vegetation, Mackenzie Delta, Yukon ... N.W.T.
wetland,

VEGETATION TYPES
OF THE
LOWER MACKENZIE AND YUKON CORRIDOR

prepared by

Forest Management Institute
Canadian Forestry Service
Environment Canada

for the

Environmental-Social Program
Northern Pipelines

January 1975

Environmental-Social Committee
Northern Pipelines
Task Force on Northern Oil Development
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PREFACE AND ACKNOWLEDGEMENTS

An initial report on the vegetation types of the Mackenzie Corridor, based on field work completed in 1971 and 1972, was published in March 1974. That report covers most of the Corridor area between latitudes 60° N and 68° N, and east of longitude 136° W (Figure 4-1.)

This present report is a continuation of that project and includes the remaining, most northerly and westerly portions of the Corridor (Inuvik, Tuk Peninsula, North Shore and Old Crow).

Since the two reports are essentially part 1 and 2 of the same project, the format of this second report has been kept the same as that of the first wherever feasible. Much of the background and introductory material has been repeated, with changes only where necessary. Similarly, some phases in the methodology were exactly the same for both reports and the descriptions of these have been adopted directly. Other, more general but important information covering the entire Corridor is given in the first report, but is only referred to, and not repeated in the present report. Several important recommendations from the first report are in this category.

The description and mapping of the vegetation was undertaken by the Forest Management Institute for the Environmental-Social Committee of the Task Force on Northern Oil Development, who provided most of the funding for the project.

The Project Leader responsible for the planning, organization and execution of the project was W.L. Wallace. Staff assigned to the project on a full-time basis were: J.P. Peaker, Senior Technical Officer, who had operational charge of photo interpretation and field checking; G.V.N. Griffith and G.A. Campbell, Senior Forest Technicians,

undertook most of the photo interpretation and ground checking. R. Piirvee was instrumental in the design of the computer-information retrieval system for the southern portion of the Mackenzie Corridor; this system was subsequently adopted also for the north. All computer programming, and preparation of statistical summaries was directed by G.T. Maloley, Supervisor, Computing Services. The assembly of this material for this report was done by R. Hirvonen.

CHAPITRE PREMIER

SOMMAIRE

Le présent rapport fait suite à "Vegetation Types of the Mackenzie Corridor"*, IMF 1974, et il décrit brièvement les types de végétation dans les sections Old Crow, North Shore, Inuvik et Tuk du Corridor.

Lors de ce travail, l'auteur poursuit son travail selon les techniques d'interprétation et de cartographie mises au point lors de travaux de cartographie antérieurs. Cependant, il a revisé sa classification pour définir adéquatement les types de végétation fort différents que l'on trouve en ces régions très nordiques. Vu que les photos aériennes disponibles étaient de qualité inférieure, les interprètes se sont fiés aux figures du relief et à la topographie, outre les teintes des photos.

On remarque sept classes majeurs subdivisés en un à cinq soustypes, qui font au total 20 types de végétation. Leurs caractères sont suffisamment distinctifs pour qu'ils puissent être interprétés sur des photos disponibles à l'échelle approximative de 1:60,000. Les types furent lisérés sur les photos puis leur plan fut transféré sur du cronaflex à l'échelle de 1:125,000, duquel on peut se procurer des imprimés en blanc et en noir. Les sections nordiques concernées couvrent environ 19,000 milles carrés.

*Le Corridor fut défini arbitrairement par l'auteur. Le Gouvernement n'a pas défini ou établi un Corridor de Transport spécifique.

L'auteur décrit le couvert forestier, la strate des grands arbustes, celle des petits arbustes, et la strate herbacée. Il a fait, en rapport avec ces strates, des observations sur le permafrost et autres conditions spéciales. Les aires forestières, bien que faibles, ont été classifiées et cartographiées en plus de détails: l'auteur fournit les espèces, la hauteur du peuplementet la densité du couvert.

Pour faciliter la cartographie à petite échelle (1:500,000), les 20 types de végétation ont été groupées en classes de types qui se ressemblent. L'auteur produisit avec ces classes 10 cartes coloriées à 1:500,000 et elles sont incluses sous pli séparé.

Toutes les données cartographiées font partie d'un système à l'ordinateur, ce qui permet une compilation rapide des superficies par type de végétation et condition forestière. L'auteur a compilé des sommaires pour chaque section du Corridor, aussi pour tout le corridor et il existe des possibilités de compiler des statistiques pour n'importe quelle portion du Corridor.

Les cartes et les sommaires statistiques serviront à juger l'importance des problèmes concernant certaines conditions ou régions. Ils peuvent aussi servir à identifier des situations uniques our rares. Ce système d'information pourra servir lors d'analyses de planification et multi-disciplinaires du Corridor.

L'auteur résume ci-dessous les activités anticipées dans le Corridor. Ses recommandations détaillées ont paru ailleurs (IMF 1974), excepté la recommandation d'établir des réserves forestières dont trois dans la section nord du Corridor sont décrites ici.

Les recommandations fournissent des moyens pratiques d'harmoniser les besoins contraires lorsque l'on compare l'utilisation des ressources non renouvelables au maintien et à la mise en valeur des ressources renouvelables et essentiellement territoriales. Les recommandations sont groupées selon leur importance scientifique générale, selon les activités de construction et selon leur nature générale.

Celles d'importance scientifique générale insistent sur le besoin d'études scientifiques additionnelles concernant le rôle que jouent les incendies dans un environnement nordique, d'études sur la régénération et la succession des plantes en milieu forestier ou non, et la recherche sur les dégâts causés par le pétrole renversé. On doit aussi faire de plus amples relevés des forêts, des insectes et maladies des arbres, et photographier de diverses façons à obtenir des données permanentes sur les conditions "avant" et "après". De manière plus générale, on a besoin d'un système standard de collection des données, d'une terminologie standard, et de l'usage du système métrique.

Pour la construction et l'opération de pipe-lines et de routes, il serait urgent de suivre certaines de nos recommandations vu que des dommages importants peuvent être causés lors des phases initiales des travaux. Ceci inclut des contrôles arbitraires, à court terme et des d'aménagement concernant des usages multiples. On recommande immédiatement de: établir des aires de développement spécialement contrôlées autour des établissements existants et futurs; désigner des réserves formées de bandes de chaque côté de tous les chemins, les lacs et les cours d'eau importants; choisir les aires de coupes forestières et contrôler leur concentration; contrôler le choix des études expérimentales destructives ou des activités opérationnelles accessoires reliées à la construction en milieu forestier; établissements améliorés de détection des incendies forestiers et de lutte contre ceuxci. En rapport avec les constructions, on doit contrôler les espèces de plantes introduites utilisées pour stabiliser le sol, prévenir les dommages causés par le drainage limité, la poussière, les herbicides et la pollution par le SO_2.

Plusieurs recommandations générales étrangères aux études sur la végétation incluent le contrôle des lignes séismiques, la mise sur pied de programmes d'information publique et la préservation de certains sites.

Du point de vue administratif et politique, il faudra surtout qu'une portion substantielle du Corridor et régions adjacentes soient désignées comme réserves forestières. Une telle politique est prérequise pour bien planifier, aménager, utiliser et conserver les ressources naturelles renouvelables qui sont uniques ou typiques de chaque région. Ces réserves seraient aménagées de façon multiple (foresterie, faune et flore, récréation, esthétique). Dans chaque parc, on réserverait des aires écologiques, des aires d'études expérimentales sur l'environnement. L'auteur propose dix parcs de la sorte, dont trois existant dans la région nordique couverte par le présent rapport. En tout: 22,000 milles carrés. L'auteur espère que l'on acceptera au plus vite ses recommandations afin que les réservations nécessaires soient effectuées et que des règlements spéciaux provisoires soient dictés avant que l'on construise les routes les pipe-lines.

CHAPTER 1

SUMMARY

This report is a continuation of "Vegetation Types of the Mackenzie Corridor"*, 1974 and briefly describes the vegetation types found in the Old Crow, North Shore, Inuvik and Tuk sections of the Corridor.

Interpretation and mapping techniques, developed for the earlier mapping, were continued for the present work. However, a revised classification was developed to adequately define the markedly different vegetation types occurring in these far northern areas. Because of the inferior quality of available air photographs, the interpreters had to rely on landform and topographic position as well as photo tone and texture in type delineation.

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*The Corridor referred to here was defined arbitrarily by the investigator for mapping purposes. A specific Transportation Corridor had not been defined or established by the Government at the time the project commenced.

There are seven major vegetation classes which are subdivided into one to five subtypes to make a total 20 vegetation types. These have enough distinctive characteristics to be interpreted from available photography at scales of approximately 1:60,000. These types have been delineated on air photographs and transferred to cronaflex base maps at a scale of 1:125,000 from which uncoloured prints are available. The mapping in the northern sections covers approximately 19,000 square miles.

The tree cover, high shrub, low shrubs, and ground vegetation characteristics of each type have been described and observations on permafrost and other special conditions associated with them have been made. Forest areas, though meagre in the northern sections, have been classified and mapped in more detail, and include information on species composition, stand height and canopy density.

To facilitate small-scale (1:500,000) mapping, the 20 vegetation types have been grouped into vegetation-type-aggregates exhibiting similar characteristics. Ten coloured maps showing seven type aggregates were then produced at that scale and are presented under separate cover.

All mapped data have been entered into a computer system. This system allows for a rapid compilation of area summaries showing area covered by vegetation types and mapped forest conditions. Summaries have been compiled for each Corridor section, map sheets and for the entire Corridor, and the possibility of compiling further statistics for any portion of the Corridor exists.

The maps and statistical summaries are of importance in judging the magnitude of problems associated with particular conditions or areas. They are also valuable in identifying situations that may be unique or rare. It is expected that major use can be made of this information system during future planning and multi-disciplinary analyses of the Corridor.

Recommendations relating to the anticipated activities in the Corridor area are summarized briefly in the following paragraphs. The recommendations are published in detail in the earlier (1974) report on the vegetation types of the Mackenzie Corridor and are not repeated in the present report. The exception is the recommendation on the establishment of forest reserves and the description of three of these reserves which do occur within this northern portion of the Corridor.

The recommendations provide what are considered to be practical means of harmonizing the conflicting requirements involved in utilizing non-renewable resources and maintaining or enhancing the value of renewable and primarily land-based resources. The recommendations are grouped under those of general scientific importance, those related to construction activities, and those of a general nature.

Recommendations dealing with matters of general scientific importance emphasize the need for additional scientific studies related to such matters as the role of fire in the northern environment, studies of regeneration and plant succession in forest and non-forested plant associations, and research on oil spills. Additional survey data are also required with respect to forested areas, insect and disease conditions, and photographic coverage in various forms to provide permanent records of 'before' and 'after' conditions. Scientific recommendations of a more general nature point out the need for a standardized information retrieval system, use of a standard terminology, and the use of the metric system.

