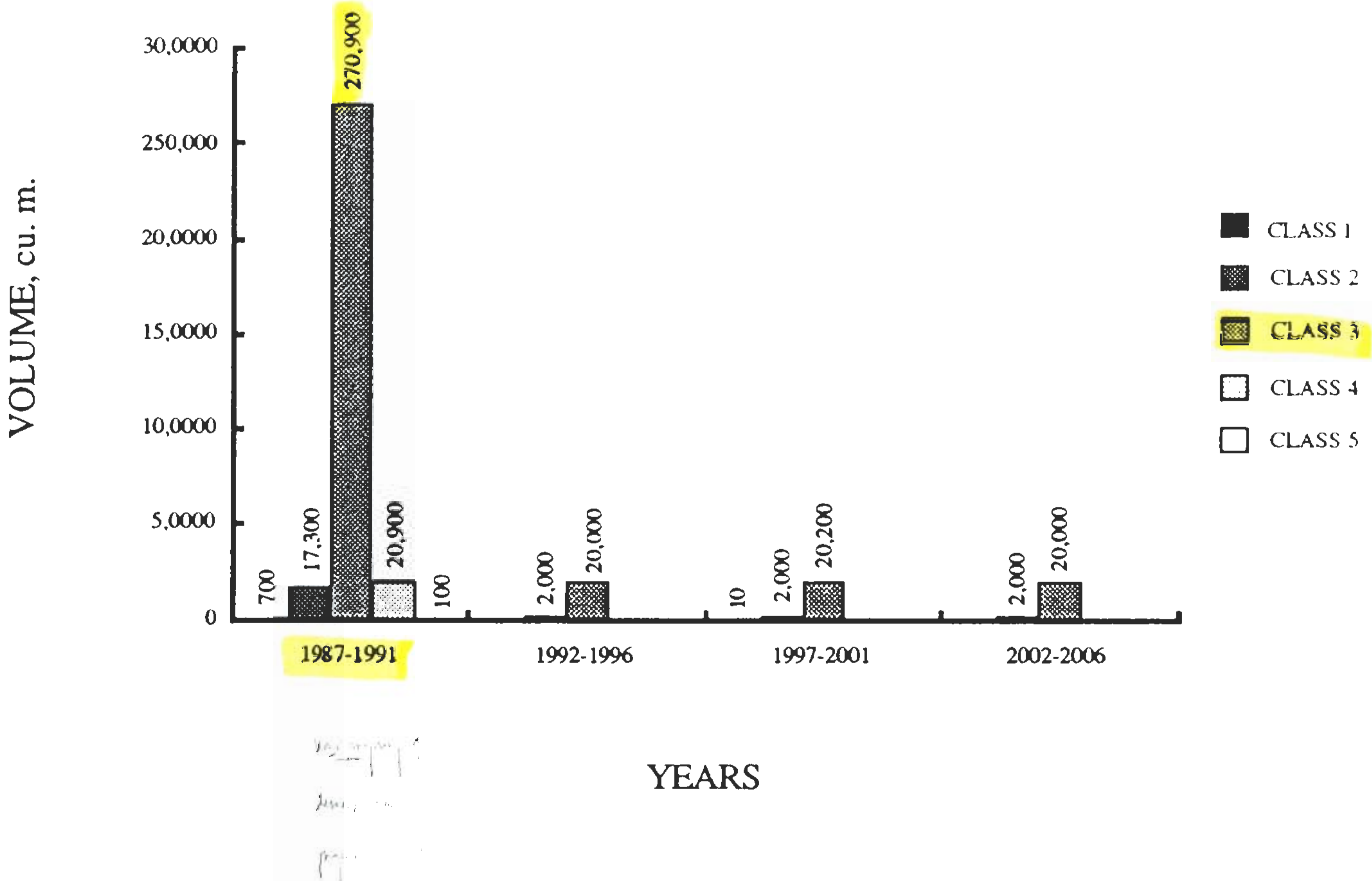


FIGURE 17 DEMAND FOR GRANULAR RESOURCES-PAULATUK

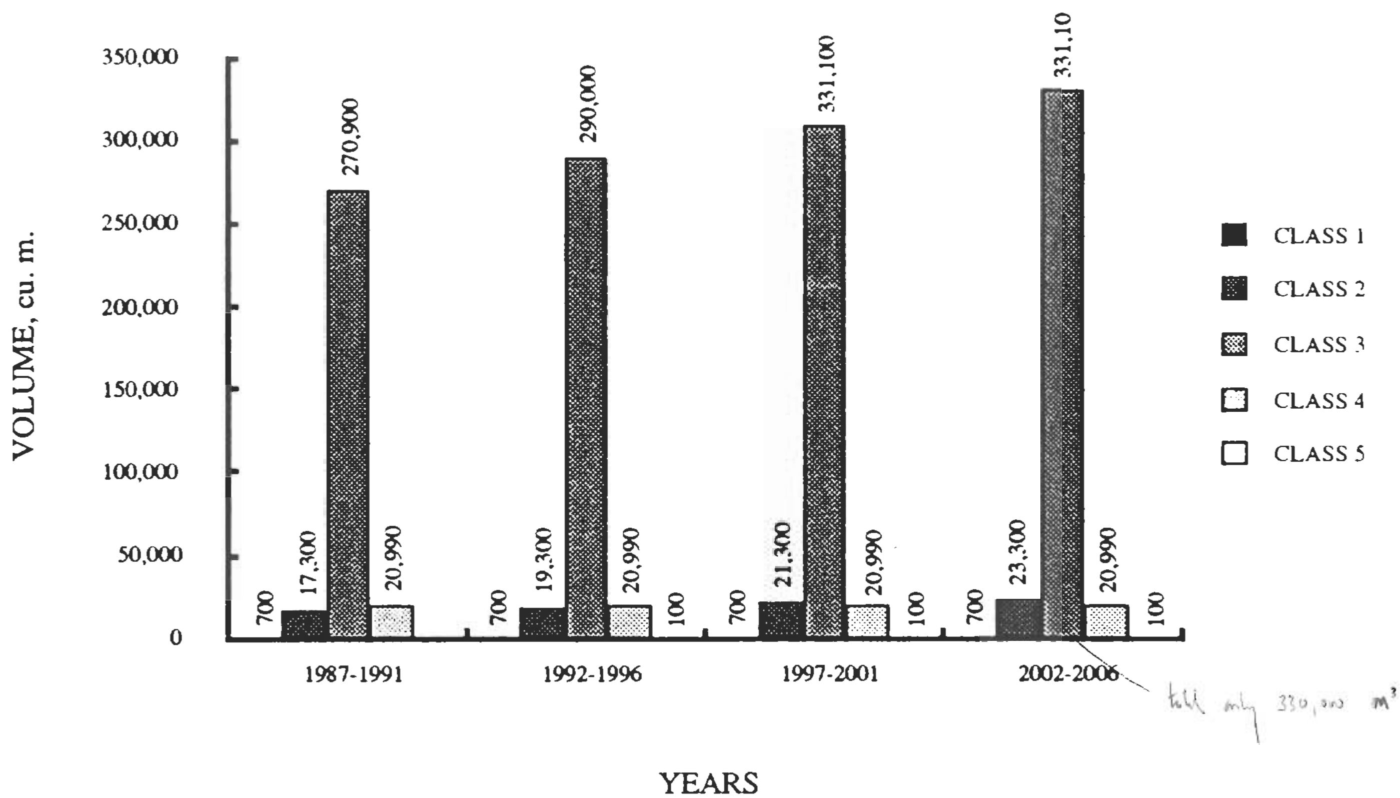


FIGURE 18 CUMULATIVE DEMAND FOR GRANULAR RESOURCES-PAULATUK

4.2.2 Class 1

Paulatuk has indicated a demand for 700 cubic metres of Class 1 material for the years between 1987 and 1991, inclusive. A further demand for 10 cubic metres of Class 1 material has been expressed for the years 1997 through 2001.

