Granular Resource Requirements for Proposed Mackenzie Valley Pipelines:

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Northern Oil and Gas Action Program (NOGAP) Project A4:
Granular Resources Inventory and Management

NOGAP Project Manager:
R.J. Gowan
Department of Indian Affairs
and Northern Development (DIAND)

Prepared by:
R.J. Mahnic and T.J. Fujino
Stanley Associates Engineering Ltd.

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Stanley

SECTION 4.

TECHNICAL PANEL "B"

REGIONAL BORROW DEPOSITS INVENTORIES

REGIONAL BORROW DEPOSITS INVENTORY: SOUTH SLAVE REGION

Nick Hernadi, P.Eng.

Senior Geotechnical Engineer
Thurber Engineering Ltd., Calgary, Alberta

ABSTRACT

A 1987 study by Thurber Consultants, funded under the NOGAP Program, was undertaken to investigate granular aggregate supply and demand, and to develop a suitable management strategy for the granular resources of the South Slave Region of the Northwest Territories. The study also addressed the identification and rehabilitation of depleted sources. Total reserves in the order of 83,000,000 m^3, contained in a large number of sources, was identified with a projected maximum demand of only about 1,100,000 m^3 over a 5-year period (1988 to 1992, inclusive). However, while supply considerably exceeds current demand, conflicts and competition between sources and for different material classes were also identified.

A number of aggregate sources in the region were found to be depleted, or likely to be depleted in the near future. In addition, numerous borrow pits were opened up during highway and railway construction and have since been abandoned. Procedures for site restoration and rehabilitation were developed for clean-up, grading and contouring, overburden and topsoil replacement, drainage and erosion control, and natural revegetation. As well, recreational end uses for the depleted areas were considered such as picnic or camping areas, scenic viewpoints and road-side turnoffs. Some sites may be suitable for waste disposal, aggregate crushing, or temporary stockpiling.

Introduction

During 1987, the Department of Indian and Northern Affairs retained Thurber Consultants Ltd. to develop a Granular Resources Management Strategy for the South Slave Region of the Northwest Territories (NWT). The study was funded under the Northern Oil and Gas Action Program (NOGAP). The project was carried out by Thurber Consultant's Ian Jones as the Project Geologist, and Nick Hernadi as the Project Engineer.

The study region was subdivided into five Resource Management Areas, defined in relation to the existing transportation network, the supply/demand situation around various communities and the current pattern of resource usage. Figure 1 shows the study region and the five Resource Management Areas.

The principal components of the study included:

- review of available information;
- contacts with granular materials users;
- field investigations;
- laboratory testing;
- supply/demand analysis;
- formulation of development strategy; and,
- preparation of rehabilitation plans.

The scope of work under these tasks is described in the following sections of this paper.

