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GEOLOGIC INTERPRETATIONS AND EVALUATIONS OF THE DEMPSTER HIGHWAY AREA

TERRAIN ANALYSIS AND MAPPING SERVICES LTD.
BOX 158 CARP, ONTARIO

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Terrain Analysis and Mapping Services Ltd.
Box 158, Carp, Ontario

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1.0 EXECUTIVE SUMMARY

Geological maps at a scale of 1:100,000 showing the distribution, morphology and composition of the surface materials of the Dempster Highway study area are presented herein. The surficial geology is described in the text and in the terrain inventory legend.

Suitability maps for the construction of permanent facilities or intensive use of terrain; pipeline construction; construction of temporary facilities or light use of terrain; sewage lagoons and sanitary landfills; and construction materials including workability and usefulness as general fill and source of gravel and sand at a scale of 1:100,000 for the Dempster Highway Corridor are included. In addition, areas of unique geomorphology and geology are identified and briefly evaluated.

Five classifications are established to evaluate the suitability of terrain for a variety of purposes. These classifications are a comment upon the relative amount of terrain modification required to adapt terrain to a specific use or facility, upon the relative amount of effort required to maintain a use or facility, upon the amount of effort required to prevent physical disturbance and deterioration of the immediate environs from a specific use or facility, and upon the amount of preliminary investigations that might be required before a facility or use should be considered or completed. The classification is based on terrain factors that allow any undisturbed terrain type's suitability to be classified in a northern environment frequently characterized by permafrost and periglacial processes. These factors include slope; drainage; flood hazard; permafrost and ice contents; hazards due to mass wastage, fault activity, rock glaciers, etc.; bedrock depth; and material composition and stoniness.

The suitability maps are to be used only as a guide to planning and development in that they outline the major problems

and degree of problems for specific utilization within an area. Site assessment may determine that a site may be more or less suitable for a specific purpose than is defined on the suitability maps because of variability of the properties of terrain types within an area, and limitations of accuracy of the terrain typing, terrain type characterization and suitability evaluation. Accuracy of the suitability maps is limited by the accuracy of the base data or terrain typing and the accuracy of characterizing terrain factors within terrain types.

2.0 INTRODUCTION

2.1 Objectives

The objectives of this study are to prepare surficial geology maps at a scale of 1:100,000 of the Dempster Highway study area; to derive suitability maps at the same scale of terrain in the Dempster Highway Corridor for construction of permanent facilities or intensive use of terrain; pipeline construction; construction of temporary facilities or light use of terrain; sewage lagoons and sanitary landfills; construction materials including workability and usefulness as general fill and source of gravel and sand; and to indicate areas of unique geomorphology and geology. The suitability maps are to be based on evaluations and interpretations of maps of the surficial geology and landforms of the area, and brief field investigations. These maps are to be such that they can be used for planning the use of renewable resources, economic development, land management, and provision of services for recreation and tourism in the Dempster Highway Corridor.

2.2 Regional Setting

Only an outline of physiography, relief, surficial geology and materials is given herein. For a more comprehensive treatment of these subjects one is referred to the terrain inventory legend (Table 2.3), the text on "Detailed Geology and Quaternary History" (Section 2.3), and references concerning these subjects listed in the "Selected Bibliography" (Section 11.0).

2.2.1 Physiography and Relief

The Dempster Highway area includes, from north to south, parts of the Richardson Mountains, Porcupine Plateau, Ogilvie Mountains and Yukon Plateau.

The Richardson Mountains are characterized by moderate to steep slopes and rounded, north-south trending ridge crests, which rise 700 metres above the adjacent Porcupine Plateau. The streams are deeply incised in a rectangular to trellis pattern. At their western edge the mountains become abruptly lower and appear to merge into the Porcupine Plateau: the last row of hills form flatiron-shaped protruberances on the gentle even slope of the Plateau.

The Porcupine Plateau includes the Embankment Hills, Peel Valley, Eagle Plain and an unnamed low rolling area, which parallels the west flank of the Richardson Mountains. The latter area generally has a relief of 100 metres with some ridges rising up to 200 metres higher than the surrounding area. Rivers, arranged in a trellis pattern, cross this area as they flow westward from the Richardson Mountains. Well integrated dendritic drainage pattern with long, broad interfluves is characteristic of the Eagle Plain. The crests of the interfluves are accordant, rounded and rise less than 150 metres above the adjacent streams. Only the Eagle River exhibits a flat-floored valley with steep terraced sides unlike the broad V-shaped valleys of the other streams. To the south of the Eagle Plain, lies the 20 km wide, 200 metre deep flat-floored, steep-sided Peel Valley. In this valley, the northward flowing Blackstone River joins the northeastward flowing Ogilvie River to form the Peel River. To the west of the Peel Valley lie the Embankment Hills, a series of long, curving ridges trending almost north-south. They have steep flanks and rounded, almost flat crests, which stand over 300 metres above the intervening streams: the streams show a trellis drainage pattern.

The Northern, Central and Southern Ogilvie Ranges and the Ogilvie and Taiga Valleys comprise the Ogilvie Mountains. The Northern Ogilvie Ranges are a series of broad, steep-sided ridges, which rise 500 metres above intervening streams: the streams show a trellis drainage pattern. The Central Ogilvies

consist of steep-sided, round-topped east-west trending ridges that are transected by Engineer Creek: total relief is 1,000 metres and streams are arranged in a trellis pattern. The Southern Ogilvies are the most rugged of all the mountain ranges in the area, with jagged crests and steep to precipitous flanked peaks, which rise 1,000 metres above broad, flat-floored valleys: drainage shows a well developed trellis pattern with the North Klondike River and Tombstone and Blackstone Rivers dissecting the ranges completely. The Ogilvie Valley within the area is 8 to 10 km wide, paralleling the Ogilvie Mountains in an east-west orientation, and its floor is flat to undulating: drainage is off the mountains on either side into the Ogilvie River, which generally follows the valley and then turns north out of the valley to flow between the Northern and Central Ogilvie Ranges. The Taiga Valley, lying between the Central and Southern Ogilvie Ranges, is an irregularly shaped area with an undulating surface up to 30 km wide: drainage, principally the Blackstone River and its tributaries, generally flows northward across the valley.

The Yukon Plateau is represented within the area by the Klondike Plateau and the Tintina Trench, which separates the Klondike Plateau from the Ogilvie Mountains. The Klondike Plateau has a gently rolling surface, which is deeply incised by streams, many of which are gold bearing: slopes are steep with narrow valley floors. The Tintina Trench, an extension of the Rocky Mountain Trench, is a 20 - 30 km wide, flat-floored valley, which is inset 500 metres below the surrounding mountains and plateau. The main rivers in this part of the Trench are the Klondike River and its tributaries, the North Klondike River and Flat Creek. These rivers flow in valleys incised 200 metres below the main floor of the Trench.

2.2.2 Surficial Geology and Materials

Most of the study area, including the Porcupine Plateau, the northern part of the Ogilvie Mountains, the extreme

western ridge of the Richardson Mountains and the Yukon Plateau, shows no evidence of having been glaciated. This area has been subjected to weathering and subaerial erosion, which have generated thick accumulations of colluvium, a few bedrock scarps along steep valley and mountain sides, and along the ridge crests in the Northern and Central Ogilvie Ranges and spectacular tors or castellated outcrops, which stand several metres above the surrounding slope.

The composition of the colluvium is variable both areally and with depth as it depends on the composition and texture of the underlying bedrock and on the degree and rate of mass movement. For example, on the Eagle Plain, colluvium derived from a shale is commonly a plastic silty clay with very few small angular plates of shale at the surface, becoming more stoney with depth until it is essentially broken shale bedrock at 10 to 15 metres depth; whereas colluvium derived from an adjacent sandstone bed is a silty sand with angular cobbles and pebbles at the surface grading to broken sandstone bedrock at 2 metres depth. Colluvium is generally thinner and much coarser grained in the Ogilvie Mountains due to the faster rate of mass wasting. As a result, most slopes are mantled by angular pebbles, cobbles and boulders of the local bedrock with little fine material. At the base of all slopes, the surface runoff has deposited accumulations of silt, clay and organic material in alluvial aprons.

If the erosion process continues to its completion, a pediment would form with smooth areas gently sloping down to the major rivers. Pediments formed in the past are represented by smooth, gently sloping areas underlain by a planated rock surface graded to a higher level than that of the present streams and covered by colluvium and gravel.

The glaciers, which formed on the Canadian Shield during the Quaternary Period, only encroached on the extreme north-

eastern part of the area. No evidence exists to suggest that the glacier crossed the last ridge of the Richardson Mountains to reach the Porcupine Plateau. The Laurentide ice deposited small patches of till and erratics in the area it affected.