4.2.3 Class 2

The Class 2 granular material requirement is 23,300 cubic metres. This demand is split between each of the four time periods, with a demand of 17,300 cubic metres in the first five years and 2,000 cubic metres in each of the subsequent five-year blocks. The proposed construction of a new airstrip will demand 10,000 cubic metres between 1987 and 2001.

4.2.4 Class 3

Three hundred and thirty one thousand, one hundred cubic metres constitutes the total demand for Class 3 material. The demand for 1987 through 2001 has been indicated to be 270,900 cubic metres, with airstrip construction responsible for 250,000 cubic metres of the requirement. In subsequent year blocks, the demand declines to 20,000 cubic metres except for the period of 1997 through 2001, when 20,200 metres of material are required.

4.2.4 Class 4

The Class 4 granular material requirement is 20,900 cubic metres. All of the demand exists within the first five years of the study period. There is no apparent requirement for material of this type in subsequent years under consideration.

4.2.5 Class 5

Only 100 cubic metres of Class 5 material are required for Paulatuk, with all of the demand occurring between 1987 and 1991.

5.0 DEVELOPMENT SCENARIO

5.1 General

Paulatuk's granular materials have historically been obtained from a pit located a few kilometres south of the Hamlet. The material is only fair in quality, but due to the rather modest demands imposed by the community, there have been no substantial borrow pit development activities.

This situation will obviously change if the planned construction of a new airstrip occurs, since the demands imposed by the airstrip will require significant development of certain borrow sources. Following the opening of new borrow pits, the Hamlet will have ready access to granular material superior in quality to that currently available.

The development scenario for the community of Paulatuk is summarized in Table 26 and is presented in detail in the following section.

5.2 Class 1

The twenty year demand for Class 1 granular material is nominal and consists of 710 cubic metres. However, based on a review of potential borrow materials in the Paulatuk region, there are no suitable sources of Class 1 borrow material in the area. It is, therefore recommended that all required Class 1 granular borrow material be obtained from Source 87-P-12, recently identifed as a prime source of Class 2 borrow material.

5.3 Class 2

Class 2 granular material requirements are a modest 23,300 cubic metres. It is recommended that this demand be obtained from newly identified Source 87-P-12, a fluvial terrace located 10 kilometres from Paulatuk. This source has not been explored in detail, but should serve as a suitable source of Class 2 borrow material. As there are no sources of Class 1 borrow material in the area, it is also recommended that select 87-P-12 material serve as Class 1 borrow.

5.4 Class 3

Class 3 borrow material requirements are relatively large considering the size of Paulatuk. Most of the demand is generated by the planned relocation of the airstrip. There are several sources of Class 3 borrow in the area, but the source currently recommended for exploration and development is Source 87-P-23, a delta located 2.5 kilometres south of the community.

5.5 Class 4

The demand for Class 4 granular material occurs during the first five years of the period considered under the study and amounts to 20,900 cubic metres. This material could be obtained adjacent to the community at Source 87-P-22, but in light of the large demand imposed by the planned relocation of the airstrip, it is recommended that all Class 4 borrow material be obtained from Source 87-P-12 while the Class 3 material requirements are being extracted. This would result in the opening of only one pit rather than two and in the use of superior material for Class 4 purposes, which is appropriate, given the nominal Class 4 granular material requirements.

5.6 Class 5

Paulatuk's Class 5 granular material requirement amounts to 100 cubic metres over the period considered by the study. As there are no appropriate sources of Class 5 borrow material located within the study area, it is recommended that all Class 5 requirements be satisfied with over-sized material from Source 87-P-23.

TABLE 26 GRANULAR RESOURCE UTILIZATION-PAULATUK

MATERIAL		1987-1991	1992-1996	1997-2001	2002-2006
CLASS 1	Demand, cu. m.	700		10	
	Source(s)	87-P-12		87-P-12	
CLASS 2	Demand, cu. m.	17,300	2,000	2,000	2,000
	Source(s)	87-P-12	87-P-12	87-P-12	87-P-12
CLASS 3	Demand, cu. m.	270,900	20,000	20,200	20,200
	Source(s)	87-P-23	87-P-23	87-P-23	87-P-23
CLASS 4	Demand, cu. m.	20,900			
	Source(s)	87-P-23			
CLASS 5	Demand, cu. m.	100			
	Source(s)	87-P-12			

NOTES:

1. No Class 1 granular material is available in the Paulatuk area and it is suggested that selected that selected portions of Source 87-P-12 (a Class 2 source) be used when Class 1 material is required.
2. Source 87-P-23 is the southern extension of Paulatuk's current granular material supply. The source is designated a Class 3 deposit, but will provide material for Class 4 purposes.
3. There is no readily available Class 5 material in the area; however, oversized material can probably be obtained from Source 87-P-12, the recommended source of Class 2 borrow material.

6.0 BORROW SOURCE DEVELOPMENT RECOMMENDATIONS

6.1 General

The following sections present guidelines and recommendations for developing a management plan.

These recommendations have taken into consideration information presented in the Environmental Guidelines: Pits and Quarries Handbook (Indian and Northern Affairs Canada, 1983), and the draft Territorial Lands and Public Lands Pits and Quarries Regulations. The ILA currently do not have regulations governing pits and quarries, but generally follow the guidelines suggested in the above documents.

6.2 Objectives

Site-specific management plans must consider the requirements and constraints of regional borrow demand and availability. Each plan should ensure that economical recovery of quality granular materials is achieved at each pit while minimizing the adverse environmental impact. The environmental impact on the region can be minimized by restricting granular recovery operations to a select number of pits, realizing that maximum extraction from a pit will likely cause a slight rise in material cost. This cost increase must be weighed against the environmental costs associated with high grading the better drained surface materials. This local practice frequently results in numerous smaller pits being worked simultaneously or sequentially. Pit management plans should be developed primarily to maximize the utilization of limited resources and to minimize environmental disturbance.

6.3 Pit Access

Access to sources of granular material should be by the most economical, least environmentally damaging manner. Areas with granular resources located nearby (Inuvik, Holman, Paulatuk and Sachs Harbour) can access certain resources with all weather roads. Areas with distant resources (Aklavik and Tuktoyaktuk) can usually only obtain borrow in the winter by tundra/ice roads or in the summer by barge, if the sources are located adjacent to a waterway.

Summer operations would require construction of temporary access roads from the sources and docking facilities for barges. The construction of these facilities would probably require large quantities of granular materials, and would significantly reduce the recoverable volumes.

6.4 Pit Development

6.4.1 Site Preparation Work

Site preparation should be conducted in advance of excavation to prevent contamination of granular materials. This preparation also should preferably be carried out in winter to minimize disturbance to the surrounding terrain. Snow should be cleared from both the area to be excavated and yard areas and placed so as to minimize subsequent pit infilling by drifting snow. Topsoil consisting of peat and organic soils, while typically scarce, should be stripped where possible and stockpiled or windrowed at the edges of the pit area. Windrows should be placed parallel to slope direction to prevent ponding of surface water during spring, or contamination of granular materials. Inorganic overburden materials should be stripped and placed in separate stockpiles or windrows, with similar consideration of drainage considerations. The stripped materials are to be reserved for reclamation purposes. Disturbed areas must be kept to a practical minimum.