Review of Available Information

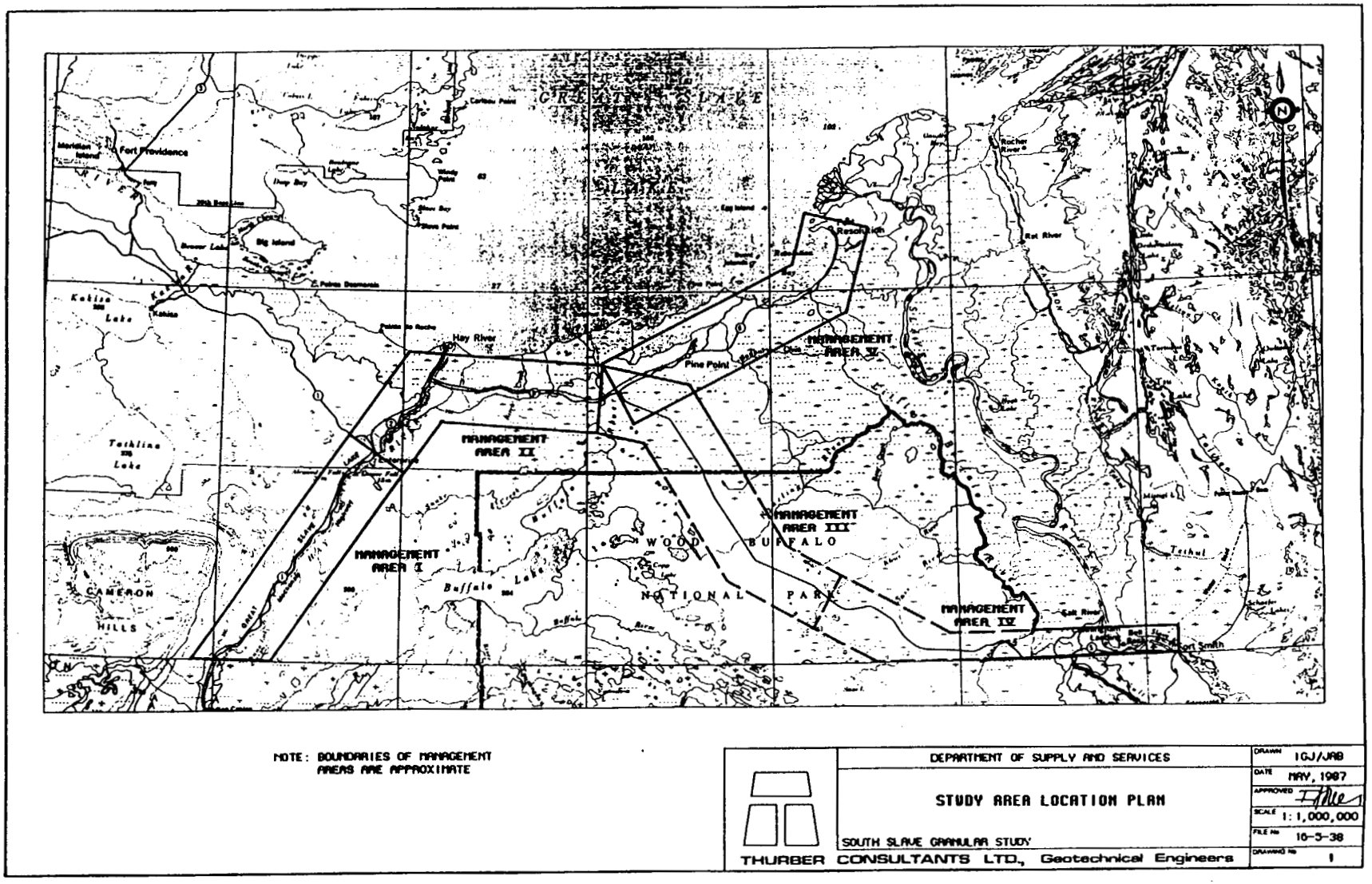
Initial research into the borrow deposits inventory of the South Slave region consisted of a review of:

- surficial geology and bedrock geology maps;
- a number of consultants' reports prepared between 1974 and 1986 for various areas within the study area; and,
- a terrain analysis using typically 1:50,000 airphoto coverage.

Contact and Interviews with Users and Managers of Granular Materials

The purpose of these interviews was to establish historic demands and forecasts of future demands, as well as to identify favoured past, present and future

Figure 1. **South Slave Region: Resource Management Areas**



sources for all types of material. Contacts included:

- Municipal, Territorial and Federal managers;
- Northern Transportation Company Ltd.;
- CN Rail; and,
- Pine Point Mines.

Field Investigations

The main purposes of the field investigations were:

- to conduct a field reconnaissance of all existing accessible granular sources;
- to sample granular materials from exposures and stockpiles;
- to photograph exposed granular materials and pertinent features of each source; and,
- to carry out an aerial survey of existing active, depleted and abandoned pits.

Laboratory Testing

In addition to grain size analyses, aggregates potentially suitable for concrete production were tested for L.A. Abrasion, sulphate soundness and petrographic analyses.

Supply/Demand Analysis by Management Area

The supply/demand analysis consisted of:

- analysis of the supply of proven, probable and prospective reserves of various quality aggregates;
- identification of depleted, nearly depleted or abandoned sources;
- analysis of the demand data for various types of aggregates; and,
- assessment of the suitability of available granular materials to supply the regional demands for concrete aggregates.

Formulation of Development Strategy

Based on the supply/demand analysis, and the identified areas of competition and conflict for specific deposits and material classes, a development strategy was formulated involving:

- requirements for additional exploratory work;
- dedication of sources to specific uses to promote conservation and effective usage of remaining resources; and,
- site development, environmental protection and source restoration.

Preparation of Rehabilitation Plans

Work under this task involved assessing the remaining potentially recoverable materials in depleted or nearly depleted sources and development of rehabilitation plans including:

- consideration of site end uses; and,
- preparation of site specific recommendations and conceptual sketches.