The southern part of the Ogilvie Mountains has been affected by local valley glaciers at least three times. These glaciations have over-steepened valley walls and produced characteristic U-shaped profiles. Downstream the valley floors are generally covered with morainal and glaciofluvial deposits up to tens of metres thick. Evidence for the oldest recognized glaciation can be found as far north as "Windy Pass" along the Dempster Highway and slightly further north along the Blackstone River: erratic boulders and patches of till, deposited in places on the pediment surface, during the oldest glaciation are found south of these localities. Even older glaciations may have extended beyond this area, but no evidence remains to support this hypothesis. Deposits of old glaciations were identified in the extreme southern part of the area near Flat Creek. Evidence for two younger glaciations occur within the glaciated area. The younger glaciation (McConnell glaciation) is marked by well developed moraines near the mouths of tributary valleys. McConnell, terminal moraines occur in the North Fork Pass area and in the North Klondike valley near Tombstone campsite. The older glaciation (Reid glaciation) is marked by terminal moraines in the Chapman Lake area and along the sides of the North Klondike Valley at its juncture with the Tintina Trench along the Dempster Highway as the glaciers flowed out of the tributary valleys to form major trunk glaciers.

In valley bottoms, beyond the limits of each glaciation, meltwater from the ablating glaciers deepened the river valleys and deposited glaciofluvial and alluvial deposits. These deposits, mainly terraces, occur along all the major rivers in the area, but are particularly well developed along Engineer Creek and Ogilvie and Peel Rivers. Along the Eagle and Whitestone

Rivers and Canyon Creek terraces were formed by meltwater from the Laurentide Ice sheets. Terrace altitudes were in part controlled by the formation of lakes in the Old Crow and Bell Basins and by damming of the present drainage by the Laurentide Ice. Tectonic movements have also altered the elevation of some of these terraces, particularly the oldest ones, and made them difficult to correlate.

Peat and fine grained alluvium accumulated on many terraces during postglacial time; the peat is thickest on the second terrace level along Engineer Creek. In places, wind erosion from unvegetated areas produced deposits of silt, which is thickest in the Tintina Trench where several metres of silt occur on the pediment and the oldest glacial deposits.

Mass wasting and stream erosion have also affected the area, formed alluvial fans and aprons along the sides of valleys and caused the development of many landslides. The landslides vary from skin flows and retrogressive-thaw flow slides to large, deep-seated rotational slumps, best seen along the edges of the Flat Creek Beds. Rock glaciers have formed both in the debris in abandonned cirques and in old slumps in the Ogilvie Mountains; many can be seen along the North Klondike valley from the Dempster Highway.

Permafrost occurs throughout the region except perhaps in the southern part under steep south-facing slopes and the major rivers and lakes. Medium to high ground-ice contents are common at concave breaks in slope and in poorly drained areas underlain by fine-grained sediments. Thermokarst has contributed to the hummocky topography of the end moraines, particularly in the vicinity of Chapman Lake.

2.3 Detailed Geology and Quaternary History

The map units discussed herein and shown on maps 2.1-2.7 are described in the Terrain Inventory Legend (Table 2.3)

with respect to their nature and thickness, distribution and stratigraphy, geomorphology and drainage, permafrost and ice content, and other engineering characteristics. This section will describe in detail the Quaternary geology of each map area and explain the events and processes that produced the surficial geology as shown on maps 2.1-2.7. Specific reference will be made to key localities and sections observed in the field; many of these are indicated on the Unique Features maps 10.1-10.7. To avoid repetitious descriptions of the major features and events, they will be described in one section where most pertinent, and cross-referenced in other sections.

2.3.1 Yukon Plateau - Map 2.1

The Yukon Plateau is represented within map 2.1 by the Klondike Plateau and the Tintina Trench.

The Klondike Plateau is composed of several broad round-topped ridges separated by narrow valleys. The highest point of the Plateau in the map area is Mount Leotta (960 metres altitude). Streams flow in narrow, steep-sided, V-shaped valleys up to 200 metres deep. The edge of the Plateau is marked by a steep 450 metre slope down to the Klondike River and Flat Creek in the Tintina Trench. The area is underlain by the Nasina "Series" comprising low-rank metamorphosed sedimentary rocks, mainly micaceous quartzites, schists and gneisses of uncertain age. In places these rocks are overlain by Tertiary volcanics and sediments.

The Tintina Trench comprises a flat mesa and the broad valley of the Klondike River to its north. The altitude of the top of the flat mesa is 640 metres and of the floor of the Klondike valley, 533 metres. Drainage on the mesa is in a trellis pattern with steep-sided gullies flowing into northward flowing tributaries to the Klondike River. The area is underlain by Tertiary and Quaternary sediments, the former being exposed in the scarps that bound the mesa where they are generally referred

to as the Flat Creek Beds and are composed of well stratified, well sorted, sericitic, fine to medium sand and silt overlain by gravel: they are underlain by Ordovician to Silurian chert and argillite, which outcrop in the northeast part of the mesa.

Remnants of a late Tertiary pediment occur in the Klondike Plateau area as smooth, gently sloping areas near the crests of the mountains. The pediment was probably formed penecontemporaneously with the deposition of the White Channel Gravels, which underlie the highest terraces along Hunker Creek and other creeks to the west of the map area. The exact age of the White Channel Gravels is unknown, but has been ascribed to the Pliocene; the pediment was formed during the late Tertiary or early Pleistocene (Sections: 2.3.2 and 2.3.6).

Prior to any glaciation, the Klondike River flowed southeast to the Stewart River with a drainage divide being just east of the mouth of Hunker Creek. The earliest glaciation formed piedmont glaciers in the Tintina Trench and reversed the flow of the Klondike to its present configuration. The Flat Creek Beds have been interpreted as glaciofluvial gravels overlying glaciolacustrine silts and sands, which were deposited during this glacial event, but it appears more likely that the sericitic sands and silts are Tertiary and relate to the sericitic White Channel Gravels (Pliocene) and that the upper gravels are of Pleistocene age and relate to this glacial event. The top of the Flat Creek Beds appears to be aligned with the top of the Klondike Gravels, which occur on terraces overlying or, in places, near the mouths of creeks, interbedded with the uppermost part of the White Channel Gravels. Moreover, both the Flat Creek Bed gravels and Klondike Gravels contain clasts derived from the Ogilvie Mountains (unlike the underlying units). On the basis of this, the Flat Creek Bed gravels and Klondike Gravels are correlated and interpreted as being due to the earliest Pleistocene glaciation. An ash overlying the Klondike Gravels is dated at 1.2 my.

The extent of the earliest glaciation is unknown. The Klondike Plateau was probably never glaciated but one or more of the earliest glaciations may have flowed down the Tintina Trench. The only evidence of the extent of the earliest glaciation is an exposure of till in a borrow pit at the intersection of the old and new Klondike Highways (Map 10.1). At this location the sequence from top to bottom is: 2 metres well stratified, well rounded gravel and sand; 7 metres silty diamicton; 11 metres well stratified sandy, pebbly gravel; 2 metres medium to coarse sand. The upper gravel is interpreted as pre-Reid outwash and therefore the diamicton must be a pre-Reid till. The underlying gravel and sand may be outwash from this or an earlier glaciation or may be of lacustrine or glaciolacustrine origin. The sequence has been correlated to the Nansen Drift. Unfortunately the extensive landsliding in this region has made the tracing of units difficult and therefore the stratigraphic relationships are inconclusive without further work. Moreover, the extent of this glaciation is unknown.

A truncated Luvisol, indicative of a warm, subhumid climate with grassland - shrub vegetation has developed at the top of the upper pre-Reid gravels. This was succeeded by a very cold dry period (Reid glacial?) during which frost cracks developed in the soil. Eolian activity filled these frost cracks with sand, produced ventifacts on the surface and deposited a veneer of loess in places during the McConnell glaciation. An Orthic Sombric Brunisol (Brunisol (Eutric)) developed during postglacial time.

Downcutting of the Klondike River and its tributaries occurred between the earliest (Nansen?) and Reid glaciations. Reid and McConnell glaciations caused fluctuations in the regime of the Klondike River and the formation of two major river terraces. The changes in the level of the Klondike River produced several terrace levels along the tributary creeks; on some creeks, particularly along Hunker and Allgold Creeks, mammal bones have been recovered from the terrace gravels during placer mining operations

(Map 10.1). The bones have been dated at 22,000 - 32,000 B.P. and are indicative of a grassland environment. The downcutting of the Klondike River and Flat Creek probably caused the massive, deep-seated, retrogressive landslides along the scarps of the mesa area (Map 10.1), and the smaller slumps on the north side of the Klondike Plateau.

2.3.2 Yukon Plateau and Southern Ogilvie Ranges - Map 2.2

The Yukon Plateau in this map area (Map 2.2) comprises the Klondike Plateau, which is described in Section 2.3.1 and the Tintina Trench. This part of the Tintina Trench is a rolling plain sloping southward from 1000 metres altitude at the edge of the Ogilvie Mountains to 600 metres altitude above the Klondike River, which flows in a 90 metre deep valley inset into the plain. The drainage pattern is subparallel with rivers and streams flowing from the Ogilvie Mountains to the Klondike River: streams become more deeply incised toward the south. The area is probably underlain by Tertiary rocks; however they only outcrop in a few places. They consist of arkosic and micaceous sandstones (occuring near the powerhouse), shale and conglomerate (occuring in the high bluffs east of the North Klondike River along the ditch) and lignite, which was mined at the Gates Mine during the early part of this century (Map 10.2). On the basis of many plant fossil identifications, an Eocene age has been ascribed to these units. Sedimentation was probably continuous throughout most of the late Cretaceous and Tertiary, and rocks both younger and older than Eocene may be present.