6.4.2 Extraction Methods

Winter recovery operations will normally consist of the ripping of friable frozen granular material and pushing it into temporary windrows or stockpiles for loading. This type of extraction can be conducted with conventional equipment including bulldozers with rippers, loaders, and trucks. Poorly-bonded or friable granular material will usually be located near the surface of deposits that exhibit positive relief. If an insufficient volume of material cannot be obtained through ripping, blasting will be necessary.

Summer operations will typically consist of stripping and windrowing or stockpiling thawed layers of granular material with bulldozers, commencing when thaw has progressed about 0.5 m into the deposit. The cycle of operation is largely dependent on the rate of thawing, and the drainage considerations. This method allows potentially greater annual recovery by progressively increasing the amount of thawed material, and it may enhance drainage of the material in stockpiles or windrows.

Experience has shown that winter excavation of frozen stockpiles windrowed the previous summer, may be just as difficult as winter excavation directly from the borrow source unless the stock pile process results in a significant reduction in natural moisture content. Moisture reduction from 10 percent in situ to 5 percent in a stockpile has been achieved by use of conveyors during favourable summer conditions (Hayley and MacLeod, 1977). Frozen gravel stockpiles with a moisture content less than 5 percent are usually sufficiently friable for direct loading without ripping.

Drilling and blasting of frozen ground in the winter has proven cost effective for larger operations. The techniques developed and used extensively at Prudhoe Bay, Alaska, is to remove gravel in lifts 5.5 m thick, by drilling shot holes 6 m deep on a 3 m pattern. Load factors are typically 0.9 kg of ANFO explosive per cubic metre of gravel to create manageable size chunks. Typical specifications for Alaska winter construction restrict the size of frozen gravel chunks to 200 mm.

6.4.3 Treatment of Massive Ice

Logistical constraints caused by massive ice during summer development of YaYa Lake pit are described by Hayley and MacLeod (1977). Where practical, the extent of massive ice in a prospective deposit should be defined prior to pit development. The development plans should include methodology for coping with ice bodies as they are encountered.

Where practical, large bodies of massive ice should be avoided. Thin, or less extensive massive ice within the granular material at higher elevations should be excavated and wasted, or exposed to permit thawing during the summer months. Drainage must be considered with either method of disposal.

Relatively thin layers of massive ice at depth may be permitted to thaw provided all overlying recoverable granular materials are removed during one extraction season. Formation of thaw ponds as ice melts during the summer is inevitable in this situation. Appropriate measures must be taken to control drainage and to protect, and ensure access to, adjacent recoverable granular materials.

It may be desirable to identify and preserve thicker ice bodies at depth. If this material thaws it is likely to prevent recovery of adjacent materials, or result in major disturbance of the surrounding areas. A minimum cover of 1.5 m of granular material should be left as insulation over massive ice to prevent excessive thawing. Criteria for establishing the minimum thickness of massive ice beds which should be preserved is influenced by topographic relief, thickness and extent of granular materials, and the effect of thaw ponds on surrounding terrain. Operators involved with large extraction operations may simply wish to excavate and waste the ice.

6.4.4 Drainage Considerations

Adequate drainage of pit areas must be maintained to ensure availability of recoverable granular material and to attain required annual extraction rates. Higher moisture contents inhibit thawing, increase excavation costs and reduce material quality. Small amounts of meltwater runoff from ice bonded and thinly ice-lensed granular materials could be allowed to seep into the surrounding terrain. Larger amounts of runoff, from thawing of large massive ice bodies, should be directed to retention ponds or sumps excavated in the pit floor. Where gravity drainage is possible, natural ponds or drainage ditches may be effective at removing water from the site. However, excavated ditches are generally ineffective in areas of high ice content.

It is essential that pit drainage facilities be maintained and updated frequently to ensure that moisture drains away from the working face, and that ponded runoff does not accumulate on recoverable granular material. Where thaw ponds are allowed to form by exposing buried massive ice, or where collection ponds are created, care should be taken to preserve and maintain access to adjacent recoverable granular materials. A development plan to adequately account for pit drainage is particularly important where summer extraction operations are employed.

6.4.5 Waste Material

All lenses of fine-grained material (silts and clays) found within the granular deposit, should be stripped and wasted. Waste material should be stockpiled near the stockpiled overburden for use in pit reclamation. Fine-grained waste material at depth will undoubtedly have high excess ice contents, hence it may be advisable to construct a dyke of drier overburden around waste piles to prevent flow of thawed waste onto surrounding terrain or into pit areas.

6.5 Restoration

Restoration measures are required whether the pit is being abandoned temporarily or permanently. All worked areas should be cleaned of all debris, and graded to remove all topographic irregularities. Where abandonment is temporary, positive drainage away from existing faces and access routes must be provided by grading or by ditching to ensure the future recovery of remaining materials. Berms should be constructed at the top of pit faces, if necessary, to prevent surface runoff from entering the pit area.

Prior to permanent abandonment, the edges of worked areas or pit walls should be recontoured to blend into the surrounding terrain. All obstructions to natural drainage should be removed and any slopes graded to prevent runoff from channelling and downcutting. If thaw ponds and lakes and massive ground ice are common in the area, flooding of pits is an acceptable, and frequently inevitable, method of restoration. Areas which are not likely to become flooded should be smoothly graded and covered with stockpiled overburden and organics.

Revegetation may be feasible in certain areas by redistributing stockpiled organic topsoil and peat over the graded slopes of areas unlikely to be flooded, and by seeding or allowing reinvasion of natural vegetation, depending on the nature of the site and the quality of the topsoil. Fine-grained overburden soils are generally adequate for surface reclamation, however, the amount of naturally-occurring topsoil is very limited at some sites. The fertility of these soils may require enrichment for revegetation.

6.6 Site Specific Development Plans

6.6.1 General

The site specfic development plans presented in the following report subsections pertain to selected sources that are prominent in the development scenario proposed for the community of Tuktoyaktuk. The level of detail presented for each source reflects the amount of information available for a particular deposit.

6.6.2 Source P-87-12

Access

The source is located at the east edge of the Hornaday River and is accessible only during the winter by a tundra/ice road.

Site Preparation

The site is currently undeveloped. However, in the event that extensive site preparation is required, activities should be conducted in accordance with the recommendations presented in Section 6.4.1 of this report.

Extraction Methods

No subsurface information regarding site conditions is available for this source. However, it is considered that extraction of the top 1.5 metres of the resource should be feasible during the winter by ripping and pushing frozen granular material into temporary stockpiles for loading onto trucks. In subsequent years, the remainder of the material may drain sufficiently to be extracted.

Drainage Considerations

The pit floor should be graded where possible, to ensure gravity drainage of surface and melt water. Water should be collected and discharged in an environmently acceptable manner. Good drainage enhances seasonal thaw and limits the ingress of water.

Treatment of Massive Ice

Massive ground ice may be encountered at the source. Depending on the extent and distribution of the ice, it may either be excavated and wasted or covered with an insulating blanket of granular material and left in place. More detailed information on dealing with ground ice is contained in Section 6.4.3 of this report.

Restoration

If large-scale borrow material extraction occurs at the pit, restoration activities should be implemented following completion of extraction activities.