GEOLOGICAL SETTING AND SITE CONDITIONS

Types of Granular Aggregate Sources

Five main types of surficial deposit with potential as sources of granular aggregate have been identified in the South Slave Region. These are, in decreasing order of significance:

- glaciofluvial ridges (gravel and sand);
- glaciolacustrine and lacustrine beach ridges, spits and lag deposits (gravel and sand);
- alluvial floodplain and terrace deposits (sand and gravel);
- recent lacustrine beaches (silty sand); and
- eolian dunes and ridges (silty sand).

In addition, some bedrock sources have been identified for the production of granular materials.

Permafrost

The South Slave Region is located within the southern part of the discontinuous permafrost zone, hence permafrost occurrence is widespread in organic terrain, less prevalent in glacial tills and

glaciolacustrine soils, and usually absent in granular aggregate deposits.

AGGREGATE SUPPLY AND DEMAND

Within the entire study region a total of 104 aggregate sources were identified, which included 23 deposits actively being developed, 65 undeveloped deposits and 16 deposits which have been depleted or abandoned. Most of these sources are within 5 to 10 km of the transportation network and communities.

Total prospective reserves of all classes of materials in the order of 83,000,000 m^3 were identified. However, the distribution of the materials is such that not all classes of aggregates are available within a given management area, and the higher quality materials are frequently confined to a limited number of sources.

A brief summary of the material classification system used in the study follows:

Class 1: Excellent quality material, such as well graded sands and gravels suitable for use as asphalt or concrete aggregates with a minimum of processing.

Class 2: Good quality materials suitable for base and surface course aggregates or structure supporting fills. Production of concrete aggregates may also be possible with extensive processing.

Class 3: Fair quality aggregates consisting generally of poorly graded sands and gravels with or without substantial silt content.

Class 4: Poor quality materials generally consisting of silty, poorly-graded fine sand, with minor gravel.

Class 5: Bedrock of fair to good quality.

Based on the interviews with the users and managers of granular materials in the study area, 5-year high and low demand projections were developed for each Management Area for each class of aggregate for the 1988 to 1992 time frame.

A summary of the prospective supply versus 5-year high demand projection for each class of aggregate in each Management Area is shown in Table 1. As shown, the total supply greatly exceeds the total maximum 5-year demand projection of about 1,100,000 m^3, however, the higher class of aggregates are not available in all Management Areas.

GRANULAR RESOURCE MANAGEMENT STRATEGY

Based on the supply inventory and the projected aggregate requirements over the next 5 years, a granular resource management strategy was developed with specific recommendations given for each identified source.

The assumptions made in developing the strategy were as follows:

- conservation of aggregate, for the highest quality uses to which it is suited, is a priority, so as to minimize "high grading" and limit the continuing requirements to locate new sources of high quality material;
- logical and orderly development of individual sources (from preliminary exploration through extraction to site restoration) is essential, so that the extraction of different classes of material from any particular source is maximized;
- supply-demand conflicts within management areas and competition for sources and aggregate classes should be minimized;
- utilization of the concrete aggregate resources that are available in the Region should be optimized;
- restoration and rehabilitation of depleted sources should take place on a continuing basis as resource development proceeds; and
- adequate reserves of suitable material for specific community uses should be assured.

The recommended resource management strategy was summarized in a series of tables for each Management Area. An example is shown on Table 2.

Table 1. South Slave Region: Prospective Aggregate Supply and Demand

SOUTH SLAVE REGION SUMMARY OF PROSPECTIVE AGGREGATE SUPPLY AND 5-YEAR (1988 TO 1992) MAXIMUM DEMAND (M^3)					
Management Area	Aggregate Class				
	1	2	3	4	5
1 - demand - supply	100 --	275,000 --	500 1,800,000	-- 8,500,000	-- 1,500,000
2 - demand - supply	113,000 305,000	169,000 3,180,000	167,000 16,000,000	40,000 3,800,000	-- --
3 - demand - supply	-- --	61,000 3,760,000	10,000 5,050,000	-- 1,160,000	-- --
4 - demand - supply	7,500 --	110,000 --	9,000 12,750,000	28,000 --	-- --
5 - demand - supply	5,000 --	70,000 690,000	14,000 18,280,000	20,000 4,410,000	100 2,250,000
Total - demand - supply	125,600 305,000	685,000 7,630,000	200,500 53,880,000	88,000 17,870,000	100 3,750,000

SOURCE RESTORATION CONCEPTS AND PROCEDURES

Restoration concepts and recommended procedures included consideration of the following points:

Site Clean-up

- removal of buildings, machinery, fuel containers and related debris; and,
- where temporary abandonment is considered, some equipment could be permitted to remain on site, pending renewed extraction activity.