The Southern Ogilvie Ranges rise to a maximum altitude of 2193 metres as Tombstone Mountain; the average relief is over 1000 metres. Slopes are steep and mountain crests are sharp and jagged; particularly the Tombstone Range where the towering pinnacles are due to well developed vertical joints in

in igneous intrusive rocks. The drainage is arranged in a trellis pattern; the main rivers being the North Klondike River, O'Brien Creek, and Chandindu River. The valleys are steep sided with wide flat floors and U-shaped profile typical of glaciated valleys. The mountains in this map area have a central core of Jurassic and Cretaceous schists, quartzites, diorites, gabbros and syenites, surrounded by Precambrian to Silurian quartzites, slates, volcanics, cherts and argillites: they have been thrust faulted and folded into their present positions during the Columbian orogeny (Cretaceous). It should be noted that the Tintina Trench is still active as shown by post glacial movement on a fault near the mouth of the North Klondike Valley.

During the Late Tertiary, the area was subjected to subaerial erosion, which formed the general topography of the Ogilvie Mountains and a large pediment surface sloping down to the Klondike River. The pediment is underlain in part by Eocene rocks in this map area, and further north (Section 2.3.3) is overlain by till from the oldest glaciation. Therefore it formed during the late Tertiary. The pediment surface was later dissected in response to the down cutting of the Klondike River by the streams and rivers which now cross it. Some landslides along these streams probably resulted from this dissection.

The extent of the pre-Reid glaciations in this area is unknown; high level gravel terraces which are probably correlative of the outwash overlying the Flat Creek Beds, exist along the north side of the Klondike Valley to the east of the North Klondike. However exposures are poor and till was not identified.

The last two glaciations in this area are well recorded by their deposits and the associated landforms. During these glaciations the glaciers were confined to valleys; flowing from cirques along the interfluves down tributary valleys and, in

places, uniting in the main valley to form a trunk glacier. Cirque ages are already published.

During the older glaciation, the Reid glaciation, glaciers from the Tombstone Mountains (Map 10.2) and from tributary valleys flowed westward down the Tombstone, Little Twelve Mile and Chandindu River valleys to near the mouth of Alder Creek (to the west of the map area 2.2) and eastward down the North Klondike River Valley to about the ditch near the Klondike River. The terminal position is well marked on the west side of the North Klondike River by the extensive area of morainal ridges and steep-sided, flat-floored meltwater channels which parallel the moraines. The glacial limit on the east side of the North Klondike River is less distinct and is marked primarily by the break in slope between the pediment and the North Klondike Valley. The limit is most distinct near the ditch but is obscurred by landsliding on the steep slopes; a small moraine may exist along part of this limit. Outwash was deposited into the Tintina Trench and may have pushed the Klondike River against the south side of its valley; on retreat, the outwash was deposited on the floor of the North Klondike Valley where for the most part it has been covered by later sediments. A similar sequence of events must have occurred in O'Brien Creek; the Reid Limit along the valley sides is marked in a few places by small deposits of drift. The Reid glacier in Antimony Creek did not join the main glacier in the North Klondike Valley, but formed a moraine about half way down the valley.

The McConnell glaciation was not as extensive as the Reid glaciation with the glaciers generally being limited to the tributary valleys and not coallescing to form trunk glaciers. Moreover, not all cirques that nourished the Reid glaciers were active during the McConnell glaciation. Glaciers forming in the Tombstone Mountains flowed westward down the Tombstone and Little Twelve Mile rivers, but did not reach the Chandindu River; ice also flowed eastward from the Tombstone Mountains down the North

Klondike, but built a moraine where the river now turns south near the Tombstone campsite south of North Fork Pass (Map 2.3). Ice flowed down O'Brien Creek to its first major tributary from the west, but was not joined by the glacier in this tributary, which built a moraine several kilometers up its valley. Meltwater from the McConnell galciers, deposited outwash in front of the ice. This outwash is preserved as a low terrace inset into the higher Reid terrace along the present rivers. During all of the glacial periods, eolian activity deposited loess over much of the area, particularly on outwash deposits and on the pediment in the Tintina Trench (Map 10.2).

Periglacial and other subaerial mass wasting processes, both during glacial and non-glacial times has constantly been eroding the land surface, in places producing thick accumulations of colluvium. Most notable are the landslides which are post-Reid in age along the North Klondike River. The initial unstable conditions probably were caused by over-steepening of the valley walls by the Reid glacier. Rock glaciers have formed in these landslide deposits and are presently active; other rock glaciers are active in cirques of the former glaciers. Streams flowing from tributary valley have formed alluvial fans along the sides of the main valley. Well developed fans along the North Klondike and O'Brien valleys inset into older fans, presumably relate to different glacial - non-glacial events.

2.3.3 Southern Ogilvie Ranges and Taiga Valley - Map 2.3

This part of the Southern Ogilvie Ranges reach a maximum altitude of 2130 metres southeast of North Fork Pass; however most of the peaks are over 1800 metres. The major valley floors lie below 1250 metres and are arranged in a rectangular pattern. Mountain peaks are sharp, slopes are steep, and valley floors are broad and flat as a result of glaciation. The main rivers of the area are the northward flowing East Blackstone, Blackstone, and West Hart Rivers and Lomond Creek, a

tributary to the West Hart. North Fork Pass is the divide along the highway between Peel River drainage (to the Arctic Ocean) and the Yukon River drainage (to the Bering Sea). The Southern Ogilvie Ranges consist mainly of Precambrian or Cambrian quartzites, slates, schists and volcanics, Ordovician chert and argillite and Devonian to Permian slate, limestone and chert.

The Taiga Valley is a gently rolling area with up to 100 metres relief, and lies between the Southern and Central Ogilvie Ranges. The latter ranges occur in the extreme northeastern part of this map area, are described in Section 2.3.4. The Taiga Valley is underlain by poorly resistant late Paleozoic rocks, which rarely crop out in the area. Most relief may be attributed to glacial landforms.

Since the deposition and final uplift of the Ogilvie Mountains, the area has primarily been affected by sub-aerial erosion. This has resulted in the formation of a gently northward sloping pediment. This surface, which probably formed during the early Tertiary (Section 2.3.2), has been dissected by streams and glaciers, such that only remnants of the original surface remain (see also Section 2.3.6).

Patches of till beyond the Reid glacial limit are evidence of pre-Reid glaciations. These are located mainly in the northwest section of the map area where isolated patches of hummocky till occur on the pediment surface. Other occurrences of till, just beyond the Reid limit, have also been ascribed to the pre-Reid advance. Similarly in the northwest part of the map area occurrences of till beyond the limit of Reid glaciation in Lomond Lake valley and in the next major valley to the northeast exist. Moreover till also occurs above the Reid limit in the areas between the Blackstone and the East Blackstone Rivers and to the east of the East Blackstone. Erratic boulders were located up to altitudes of 1525 metres, 4 km northwest of Chapman Lake, and up to 100 metres above Reid Limit along the East Blackstone River valley. From the

preceding distribution of till and erratics it can be concluded that the pre-Reid glaciation was more extensive than the Reid glaciation, and generally followed the same pattern of ice flow and deglaciation. At its maximum extent ice filled the major valleys at least 100 metres higher than and extended further north than the Reid. Only at one location (Map 10.3) within the Reid glacial limit along the East Blackstone River was pre-Reid till identified. From top to bottom the section is: 6 metres of grey, sandy Reid till; 2 metres of interbedded coarse sand and pebble gravel; 4 metres clayey silt with rounded pebbles; 3 metres of interbedded sand and cobble gravel; 5 metres of slumped section; 5 metres of grey, clayey till. The intervening stratified sediments may be either outwash or alluvial plain sediments. Even though the pre-Reid glacial deposits are mapped and described as being attributable to one event, the possibility exists that more than one pre-Reid glaciation locally occurred and that the deposits may be the result of more than one glaciation. Furthermore, it is difficult to correlate local deposits with the glaciations south of the Ogilvie Mountains (Nansen or Klaza) with the present, limited knowledge.

Reid glaciation is marked by major valley glaciers flowing from cirques in the Southern Ogilvie Ranges, northward down the Blackstone and East Blackstone Rivers, eastwards down the West Hart River, and northwestward along the unnamed valley north of Lomond Creek. The moraines built at the limit of the glacial advance are distinct, particularly in the Chapman Lake area, north of the Blackstone River and east of the East Blackstone River. Correlation of the moraines, can be difficult due to the different altitudes at which they are located. Moraines at different altitude have been explained by two pulses of the same major glaciation or have been, in part, correlated to Reid, with the remainder designated as being of uncertain age. Part of the problem is the moraines have been correlated on the basis of morphology, a technique considered by some as being invalid in

this area. The extent of thermokarst development on the moraines was also not found to be age related. Radiocarbon dates on basal peats in thermokarst areas are from 3,000 B.P. to 13,870 B.P. and probably reflect the age of the thermokarst, rather than the age of the underlying material. During deglaciation, meltwater deposited glaciofluvial gravels along the major valleys.