Restoration should be conducted concurrent with small-scale, on-going development. All restoration should be conducted in accordance with the recommendations presented in Section 6.5 of this report and should primarily consist of contouring and roughening the abandoned areas of the pit to ensure adequate drainage occurs and that large volumes of water are not trapped within the pit area. Revegetation can be examined as pit abandonment activities proceed.

6.6.3 Source P-87-23

Access

The source is located south of the community of Paulatuk and is accessible on a year-round basis on an all-weather road.

Site Preparation

The site is largely undeveloped, with the exception of a small-scale development on the northern-most extent of the deposit. However, in the event that extensive site preparation is required, activities should be conducted in accordance with the recommendations presented in Section 6.4.1 of this report.

Extraction Methods

Extraction of the top 1.5 metres of the resource should be feasible during the winter by ripping and pushing frozen granular material into temporary stockpiles for loading onto trucks. In subsequent years, the remainder of the material may drain sufficiently to be extracted.

Drainage Considerations

The pit floor should be graded where possible, to ensure gravity drainage of surface and melt water. Water should be collected and discharged in an environmentally acceptable manner. Good drainage enhances seasonal thaw and limits the ingress of water.

Treatment of Massive Ice

Massive ground ice may be encountered at the source. Depending on the extent and distribution of the ice, it may either be excavated and wasted or covered with an insulating blanket of granular material and left in place. More detailed information on dealing with ground ice is contained in Section 6.4.3 of this report.

Restoration

If large-scale borrow material extraction occurs at the pit, restoration activities should be implemented following completion of extraction activities. Restoration should be conducted on a concurrent basis for small-scale, on-going development. Any restoration should be conducted in accordance with the recommendations presented in Section 6.5 of this report and should primarily consist of contouring and roughening the abandoned areas of the pit to ensure adequate drainage occurs and that large volumes of water are not trapped within the pit area. Revegetation can be examined as pit abandonment activities proceed.

7.0 RECOMMENDATIONS

7.1 General

The recommendations contained in the following sections pertain to additional work required to confirm the quantity and quality of granular resources contained in sources that are prominent in the development scenario proposed for the community of Paulatuk and are presented with regard to all information collected and reviewed during the study.

In summary, the recommendations concern the effort necessary to confirm the volume and quality of material available from local granular sources.

7.3 Source 87-P-12

Source 87-P-12 is unexplored although it has the potential to supply a substantial portion of the borrow material required for construction of Paulatuk's planned new airstrip. Prior to the onset of airstrip constuction, a geotechnical drilling program should be carried out at the source in an effort to determine the quality and quantity of granular material available in the source.

7.4 Source 87-P-23

Source 87-P-23 currently supplies all of Paulatuk's required granular resources and will be a major supplier of granular material for construction of the new airstrip. However, only the northern-most portion of the source is open at present. It is recommended that geotechnical drilling be conducted at the source prior to airstrip construction to determine the quality and quantity of available borrow materials. If airstrip construction does not occur, a geotechnical program would be of only limited value.

LIST OF TABLES

LIST OF FIGURES

REFERENCES

AKLAVIK AREA

EBA ENGINEERING CONSULTANTS LTD., 1983a. Evaluation of Potential Sources of Quarry Rock for Marine Structures in the Beaufort Sea Region. Report submitted to the Department of Indian and Northern Affairs, Ottawa, November 1983.

LAWRENCE, D.E., SHNAY, F.G. and VANDINE, D.F., 1972. Granular Resource Inventory- Mackenzie-Aklavik, NTS 107B W1/2. Report prepared by Geological Survey of Canada for the Department of Indian and Northern Affairs, Ottawa, 1972.

LAWRENCE, D.E., SHNAY, F.G., VANDINE, D.F. and THEROUX, L.L., 1972. Granular Resource Inventory- Mackenzie-Aklavik, NTS 107B E1/2. Report prepared by Geological Survey of Canada for the Department of Indian and Northern Affairs, Ottawa, 1972.

RIPLEY, KLOHN & LEONOFF INTERNATIONAL LTD., 1973. Community Granular Materials Inventory- Inuvik, NWT. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, 1973.

R.M. HARDY AND ASSOCIATES LTD. and TERRAIN ANALYSIS AND MAPPING SERVICES LTD., 1976. Granular Materials Inventory: Yukon Coastal Plain and Adjacent Areas. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, 1976.

INUVIK AREA

EBA ENGINEERING CONSULTANTS LTD., 1976a. Geotechnical Evaluation of Granular Material, Mackenzie Delta Area. Report submitted to the Department of Indian and Northern Affairs, Ottawa, March 1976.

INUVIK AREA, cont'd

EBA ENGINEERING CONSULTANTS LTD., 1976b. Evaluation of Potential Rock Quarries: Rocky Hill-Campbell Lake Area, NWT. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, 1976.

EBA ENGINEERING CONSULTANTS LTD., 1983a. Evaluation of Potential Sources of Quarry Rock for Marine Structures in the Beaufort Sea Region. Report submitted to the Department of Indian and Northern Affairs, Ottawa, November 1983.

HARDY AND ASSOCIATES (1978) LTD., 1986. Granular Resource Potential - Lower Mackenzie Valley. Report submitted to the Department of Indian and Northern Affairs, Ottawa, March 1986.

NORTHERN ENGINEERING SERVICES CO. LTD., 1976. Pipeline Related Borrow Investigations (3 volumes). Report submitted to Canadian Arctic Gas Study Limited, November 1976.

RIPLEY, KLOHN & LEONOFF INTERNATIONAL LTD., 1973. Community Granular Materials Inventory - Inuvik, NWT. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, 1973.

RIPLEY, KLOHN & LEONOFF INTERNATIONAL LTD., 1973. Granular Materials Inventory - Zone III, and Zone IV, Zone V, Zone VI (2 volumes). Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, 1973.

TECHMAN LTD., 1976. Preliminary Borrow Source Study, Mackenzie Valley Corridor (4 volumes). Report submitted to Beaufort Delta Oil Project Limited.

TUKTOYAKTUK AREA

BBT GEOTECHNICAL CONSULTANTS LTD., GVM GEOLOGICAL CONSULTANTS LTD., AND TERRAIN ANALYSIS AND MAPPING SERVICES LTD., 1983. Granular Materials Evaluation, Deposits 168 and 211, Tuktoyaktuk, NWT. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, May 1983.

EBA ENGINEERING CONSULTANTS LTD., 1973. Evaluation of Offshore Borrow Resources and Investigation of a Proposed Airstrip Site, Tuktoyaktuk, NWT. Submitted to Imperial Oil Ltd., Frontier Planning Group, Calgary, June 1973.

EBA ENGINEERING CONSULTANTS LTD., 1975. YaYa Granular Resources Study, 1975 (2 volumes). Report submitted to Arctic Petroleum Operators Association (APOA), Calgary, September 1975.

EBA ENGINEERING CONSULTANTS LTD., 1976. Geotechnical Evalaution of Granular Material, Mackenzie Delta Area. Report submitted to the Department of Indian and Northern Affairs, Ottawa, May 1976.

EBA ENGINEERING CONSULTANTS LTD., 1983b. Granular Resource Development and Management Plan for Tuktoyaktuk, NWT. Report submitted to the Department of Indian and Northern Affairs, Ottawa, December 1983.

EBA ENGINEERING CONSULTANTS LTD., 1986 Granular Resource Evalauation, Richards Island, NWT. Report submitted to the Department of Indian and Northern Affairs, Ottawa, December 1986.