For pipeline and highway construction and operation, a number of the recommendations are of considerable urgency since much damage occurs in the initial phases of the work. Both short-term, arbitrary controls and long-term, multiple-use management are involved. Recommendations of a stop-gap nature required immediately include: establishment of specially-controlled development areas around existing or anticipated settlements; designation of reserve strips along all roads, major rivers, and lakes; designation and control of the concentration of cutting operations and/or destructive experimental studies or ancillary operational activities associated with construction in forested areas; improved fire detection and control facilities. Other construction-oriented proposals relate to the control of introduced plant species in soil stabilization programs, prevention of damage through impeded drainage, dust, herbicides, and SO^2 pollution.

Several general recommendations not related to the vegetation study suggest the control of seismic lines, establishment of public-awareness programs and the preservation of certain sites.

From an administrative and political viewpoint the primary recommendation is that a substantial portion of the Corridor and adjacent areas be designated as forest reserves. This is required to provide for orderly planning, management, use, and conservation on a unit basis of the renewable natural resources unique or typical of each area. They would be managed on a multiple-use basis for forestry, wildlife, recreational and aesthetic values. Within each unit, special areas would be preserved as ecological reserves, and others designated for experimental environmental studies. Ten such areas have been proposed, three in the northern part covered by this report, totalling approximately 22,000 square miles. An early policy decision to implement this concept is urged so that the necessary reservations can be made and interim special regulations established prior to highway or pipeline activities.

CHAPTER 2

INTRODUCTION

With the discovery of oil and gas in July, 1968, at Prudhoe Bay, Alaska, came the recognition by the Canadian Government that similar discoveries might be made in the Canadian Arctic, and that Government should be in a position to react to such discoveries. In December, 1968, the formation of a federal Task Force on Northern Oil Development was announced in the House of Commons. It was then stated: "Its purpose will be to bring together all information on the existing oil situation in the North, on transportation routes that might be used, and to coordinate all available information from all federal agencies and departments, and then report and make proposals to the Government". Several committees have been set up under the Task Force, one of which is the Environmental-Social Committee. The specific objectives of the Environmental-Social Committee are, in part, as follows:

a) to provide the base data required to develop an understanding of the northern environmental and ecological balance, with particular emphasis on the probable pipeline route along the Mackenzie Valley;

b) to provide the technical and scientific information necessary to assess the probable impact on the environment of building and operating pipelines along the anticipated route;

c) to ensure that the Government is in possession of adequate information on the northern environment to be able to assess applications to build pipelines and to reach decisions

> which will involve balancing possible interference with the environment against possible economic and social benefits.

The Forest Management Institute of the Canadian Forestry Service, Department of the Environment, is one of the agencies involved in working to meet these objectives of the Environmental-Social Committee. The specific task, by the Forest Management Institute, of mapping the existing forest and non-forest vegetation within the broad corridor considered for pipeline and transportation routes, has been funded through the Environmental-Social Committee.

This entailed first the preparation and testing of a suitable classification system to be used in such mapping. The maps had to contain basic descriptions of the essential characteristics of the vegetation types that were significant in describing terrain sensitivity and on the possible impact of construction activity on the environment. Furthermore the task involved an analysis of the vegetation maps and the preparation of recommendations based on this analysis. A review of the current state of knowledge revealed that the vegetation maps required for a multidisciplinary assessment of technological impact should include information of species composition, height and density of plant cover and the patterns of species associations. Such basic information on the various vegetation strata was required, whether one was concerned with appraising the possible damage to wildlife habitat, with assessing the ecological uniqueness of areas, with assessing the possible commercial importance of forests or in appraising the insulating effects of vegetation over permafrost, etc. The system of course also had to be practical for there were severe constraints both in time and in the availability of aerial photography.

Two classification systems were developed by the Forest Management Institute, one for the south and the central parts of the Corridor, the other for the most northern areas. The first is described fully in the 1974 report on the vegetation types of the Mackenzie Corridor and does not apply to the areas covered by the present report. The latter is described in Chapter 6 and in the associated appendices. The field, photo-interpretation and mapping methods and the approach to analysis used in the four northern sections are described in Chapter 5. Discussions and conclusions are given in Chapters 7 and 8.

The vegetation-mapping project of the Forest Management Institute is in coordination with other projects in the Mackenzie Transportation Corridor. Most relevant is the work by the Northern Forest Research Centre (NFRC), Canadian Forestry Service. They, working is support of the mapping of surficial geology by the Geological Survey of Canada, have prepared descriptions of the relationships between landform, vegetation cover and permafrost. NFRC has also undertaken studies to determine the role of vegetation in stabilizing the active soil layer and in determining its response to disturbance. Floristic descriptions by the NFRC have been of value in both FMI reports. Generally it is expected that the strongest and most valuable conclusions will be reached by combining the data of the Forest Management Institute mapping project with the result of the sensitivity studies and descriptions of NFRC and with the research of other agencies, such as that of the Canadian Wildlife Service and Arctic Land-Use Research (ALUR) programs.

CHAPTER 3

SUMMARY OF CURRENT STATE OF KNOWLEDGE

The Forest Management Institute arranged, under contract, for the completion of an annotated bibliography of permafrost-vegetation-wildlife-landform relationships. This 350-page work (Roberts-Pichette 1972), available from the Forest Management Institute, includes a statement of the current state of knowledge as it would apply to proposed activities in the Mackenzie Transportation Corridor.

A systematic mapping of the vegetation in the Mackenzie area had never been undertaken and generally, for most areas, vegetation maps were non-existent or inadequate even for the very few localized areas in which studies had been conducted. It was against this background that the FMI mapping project began in 1971 and which resulted in the publication of the report "The Vegetation Types of the Mackenzie Corridor," 1974. The present report is primarily a continuation of that publication and covers those areas of the Corridor not included in the first report.

CHAPTER 4

STUDY AREA

4.1 Corridor Sections

In the early stages of the project, the area to be mapped was defined only approximately. However, following preliminary investigations, and as more details on proposed pipeline and transportation routes become available, a Corridor was defined, which included most of the proposed alternatives. The Corridor, shown in Figure 4-1, is approximately 1,000 miles long, and varies in width from 10 to 50 miles. The total Corridor is subdivided into ten sections, four of which are described in this report. Section boundaries were made to coincide with the boundaries of NTS map sheets at 1:250,000 (Figure 4-1). Figure 4-1 gives a precise picture of the area mapped. On a few map sheets vegetation mapping extended outside the designated sections. While such information is shown on the map, the area data on vegetation types presented in this report is confined entirely to the area mapped within the section boundaries.

Since the mapping described in this report is a continuation of the 1973 project, the sequence of section numbers has been maintained (Figure 4-1). Section boundaries are somewhat arbitrary but broad differences in climate and physiography are reflected as differences in vegetation in the various sections. Descriptions of the main characteristics of the individual sections (VII to X) follow.

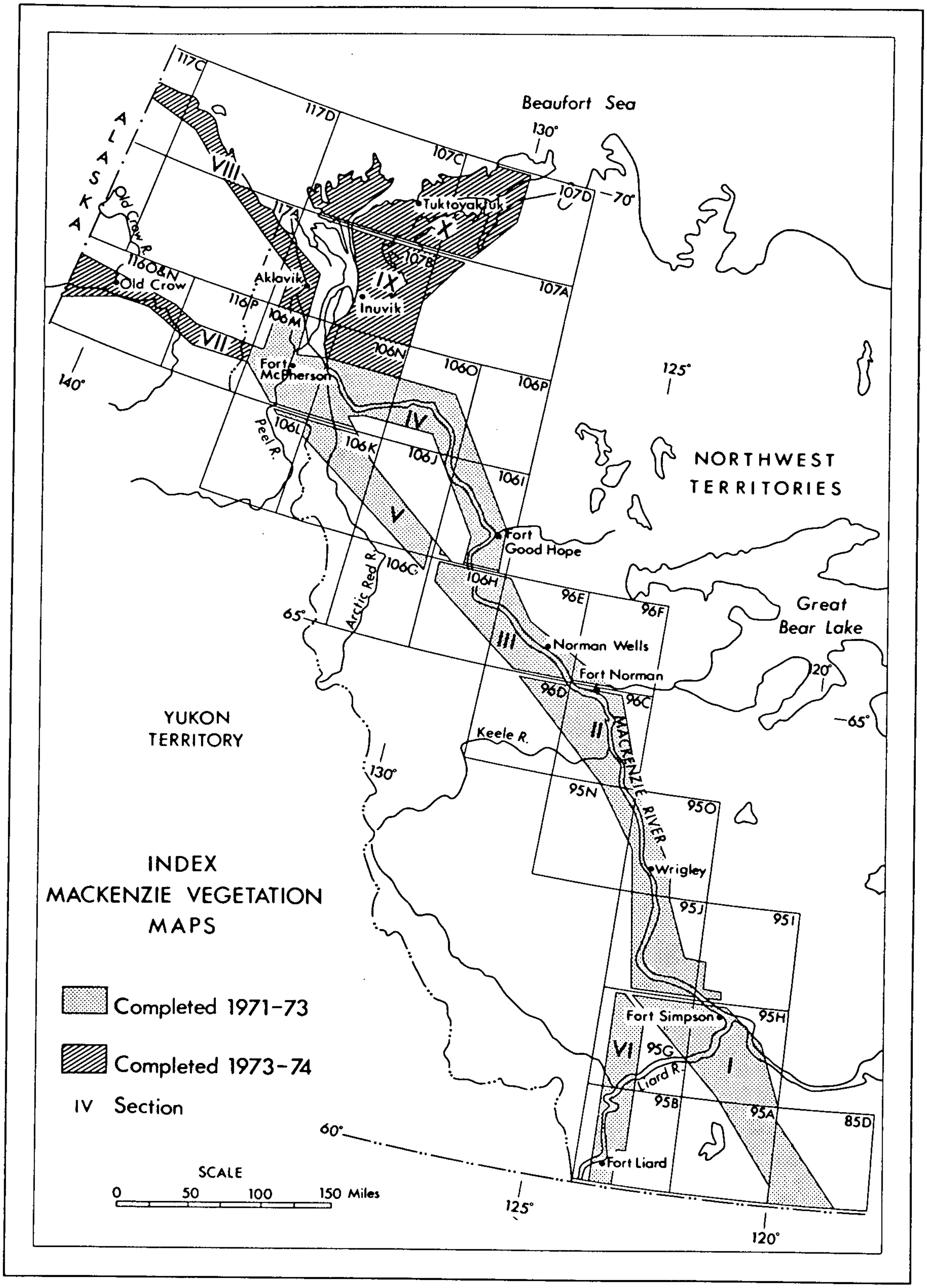

FIGURE 4-1. Corridor location and area mapped.

4.2 Description of Corridor Sections

4.2.1 Section VII - Old Crow

Map Sheets 116 N and O, 116 P. Length 135 miles; width 10-30 miles; area 3,300 square miles.

This section stretches almost due west from Fort McPherson, through the Richardson Mountains by the Stony Creek pass to the Rat, Bell and Porcupine river valleys across the Yukon to Alaska. It includes a great variety of landforms and vegetation types. The Richardson Mountains, Porcupine Plateau, Old Crow Plain and Old Crow Range are the physiographic divisions represented (Anon. 1970). Much of the area west of the Richardson Mountains has not been glaciated.

The proposed IBP (International Biological Program) reserve number 5, which encompasses Old Crow Flats, is, in part, within this section and an important caribou migration route crosses the section near the village of Old Crow.