The McConnell glaciation was much less extensive than the earlier glaciations; terminal moraines occur near the mouths of the tributary valleys; the most spectacular being the "hammer-head" moraines developed in North Fork Pass (Map 10.3). Not all cirques that supplied the glaciers for the Reid glaciation were active during the McConnell. During retreat of the McConnell glaciers, meltwater deposited outwash terraces set into the Reid terraces. The McConnell terraces were later incised by the present streams such that they are the first major terrace above the present flood plain.

Lakes formed in some areas behind dams of morainal debris deposited during a glaciation. In most cases these lakes were short lived as the outlet streams cut down through the dams; in other places, for instance in the headwaters of the Blackstone River, the lake dammed behind the McConnell moraine lasted sufficiently long to deposit a substantial thickness of material. During and immediately following each glaciation, eolian activity deposited thin loess over deposits on the valley floors.

The modern processes of erosion include mass wasting and alluviation. Active layer detachment slides and retrogressive-thaw flow slides are common on glacial deposits; solifluction, creep and frost shattering of rock occur on all slopes. Some low slopes along the banks of the Blackstone and East Blackstone rivers have been attributed to solifluction. Rock glaciers are common in cirques in the southern part of the map area, but are rare in the northern part. Alluviation has produced fan and apron deposits at the base of most valley walls; alluvial

plains occur along the largest rivers. River icings are formed on a number of rivers in the area, notably the North Klondike and the East Blackstone (before it enters North Fork Pass). Other river icings on smaller streams may be up to several metres thick and be visible until August (Map 10.3).

Permafrost is evident because of the extensive thermokarst and ice-wedges developed on many glacial deposits. Several closed-system pingos occur on the low alluvial terraces along the Blackstone River valley to the west of Chapman Lake; the surface aquatic peat (formed before the pingo) has been dated at 5820 $\pm$ 90 B.P.. Palsen which are indicative of the ice-rich materials, have developed on the poorly drained area within the North Fork Moraines.

2.3.4 Central and Northern Ogilvie Ranges, and Ogilvie and Taiga Valleys - Map 2.4

In this map area, the Central Ogilvie Ranges are divided into two parts by the Ogilvie Valley. The narrow, rounded mountain peaks become progressively lower from 1875 metres northeast of Chapman Lake (Map 2.3) to 1075 metres to the north of this map area. The mountains have been dissected by major rivers, namely Engineer Creek and the Ogilvie and Blackstone Rivers, which flow northward in wide valleys. The tributary streams flow in narrow, steep-sided valleys arranged in a radial pattern around the main mountain crests. The mountains are composed of deformed Precambrian argillites and quartzites, and Cambrian to Devonian limestones, dolomites and shales.

The Northern Ogilvie Ranges, in the northwest corner of the map area, are separated from the Central Ogilvie Ranges by the Ogilvie River to the east and the Ogilvie Valley to the south. They attain the maximum altitude of 1350 metres on Mount Jeckell, but most peaks are less than 1200 metres. Broad,

rounded ridge crests, steep flanks and narrow valleys are typical of this area. The drainage pattern is mainly trellis with the main streams flowing in broad, steep-sided valleys. The area is underlain by folded and faulted Silurian to Carboniferous limestones, dolomites, shales and cherts.

The Ogilvie Valley is a broad, gently undulating area with average altitude of 750 metres and up to 100 metres of relief, mainly due to the incision of the Ogilvie River. The Ogilvie River drains most of the valley and flows from west to east in western part of the map area and then turns north between the North and Central Ogilvie Ranges. The Ogilvie River, to the west of the map area follows the Ogilvie Valley, but just before it enters the map area makes a sharp turn to the south into the Central Ogilvie Ranges. Within the Central Ogilvie Ranges it is joined by a major tributary from the west and flows northward through a series of spectacular incised meanders back to the Ogilvie Valley at a point 2.5 km east of where it turned south. The Ogilvie River then flows eastward along the north side of its valley. Although the area has never been glaciated, the Ogilvie River has acted as a spillway for meltwater from glaciers in the Nahoni and Southern Ogilvie Ranges to the west. It is believed that the erratic flow pattern described above is due mainly to stream capture caused by downcutting of various tributaries during the glacial periods because the incised meanders appear to have been very recently cut as compared to the rest of the Ogilvie River valley. The Ogilvie Valley is underlain by Cambrian to Devonian limestones, dolomites and shales, which have been folded into a broad syncline and later faulted.

The Taiga Valley, occurring in the southwest corner of the map area, is a gently rolling area of less than 100 metres relief. The drainage is dendritic with streams flowing in broad U-shaped valleys with low sloping sides. It is underlain by Cambrian to Devonian limestones, dolomites and shales of low resistance to erosion.

The area has undergone continuous subaerial erosion since the mountains were upthrust during the Laramide orogeny during the Cretaceous to Early Tertiary. This has resulted in thick accumulations of colluvium on most slopes. Bedrock exposures are common with only the most resistant limestones and dolomites outcropping in steep slopes and on ridge crests as tors and castellated outcrops. A gently sloping pediment occurs on most interfluves at levels higher than the alluvial terraces. The age of the pediment is late Tertiary (Section 2.3.2); its genesis is described in Section 2.3.6.

The area has only been glaciated in the extreme southeast part of the map area where pre-Reid glaciers forming in the cirques to the east of the Blackstone River flowed down and across the Blackstone valley and into the low area west of the Blackstone; this ice flow may have been joined by ice flowing down the Blackstone from Chapman Lake (to the south); however the valley near the southern limit of this map area is narrow and would restrict flow. The glaciers deposited patches of hummocky drift to the west of the Blackstone River and built a terminal moraine which now forms the drainage divide between the Blackstone River and Engineer Creek at "Windy Pass" (Map 10.4).

Reid glaciers formed in the cirques to the east of the Blackstone River, but they do not appear to have flowed further west than the present position of the Blackstone. Deposits of Reid drift occur in the eastern bluffs along Blackstone River and in patches up the tributary valleys.

The McConnell glaciation was not very extensive in this map area: glaciers formed in only a few of the Reid cirques and extended only 2 - 4 metres down the valleys.

Meltwater deposited outwash beyond the limit of the pre-Reid glaciation, particularly along the Blackstone River

and in the headwaters of Engineer Creek. These deposits have since been dissected by rivers, and now occur as high terrace deposits. Lower terraces standing above the flood plain at similar levels to terraces formed during the Reid and McConnell glaciation in glaciated areas have been correlated with the glacial terraces. The lowest (McConnell) terrace is only 1 - 3 metres above the present flood plain; the intermediate (Reid) terrace is several (2 - 7) metres higher than the lowest. The oldest (pre-Reid) terrace is much higher (up to 40 metres) than the Reid and is only a few metres below the pediment in some places.

The pre-Reid glacier which built the "Windy Pass" moraine was the only glacier to cross the divide there and deposit outwash down Engineer Creek. Erratics from this outwash occur on lower terrace deposits, and indicate that the terraces are formed of reworked material from high terraces. The Reid terrace in Engineer Creek is characterized by a thick (3 metres) accumulation of peat. Wood from the base of a 3 metre thick frozen peat exposure at the side of the Dempster Highway gave an age of 4630 $\pm$ 130 B.P. indicating that the peat accumulation postdates glaciation and particularly the terrace on which it is formed.

Recent geological processes include solifluction, creep and active layer detachment slides, which occur mainly on shales; good examples of active layer detachment slides occur along Engineer Creek, particularly where the slopes are very steep (Map 10.4). Alluviation has formed alluvial fans and aprons along most valley walls; alluvial plains occur along most of the major rivers and creeks. On the smaller creeks, the stream channel only contains water during peak flow periods; through much of the year the river flows through its coarse bed (Map 2.3.4).

Of special interest are the geothermal springs that occur along the Dempster Highway in Engineer Creek (Map 10.4). They are highly sulphurous, and flow at a constant temperature year-round; the temperature is cool since they flow through perma-

frost. In the vicinity of the springs many terrace gravels are poorly cemented with rotten erratic clasts; this is probably an effect of the geothermal water, and is not related to the age of the material.

2.3.5 Central and Northern Ogilvie Ranges and Porcupine Plateau - Map 2.5

The Central Ogilvie Ranges, occurring in the southeastern part of this map area, reach a maximum altitude of 1570 metres at Mount Cronkhite; the peaks become lower toward the northwest, reaching 1070 metres to 1280 metres in the last series of ridges. The mountains have rounded crests and steep flanks, which descend to narrow valleys. The drainage is in a trellis pattern with streams flowing away from the centre of the range to the surrounding rivers. The mountains are formed of highly deformed Cambrian to Carboniferous shales, limestones and dolostones and Permian limestones, sandstones and conglomerates.

The Northern Ogilvie Ranges, limited to the southwest corner of the map area, are separated from the Central Ogilvie Ranges by the Ogilvie River and are bounded on the north by the Porcupine Plateau. This is only the eastern extremity of this range and as such they only rise to 875 metres. Narrow steep-sided valleys are arranged in a trellis pattern; the ridge crests are broad and rounded. The underlying bedrock is composed of highly deformed Devonian to Carboniferous shales, limestones and dolomites.