EPEC CONSULTING WESTERN LTD., 1982. Dredging and Construction Observations of the Tuktoyaktuk Potable Water Reservoir. Report submitted to the Government of the Northwest Territories, Department of Public Works, Yellowknife, September 1982.

TUKTOYAKTUK AREA, cont'd

R. M. HARDY AND ASSOCIATES LTD., 1977. Granular Materials Inventory, Tuktoyaktuk, NWT. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, August 1977.

R. M. HARDY AND ASSOCIATES LTD., 1978. Geophysical Evalauation of Granular Materials Resources, Tuktoyaktuk, NWT. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, March 1978.

HARDY AND ASSOCIATES (1978) LTD., 1979. Granular Materials Inventory, Phase III, Tuktoyaktuk Harbour, NWT. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, April 1979.

HARDY AND ASSOCIATES (1978) LTD., 1980. Granular Materials Inventory, Tuktoyaktuk, NWT., Sources 160 and 161. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, March 1980.

HARDY AND ASSOCIATES (1978) LTD., 1986. Interim Report- Phase I, Community Granular Management Plan, Tuktoyaktuk, NWT. Prepared for the Government of the Northwest Territories, Department of Public Works Highways Division, Yellowknife, NWT., July 1986.

HARDY BBT LTD., 1986. Interim Report- Phase II, Field Reconnaissance, Community Granular Management Plan, Tuktoyaktuk, NWT. Prepared for the Government of the Northwest Territories, Department of Public Works Highways Division, Yellowknife, NWT., November 1986.

KLOHN LEONOFF CONSULTANTS LTD., 1974. Granular Materials Inventory, Parsons Lake, NWT. Report submitted to Gulf Oil Canada Ltd., October 1974.

MOLLARD, J.D. and ASSOCIATES LTD., 1972. Gravel Inventory Survey, Richards Island and adjacent areas. Report submitted to Arctic Petroleum Operators Association, Calgary, 1972.

PUBLIC WORKS CANADA 1976. Geotechnical Investigation, Mile 970 to Mile 1059, Mackenzie Highway, Volume III. (Combined data 1976-1980) , April 1981.

RIPLEY, KLOHN & LEONOFF INTERNATIONAL LTD., 1973. Community Granular Materials Inventory- Tuktoyaktuk, NWT. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, 1973.

RIPLEY, KLOHN & LEONOFF INTERNATIONAL LTD., 1973. Granular Materials Inventory- Zone I, Zone II and Zone III (3 volumes). Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, 1973.

TERRAIN ANALYSIS and MAPPING SERVICES LTD., 1976. Ya-Ya Lake Esker Complex: Site Development and Restoration Plan. Report submitted to the Department of Indian Affairs and Northern Development, Ottawa, October 1976.

THURBER CONSULTANTS LTD., 1981. Tuktoyaktuk Potable Water Reservoir- Geotechnical Report No. 1, Borrow Source and Site Investigations. Report submitted to EPEC Consulting Western Ltd., March 1981.

HOLMAN, PAULATUK AND SACHS HARBOUR AREAS

TRANSPORT CANADA, 1986. Granular Resources- Various northern sites. Letter report prepared for Indian and Northern Affairs Canada, Ottawa, 1986.

SOURCE NUMBER, TEXT REFERENCES AND CROSS REFERENCES

PRIMARY SOURCE NO. OR NAME AND TEXT REFERENCE		CROSS-REFERENCE SOURCE NO. OR NAME AND TEXT REFERENCE	
150	RKL 1973, ZONE 1	157	HARDY 1977
151	RKL 1973, ZONE 1		
152A	RKL 1973, ZONE 1		
153	RKL 1973, ZONE 1	165	HARDY 1977
154	RKL 1973, ZONE 1	166	HARDY 1977
155	RKL 1973, ZONE 1	2.01	HARDY 1986
156	RKL 1973, ZONE 1	T108-112	RKL 1973, TUKTOYAKTUK
157	RKL 1973, ZONE 1	T100-103,150	RKL 1973, TUKTOYAKTUK
158	HARDY 1977	T104,106,107	RKL 1973, TUKTOYAKTUK
159	HARDY 1977	TUK HARBOUR, AIRSTRIP	EBA 1973
160/161	HARDY 1977	TUK HARBOUR, AIRSTRIP	EBA 1973
162	HARDY 1977		
163	HARDY 1977		
164	HARDY 1977		
165	HARDY 1977	153	RKL 1973, ZONE 1
166	HARDY 1977	154	RKL 1973, ZONE 1
167	HARDY 1977	T113	RKL 1973, TUKTOYAKTUK
168	HARDY 1977	168	BBT 1983
169	HARDY 1977	169	HARDY-BBT 1986
170	HARDY 1977		
171	HARDY 1977	25	DPW 1976
172	HARDY 1977	24, 24A, 24B	DPW 1976
173	HARDY 1977	23, 23A, 23B, 23C, 23D	DPW 1976
174	HARDY 1977		
175	HARDY 1977		

SOURCE NUMBER, TEXT REFERENCES AND CROSS REFERENCES, cont.

PRIMARY SOURCE NO. OR NAME AND TEXT REFERENCE		CROSS-REFERENCE SOURCE NO. OR NAME AND TEXT REFERENCE	
176	HARDY 1977		
177	HARDY 1977		
181	HARDY 1977		
183	HARDY 1977		
184	HARDY-BBT 1986		
211	BBT 1983	211	RKL 1973, ZONE 2
211E	EBA 1986		
214	BBT 1983	2.02	HARDY-BBT 1986
215	EBA 1986	2.03	HARDY-BBT 1986
216	RKL 1973, ZONE 2	216	EBA 1986
216S	EBA 1986		
217	RKL 1973, ZONE 2	217	EBA 1986
217E	EBA 1986		
218	RKL 1973, ZONE 2	218	EBA 1986
218N	EBA 1986		
219	EBA 1986	219	EBA 1986
222	EBA 1986	222	EBA 1976a
300A	RKL 1973, ZONE 3		
301	RKL 1973, ZONE 3		
302	RKL 1973, ZONE 3		
303	RKL 1973, ZONE 3	303; 2.08	EBA 1976a; HARDY-BBT 1986
304	RKL 1973, ZONE 3		
305	RKL 1973, ZONE 3		
306	RKL 1973, ZONE 3		
307	RKL 1973, ZONE 3		

SOURCE NUMBER, TEXT REFERENCES AND CROSS REFERENCES, cont.

PRIMARY SOURCE NO. OR NAME AND TEXT REFERENCE		CROSS-REFERENCE SOURCE NO. OR NAME AND TEXT REFERENCE	
308	RKL 1973, ZONE 3		
309	RKL 1973, ZONE 3		
310A	RKL 1973, ZONE 3		
311	RKL 1973, ZONE 3		
312	RKL 1973, ZONE 3		
313	RKL 1973, ZONE 3		
314	RKL 1973, ZONE 3		
315	RKL 1973, ZONE 3		
316	RKL 1973, ZONE 3		
317	RKL 1973, ZONE 3	2.17	HARDY-BBT 1986
318	RKL 1973, ZONE 3		
319	RKL 1973, ZONE 3		
320	RKL 1973, ZONE 3		
321	RKL 1973, ZONE 3		
322	RKL 1973, ZONE 3	2.16	HARDY-BBT 1986
323A	RKL 1973, ZONE 3	2.15	HARDY-BBT 1986
324A	RKL 1973, ZONE 3	2.14	HARDY-BBT 1986
325	RKL 1973, ZONE 3	2.41	HARDY-BBT 1986
326	RKL 1973, ZONE 3	326A; 2.12	EBA 1976b, HARDY-BBT 1986
327	RKL 1973, ZONE 3	2.33	HARDY-BBT 1986
328A	RKL 1973, ZONE 3	2.39	HARDY-BBT 1986
I400	RKL 1973, ZONE 3		
I401A	RKL 1973, ZONE 3	2.47	
I402	RKL 1973, INUVIK		
I403	RKL 1973, INUVIK		

SOURCE NUMBER, TEXT REFERENCES AND CROSS REFERENCES, cont.