Verification of Source Depletion

- Where source boundaries are not defined by distinct ridges, source depletion must be confirmed by material thickness and quality. At least 0.8 m thickness should be available for economic extraction.
- Field testing outside of the pit boundaries may be necessary to confirm.

Determine Preferred End Uses

Due to the proximity of the sources considered in this study to transportation corridors in the South Slave Region, a number of potential end uses could be considered for depleted sites, including:

- road side rest areas;
- road side campgrounds;
- aggregate crushing or stockpile sites; or,
- waste disposal sites for community use.

Grading and Contouring

- Grading at sites to be abandoned only temporarily should be such that remaining aggregate reserves are not sterilized.
- Depleted sites should be graded and contoured to eliminate surface depressions as much as possible. Maximum slopes of 2 horizontal to 1 vertical are recommended and slope crests should be rounded and should blend into the surrounding terrain.

Table 2. Management Area II: Aggregate Supply and Demand Recommendations

AGGREGATE SUPPLY AND DEMAND MANAGEMENT AREA II B. Highway 5							
Deposit	**Location/Access**	**Landform and Material**	**Environment and Development Concerns**	**Aggregate Supply**	**Aggregate Demand (1988 - 1992)**	**Future Work**	**Comments**
5-1	1 km S of highway (km 3), 8 km S of Hay River; trail into site	Beach ridge; gravelly sand	--	--	--	--	Deposit long depleted, with good natural revegetation
5-2	S of highway (km 7), 10 km SE of Hay River; no access	Beach ridges; gravelly sand	Close to Sandy River valley	Class 4: 35,000m^3 (prospective)	None projected	None proposed	Development not recommended at this time
5-3 (HR-106)	8 km N of highway, 6 km E of Hay River; poor access through Indian reserve	Beach ridges; gravelly sand	On Hay River I.R. close to Sandy River and lake shore	Class 4: 1,000,000m^3 (prospective)	None projected	None proposed	Development not recommended
5-4	15 km S of highway (km 10); 25 km NE of Enterprise; no access	Glaciofluvial ridges; sandy gravel	None identified	Class 3: 375,000m^3 (prospective)	None projected	None proposed	Development not recommended at this time
5-5	14 km S of highway, 25 km SE of Hay River; no access	Beach ridges; sandy gravel	None identified	Class 3: 2,400,000m^3 (prospective)	None projected	None proposed	Development not recommended at this time; however, could be opened up after Deposit 5-6 is depleted
5-6 (HR-109A; Mile 12S)	6 km S of highway (km 18), 22 km SE of Hay River; access via Fort Smith winter road	Glaciofluvial ridges; sandy gravel	None identified	Class 1: 70,000m^3 (proven); Class 2: 95,000m^3 (proven); Class 3: 130,000m^3 (proven)	Class 1: 12,000m^3 Class 2: 48,000m^3 Class 3: 5,000m^3	Potential of ridges to SW of main deposit should be investigated; low priority	Source of good to excellent aggregate in Management Area II; continued development recommended

Control of Surface Drainage and Erosion

- Pit development has often resulted in poor surface drainage, including ponding of water in shallow depressions.

- Recontouring should aim to promote positive site drainage and eliminate closed depressions, where possible.

Replacement of Overburden and Topsoil

- Available stockpiled overburden and topsoil should be spread evenly over the graded and contoured site.

Revegetation

- Experience has shown that natural revegetation of abandoned sites in the forested areas of the southern NWT is relatively rapid due to the abundance of natural seed sources.

- Spreading of stockpiled topsoil will encourage this natural revegetation.

- Only limited use of seeding and application of fertilizer in this area is expected to be required.

All sources identified as abandoned, depleted or nearly depleted were considered for source restoration on a site specific basis. In presenting the recommended area restoration plans, annotated airphoto mosaics, oblique air photographs and conceptual sketches were prepared and utilized.

REQUIREMENTS FOR ADDITIONAL EXPLORATORY WORK

To complete the granular resource management strategy for the South Slave Region, recommendations were given for additional exploratory work to determine the distribution of granular materials remaining in developed sources, as well as to prove up probable and prospective aggregate reserves in undeveloped deposits.

The objective was to assist with planning and budgeting for future granular resource exploration plans, rather than to scope out detailed site specific exploration plans.