The Porcupine Plateau comprises the Embankment Hills, the Eagle Plain and the Peel Valley.

The Embankment Hills rise to a maximum altitude of 1070 metres, with most of the ridge crests being only slightly lower. The ridges are long, very broad and round with moderately steep slopes. The streams are arranged in a trellis pattern in broad valleys and flow northward into the Whitestone, except along

the slope beside the Peel Valley; this first ridge marks the drainage divide between the Mackenzie - Peel (Arctic Ocean) and Yukon (Bering Sea) drainage basins. The area is underlain by gently folded Upper Cretaceous sandstones, siltstones and shales.

The Eagle Plain occupies the northern part of the map area with ridge crests attaining a maximum altitude of 925 metres along the edge of the Peel Valley and becoming lower to the north. Broad round ridge crests and broad shallow valleys give a local relief of less than 100 metres. The drainage pattern is dendritic. Gently folded Upper Cretaceous sandstones, siltstones and shales underlie the area.

The broad flat-floored (500 metre altitude) Peel Valley lies between the Eagle Plain and the Ogilvie Mountains. The Ogilvie River flows westward along the northern edge of the valley floor; parallel tributaries join it from the south. The Ogilvie joins the Blackstone River to become the Peel River near the eastern edge of the map area. The Peel Valley is underlain by Lower Cretaceous argillites, and Permian limestones and sandstones.

This area has been affected by the processes of subaerial erosion and alluviation since its tectonic origin. In general this has resulted in the accumulation of thick colluvial deposits on ridge crests and slopes and alluvial aprons and fans in the valley bottoms. Bedrock outcrops are restricted to the most resistant lithologies and occur as scarps or as tors or castellated outcrops on the ridge crests. In places, groundwater dissolution has eroded some of the limestone units producing caves (Map 10.5) and collapse features (east of the map area).

The long period of subaerial erosion has resulted in the formation of a pediment, which occurs along all the major rivers and streams, but is best developed in the Peel Valley. The pediment is a flat to gently sloping rock surface covered with over

3 metres of silt colluvium. The colluvium appears to have been affected by thermokarst, as the surface of the colluvial plain is pitted by inactive thermokarst depressions. The pediment is of late Tertiary age (Section 2.3.2).

In the Peel Valley, a high terrace stands well above the present Ogilvie River, slightly below but distinguishable from the pediment. Typically it is underlain by 10 - 15 metres of locally derived gravels overlain by 5 metres of silt and 1 - 2 metres of peat. The surface shows a mottled pattern caused by thermokarst activity, stream dissection and colluviation. At one location (Map 10.5) a section contained from top to bottom: surface peat; 4 metres silt with many peaty layers; 0.5 metres silt with a lens of volcanic ash and ice layers; 1.5 metres organic silts containing four truncated ice wedges; 8.5 metres covered; gravel; rock. The truncated ice wedges, are probably of McConnell age: modern ice wedges were noted in a section that terminated in the surface peat. The ash is equivalent to one of the Old Crow tephras; one of which has been dated at greater than 50,000 B.P. The silts are interpreted as loess and re-worked loess; the terrace itself, as being a preglacial feature (see section 2.3.6).

The area was not glaciated during the Pleistocene, however terraces were formed along the main rivers in response to the effects of the glaciers, which were present in adjacent regions. In general the Peel River was an outlet for meltwater from the glaciers that formed in the headwaters of the Ogilvie and Blackstone River systems, and terraces are present that probably equate to the Reid and McConnell glaciations.

At its maximum extent during the Illinoian or early Wisconsin, Laurentide ice advanced to within 50 km of the eastern edge of the map area, damming the Peel River and diverting its flow into the Eagle River via a spillway now occupied by "Palmer", Davis and Moose Lakes and Canyon Creek (Map 10.6). Similarly, the drainage was diverted during the Wisconsin glacia-

tion. Two well developed terraces along the Ogilvie, Blackstone and Peel Rivers, the lower being more of a terrace-complex, reflect these changes in discharge. The higher terrace, presumed to be of Illinoian or Early Wisconsin age, occurs 5 - 10 metres above river level, and is characterized by thick peat over thin gravel accumulation on the rock benches. The lower terrace, presumed to be of late Wisconsin age is relatively free of peat, being mainly composed of gravel. This terrace occurs 2 - 5 metres above the present river level, and appears to comprise several levels, which in places merge together. At some stream junctions, the lower terrace may merge into the higher terrace.

The history of the Whitestone drainage system, in the northwest part of the map area is related to the history of the Bell and Old Crow Basins and Porcupine Rivers into which it flows. Tertiary or early Pleistocene downwarping produced the Bell and Old Crow Basins which drained to the east via McDougall Pass. Illinoian or early Wisconsin Laurentide ice apparently dammed this outlet and caused the formation of the large glacial lake, which drained to the west. Readvance of the Laurentide Ice during the late Wisconsin, reformed the glacial lake as before. However, as the western outlet was eroded below the level of McDougall Pass during the late part of this phase, the drainage of the basin remained westward after retreat of the Laurentide Ice.

Three terrace levels occur along the tributaries to the Whitestone River. The high terrace is just below the pediment level and is presumed to be of preglacial origin (see Section 2.3.6). It exhibits a mottled surface caused by thermokarst and mass wastage similar to the high terrace in the Peel Valley. The two low level terraces are covered by up to 2 metres of peat overlying silt and organic silts. At one location (Map 10.5) the silts overlie 2 metres of sphagnum peat. The two lower terraces are correlated with glacial terraces to the south; the upper being Illinoian or early Wisconsin (Reid?) in age and the lower being late Wisconsin in age.

Presently active processes in the area are alluviation and colluviation. Weathering, frost shattering and creep have produced thick accumulations of colluvium on ridge crests and slopes; alluvial aprons and fans occur at the foot of slopes along creeks and gullies in most valleys. Many terraces are overlain by 1 - 3 metres of colluvial and fine grained alluvial fan deposits. Organic material at the base of these deposits have been dated at 6600 to 7490 B.P. It appears that a period of alluvial fan and colluvium formation commenced at about this time, probably because of climatic changes. The pollen stratigraphy in adjacent areas indicates a minor climatic change about this time.

The properties of the colluvium are dependant on those of the underlying bedrock from which it is derived. Certain lithologies, mainly Carboniferous (Hart River Formation) and Upper Cretaceous (Eagle Plain Formation) shales, have produced colluvium that on thawing becomes very unstable as it has very little shear strength. Terrain underlain by these lithologies may be identified by abundant small landslides and slump scars, which occur along creeks and gullies.

2.3.6 Porcupine Plateau and Richardson Mountains - Map 2.6

The Porcupine Plateau comprises the Eagle Plain and an unnamed area to the east between the Eagle Plain and the Richardson Mountains.

This map area includes the southeastern extremity of the Eagle Plain, which has up to 450 metres of relief and reaches a maximum altitude of 900 metres in the area southeast of the Dempster Highway. The area to the northwest of the highway is more typical of the Eagle Plain, having less than 300 metres of relief and an average altitude of 450 metres. The well developed dendritic drainage pattern is formed by streams flowing in broad valleys separated by broad rounded ridges. The area is underlain by

Cretaceous sandstones, shales and limestones, and Devonian sandstones and shales.

The unnamed unit between the Eagle Plain and the Richardson Mountains, is a broad low lying area with north-south oriented, elongated ridges. The relief of the area is 200 metres, and has a maximum altitude of 600 metres. Streams flow from the Richardsons westward in a trellis drainage pattern. The underlying bedrock marks the first exposed belt of folded and faulted rocks of the Richardson Mountains and comprises Devonian shales, sandstones and siltstones.

Only the westernmost range of the Richardson Mountains occurs in the map area. They attain a maximum altitude of 1175 metres, but summits become lower toward the south and reach only 950 metres altitude. Drainage is away from the central ridge to the sides in a trellis pattern; only one stream, Canyon Creek, crosses the axis of the mountains. The mountain tops are broad and flat to rounded, slopes are steep, and gullies are narrow. The valley to the east of main ridge is broad. The mountains are formed of the Upper Cambrain to Lower Devonian (Road River Formation) shale.

Colluviation and alluviation are the processes that have formed this landscape after tectonism (Laramide orogeny) folded the rocks to their present structure. The depth of weathering and weathering products vary significantly and depends on the parent lithology. Up to 10 - 15 metres of silty clay with pebble-sized shards overlie shale lithologies whereas 2 metres of silty sand with abundant angular pebbles and cobbles overlie sandstone units; conglomerate units weather to silty clay with rounded pebbles. The mechanical properties of the unfrozen colluvium is also quite variable; the sandstone derived colluvium is quite stable with significant strength; the shale derived colluvium is unstable and has very low shear strength as indicated by the numerous landslides in these units. Ice contents of the colluvial

deposits are quite variable depending on slope and lithology throughout the area. Many winter roads, airstrips, drilling sites, and seismic lines used during the petroleum exploration during the 1950's are still quite visible today, and show for the most part very little degredation of the permafrost or ground subsidence, except along roads where the surface peat was disturbed or stripped. In such disturbed areas the road may have subsided 1 - 2 metres below the surrounding terrain. Thermal degradation or stripping of peat may also lead to channelling of surface runoff and development of 1 - 2 metres deep gullies. Subsidence on upland drill sites, airstrips and seismic lines was generally minimal.