Merchantable timber occurs in small stands along the Porcupine River and tributary streams such as the Driftwood River and Lord Creek. The predominant vegetation is spruce/moss and upland shrub types.

4.2.2 Section VIII - North Shore

Map Sheets 107 B, 117 A, 117 C, 117 D.
Length 180 miles; width 20 miles; area 3,600 square miles.

This section extends north (from the southern boundary of Map Sheet 107 B) along the west side of the Mackenzie Delta to the Arctic Coast at Shingle Point and then northwesterly along the coast to the Alaska-Yukon border (longitude 141° W). The Mackenzie Delta, Richardson Mountains, and Yukon Coastal Plain are the physiographic divisions represented in this section.

In the southern portion, a pipeline would be confined to a relatively narrow strip by the Mackenzie Delta to the east and the Richardson Mountains to the west. Across the Yukon, the most probable location for a pipeline would be within a few miles of the Beaufort Sea.

There are no stands of commercial timber in this section, the only tree cover occurs on the Delta and in a few sheltered side valleys. The predominant vegetation cover is cotton grass/sedge and upland low shrub tussock types.

4.2.3 Section IX - Inuvik

Map Sheets 106 M, 106 N, 107 A, 107 B.
Area 5,400 square miles.

This section extends north from about 67°40' N, where it joins Section IV (1973) to 69°00' N, the northern edge of map sheets 107 A and 107 B. The western boundary is the East Channel while the eastern boundary is at 132°00' W to 68°23' N and then northeasterly parallel to the Miner

River. About three quarters of this section is in the Anderson Plain physiographic division, the remainder in the Mackenzie Delta division. The numerous lakes in the latter are the most striking physiographic distinction between the two divisions.

Scattered, low density stands of very stunted black spruce occur slightly beyond the north and east boundaries of this section and only in the most favourable, sheltered sites, but near the southern boundary of the section forested areas become common. About 2,600 square miles or 48 percent of the section supports a tree cover, most of which is of no commercial value. Moss and lichen are the predominant lesser vegetation types.

4.2.4 Section X - Tuk

Map Sheets 107 C, 107 D.
Area 6,400 square miles.

This section encompasses all the land area on Map Sheet 107 C and most of that on Sheet 107 D, west of longitude 130°00' W. The entire section, within the Mackenzie Delta physiographic division, is dotted with lakes - almost 40% of the section is water.

Only a very small portion in the southeast corner of the section supports tree growth and this, very open-grown, stunted black spruce. Low shrub, moss and lichen vegetation types are the most common in this section.

CHAPTER 5

METHODS OF STUDY AND SOURCES OF DATA

Many of the techniques developed in the 1972-74 mapping were used in this project. The personnel employed had worked on the mapping of the southern portion of the corridor and this facilitated the preparation of the legend, the field sampling and mapping operations for the north.

5.1 Interpretation of Aerial Photographs and Field Checking

The photography used was black-and-white panchromatic with scales ranging from 1:50,000 to 1:70,000. Most of this photography had been taken in 1970, 1971 and 1972. Photo interpretation commenced in early 1973 and the provisional mapping was completed in time for field checking.

The field work was done in July and early August. Due to the vastness of the area to be covered in the short period of time the field investigations were mainly in over-flying the mapped areas with many spot checks on vegetation; corrections were made directly on the aerial photographs. Detailed sampling was done on specific areas with a total of 63 sample plots established; their distribution by vegetation classes is shown in Table 5-1. The plot data included information on forest cover, when present, lesser vegetation, soils, permafrost measurements to a depth of three feet and topography (sample tally sheet, Figure 5-1).

TABLE 5-1. Number of Sample Plots by Vegetation Type

SHRUB

High shrub;		Low shrub;		Low shrub wetland;	
1a	1	2a	1	3a	1
1b	4	2b	8	3b	10
1c	1	2c	9		
1d	1	2d	2		
		2e	3		
	7		23		11

Total shrub types 41

MOSS LICHEN

Moss lichen;	
4a	4
4b	5
4c	1

Total moss lichen..........10

MONOCOTYLEDONIC

Monocotyledonic wetlands;		Monocotyledonic;	
5a	2	6a	7
5b	1	6b	2
5c	0		
	3		9

Total monocotyledonic 12

TUNDRA POND FIELDS

Tundra pond fields;	
7a	0

Total tundra pond fields .. 0

Total all vegetation types 63

STAND DESCRIPTION (FM 112)

Date ____________ Air Photo No. ____________ Map No. ____________ Stand No. ____________

Based on: Aerial Obs. ________ Ocular 5 ac. Plot Nos. ________ 10f Pt. Sample Nos. ________

Photo Desig. (Type) __________ Field Desig. (Plot) __________ Field Desig. (Type) __________

Topo. Location: Ridge Top _______ Upper Slope _______ Mid Slope _______ Lower Slope _______

Upland Bench ____________ Alluvial Flat ____________ Other ________________

Slope % ________________ Aspect ________________ Depth to Permafrost ________________

Depth of: Litter ___________ Undecomposed Organic __________ Decomposed Organic __________

Mineral Soil: Gravel _______ Coarse Sand _______ Fine Sand _______ Silt _______ Clay ______

Other (Describe) ____

Stones Absent ____________ Stones Present ____________ Size ____________" to ____________"

Moisture: Very dry _____ Dry _____ Fresh ______ Wet ______ Very Wet ______ Saturated ______

Cover	Abund.[2]	Species/Occurrence[3]	Est. Stand Age
Tree Layer		wS/ bS/ P/ tA/ Po/ wB/ /	
Ht/Diam.[1]			
High Shrub (>3')			
Low Shrub (<3')			
Herb			
Grass & Sedge			
Moss			
Lichen			

General: Plot is a Good ________ Fair ________ Poor ________ Sample of the type.

Explain ____

Disturbance ____

Ground Photo No. ____________ Description ____________________________

(See reverse side for additional remarks _______)

[1] Show dominant height to nearest 10 ft. and mean diameter of trees 3.5" + to nearest inch.

[2] Indicate class abundance (total crown cover) as follows: Single specimen only (r); sporadically present (+); < 5% (1); 5-25% (2); 26-50% (3); 51-75% (4); 76-100 (5); and distribution as; random (R); small groups (S); large groups (L).

[3] Indicate in tenths the occurrence of trees (B.A.) and high shrubs (stems) by species.

FIGURE 5-1. Stand description form completed for all forest and non-forest sample areas.

5.2 Large-scale Photography

Since it was realized that costs for a detailed field sampling program to cover the Corridor would be prohibitive, it was arranged to supplement the mediocre-quality, small-scale photography and sparse field-sampling with large-scale colour photography and photo plots.

This project involved transporting cameras, film and operator from Ottawa. A Vought Gazelle helicopter stationed at Inuvik was hired by casual charter. This aircraft seemed to be the only one suitable for the operation that had the right camera hatch, ancillary power, range and stable flight characteristics. The camera used was a Vinten 70 millimetre with intervalometer control. The films exposed were Kodak Aerochrome I.R. 2443 and Ektachrome Aerographic 2448. Each Corridor section was sampled by a single line flown at 9,000 feet ASL to give an approximate scale of 1:36,000. For all this high level photography 2443 film was used. In addition designated areas were chosen on each Corridor section for larger-scale photography and this was flown to obtain an approximate scale of 1:12,000. Detailed sampling and description were carried out on a variety of vegetation types covering a line starting two miles east of Noell Lake, and running northwest and across the East Channel to about four miles northeast of Tununuk Point. This line was then photographed at scales of 1:36,000, 1:12,000 and 1:6,000 with 2443 film and at the 1:12,000 and 1:6,000 scales with 2448 film.

The flying was blessed with near-perfect photography weather but unfortunately a malfunction developed in the camera system and most of the photography proved worthless when developed in Ottawa; some portions of the photography at different scales were useable.

5.3 Map Production

Base maps were obtained by enlarging 1:250,000 National Topographic Series maps to a scale of 1:125,000. The topographic detail was also subdued to half-tone in order to facilitate drafting and the transferring of detail from typed aerial photographs.

Provisional vegetation type maps were pencil draughted prior to field work. After field work the provisional types were corrected and final draughting was inked on the original provisional sheets that had been produced on Cronaflex material. A section of a typical map is shown in Figure 5-2.

Twenty vegetation types were recognized and mapped in the northern part of the corridor. In addition to showing these, the maps give information on species composition, average stand height and canopy density for all forest stands. The height and density classes recognized and the abbreviations and codes used are given in Table 5-2.

Uncoloured vegetation maps at the 1:125,000 scale are designated as Appendix 2; copies of these are available at user's expense from Campbell Printing Ltd., 880 Wellington Street, Ottawa, Ontario, K1P 6K7.

The 20 vegetation types were grouped into 7 vegetation-type aggregates which exhibit similar characteristics. Each type-aggregate was represented with a distinct colour. A set of the 1:125,000 vegetation maps, thus coloured, were then reduced and colour prints at a scale of 1:500,000 (approx.) produced. These appear as ten map sheets (8 1/2 in. by 11 in. format) under separate cover designated as Appendix 1.