PRIMARY SOURCE NO. OR NAME AND TEXT REFERENCE		CROSS-REFERENCE SOURCE NO. OR NAME AND TEXT REFERENCE	
I404	RKL 1973, INUVIK		
I405A	RKL 1973, INUVIK		
I406	RKL 1973, INUVIK		
I407	RKL 1973, INUVIK	2.13	
455	RKL 1973. ZONE 4		
467	HARDY 1976		
456A	RKL 1973, ZONE 4		
457A	RKL 1973, ZONE 4		
463	HARDY 1976	R24	EBA 1983a
464	HARDY 1976	R25	EBA 1983a
468	HARDY 1976	R27	EBA 1983a
469	HARDY 1976	R26	EBA 1983a
PARSONS LK. 1	KLCL 1974		
PARSONS LK. 2	KLCL 1974		
PARSONS LK. 3	KLCL 1974		
PARSONS LK. 4	KLCL 1974		
PARSONS LK. 5	KLCL 1974		
PARSONS LK. 6	KLCL 1974		
PARSONS LK. 7	KLCL 1974		
PARSONS LK. 8	KLCL 1974		
PARSONS LK. 9	KLCL 1974		
PARSONS LK. 10	KLCL 1974		
PARSONS LK. 11	KLCL 1974		
R28/29	EBA 1976b	R28/29	EBA 1983a
YAYA	EBA 1975		

SUPPLY SUMMARY

PAULATUK

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-1

ILA 7(1)(a)

LOCATION: 17 km W of Paulatuk

REFERENCE(S): None

SETTING
Ridge crests

LANDFORM
Mor. ridge, Glac.lac. delta

AREA
200,000 sq m

RELIEF
30 m

CONTINUITY
5 deposits

DEVELOPMENT CONSTRAINTS
None discernible

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 8,000,000

RECOVERABLE, cu.m: 8,000,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3					4,000,000	8,000,000
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-2

ILA 7(1)(a)

LOCATION: 16.5 km WSW of Paulatuk

REFERENCE(S): None

SETTING
Inland valley

RELIEF
2 to 5 m

WINTER ACCESS
Tundra/ice road

LANDFORM
Glaciolac. delta-terrace

CONTINUITY
Semi-continuous

SUMMER ACCESS
None

AREA
140,000 sq m

DEVELOPMENT CONSTRAINTS
Poor accessibility

BOREHOLES (#)
Unknown

TEST PITS (#)
Unknown

MOIST. CON. (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 700,000 **RECOVERABLE, cu.m:** 700,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3					250,000	700,000
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-3

ILA 7(1)(a)

LOCATION: 20 km SW of Paulatuk

REFERENCE(S): None

SETTING
Talus slope

LANDFORM
Alluvial fan

AREA
650,000 sq m

RELIEF
Modest

CONTINUITY
Semi-continuous

DEVELOPMENT CONSTRAINTS
None discernible

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 1,300,000

RECOVERABLE, cu.m: 1,300,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					1,300,000	1,300,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-4

ILA 7(1)(a)

LOCATION: 15 km SW of Paulatuk

REFERENCE(S): None

SETTING
Talus slope

LANDFORM
Alluvial fan

AREA
500,000 sq m

RELIEF
<1 m

CONTINUITY
Continuous

DEVELOPMENT CONSTRAINTS
Prob. ice rich and poor qual.

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

TEST PITS (#)
Unknown

MOIST. CON. (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 500,000 **RECOVERABLE, cu.m:** 500,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					500,000	500,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-6

ILA 7(1)(a)

LOCATION: 17 km SW of Paulatuk

REFERENCE(S): None

SETTING
Crest of bluff

LANDFORM
Glaciolacustrine

AREA
400,000 sq m

RELIEF
5 m

CONTINUITY
Discontinuous

DEVELOPMENT CONSTRAINTS
Relatively inaccessible

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 1,200,000 RECOVERABLE, cu.m: 1,200,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3						
CLASS 4					400,000	1,200,000
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-7

ILA 7(1)(a)

LOCATION: 25 km SSW of Paulatuk

REFERENCE(S): None

SETTING
Upland plain

LANDFORM
Esker

AREA
700,000 sq m

RELIEF
4 to 8 m

CONTINUITY
Discontinuous

DEVELOPMENT CONSTRAINTS
Possibly ice rich

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 3,000,000

RECOVERABLE, cu.m: 3,000,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3						
CLASS 4					1,500,000	3,000,000
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-9

??

LOCATION: 12 km SSW of Paulatuk

REFERENCE(S): None

SETTING
High bluff

RELIEF
2 to 4 m

WINTER ACCESS
Tundra/ice road

LANDFORM
Glaciolacustrine basin

CONTINUITY
Discontinuous

SUMMER ACCESS
None

AREA
1.0 sq km

DEVELOPMENT CONSTRAINTS
Poor access., prob. ice rich

BOREHOLES (#)
Unknown

TEST PITS (#)
Unknown

MOIST. CON. (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 5,000,000

RECOVERABLE, cu.m: 5,000,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3						
CLASS 4					1,700,000	5,000,000
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-10

ILA 7(1)(a)

LOCATION: 9.2 km SW of Paulatuk

REFERENCE(S): None

SETTING
Valley

LANDFORM
Glaciolacustrine delta

AREA
360,000 sq m

RELIEF
Low to flat

CONTINUITY
Continuous

DEVELOPMENT CONSTRAINTS
Poor access

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 700,000 RECOVERABLE, cu.m: 700,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					700,000	700,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-11

ILA 7(1)(a)

LOCATION: 7 km ESE of Paulatuk

REFERENCE(S): None

SETTING Tidal flats	RELIEF <1 m	WINTER ACCESS Tundra/ice road
LANDFORM Delta	CONTINUITY Discontinuous	SUMMER ACCESS None
AREA 1.0 sq km	DEVELOPMENT CONSTRAINTS Low and wet	

BOREHOLES (#) Unknown	TEST PITS (#) Unknown
MOIST. CON. (#) Unknown	GRAINSIZE (#) Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 1,500,000 RECOVERABLE, cu.m: 1,500,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3					1,500,000	1,500,000
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-12

ILA 7(1)(a)

LOCATION: 10 km ESE of Paulatuk

REFERENCE(S): Transport Canada 1986

SETTING
Raised terrace

LANDFORM
Fluvial terrace

AREA
750,000 sq m

RELIEF
1 to 2 m

CONTINUITY
3 terraces

DEVELOPMENT CONSTRAINTS
Poor accessibility

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 1,200,000

RECOVERABLE, cu.m: 1,200,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					1,200,000	1,200,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-13

ILA 7(1)(a)