The pediment which has formed throughout the unglaciated parts of the Yukon is extensive and well developed in this map area. It occurs as a gently sloping high bench along valley sides and in places may form the top of the ridge. It is overlain by fine grained colluvium and mantled by up to one metre of peat. Pediment surfaces in the Old Crow Basin have a layer of gravel between the rock surface and the colluvium or peat in places; this stratigraphy was not exposed in this area, but exposures of the lower pediment materials are very rare. Pediments form in semi-arid climates by the parallel retreat of escarpments; this process involves erosion of the escarpment by weathering, mass movement and basal sapping, and transport of the eroded material across the pediment surface by creep and sheetwash. No evidence was found in this or adjacent areas to validate or negate this proposed origin for these surfaces. The pediment probably formed during the late Tertiary as the pediment is formed on Tertiary rocks (Eocene?) in the Tintina Trench, just west of the North Klondike Valley (Section 2.3.2) and is overlain northwest of Chapman Lake by pre-Reid glacial deposits and near Mount Klotz by pre-Classical Wisconsin or older Laurentide glacial deposits. Moreover meltwater from the earliest glaciation has cut terraces below the pediment surface.

Along many streams, high terraces are present that are just slightly inset into the surface of the pediment; in places it is difficult to separate the two features. The high terraces are characterized by a gently undulating surface, which appears to have been formed by gullying, thermokarst activity and other periglacial processes. Exotic lithologies do not occur in gravels on the high terraces so they were formed before the maximum extent of Laurentide glaciation. The high terraces have been incised by diverted streams and meltwater, which flowed down the Eagle River and a few of its tributaries when the Laurentide glaciers were at their limit during early Wisconsin or Illinoian. The high terraces extend downstream to underlie or merge with glacio-lacustrine and nonglacial sediments in the Bell Basin; the oldest sediments in this sequence are believed to have been deposited prior to 75,000 B.P.

During the early Wisconsin or Illinoian, Laurentide Ice flowing down the Mackenzie Valley to the Beaufort Sea impinged on the eastern side of the Richardson Mountains, flowed westward into the Bonnet Plume Basin and dammed the Peel River, diverting its water down the Eagle River via Canyon Creek, and the "Palmer", Davis and Moose Lake valleys (Map 10.6). The two low terraces present within most stream valleys within 15 metres of stream level are a reflection of this and similar later events. Along the Eagle River and some of its tributaries, the upper terrace may be higher than 15 metres above stream level because of major stream dissection in late Wisconsin and postglacial time. The upper terrace generally has thick organic silts and peat overlying gravel and bedrock, and its formation and gravel deposition is tentatively correlated with the Reid glaciation. The lower terrace lies only a few metres above adjacent flood plains and commonly grades into them. Peat and organic silt deposits on the lower terrace are generally much thinner than on higher terraces, and it is believed to have formed during and immediately following the late Wisconsin, the last major glaciation to affect this area through diversion of melt-water down the Eagle River. Along the Eagle River, some terraces

that formed during the late Wisconsin may stand at higher elevations than previously indicated because of rapid postglacial downcutting of the Porcupine River and its tributaries shortly after 13,000 B.P.

At present, stream erosion, alluvial fan and apron deposition, thermokarst and active layer failures are the obvious active processes in the lowlands; solifluction, frost creep, congeliturbation and isolated rockfalls are continuously affecting the slopes and upland areas.

2.3.7 Porcupine Plateau and Richardson Mountains - Map 2.7

The Porcupine Plateau comprises the Eagle Plain and an unnamed area to the east.

The Eagle Plain is gently rolling area attaining a maximum altitude of 925 metres in the southwestern part of the map area and becoming progressively lower toward the north where the highlands reach 450 metres. Broad rounded ridge crests with gentle slopes forming broad valleys give the area local relief of 100 to 200 metres. Streams show a well developed dendritic drainage pattern and flow northwestward into the Eagle River and ultimately to the Porcupine River. The area is underlain by Devonian shale and sandstone, Carboniferous conglomerates, sandstones and shales, and Cretaceous shale.

The unnamed area east of the Eagle Plain, parallels the edge of the Richardson Mountains and comprises the westernmost zone of rocks deformed by tectonic events that formed the Richardson Mountains. The area is composed of a series of hogback to elongated ridges which rise 100 metres above the general slope of the Eagle Plain, which rises toward the Richardson Mountains. Drainage is westward across this area from the Richardson Mountains, in a pattern that is basically dendritic, but becomes trellis as

the effect of bedrock structure becomes more pronounced. The area is underlain by Devonian to Carboniferous shales, sandstones and siltstones.

This map area encompasses part of the first main ridge and valley of the Richardson Mountains. The ridge has a broad, round to flat crest with steep sides. Numerous steep sided gullies which feed into low gradient, flat floored streams, have formed on the slopes. The drainage pattern is trellis with only a few of the streams completely dissecting the ridge. The major valley which lies to the east of the ridge has a broad, gently undulating floor across which streams flow both east (Vittrekwa and Road Rivers) and west (tributaries to the Rock River). The floor of the valley is at an altitude of 760 metres in the north part of the map area, and becomes higher (900 metres) toward the south. The ridge crest is relatively constant in altitude from 1100 to 1200 metres. The mountains are underlain by Cambrian to Devonian shales, sandstones and conglomerates in the southern two-thirds and by Devonian sandstones and shales, and Cretaceous and Jurassic sandstones and shales in the northen part.

Within this area, as throughout the Yukon Territory a high erosion surface or pediment stands well above present streams and their associated terraces. The pediment is best preserved on the Eagle Plain, where it occurs as a gently sloping surface just below or forming the crests of the interfluves. The pediment surface generally rises toward the Richardson Mountains, and occurs within the mountains along the major rivers. Pediments form by the parallel retreat of scarps in a semi-arid environment with the material being eroded from the scarp and transported across the pediment. No evidence was found to confirm or disprove this mode of origin for the pediments in this area. It should be noted that the scarps in this area are formed in Tuttle Formation (Carboniferous), and probably owe their position more to the resistance of this rock unit than to the formation of the pediment. The age of the pediment is probably late Tertiary (see Section 2.3.2).

Along many of the streams, the high terraces that are slightly inset into the pediment are present and are similar in composition and genesis as those described in Section 2.3.6. During the Illinoian or early Wisconsin, Laurentide Ice flowing down the Mackenzie Valley flowed into the Richardson Mountains in the valley of Vittrekwa River and deposited till. The limit of the glaciation is not marked by moraines but by the limit of glacial erratics principally granites, white sandstone and Rapitan conglomeratic mudstone: possibly a glacial lake was dammed between the mountains and the ice and some of the erratics were deposited by floating ice. Meltwater flowed across the divide and down the northern tributary of the Rock River, incising the river channel and forming low level terraces. Low level terraces on other creeks in the map area are related to events in the Eagle River as described in Section 2.3.6.

During the Pleistocene, periglacial processes have affected much of the terrain. Sporadic solifluction and frost creep have probably moved large volumes of surficial materials down slope. At present, solifluction lobes occur only locally and are most abundant on the moderate to steep slopes along the sides of the Richardson Mountains. Below the area of solifluction, where the slope becomes more gentle, the soil surface shows signs of cryoturbation in the form of nonsorted circles (frost boils). The ground surface is patterned by ice-wedge polygons and vegetation tussocks (locally called niggerheads) where peat has accumulated to sufficient thickness (greater than 40 cm) on the gentle slopes. In areas of high overland flow of water, particularly on slopes along the western flank of the Richardson Mountains and beneath scarps elsewhere in the map area, the water channelizes into a parallel pattern of rills (Map 2.3.7 units designated as "-R"). The rills coallesce downslope into a horsetail drainage pattern, and eventually form the headwaters of a stream. The rilled areas are typically broad theatre-shaped valley heads, mainly occurring behind a rock ridge which confines the lateral development of channels. The material underlying these units is very ice rich when frozen and soft when thawed because of the large volume of water which flows across these units. Winter roads which

parallelthe Dempster Highway show little subsidence or have caused very little terrain disturbance except where they cross rilled areas. In such places, the thaw settlement can be up to 2 metres with Thermokarst depressions and large areas of standing water being evident along the roads.