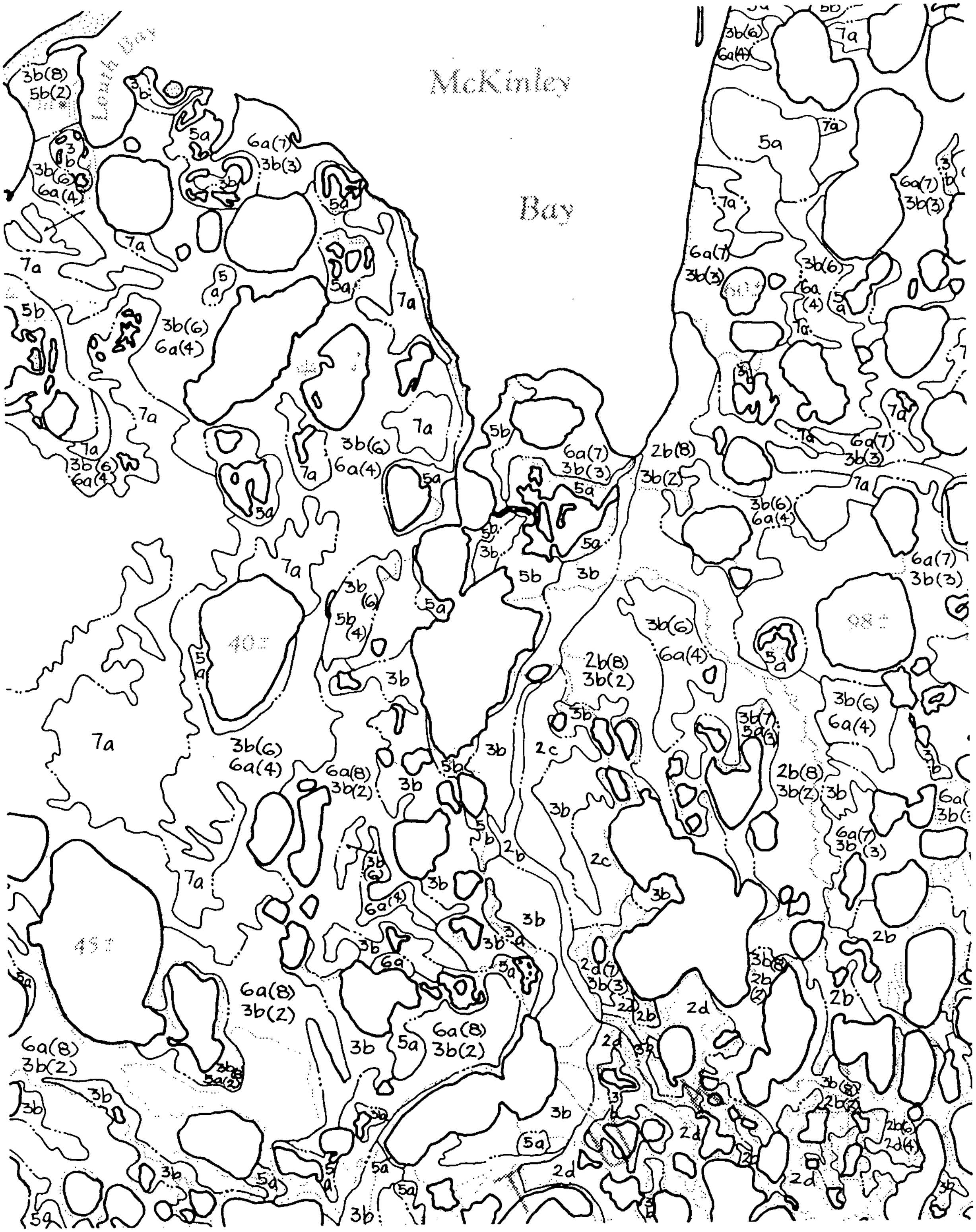

FIGURE 5-2. A typical section of the vegetation maps produced at scale 1:125,000.

(Part of map sheet 107D).

TABLE 5-2 Key to symbols used in mapping forest cover

Height	Forest cover	Canopy density %
1 - 1 to 20 feet	bS - Black spruce	1 - 1 to 20
3 -21 to 40 feet	S - White spruce or undifferentiated spruce	3 - 21 to 40
5 -41 to 60 feet		5 - 41 to 60
7 -61 to 80 feet	L - Larch	7 - 61 to 80
9 -81 feet (plus)	H - All hardwoods	9 - 81 plus

Example of Symbol

2c(8) - 80 % low shrubs, grass, sedge cover

1bS1
4b (2) - 20% lichen cover with 10-ft low density black spruce stand.

5.4 Computer Analysis of Vegetation Maps

As a basic step to any comprehensive analysis of information contained in the vegetation maps produced, the mapped vegetation data were entered into a computer system and programs for the summary and analysis of these data were written.

A systematic grid of 2-km squares, based upon Universal Transverse Mercator Grid co-ordinates, was superimposed upon the entire Corridor area. Important variables that have been mapped - e.g., vegetation type, average stand height, crown-canopy density - were recorded for each grid point. A detailed listing of information recorded is given in Table 5-3. A specially prepared coding sheet (Figure 5-3) was used.

The 2-km grid was chosen after preliminary experiments which showed that this spacing was most satisfactory when considering both the requirements of accuracy and the constraints in cost and time. However, the system is very flexible and a finer grid for areas of special concern could be incorporated.

Using these grid points it is easy to compile area summaries for any stated segment of the Corridor. Some of these summaries appear in Chapters 6 and 7 and in Appendices.

The system has great potential for multidisciplinary analyses of maps produced for the Mackenzie Transportation Corridor. For example, it would be possible to enter data from other maps, such as those describing wildlife habitat or geology, into the same system, using the same grid co-ordinate points. One could then readily produce summaries showing which features of wildlife habitat are associated with given characteristics of vegetation or geology etc.

TABLE 5-3 Map data entered into computer

	Example
Map sheet (NTS)	107 B
UTM easting ÷ 1000	570
UTM northing ÷ 1000	7556
Major vegetation type	1 a
Major vegetation type, % of area in complex	5
*Major forest cover - height, $species_1$, $species_2$ density	1201
Minor vegetation type	2 a
Minor vegetation type, % of area in complex	5
Minor forest cover	00000
Corridor Section	9

*Species Codes:
1 Spruce
2 bS
3 Pine
4 Larch
5 Hardwoods

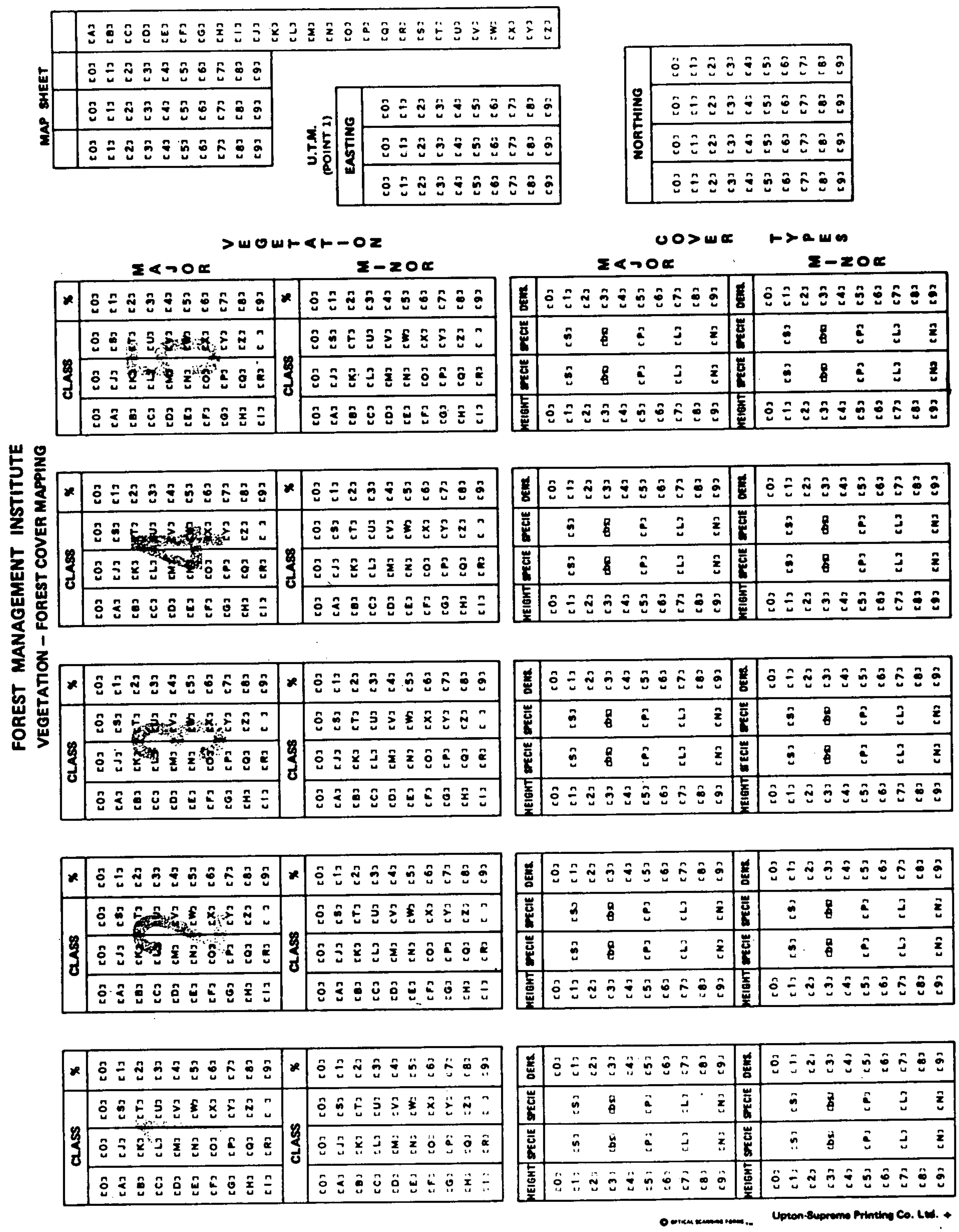

FIGURE 5-3. Coding sheet used in computer analyst's system.

CHAPTER 6

RESULTS

6.1 Development of Vegetation Classifications

A separate classification system was developed for Sections VII, VIII, IX and X after it was found impractical to try to fit the classification used for Sections I to VI to these areas. An attempt was made to have a recognizable correlation between the two legends and generally there is a parallel.

There are seven major vegetation classes which are subdivided into one to five subtypes to make a total of 20 vegetation types (Table 6-1). In addition to these, non-vegetated, burn, rock, and open and improved areas are delineated. Forest, when present, is noted on the maps along with the designated type for the lesser vegetation. The forest is described by cover type, height and density. The extent of forest cover is described briefly in Chapter 4 and area estimates are presented in Appendix 5.

The provisional legend, prepared after scanty reconnaissance work the year before, had to be revised as field work progressed. The air photo interpreters, engaged in the vegetation mapping, took part in the field work and in the legend revision. The resulting final legend is by necessity, because of the small mapping scale, broad but each type took on a unique position in the classification and could be identified with reasonable accuracy on the available air photography. The field experience gained by the interpreters proved invaluable in relating the site to vegetation characteristics and this along with photo tone and texture were the main criteria used in the classification.

TABLE 6-1 Vegetation types

SHRUB

1. High shrub
   - a) recent alluvial ...... high shrub
   - b) upland .... high shrub
   - c) eroded .... high shrub
   - d) upland fan .... high shrub, grass, sedge
2. Low shrub
   - a) ancient alluvial ..... low shrub
   - b) upland .... low shrub
   - c) upland .... low shrub, grass, sedge
   - d) variable (polygon) ... dryas, lichen, low shrub
   - e) high elevations ...... dwarf shrub, lichen, grass
3. Low shrub wetlands
   - a) flat .... low shrub, moss
   - b) flat (polygon) .... low shrub, moss, lichen

MOSS LICHEN

4. Moss lichen
   - a) variable .... moss
   - b) variable .... lichen
   - c) variable (polygon) ... grass, lichen (low shrub)

MONOCOTYLEDONIC

5. Monocotyledonic wetlands
   - a) flat or alluvial fan . sedge, grass, low shrub
   - b) flat (polygon) .... sedge grass, low shrub
   - c) flat .... moss, sedge
6. Monocotyledonic

a) variable .... grass, sedge

b) high elevations ...... grass, dwarf shrub, moss

TUNDRA POND FIELDS

7. Tundra pond fields

a) variable .... grass, sedge, low shrub

burn where vegetation has not established

rock outcrops or mountain peaks void of vegetation

open or improved land

Single symbol on map indicates a "pure" type. Double symbols indicate "complex" types with the proportion of pure types in the mapped complex designated in tenths.

Where forest cover occurs in any type, stand height, species composition, and canopy density are indicated as illustrated in the key to forest mapping symbols in Table 5-2.

6.2 Description of Vegetation Types

6.2.1 General

The vegetation types can be grouped into two major categories, those having a predominance of woody plants and the ones containing less than 50 percent woody plants.