LOCATION: 11.5 km ESE of Paulatuk

REFERENCE(S): None

SETTING Low terrace	**RELIEF** 2 to 3 m	**WINTER ACCESS** Tundra/ice road
LANDFORM Deltaic terrace	**CONTINUITY** Semi-continuous	**SUMMER ACCESS** None
AREA 1.2 sq km	**DEVELOPMENT CONSTRAINTS** Relatively thin	

BOREHOLES (#) Unknown	**TEST PITS (#)** Unknown
MOIST. CON. (#) Unknown	**GRAINSIZE (#)** Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 2,500,000 RECOVERABLE, cu.m: 2,500,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					2,500,000	2,500,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-14

ILA 7(1)(a)

LOCATION: 14 km ESE of Paulatuk

REFERENCE(S): None

SETTING
Riverbank

LANDFORM
Fluvial terraces

AREA
750,000 sq m

RELIEF
5 to 10 m

CONTINUITY
Discontinuous

DEVELOPMENT CONSTRAINTS
None discernible

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

TEST PITS (#)
Unknown

MOIST. CON. (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 1,600,000 **RECOVERABLE, cu.m:** 1,600,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3					1,600,000	1,600,000
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-15

ILA 7(1)(a)

LOCATION: 15.5 km ESE of Paulatuk

REFERENCE(S): None

SETTING
Low terrace

LANDFORM
Fluvial terraces

AREA
200,000 sq m

RELIEF
1 to 2 m

CONTINUITY
Discontinuous

DEVELOPMENT CONSTRAINTS
Very thin

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 300,000

RECOVERABLE, cu.m: 300,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					300,000	300,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-16

ILA 7(1)(a)

LOCATION: 17.2 km ESE of Paulatuk

REFERENCE(S): None

SETTING
Meander plain

LANDFORM
Low fluvial terraces

AREA
1.3 sq km

RELIEF
0.5 to 1.0 m

CONTINUITY
Discontinuous

DEVELOPMENT CONSTRAINTS
Thin, potentially ice rich

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 1,500,000

RECOVERABLE, cu.m: 1,500,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					1,500,000	1,500,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-17

ILA 7(1)(a)

LOCATION: 19 km ESE of Paulatuk

REFERENCE(S): None

SETTING Meander plain	RELIEF 3 m	WINTER ACCESS Tundra/ice road
LANDFORM Low terrace	CONTINUITY Semi-continuous	SUMMER ACCESS None
AREA 200,000 sq m	DEVELOPMENT CONSTRAINTS None discernible	

BOREHOLES (#) Unknown	TEST PITS (#) Unknown
MOIST. CON. (#) Unknown	GRAINSIZE (#) Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 500,000 RECOVERABLE, cu.m: 500,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					500,000	500,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-19

ILA 7(1)(a)

LOCATION: 20 km SW of Paulatuk

REFERENCE(S): None

SETTING
Meander plain

LANDFORM
Low fluvial terrace

AREA
430,000 sq m

RELIEF
2 to 3 m

CONTINUITY
Semi-continuous

DEVELOPMENT CONSTRAINTS
None discernible

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 1,200,000

RECOVERABLE, cu.m: 1,200,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2					600,000	1,200,000
CLASS 3						
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-20

ILA 7(1)(a)

LOCATION: 15 km S of Paulatuk

REFERENCE(S): None

SETTING
Bluff over lake

LANDFORM
Glaciolac. beach

AREA
250,000 sq m

RELIEF
3 to 5 m

CONTINUITY
Discontinuous

DEVELOPMENT CONSTRAINTS
None discernible

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 700,000   RECOVERABLE, cu.m: 700,000

MATERIAL	PROVEN, cu.m. Annual	Total	PROBABLE, cu.m. Annual	Total	PROSPECTIVE, cu.m. Annual	Total
CLASS 1						
CLASS 2						
CLASS 3					350,000	700,000
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-21

ILA 7(1)(a)

LOCATION: 11 km SSW of Paulatuk

REFERENCE(S): None

SETTING
Ridges

LANDFORM
Glaciolac. beach

AREA
175,000 sq m

RELIEF
5 to 15 m

CONTINUITY
??

DEVELOPMENT CONSTRAINTS
Difficult access

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
None

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 1,000,000

RECOVERABLE, cu.m: 1,000,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3					350,000	1,000,000
CLASS 4						
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-22

ILA 7(1)(a)

LOCATION: 1 km SW of Paulatuk

REFERENCE(S): Transport Canada 1986

SETTING Coastal plain	RELIEF Flat	WINTER ACCESS Tundra/ice road
LANDFORM Glaciolac. beach	CONTINUITY ??	SUMMER ACCESS Possible
AREA 100,000 sq m	DEVELOPMENT CONSTRAINTS Coast environment, ice rich	

BOREHOLES (#) Unknown	TEST PITS (#) Unknown
MOIST. CON. (#) Unknown	GRAINSIZE (#) Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 250,000 RECOVERABLE, cu.m: 250,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3						
CLASS 4					250,000	250,000
CLASS 5						

GRANULAR RESOURCES SUPPLY SUMMARY
Paulatuk

SOURCE: 87-P-23

ILA 7(1)(a)

LOCATION: 2.5 km S of Paulatuk

REFERENCE(S): None

SETTING
Ridge tops

LANDFORM
Glaciofluv. delta

AREA
1.5 sq m

RELIEF
5 to 20 m

CONTINUITY
At least 7 areas

DEVELOPMENT CONSTRAINTS
Ice rich

WINTER ACCESS
Tundra/ice road

SUMMER ACCESS
Possible

BOREHOLES (#)
Unknown

MOIST. CON. (#)
Unknown

TEST PITS (#)
Unknown

GRAINSIZE (#)
Unknown

	OVERBURDEN	GROUND ICE
TYPE:	Unknown	Unknown
EXTENT:	-	-
THICK.:	-	-

POTENTIAL VOLUME, cu. m.: 2,200,000

RECOVERABLE, cu.m: 2,200,000

MATERIAL	PROVEN, cu.m. Annual	PROVEN, cu.m. Total	PROBABLE, cu.m. Annual	PROBABLE, cu.m. Total	PROSPECTIVE, cu.m. Annual	PROSPECTIVE, cu.m. Total
CLASS 1						
CLASS 2						
CLASS 3					2,200,000	2,200,000
CLASS 4						
CLASS 5						