Other periglacial processes of denudation which are presently active within the area are active-layer detachment sliding, nivation, and possibly altiplanation (Map 10.7). Active-layer detachment slides occur along steep slopes, particularly in shale derived colluvium. They are 100 - 500 metres^2 in areal extent and too small to be shown on the map. The slides move along the base of the active layer, and may occur at any time during the thaw season, but most frequently after heavy rains. In places it appears that landsliding is very active at the heads of gullies, and that it may be the principle agent for gully development. Nivation is active along the ridge crests of the Richardson Mountains as indicated by the numerous nivation hollows formed there (Map 10.7). Although significant depressions may result from this process, the result is probably limited to the formation of benches and rounding of ridge crests. Altiplanation terraces are very limited in their distribution; being restricted to the north side of Mount Joyal and of a ridge in the extreme northern part of the map area. These areas are characterized by stepped morphology comprising smooth gently sloping "treads" up to 20 metres across, and 1 metre high "risers". The "tread" areas consist of a layer of flat boulders (flagstones), the risers are formed of rubble. Water issues forth from the base of the risers and flows across the tread, eventually percollating down into it. The back portion of the tread is soft, almost "quick", conditon due to the high water content and the loose structure of the material.

3.0 METHODOLOGY

3.1 Field Investigations

During the summer of 1980, field investigations of the surficial geology of the Dempster Highway area were completed. Field investigations were carried out through foot, vehicle, and helicopter traverses. A general appreciation for the slope, topography, bedrock depths, material grain-size distribution, compaction and permeability, permafrost and ground-ice distribution, active layer thicknesses, water tables and drainage, peat thicknesses, presence of hazardous processes and features such as landslides, recent fault scraps, solifluction lobes, nivation features, rock glaciers, snow patches and flooding within various terrain types was obtained during these field investigations. These factors were investigated in detail along the Dempster and Klondike Highways in order to relate them to terrain types identified on previously published maps of surficial geology and geomorphology.

3.2 Office Studies

Office studies primarily involved interpretation of the aerial photographs of the area and preparation of surficial geology and geomorphology maps. All available information, including published reports and unpublished field notes, highway drilling logs, etc. was compiled in the form of the extended legend.

Suitability maps for construction of permanent facilities or intensive use of terrain; pipeline construction; construction of temporary facilities or light use of terrain; and sewage lagoons and sanitary landfills were prepared. This involved establishing five classifications for terrain suitability for each purpose, defining the different states of seven critical terrain factors that affect the suitability of terrain for each purpose, and

evaluating the suitability of terrain types for each purpose based on the defined guidelines. For consistency throughout the Yukon, the classification scheme used for the East Kluane Planning Area was followed, except that the terrain property guidelines for assessing the suitabilities were modified to accommodate the land uses defined for the Dempster Highway Corridor, and to accommodate minor changes in geology.

All available data concerning the granular materials were collected, analysed and collated; maps and text were prepared to define and discuss the quantity and quality of granular materials. Particular unique Quaternary features were identified and located.

4.0 SUITABILITY MAPS

4.1 Classifications

Five classifications have been established to evaluate the suitability of terrain types or areas for a variety of purposes. The classifications are GOOD, FAIRLY GOOD, FAIR (MARGINAL), POOR, AND UNSUITABLE (VERY POOR). These classifications are a comment upon the relative amount of terrain modification required to adapt terrain to a specific use or facility, upon the relative amount of effort required to maintain a use or facility, upon the amount of effort required to prevent physical disturbance and deterioration of the immediate environs from a specific use or facility, and upon the amount of preliminary investigations that might be required before a facility or use should be considered or completed. In essence, the costs required to successfully adapt an area to a specific purpose is relatively low for an area classified as GOOD and progressively increases to a maximum cost for an area classified as UNSUITABLE (VERY POOR).

It should be noted that terrain factors such as material composition and characteristics, slope, drainage, permafrost and ground ice distribution have some degree of variability in any terrain type. A suitability classification for a terrain type has to take into consideration and integrate the variability of the terrain factors. For example, an area classified as FAIR (MARGINAL) may have a terrain factor that makes the terrain type universally marginal for a specific purpose, or it may be that some of the terrain type could be classified as relatively GOOD for that purpose, but significant parts could only be classified as FAIR (MARGINAL) or POOR for that purpose.

A classification of GOOD indicates relative ease in adapting an area or terrain type to a specific use or in construction and maintenance of a specific facility. For example, road construction and maintenance on a gently-sloping well-

drained unfrozen gravel outwash surface would require minimal costs and efforts relative to road construction on other terrain types.

A classification of FAIRLY GOOD indicates a minor problem or limitation that will slightly increase the effort and cost in adapting and area or terrain type to a specific use or facility. For example, road construction and maintenance on a gently-sloping well-drained unfrozen bouldery gravel would require slightly more effort and cost, however minor, than on a gravel without boulders because of the necessity of removing the boulders.

A classification of FAIR (MARGINAL) indicates limitations are present within an area or terrain type that will require significant effort and cost in adapting the area or terrain type to a specific use or facility. For example, some preliminary investigations and special design, and extra efforts and costs will be required for road construction in an area of till underlain by permafrost with possible scattered areas having up to 0.5 metres of high ice content.

A classification of POOR indicates limitations are present within an area or terrain type that will require much effort and cost in adapting the area or terrain type to the specific use or facility. For example, road construction in an area of rilled colluvial blanket will probably involve the expense of installing many culverts and of extra fill to inhibit ponding surface runoff and thawing of the ice-rich permafrost.

A classification of UNSUITABLE (VERY POOR) indicates very severe limitations are present within an area or terrain type that are insurmountable or will require extraordinary effort and expense to adapt the area or terrain type to a specific use or facility. For example, road construction in an area where a thin veneer of peat overlies more than 5 metres of clay having very high ice contents would require special design and expensive

construction techniques to prevent deterioration of the permafrost from beneath the roadbed and associated ditches; continuous monitoring and maintenance would be required to prevent deterioration of the road and its surrounding environment.

In general, areas having a suitability classification of POOR or UNSUITABLE (VERY POOR) for a specific purpose should be avoided for that purpose where possible. Only where absolutely necessary, should the expensive required mitigative measures to allow adaption of the area probably be considered. However, neither classification excludes use of the terrain. The classification of UNSUITABLE or VERY POOR is only meant to imply that a particular purpose is impractical in a certain area or that extraordinary effort and cost is required if the area is to be used for such a purpose.

4.2 Suitability Limitations - Terrain Factors

Terrain factors were established that allow any undisturbed terrain type's suitability to be classified in a northern environment frequently characterized by permafrost and periglacial processes. These factors included slope; drainage; flood hazard; permafrost and ice contents; hazards due to mass wastage, fault activity, rock glaciers, etc.; bedrock depth; and material composition and stoniness.

Guidelines were established to give the particular state of any individual terrain factor that would define a certain degree of suitability for a specific purpose. For example, in Table 8.1 slopes of less than 1.5 degrees for some areas within a terrain type are required for the slopes to be considered as GOOD for sewage lagoons and sanitary landfills, and slopes of greater than 15 degrees throughout a terrain type indicate slopes that are UNSUITABLE (VERY POOR) for sewage lagoons and sanitary landfills. Intermediate distributions of slopes define intermediate suitabilities.

Degrees of slope were defined for evaluating the state of slope that dictates suitability classification. However, the frequency and pattern of these slopes were also considered in terrain type classifications. For example, a large flat area containing a small discontinuous scarp within it would still be as GOOD on the basis of slope if flatness was required for a certain purpose.

Drainage was evaluated partly on the position of the water table throughout the year in unfrozen terrain, but mainly on the state of drainage of the ground surface and near-surface, (i.e. an evaluation of the amount of terrain where free water was present on the ground surface or in the near-surface; and/or of time that free water was present on the ground surface or in the near-surface).

Flood hazard was evaluated on the basis of estimated frequency of flooding of terrain type. Some consideration was given to the severity of flood within an area, e.g. water depths, scour, etc., in the final evaluation.

Permafrost was evaluated on its areal distribution within a terrain type. However some consideration was given to its depth and the thickness of the active layer that characterized a terrain type. Ice contents within the upper 2 to 4 metres were considered as most critical in defining degree of suitability; however some consideration was given to ground-ice distribution at greater depths.

In evaluating hazards, the following things were considered:

> the presence, occurrence or likely occurrence of such mass wastage features as landslides, slope failures and rock falls; the occurrence or likely occurrence of geologic phenomena such as surface ruptures and earthquakes resulting from faulting; instability of

rock glaciers; liquefaction of sediments caused by seismic activity; wind deflation and movement of silty and sandy sediment; and periglacial phenomena such as frost creep, solifluction and nivation.

Flooding and phenomena directly related to permafrost and ground ice such as thermokarst and thaw-induced slope failures were not considered as they were evaluated in the flooding, and permafrost and ice content factors.

Bedrock depth was evaluated on the actual depth to bedrock. Some consideration was given to the variability of the depth to bedrock or the ruggedness of its surface.

Material composition and stoniness was evaluated as a terrain factor on the basis that grain size distribution, compaction, organic content, and boulder and cobble content defined such parameters as permeability, workability, bearing capacity and susceptibility to frost penetration and heave, all characteristics considered important in the utilization of a terrain type for most purposes considered in this report.

4.3 Terrain Type Suitabilities

The suitability of terrain types outlined on the surficial geology and geomorphology maps (maps 2.1-2.7) within the Dempster Highway Corridor were evaluated (Appendix A) to construct the suitability maps.