The woody vegetation is subdivided further into two, those sustaining substantial amounts of high shrubs (three feet or taller) and those predominately low shrubs. Further subdivisions within these are based largely on variations within individual species compositions, topographic and site considerations.

Similarly, the non-woody vegetation types are subdivided into two, moss/lichen and monocotyledon types, with further breakdown again by dominant vegetation, topographic and site factors.

6.2.2 Type 1a, High Shrub - Recent Alluvial

This vegetation type is confined to recent alluvium which is subject to intermittent flooding. These are usually flat sites with fair drainage. Silty soils or a silt content in the soil is a common feature because of the frequent deposition by flood waters. A moderate active layer is not uncommon on these locations.

Tree cover may be present in this type in sections 7, 8, and 9, south of the tree line. The tree species consist of white spruce, black spruce, white birch and balsam poplar.

Lesser vegetation consists primarily of tall shrubs which can be dense and vigorous, often reaching over ten feet in height. Willows and alders are the most common of these. Herbaceous plants do not generally form a high percent of the ground cover, but *Equisetum* , characteristic of this vegetation type, can be very numerous on localized areas. Grasses and sedges are also frequently present but mosses and lichens are usually absent.

6.2.3 Type 1b, High Shrub - Upland

This is a common vegetation type in section 7 (Old Crow) where it comprises about 15 percent of the total area. In the other three sections it is not, however, nearly as prominent.

This type usually occurs on slopes or on somewhat undulating or rolling topography. Often it is present on potentially unstable sites such as moderate slopes having a substantial active layer. The soil moisture content is usually fresh, but the soil textures are variable; this vegetation type has been observed on gravelly as well as silty and clay soils.

Minor amounts of tree growth occur in section 7 and 9. This consists of white and black spruce, mostly of small size, but some 50-foot white spruce were observed by the field crews.

The lesser vegetation is largely dwarf birch, alders and willows often exhibiting dense growth and reaching heights over five feet. In the often dense lower shrub layer *Ledum* and *Vaccinium* species are common. Herbs, grasses, sedges and mosses are usually present but not in large quantities.

6.2.4 Type 1c, High Shrub - Eroded

This type is usually found on steep upper slopes subject to constant erosion. The soil texture on these sites can be variable but they are usually excessively drained.

There may be some tree growth in sections 7 and 9 but tree species certainly are not a significant feature of this type.

The vegetation cover is dominated by woody shrubs though the growth is not generally as luxuriant as in types 1a and 1b. Dwarf birch and willows dominate the high shrubs; these two are also common, along with *Vaccinium* species, in the sparse to moderately dense lower shrub layer. Herbs and grasses are generally not significant. Mosses and lichens are often present in localized patches which have remained stable (not affected by erosion) for a considerable time.

6.2.5 Type 1d, High Shrub - Upland Fan

This type occupies only a very insignificant percent of the total area. It occurs on soils which are generally well drained and coarse textured. These areas are affected by spring runoff that denudes much of the vegetation. The site is often a telluric one, however, and where vegetation is spared from water erosion it often exhibits excellent growth and shrubs reaching ten feet in height.

Generally there is no tree growth. The most common high shrubs are alders and willows and frequent low shrubs are *Vacciniums*, dwarf birch and *Ledum*. Grasses and sedges are also common in this type.

6.2.6 Type 2a, Low Shrub - Ancient Alluvial

This vegetation type occurs on alluvial soils which are no longer subject to flooding. The soils are often silty and have fair drainage. Permafrost is common and usually very close to the surface.

Some tree growth may be present in sections 7 and 8 but is generally insignificant.

Unlike the vegetation on the recent alluvial deposits, the plant growth is retarded and the shrubs seldom exceed two feet in height. High shrubs, if present, consist of scattered alders and willows. The low shrubs are mainly willows and dwarf birch and often form a dense ground cover. Herbs, grasses and sedges, though they may be present, are not prominent. Feather mosses usually form a significant part of the vegetation cover.

6.2.7 Type 2b, Low Shrub - Upland

This vegetation type occupies approximately ten percent of the total Corridor area. It is especially prominent in sections 7, and 10 where it makes up about 17 and 16 percent of their total areas respectively.

This type is usually found on undulating topography or on moderate slopes on fresh, well-drained sites. The active layer is variable but usually less than two feet.

Some tree growth occurs in sections 7 and 9 but trees are not a characteristic feature of this type. High shrubs are generally sparsely represented by alders, dwarf birch and willows. Low shrubs form the main vegetation canopy consisting of dense growth of dwarf birch, *Ledum*, *Vaccinium* and willow. Herbaceous plants are scattered.

Grasses and sedges are frequently present. Feather mosses are common but sphagnum and lichens are relatively rare.

6.2.8 Type 2c, Low Shrub/ Sedge - Upland

This is one of the more common vegetation types in the area and cover about eight percent of the total. It is prominent in sections 8 and 10 where it makes up about 14 and 11 percent of their respective areas.

This type is generally found on similar soil and site conditions as 2b except that it is commonly associated with hummocky terrain. Permafrost is generally within one foot of the surface with the active layer being deeper on the hummocks than in the areas between.

Trees and high shrubs are usually absent. The shrubs, mainly *Ledum*, *Vaccinium* and dwarf birch, are very prominent especially between hummocks. The shrubs are less striking on the hummocks where cotton grass tussocks are often very prominent. Of the herbaceous plants, *Petasites* species is frequently encountered. Sphagnums and feather mosses are prevalent, especially between hummocks; lichens are also often present but generally to a lesser degree.

6.2.9 Type 2d, Low Shrub - Variable

This vegetation type is confined mainly to the Tuk Peninsula with scattered occurrence along the North Shore. It is sometimes associated with sandy soils sometimes overlain by a thin layer of organic or silty material. The terrain is relatively flat but distinctive by its polygon pattern. A fairly deep (two feet plus) active layer is not uncommon.

Tree species and high shrubs are absent. The often dense low shrub layer is characterized by *Dryas* species; scattered clumps of willows are also frequently present. Minor amounts of grasses and sedges may occur. Mosses are not generally prominent but lichens are characteristic in this type.

6.2.10 Type 2e, Low Shrub - High Elevation

This vegetation type is confined to high, wind-exposed locations. Often the soils are dry and very shallow over coarse rubble or rock.

The vegetation is frequently interspersed with bare areas of rock. Tree species are rarely present and because of the exposed locations a high shrub layer is unable to develop. The main vegetation consists of low woody plants, often prostrate dwarf birch, alders and willows, along with species of *Ledum*, *Vaccinium* and *Arctostaphylos*. Mosses and lichens are usually present in significant proportions.

6.2.11 Type 3a, Low Shrub Wetlands - Flat

This type occurs on flat topography where the water table is usually high and the soils wet. Permafrost is close to the surface and often immediately below the vegetation mat.

Tree species are generally absent though scattered and stunted black spruce and larch may be present in some locations. The high shrub layer is usually sparse, consisting of willows and alders. Low shrubs, the main vegetation group, most frequently contain *Ledum*, dwarf birch, *Vaccinium* and *Rubus* species. Grasses and sedges are also numerous. Mosses, including sphagnums, may compose a high percent of the vegetation cover in localized patches within this type.

6.2.12 Type 3b, Low Shrub Wetlands - Polygon

This vegetation type is most notable in sections 8 and 10 where it makes up about 12 and nine percent of their respective areas.

The vegetation occurs generally on similar locations as 3a but here the sites have a distinct polygon pattern. Most of the area is very wet with water close to or at the surface and the polygons may be low centered or disintegrating.

Trees are usually absent but scattered black spruce or larch may occur in the more southern locations. High shrubs are similarly meagre or absent. Low shrubs are the predominant vegetation and consist largely of *Ledum*, dwarf birch, *Vaccinium* and *Rubus chamaemorus*. Cotton grass is usually in evidence but in very inconsistent densities. As in 3a, feather mosses and sphagnums make up a high percent of the ground cover in localized patches, and lichens may predominate in the drier parts of the type.

6.2.13 Type 4a, Moss - Variable

This is the largest vegetation type in the region and occupies approximately 14 percent of the total area. It is especially prevalent in sections 7 and 9 where it covers about 36 and 24 percent of their respective areas. It is almost absent from sections 8 and 10.

The type is generally found on undulating to gently sloping topography. Silt and clay soils with a shallow organic layer are frequent, but drainage is usually fair to good and soil moisture content often fresh or drier. Permafrost is present, usually within one and a half feet of the surface.

This vegetation type contains over 50 percent of the forested areas in the region. Almost all of these occur in sections 7 and 9. The tree species are black and white spruce with white birch sometimes a minor component of the stand.

The lesser vegetation consists of moderate amounts of high shrubs, mostly alders, and dwarf birch. A moderate to dense cover of low shrubs is common; these are mainly *Vaccinium*, *Ledum* and dwarf birch in that order of predominance. Certain amounts of grasses and sedges are usually present. Mosses are a characteristic feature of this vegetation type and on the drier locations lichens are an important component.

6.2.14 Type 4b, Lichen - Variable

This vegetation type is the third largest in the region and occupies about nine percent of the total area. It is the major type in section 9 where it covers approximately 26 percent of the area.

The site characteristics are generally similar to those of 4a but with a tendency to be somewhat more hummocky.

This vegetation type contains substantial amounts of forested areas and is second only to type 4a in this respect. Most of the forests occur in section 9, but there are some in sections 7 and 10. White and black spruce are the main tree species with white birch often a minor component of the stands. In some areas, the field parties recorded the presence of trembling aspen, but that species was generally of very poor quality.

In the lower vegetation layers, high shrubs are not common but are sometimes represented by willows, dwarf birch and alders. Low shrubs, mainly dwarf birch, *Ledum*, *Vaccinium* and *Rubus chamaemorus*, are prevalent especially on the low, moist areas within the type. Similarly feather mosses are common in these lower locations, but lichens are the major vegetation on the remainder of the area.

6.2.15 Type 4c, Moss/Lichen - Variable, Polygon

This vegetation type occupies similar topographic and site locations as 4a and 4b but have a distinct polygon pattern. The polygons are generally high centre and the site tends to be dry, except in the polygon troughs.

There are generally no tree species and few high shrubs. Low shrubs are prevalent in the troughs with *Ledum*, *Rubus chamaemorus* and dwarf birch the main species. Mosses are also common in the troughs. On the raised, somewhat drier, portions of the polygons *Ledum* and *Rubus* are again numerous but lichens predominate.

6.2.16 Type 5a, Monocotyledon Wetlands - Alluvial Fan

This is a fairly common vegatation type in the Corridor. It accounts for about six percent of the total area with about equal representation in all four sections. It is generally found on flat to gently sloping topography; alluvial fans are typical landforms inhabited by this vegetation type. The soil tends to be moist or wetter and the active layer often a foot and a half or more.

Tree species are usually non-existent and woody vegetation is meagre with willow the most frequent representative.

The main vegetation cover are sedges and cotton grass which often form a complete ground cover. Some mosses are usually present but in minor amounts.

6.2.17 Type 5b, Monocotyledon Wetlands - Flat, Polygon

Like the previous vegetation type, this one is also found on flat or very gently sloping locations, generally wet. The active layer is not more than a foot or so. A polygon pattern is characteristic of this type and distinguishes it from 5a.