DEMAND SUMMARY

PAULATUK

GRANULAR RESOURCES DEMAND SUMMARY
Paulatuk

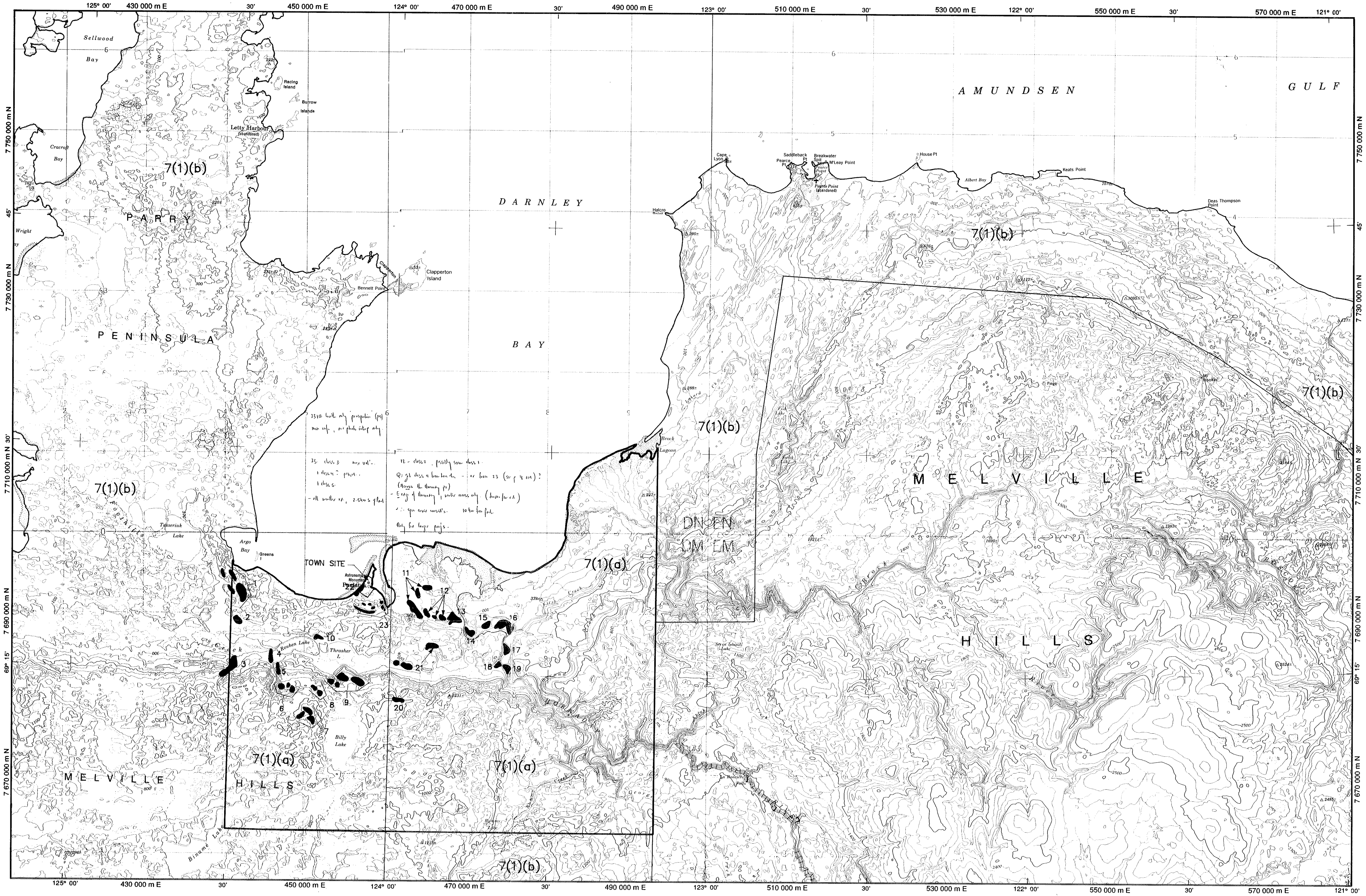
YEAR GROUP	PROJECT (¥ Denotes Speculative Project)	CATEGORY		VOLUME, cu.m.
1987-1991	AIRFIELD CONSTRUCTION	PUBLIC		
			Class 1:	
			Class 2:	10,000
			Class 3:	250,000
			Class 4:	
			Class 5:	
			TOTAL	260,000
1987-1991	ARENA	PUBLIC		
			Class 1:	
			Class 2:	200
			Class 3:	600
			Class 4:	
			Class 5:	
			TOTAL	800
1987-1991	NEW SCHOOL	PUBLIC		
			Class 1:	700
			Class 2:	600
			Class 3:	100
			Class 4:	
			Class 5:	
			TOTAL	1,400
1987-1991	ROAD/GENERAL MAINTENANCE	PUBLIC		
			Class 1:	
			Class 2:	
			Class 3:	20,000
			Class 4:	
			Class 5:	
			TOTAL	20,000
1987-1991	R/S/L LAND DEVELOPMENT	PUBLIC		
			Class 1:	
			Class 2:	2,400
			Class 3:	
			Class 4:	5,900
			Class 5:	100
			TOTAL	8,400
1987-1991	SEWAGE AND SOLID WASTE IMPROVEMENTS	PUBLIC		
			Class 1:	
			Class 2:	
			Class 3:	
			Class 4:	9,000
			Class 5:	
			TOTAL	9,000

GRANULAR RESOURCES DEMAND SUMMARY
Paulatuk

YEAR GROUP	PROJECT (¥ Denotes Speculative Project)	CATEGORY		VOLUME, cu.m.
1987-1991	STAFF HOUSE	PUBLIC		
			Class 1:	
			Class 2:	100
			Class 3:	200
			Class 4:	
			Class 5:	
			TOTAL	300
1987-1991	WATER SUPPLY IMPROVEMENT	PUBLIC		
			Class 1:	
			Class 2:	4,000
			Class 3:	
			Class 4:	6,000
			Class 5:	
			TOTAL	10,000
1992-1996	AIRFIELD MAINTENANCE	PUBLIC		
			Class 1:	
			Class 2:	2,000
			Class 3:	
			Class 4:	
			Class 5:	
			TOTAL	2,000
1992-1996	ROAD/GENERAL MAINTENANCE	PUBLIC		
			Class 1:	
			Class 2:	
			Class 3:	20,000
			Class 4:	
			Class 5:	
			TOTAL	20,000
1997-2001	AIRFIELD MAINTENANCE	PUBLIC		
			Class 1:	
			Class 2:	2,000
			Class 3:	
			Class 4:	
			Class 5:	
			TOTAL	2,000
1997-2001	DETACHMENT BUILDING	PUBLIC		
			Class 1:	10
			Class 2:	
			Class 3:	200
			Class 4:	
			Class 5:	
			TOTAL	210

GRANULAR RESOURCES DEMAND SUMMARY
Paulatuk

YEAR GROUP	PROJECT (¥ Denotes Speculative Project)	CATEGORY		VOLUME, cu.m.
1997-2001	ROAD/GENERAL MAINTENANCE	PUBLIC		
			Class 1:	
			Class 2:	
			Class 3:	20,000
			Class 4:	
			Class 5:	
			TOTAL	20,000
2002-2006	AIRFIELD MAINTENANCE	PUBLIC		
			Class 1:	
			Class 2:	2,000
			Class 3:	
			Class 4:	
			Class 5:	
			TOTAL	2,000
2002-2006	ROAD/GENERAL MAINTENANCE	PUBLIC		
			Class 1:	
			Class 2:	
			Class 3:	20,000
			Class 4:	
			Class 5:	
			TOTAL	20,000
1987-2006	SUMMARY OF DEMAND VOLUMES Paulatuk			
			Class 1:	710
			Class 2:	23,300
			Class 3:	331,100
			Class 4:	20,900
			Class 5:	100
			TOTAL	



Scale 1:250 000 Échelle

Miles 5 0 5 10 15

Kilometres 5 0 5 10 15 20 25

LEGEND

- 7(1)(a) Lands Boundary
- 7(1)(b) Lands Boundary
- Approximate Boundary of Granular Source
- 87–P–23 Granular Source Number
- Proposed International Biological Program Area

EBA Engineering Consultants Ltd.	PROJECT: INUVIALUIT SETTLEMENT SAND AND GRAVEL INVENTORY AND MANAGEMENT PLAN
CLIENT: INDIAN AND NORTHERN AFFAIRS CANADA	TITLE: GRANULAR DEPOSIT LOCATIONS PAULATUK DISTRICT OF MACKENZIE, N.W.T.
DATE 87/02/20 · DWN. EBR · CHKD.	DWG. NO. 0101-4575-005