Trees and high shrubs are insignificant. Low shrubs, however, often form a substantial part of the vegetation in the wetter areas within the type. Willows, *Ledum* and dwarf birch are the most common of these. Mosses may also be numerous in the wetter locations, but overall, sedges and cotton grass predominate.

6.2.18 Type 5c, Monocotyledon Wetlands - Flat, Saturated

This vegetation type occurs only on a negligible percent of the Corridor area. The sites are saturated or partly water covered and permafrost is at least two feet below the surface.

The major vegetation is floating sphagnum mosses and sedges. Tree species and high shrubs are generally absent. Low shrubs are meagre with *Rubus chamaemorus* the most frequent.

6.2.19 Type 6a, Monocotyledon - Variable

This is one of the more prevalent types within the Corridor and occupies approximately seven percent of its total area. It is especially prominent in section 8 where it covers about 29 percent of the area.

This type occurs mainly in upland areas and is often associated with slopes. Surface water is evident in mid-summer and on some of the steeper slopes surface erosion takes place. Permafrost is generally close, within one foot, to the surface.

Generally tree species and the higher shrub layer is absent. Low shrubs are also minor, seldom forming over 25 percent of the ground cover; most frequent shrubs are dwarf birch, *Vacciniums*, willows and *Ledum*. Herbs are also minor with Lupine and *Petasites* species occasionally present in noticeable numbers. The most prominent vegetation are tussock form cotton grasses and sedges which often form a complete, lush ground cover.

6.2.20 Type 6b, Monocotyledon - High Elevations

This vegetation type is found on upper and middle slopes where the moisture varies from dry to moist. In these sites permafrost is usually close to the surface.

Tree species and the high shrub layer are usually absent. Low shrubs are most often represented by *Ledum*, *Vaccinium*, *Rubus chamaemorus* and *Arctostaphylos* species, but form only a minor part of the vegetation cover.

Mosses and, occasionally on the drier locations, lichens are fairly frequent but tussock cotton grasses and sedges are the main vegetation cover though generally not as lush as in type 6a.

6.2.21 Type 7a, Tundra Ponds

This classification is quite unique and forms only a small percent of the Corridor area, confined almost entirely within section 10. These areas are dotted with small thermokarst lakes - too small, for the most part, to show individually at a scale of 1:125,00. However, they can often be spotted on the base maps by the multitude of larger lakes that appear with the topographic detail. Since small ponds are the dominant feature in this classification, the compilations and summaries consider it as water.

On the land areas between the ponds, cotton grasses and sedges make up the major component of the vegetation cover. Trees are absent and high shrubs sparse. Low shrubs are usually present but are of variable composition depending on drainage and soil conditions.

6.2.22 Burn (unclassified)

This comprises areas on which the vegetation has been recently burned off wholly or partially. In areas of the most recent burns, little or no vegetation has re-established itself. On slightly older burns, where some vegetation has come in since the fire, it often is of a pioneer type which may or may not be characteristic of the site before the fire. Since it often is not, it was felt that further classification, from a vegetation standpoint, of recently burned-over areas would be of limited use for site evaluation.

Burned-over areas are significant as fire is probably the most influential factor in altering the vegetation cover. When the burn is intense it removes the insulating mat from frozen areas and exposes the soils to the sun and rains, thus lowering the permafrost and returning the site, usually, to a more productive one from a vegetative standpoint.

6.2.23 Rock

Areas of rock outcrops, mountain tops, etc, which, for the most part, are void of vegetation were simply mapped as rock (^^^) with no accompanying vegetation symbol. Those rocky slopes or mountain tops which do have a tree cover, usually of low density, and a very shallow soil layer were also designated as rock, but with appropriate symbol for cover-type combination.

6.2.24 Open and improved

This classification includes all areas altered by man such as air strips, townsites and all other man-made projects which occupy an area large enough to map at the scale of 1:125,00. For example, though they are a common occurrence in the area, seismic lines do not generally add to this classification because they are so narrow that if mapped at this small scale, they show up only as a line representing their location but the width of this line would have no relation to the true width of the seismic line.

6.2.25 Water

This classification includes all bodies of open water which are large enough to be shown at a scale of 1:250,000 on the National Topographic Series maps that were enlarged to 1:125,000 for this project.

6.3 Vegetation Complexes

The individual vegetation types are clearly defined and discrete. However, when mapping at 1: 125,000 areas will be encountered that are too small to be mapped individually and thus must be shown as a mixture with adjacent types. The map symbol in such cases also shows the proportion (in tenths) of each component of the complex types. All subsequent compilations, such as area summaries, consider these proportions. Since multiple complexing procedures would destroy the initial advantages of a discrete and well-defined vegetation-classification system, the rule that no vegetation complex should ever include more than two types was adapted, and proved quite feasible. However, in a few situations, such as areas of transition from one type to the next where classifications are not clear-cut, personal judgement had to be relied upon and compromise decisions adopted.

6.4 Vegetation-Type Aggregates

To provide useable maps at a scale of 1:500,000 vegetation types having similar vegetation and/or site characteristics were grouped. Within each group, response to disturbance is expected to be rather similar. The type aggregates should therefore be of considerable assistance in terrain-sensitivity studies at the broad reconnaissance level. Ranking of these vegetation-type aggregates on the basis of 'sensitivity' to various disturbances was beyond the scope of this survey.

Each vegetation-type aggregate is described in Table 6.2, and the areas and percentages of each, by Corridor sections, are shown in Tables 6.4 and 6.5.

Coloured prints of the vegetation-type aggregate maps (1:500,000 scale) are presented as Appendix 1.

Table 6-2 Vegetation-type aggregates for small-scale mapping

Vegetation-type aggregates	Description	Map Colour
1a, 2a	Recent and old alluvial sites that are subject to flooding and stream erosion. Tree growth may be present in the southerly mapped regions. These sites support dense shrub growth.	Grass green
1b, 2b, 2c, 2d	Variable terrain but commonly found on upland sites. Shrubs are the predominant vegetation and tree growth may be significant on some southern sections. Permafrost is present and thermal erosion may be a problem if surface layer is disturbed.	Bice green

1c, 1d	Upland eroded sites where unstable soil conditions affect vegetation survival and most areas are only partially vegetated. Some areas, however, support good shrub and tree growth where solifluction has created frost-free pockets of soil that receive ample telluric water for good plant growth.	Red
3a, 3b, 4a, 4b, 4c, 6a	Variable terrain but generally on lower slopes and on flatter terrain than preceding types. Permafrost is close to surface and removal of vegetation mat will cause thermal erosion. Tree growth may be present in some locations to the south. Vegetation is low shrub and moss on 3 and 4 types and sedge, grass and shrub on 6 type.	Lemon Yellow
2e, 6b	Upper slopes that are subjected to wind erosion. These are sometimes only partially vegetated with shrub, grass and moss that are stunted by wind damage.	Blush
5a, 5b	Found on flat to gently sloping terrain that are generally poorly drained. There is no tree cover associated with any of these types and lesser vegetation is sedge, grass and low shrub mixtures.	Lavender

5c, 7a	Terrain is generally flat to gently undulating. Tree growth does not occur on these types and mosses, sedges and grass are the main plant species. These types are not particularly similar but were grouped because it was not practical to assign them separate colours with the small area involved.	Orange

6.5 Floristic Descriptions

Generalized descriptions on the density and frequency of the most important species in the tree, shrub and lower vegetation layers have been included under 6.2, descriptions of the vegetation types.

6.6 Statistical Summaries of Map Data

Under 5.4, a description of the computer system that has been developed for analysis of mapped data is given. This system allows the rapid summary of statistics showing the area occupied by vegetation types or other conditions, such as, for example, tree density or average stand height. Data on any combination of variables can also be extracted to meet specific requirements.

Some general statistics are included in the text. One example is Table 6.3 which shows the area occupied by the various vegetation types recognized in this study. Other examples are Tables 6.4 and 6.5 which summarize the area distributions by vegetation-type aggregates.

More comprehensive summaries are under separate cover as described in Appendices 3 to 7.

Table 6.3 Vegetation type areas in square miles

	Vegetation class	Section				Total	Percent of total
		VII	VIII	IX	X		
1a	High shrub - recent alluvial	77	232	118	102	529	2.8
1b	High shrub - upland	489	95	227	76	887	4.7
1c	High shrub - eroded	145	137	38	2	322	1.7
1d	High shrub - upland fan	---	5	---	---	5	0.0
2a	Low shrub - ancient alluvial	103	7	17	71	198	1.1
2b	Low shrub - upland	561	13	291	1,005	1,870	10.1
2c	Low shrub - sedge - upland	7	514	341	709	1,571	8.4
2d	Low shrub - variable	---	14	---	143	157	0.8
2e	Low shrub - high elevation	159	259	2	1	421	2.3
3a	Low shrub wetlands - flat	2	---	26	47	75	0.4
3b	Low shrub wetlands - polygon	---	446	56	578	1,080	5.8
	Total Woody vegetation	1,543	1,722	1,116	2,734	7,115	38.1
4a	Moss - variable	1,200	8	1,317	51	2,576	13.8
4b	Lichen - variable	50	4	1,425	205	1,684	9.0
4c	Moss lichen - variable, polygon	-----	3	32	42	77	0.4
5a	Monocot. wetlands - alluvial fan	145	205	223	451	1,024	5.5
5b	Monocot. wetlands - flat, polygon	84	136	19	158	397	2.1
5c	Monocot. wetlands - flat, saturated	2	---	---	---	2	0.0
6a	Monocotyledons - variable	---	1,040	69	255	1,364	7.3
6b	Monocotyledons - high elevations	12	134	---	7	153	0.8
	Total bryophytes lichen & Monoctyledons	1,493	1,530	3,085	1,169	7,277	38.9
R	Rock	84	55	19	---	158	0.8
U	Burn	38	---	247	---	285	1.6
Z	Open or improved	---	---	2	---	2	0.0
	Total other land	122	55	268	---	445	2.4
	Total land	3,158	3,307	4,469	3,903	14,837	79.4
7a	Tundra ponds	---	---	3	54	57	0.3
W	Other water	159	261	941	2,439	3,800	20.3
	Total water	159	261	944	2,493	3,857	20.6
	Grand Total	3,317	3,568	5,413	6,396	18,694	100.0

TABLE6.4 Areas of vegetation-type aggregates in square miles

Vegetation-type aggregates	Section				Total
	VII	VIII	IX	X	
1a, 2a	181	240	134	173	728
1b, 2b, 2c, 2d	1,056	636	859	1,932	4,483
3a, 3b, 4a, 4b, 4c, 6a	1,251	1,501	2,926	1,179	6,857
5a, 5b	230	341	242	609	1,422
7a, 5c	2	---	3	54	59
1c, 1d	145	141	38	2	326
2e, 6b	172	393	2	8	575
Water Rock, burn etc.	281	316	1,209	2,438	4,244
Total	3,318	3,568	5,413	6,395	18,694

TABLE 6.5 Areas of vegetation-type aggregates as percentage of total area in section

Vegetation-type aggregates	Section				All
	VII	VIII	IX	X	
1a, 2a	5	7	3	3	4
1b, 2b, 2c, 2d	32	18	16	30	24
3a, 3b, 4a, 4b, 4c, 6a	38	42	54	18	37
5a, 5b	7	9	4	10	7
7a, 5c	--	--	--	1	--
1c, 1d	5	4	1	--	2
2e, 6b	5	11	--	--	3
Water, rock, burn, etc.	8	9	22	38	23
Total	100	100	100	100	100

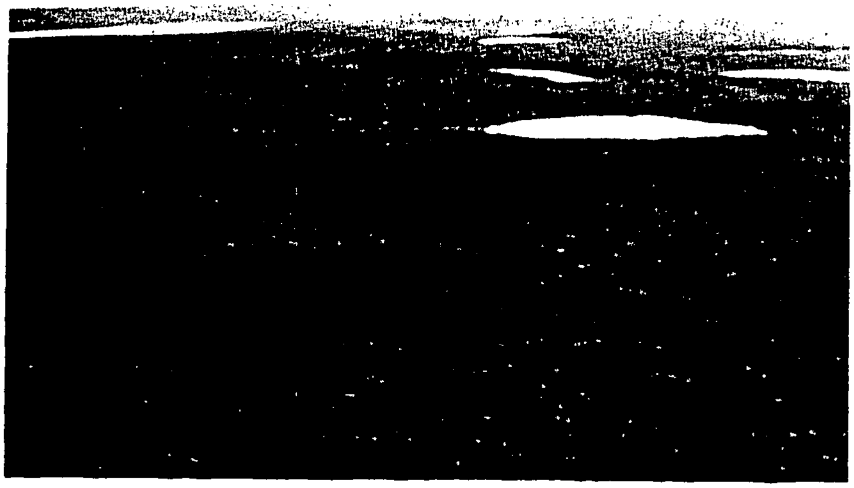

FIGURE 6-1
Type 1b, upland area with high shrub cover consisting of dwarf birch and willow species.

FIGURE 6-2
Type 1c, an excessively drained gravel slope. Note patchy high brush (dwarf birch) and lichen cover.

FIGURE 6-3
Type 1d, upland alluvial fan north-west of Ft. McPherson supporting high shrubs, cotton grass and sedge.

FIGURE 6-4
Type 2b predominantly low shrub cover with small patches of cotton grass. Note lichen area in left background.

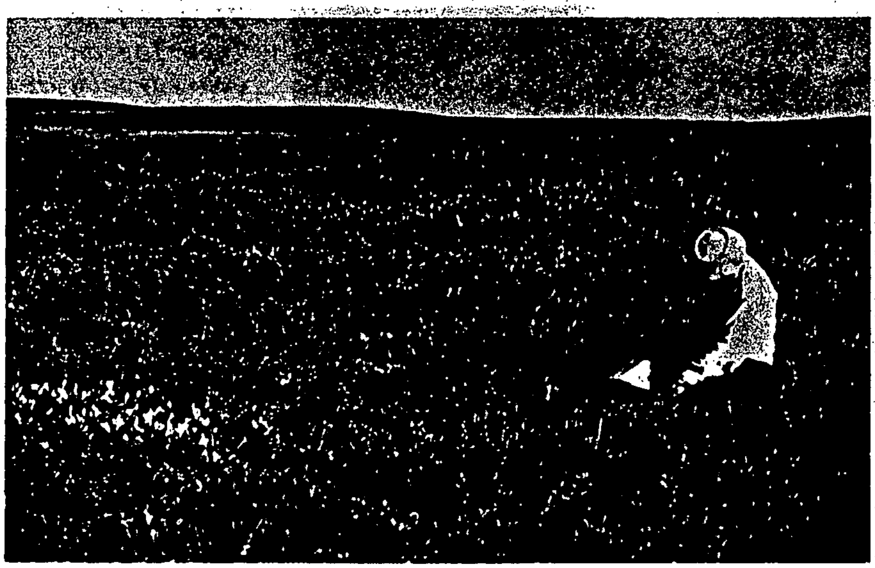

FIGURE 6-5
Type 2c on undulating topography with typical vegetation consisting of low shrub, sedge and cotton grass.

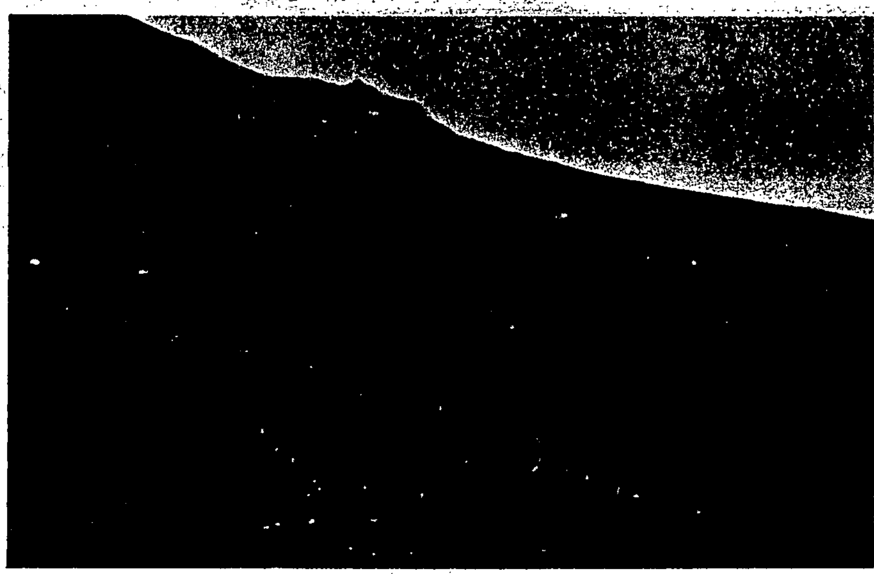

FIGURE 6-6
Type 2e on a dry, windswept hilltop only partially covered by low shrubs and moss.

FIGURE 6-7
Type 3b with dwarf birch, ericaceous shrubs, moss and lichen on the raised polygon ridges and sedge in moist central depression.

FIGURE 6-8
Type 4b with lichen, moss and low shrub cover on polygons.

FIGURE 6-9
Type 4c in foreground with low shrub, lichen and moss on polygons.

CHAPTERS 7 & 8

DISCUSSION AND CONCLUSIONS

7/8.1 General Comments

This report is a continuation of "Vegetation Types of the Mackenzie Corridor", FMI 1974, and the methodology and information presented in the two reports supplement one another. For complete coverage of the extent and distribution of the vegetation patterns and of the implications and conclusions associated with them, refer to both reports.

Other work, closely related to this study, is that undertaken by staff of the Northern Forest Research Centre at Edmonton, who are providing data on the vegetation associated with various physiographic features of the area (Zoltai and Pettapiece, 1973).

Prior to the work done under the Environmental Social Program, Northern Pipelines, the extent of vegetation and related studies in the Corridor area have been very limited and localized. The present studies have shown that it is operationally feasible to classify the vegetation in the Corridor area into vegetation types that can be interpreted and mapped from available aerial photography. The vegetation characteristics of the types recognized are closely correlated with some physiographic features, with permafrost, and drainage conditions. In many instances vegetation is a critical factor in preserving the equilibrium of the permafrost.

These types have been mapped and described in some detail (Chapter 6) and where applicable additional detailed information on the forested areas has been included.

7/8.2 Application and Interpretation of the Results

Attention is drawn to the fact that this information is not only valuable in judging the direct effects of construction (disturbance of insulating vegetation layer) but also in appraising the impact of human interference on wildlife habitat and food supply.

The main value of these vegetation maps and of the associated system for computer analysis (which produces such data as those in Appendices 3 to 7) will be in providing basic facts for multidisciplinary analyses of specific routes proposed. The value of these data will lie not so much in the definition of entirely new problems but in allowing a reliable, quantitative assessment of situations where educated guesses might otherwise have been necessary. The tables presented clearly show which vegetation conditions deserve special attention because of their abundance and therefore the high probability of being encountered. The figures reflect those types which are rare or unique and as such may be of special interest.

The flexibility of the computer system will make it possible to add or delete new variables in any analysis and also combine the vegetation maps with maps produced by other studies. For example, data from other maps such as geological or wildlife-habitat maps could be incorporated to produce statistics and displays combining variables from several map series. There should be no need to return to the maps for the usually laborious copying or dot-gridding of mapped data.

The use that can be made of vegetation or ecosystem mapping depends largely upon scale. The present vegetation types and type aggregates are applicable for general planning and assessment of alternate route locations at scales of 1:125,000, and 1:500,000 respectively. They are not suitable for the evaluation of localized problem areas where scales of 1:50,000 and larger are required. The vegetation types and type aggregates mapped serve as a simple guide in identifying the associated ecosystems and the ecosystem components. Also, ecosystems having similar vegetation will tend to have similar reactions to specified disturbances. This grouping of vegetation types may provide a useful stratification for sensitivity evaluation and a broad basis for more detailed studies of ecosystem interactions and responses to various disturbances.

There is permafrost in most areas in the northern portion of the Corridor covered by this report. The current equilibrium is due to a thick insulating layer of organic materials and vegetation. Special procedures and precautions will have to be followed in such areas.

The more detailed information collected on forest stands shows how restricted and limited are the commercial timber resources in the north. Generally the best stands grow on alluvium along the main rivers and because of this location are highly conspicuous, giving the appearance of being rather abundant. However, the statistical summaries show that their total area is very small. A knowledge of this is one of many arguments that leads to the strong recommendation for the establishment of forest reserves with strict controls on cutting and on orderly management of such stands and associated wildlands for multiple use. The few operations in the north have already provided examples of how even relatively well-managed logging and saw-milling operations can rapidly deplete and devastate seemingly valuable forests that have a very low growth potential and little ability to recuperate.

The influence of fire is a major ecological problem that has been the topic of much theoretical discussion. Significant impact on the ecological balance can be expected both from an increase in forest fires as well as by an "unnatural" increase in fire protection. The extent of fires, both recent and old, are evident from the maps and area summaries. The maps in conjunction with the descriptive material of Chapter 6 can provide preliminary insight into the effect of fires. Uniform sites, partially traversed by a fire in the past, can be used in this respect to formulate general comparisons between burned and unburned areas.

Each vegetation type has its own characteristic floristic composition of the shrub and lower vegetation layer, described in Chapter 6. For wildlife management, this information provides a means for assessing the food supply and the protection that the various types afford to wildlife, and are being used for habitat mapping. The vegetation maps combined with the wildlife ecology maps could provide a sound factual basis for assessing the impact of human interference on wildlife populations.

During the vegetation mapping one could not help but notice the very significant impact that past seismic line construction has had upon the northern environment. Seismic lines are common and many examples of their effects on vegetation, on changing drainage patterns and in a few cases of serious erosion were evident. Somewhat greater attention should be given to the problems caused by seismic line construction.

Old seismic lines and roadways are excellent locations at which to study the long-term effects of disturbance.

The maps, computer summaries and descriptive material produced during this project form a sound basis for future studies. They can point out many areas of interest and importance and thus direct the researcher to where additional knowledge is desireable and essential. Analyses of the combined input from other groups and disciplines would be useful and in many cases essential.

7/8.3 Reliability of Results

In using the maps produced and in making any analysis of other data presented one should consider the strengths and limitations of this study. The following remarks are accordingly provided:

7/8.3.1 The Classification of Vegetation Types

The vegetation classification was developed following reconnaissance of the northern extremities of the Corridor. It was found that the conditions there differed from those in the south to the extent that it was considered advantageous to obtain for the north a separate system of vegetation-type classification from that previously used in the south. This was done and, after slight revisions following the 1974 field work, the classifications presented in Table 6-1 were adopted.

The classification was developed by personnel with several years experience in photo interpretation, mapping and field checking of forest and wildland conditions in the Yukon and Northwest Territories. The system was found to be eminently practical for operational mapping; cases where vegetation conditions did not fit the system well were rare. But, because of the inferior quality of available air photographs, the interpreters had to rely on landform and topographic position as well as photo tone and texture in type delineation.

7/8.3.2 Aerial Photography

Most of the interpretation and mapping of vegetation was undertaken from existing small-scale photography whose specifications were not oriented toward such a use. Since the quality of the photography was generally uniform, differences in interpretation between various segments of the Corridor are probably not of practical significance.

The photography was fairly recent, panchromatic black and white of mediocre quality. This was to be supplemented by large-scale colour photography taken during the summer of field checking. Though most of the latter photography was ruined because of malfunctioning in the camera, it provided very limited comparative coverage for parts of the Corridor area.

The photo interpretation was done by experienced interpreters who were also involved in the field work and generally a high standard of photo interpretation can be expected.

7/8.3.3 Vegetation Maps

Since the two map scales are small and the vegetation types and type aggregates quite broad there are the usual limitations on precision: small pockets of one type, scattered through a larger type may not be recognized in mapping and any specific point may therefore be misclassified. The maps are not intended for detailed work in critical areas; a larger map scale and additional field checks would be required for such areas.

7/8.3.4 The Statistical Summaries

The statistics on area are subject to only trivial sampling errors when they apply to vegetation types, the total Corridor area, Corridor sections and other major categories. Errors become high for small categories; e.g., any values on "open or improved" are subject to errors that represent a high percentage of the mean value estimated.

CHAPTER 9

IMPLICATIONS AND RECOMMENDATIONS

9.1 General Comments

Throughout the Corridor there are areas of high scenic, wildlife, recreational, or scientific importance that must be conserved. One group of values is due to the potential of the tourist industry and the role of vegetation in meeting recreational needs. At least as important are the scientific values contained in this unique region; Canada has its own scientific interests as well as an international responsibility to conserve and protect such areas. This commitment has been re-emphasized at the United Nations Conference on the Human Environment held recently in Stockholm.

To maintain the foregoing values requires two types of action. The first is for temporary controls of a somewhat arbitrary nature that can be enforced until such time as more comprehensive plans are prepared. This is necessary to prevent the unplanned and uncontrolled exploitation or destruction of any of the areas of value during the critical construction phase for highways or pipelines. The second is for the orderly, long-term management of the resources in the area.

Numerous important recommendations, relating to the use, protection, and conservation of the renewable, land-based resources, in the proposed Mackenzie Valley Corridor, were brought forth in the earlier report "Vegetation Types of the Mackenzie Corridor". Those recommendations cover a wide range of disciplines from pure aesthetics to scientific research. These recommendations apply to the northern portion of the Corridor and they must be considered. They are not repeated here except for specific recommendations concerning forest reserves in the area.

9.2 Forest Reserves

The recommendations place primary emphasis on forested areas, because of their limited extent in the Territories and the anticipated major increase in demand for their utilization that will accompany the opening up of the area by highway and pipeline-construction activities. Apart from the economic value of forest products, which is of major local but not national importance, the forests' other values must be considered. The forests are vitally important because of their aesthetic and scientific value and above all because they are a significant part of the northern ecosystem with important roles as wildlife habitat and ensuring terrain stability and equilibrium in areas of permafrost. Slow growth rates, highly sensitive terrain and inadequate knowledge of forest-regeneration patterns in the north pose special problems.

Forest reserves within the Territories would, in contrast to national parks, normally be managed on a multiple-use basis, providing, where appropriate, timber supplies, wildlife habitats, and recreational facilities. They would be managed and operated on a unit basis. Within each, special areas would be preserved for ecological reserves, and others designated for experimental environmental studies. The early establishment of such forest reserves is imperative, otherwise, the necessary reservations and special regulations related to them cannot be developed prior to highway or pipeline-construction activities.

In all, ten such reserves, totalling approximately 22,000 square miles, were proposed (Figure 9-1). Three of these, Delta Forest, Porcupine Reserve and Firth Reserve, occur wholly or partly within the area covered by this report and are described subsequently.

DELTA FOREST (4,000 square miles)

Location: The southern boundary is at latitude 67°30'N, the northern boundary is at latitude 68°30'N, the western boundary is that between the Yukon and Northwest Territories, and the eastern boundary is the western shore of the middle channel of the Mackenzie River in the Delta. It includes a large island at Point Separation.

Description and Reason for Reservation: This area includes a large portion of the forested alluvial soils in the Mackenzie Delta. The existence of relatively large supplies of merchantable spruce saw timber north of The Arctic Circle is unique. Part of the alluvial spruce area must be preserved, but a substantial portion could be harvested under closely supervised conditions to provide a local supply of timber, while still maintaining suitable game habitats and aesthetic values.

In addition to the alluvial soils in the Delta, the reserve encompasses the Rat River and the upland sites in the Richardson Mountains. High shrub growth is the dominant vegetation at the northern extremity, on sites which would normally support tree growth in the southern part of the Corridor. IBP Site No. 7 in the Rat River area is included.

Quantitative estimates of timber values are available from a reconnaissance timber survey in the 1960's. Information on both non-forested and forested conditions for part of the area is provided by the 1971-1972 surveys.

PORCUPINE RESERVE (600 square miles)

Location: The southern boundary is latitude 67°27'N, the north boundary is at latitude 67°45'N, the eastern boundary is longitude 138°00'W, and the western boundary is longitude 139°30'W.

Description and Reason for Reservation: This forest includes some of the best alluvial timber in the unglaciated area west of the Richardson Mountains and differs appreciably from stands on the east side. The supply of merchantable timber in this area, which is upstream from Old Crow, is relatively limited and close controls are essential.

The Porcupine River bisects the proposed national forest and most of the vegetation types present from the Richardson Mountains to Old Crow are represented within it. Samples of each would constitute several ecological reserves.

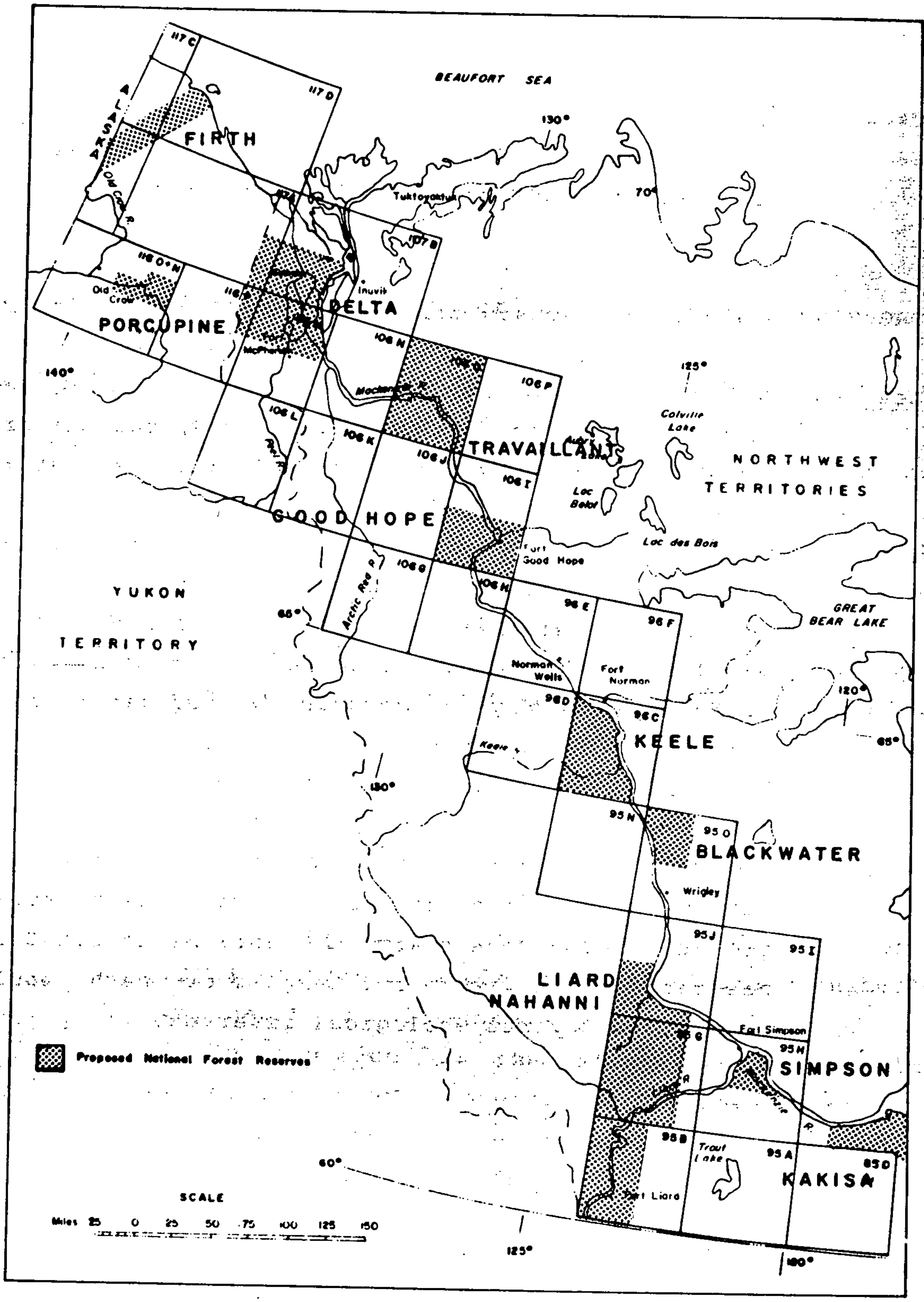

FIGURE 9-1. Index of proposed Forest Reserves.

FIRTH RESERVE (1,200 square miles)

Location: Boundaries are about 10 miles on each side of the Firth River, running from the USA/Canada border in the south to the Beaufort Sea in the north. Southern extremity should join with the proposed IBP or other special areas and connect with the game reserve in the Old Crow Flats, probably following down Timber Creek.

Description and Reason for Reservation:

The Firth River valley is the most northerly part of Canada in which white spruce occurs. However, there is no merchantable timber in the proposed reserve. Its primary value is as a very scenic area of considerable ecological interest. The transition from the Old Crow Flats through the mountain valleys to the coastal plain covers an exceptionally wide range of conditions. It is understood that the area is an important habitat for ungulate populations.

Vegetation maps cover the area between the coast and the foothills of the British Mountains, a width of approximately 15 miles. Unfortunately these maps do not extend farther inland and consequently coverage is lacking for most of the area within this reserve.

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