Some terrain types were known to have properties that would differ from area to area, and hence would have different suitabilities for the same land use. The terrain types were then evaluated separately within the different defined areas. For example, intermediate level alluvial terraces having one metre of surface peat, and intermediate terraces along Engineer Creek having over three metres of surface peat have been evaluated separately in Appendix A.

In defining the terrain type suitability, all terrain factors are considered. The suitability of the terrain type is then defined by the terrain factor or factors having the relatively lowest degree of suitability. For example, if all terrain factors within a terrain type are GOOD or FAIRLY GOOD, except for drainage and flood hazard, which are POOR, the suitability of the terrain type is POOR with drainage and flood hazard being the limiting factors.

4.4 Suitability Maps - Usage and Accuracy

The suitability maps, which show the suitability classification as defined in Section 4.1 and the limiting factors as defined in Section 4.2, have been derived by transposing the suitability and limiting factors of terrain types to areas mapped as those terrain types. Due to cartographic and practical limitations some small areas have not been separately classified.

The suitability maps are to be used only as a guide to planning and development in that they outline the major problems and degrees of problems for specific utilization within an area. Site assessment may determine that a site may be more or less suitable for a specific purpose than is defined on the suitability maps for a complete area because of variability of the properties of terrain types, and limitations of accuracy of the terrain typing, terrain type characterization and suitability evaluation. However, the limiting factors do define problems that might be avoided by careful site selection or that could be relieved by mitigative measures that would allow development within reasonable effort and cost (the latter being defined by the necessity and return provided by the utility or use). For example, a road to a mine across an area classified as P - br, sl (poor suitability due to bedrock or slope factors) or U - br, sl (unsuitable due to bedrock or slope factors) would probably be undertaken after investigations determine where the deepest bedrock and lowest

slopes were present in spite of costs, whereas a road to a cottage in a similar area would probably be considered impractical and too costly. The suitability maps do not negate the requirement for individual site investigations prior to utilization for many purposes. For example, investigations of materials, drainage, etc. would still be required for the installation of a sewage lagoon, even in an area classified as GOOD for that purpose.

The accuracy of the suitability maps is limited by the accuracy of the terrain typing, the accuracy of the characterization of the terrain types and the degree to which the characterization applies to unique areas and sites within terrain types. The terrain typing was completed by airphoto analysis with limited ground checking and some errors are inherent. However, even if the terrain typing is in error, the fact that the airphoto patterns were similar enough to cause incorrect terrain typing indicates that some aspects of the erroneous units are the same and consequently that the suitability classification may be partly applicable.

The evaluations of suitability are subjective. Some errors in the degree of limitation imposed by a terrain factor on the suitability of a terrain type for a specific purpose are probable; but it is also probable that the error will only be relative. For example, imperfect drainage may define an area as being POOR for road building on maps in this report, whereas authorities in road construction may consider terrain marked by imperfect drainage as being FAIR (MARGINAL) or UNSUITABLE (VERY POOR) for road construction, but not probably FAIRLY GOOD or GOOD. It is also probable that similar suitability classifications with different terrain limiting factors do not have equal environmental or economic implications. For example, terrain classified as FAIR because of permafrost and ground ice may be more difficult or expensive for pipeline construction than terrain classified as FAIR because of shallow bedrock. However, it is beyond the scope of this report to make a cost analysis of all limiting factors for all specific uses.

In areas where limiting factors have been determined to be less severe than originally anticipated, or where all terrain factors need be considered for a special purpose, or where terrain types are not classified because they are too small to map or are outside the corridor, the user will have to refer to the evaluation tables given in Appendix A for the required information. Some terrain types outside the Corridor may not have had their suitability evaluated or classified, and the user will have to consult the extended legend and the terrain property guidelines for assessing suitabilities for the pertinent land use. Again it should be emphasized that individual areas or site investigations may be required before proceeding with a particular land use.

5.0 SUITABILITY FOR CONSTRUCTION OF PERMANENT FACILITIES OR INTENSE USE OF TERRAIN

The suitability maps (Maps 5.1-5.7) assume that the facilities will be used on a year-round basis and that they will be constructed and maintained on undisturbed terrain. The types of land use considered in this section include linear earthworks such as highways, roads, airstrips, etc., and structures built on a foundation such as buildings, storage tanks, transmission lines, etc. It is assumed that the materials required for earthwork construction (embankments and fills) will be obtained locally where possible.

In areas of permafrost, it is assumed that linear earthworks will be built on embankments of sufficient thickness to minimize thaw of the permafrost, and that the upper surface will be graded and ditches and culverts will be present as required to provide adequate drainage. No provision is made on the suitability maps for the source of surfacing material, which is assumed to be stablized crushed gravel, till or rock. It is assumed that structures will be founded on piles well set into permafrost. If the buildings are to be heated, it is assumed that they will be separated from the ground to provide sufficient space for air circulation or that sufficient insulation will be placed beneath the structure to minimize the thaw of the permafrost. Structures built on pads would be analogous to linear earthworks and would include the same assumptions. The utilities are assumed to be supplied either in insulated buried conduits or in utilidors. No allowance is made for water supply or waste disposal. It is also assumed that some ground around the buildings will be disturbed by surface traffic and that a pad would be constructed if surface traffic is expected to be high.

Hazards caused by permafrost will be less and mitigative measures may not be necessary in non-permafrost areas or where the frost table is deep; this is generally reflected by improved

suitability ratings of some units in the southern part of the area. Moreover, it may be possible in some well drained sand and gravel units to construct buildings with basements and roads directly on the sub-base.

The terrain factors were evaluated on how they affect initial construction, mainly ground preparation, load capacity, stability and maintenance of the facility. Slope, drainage, permafrost, bedrock depth, material composition and stoniness primarily affect construction and load capacity whereas flood hazard, ice contents and hazards due to mass wastage, rock glaciers, faulting and liquefaction primarily affect stability and maintenance. The terrain property guidelines for assessing suitability for permanent facilities or intensive use of terrain are defined in Table 5.1.

Table 5.1 Terrain Property Guidelines for Assessing Suitability for Construction of Permanent Facilities or Intensive Use of Terrain

Different states of individual terrain factors are established that allow the suitability of the undistu terrain type to be evaluated for construction or installation and maintenance of permanent facilities or intensive use of terrain.

Terrain Factor (symbol)	Degree of Terrain Suitability				
	Good - G	Fairly Good - FG	Fair (Marginal) - F	Poor - P	Unsuitable - U (very poor)
Slope (sl)	Less than 4 degrees	Less than 8 degrees	Less than 12 degrees	Slopes between 12 and 18 degrees	Greater than 18 degrees
Drainage (wt)[1,2,3]	Rapid to well drained; greater than 1 m to water table	Well to moderately well drained; greater than 0.75 m to water table	Moderately well to imperfectly drained, generally 0.5 to 0.75 m to water table	Imperfectly to poorly drained; less than 0.5 m to water table	Poorly drained; water table continuously nea surface
Flood Hazard (fl)	No flooding	No flooding	Very rare; subject to once in 100 years or less	Occasional; subject to once in 10 to 100 years	Annual flooding
Permafrost and ice contents (pf)[2,4]	No permafrost or active layer greater than 2 m thick	Active layer greater than 1 m thick; low ice contents	Active layer less than 1 m thick; areas of medium to high ice contents are rare	Active layer less than one metre thick. Up to 1 m of near-surface sediments having medium to high ice contents, isolated sediments at depth with high ice contents	Active layer les than 1 m thick, sediments having high ground-ice contents to dept greater than 1 m
Hazards due to mass wastage, fault activity, rock glaciers, etc. (hz)[5]	No hazard	No hazard	Slow near-surface soil creep; isolated rock fall and skin flows within 1 km of postglacial active fault	Rock falls and skin flows common, rotational slumps rare; within 0.5 km of postglacial fault; moderate solifluction, nivation or soil creep. Within 0.5 km downslope of rock glacier	Rock falls and s flows abundant, rotational slump common. Within km of postglacia fault; rapid sol fluction, nivati or soil creep. Within 0.25 km downslope of roc glacier
Bedrock Depth (br)[2]	Greater than 3 m for slopes greater than 4°; greater than 1 m for slopes less than 4°.	Greater than 2 m for slopes greater than 4°; greater than 0.5 m for slopes less than 4°	1 - 2 m for slopes greater than 4°; less than 0.5 m for slopes less than 4°	0.5 - 1.0 m for slopes greater than 4°, less than 0.5 m for slopes less than 4°	Less than 0.5 m
Material composition and stoniness (mt)[6,7]	Gravel and sand; sandy till; stones less than 5%	Silty sand, silty gravel; stones less than 10%	Clayey silt, silty sand, silty clay. Stones 10 - 25%	Clay, organic silts. Organics less than 1 m thick. Stones 25 - 50%	Organics thicker than 1 m. Stone greater than 50%

1. For drainage characterization see Canada Soil Information System (Canada Soil Survey Committee, 1978).
2. In cases of buildings separated from the ground and where the limiting factors are drainage, permafrost and ice contents bedrock depth, the degree of suitability should be altered to a more favorable rating because of less interaction betwee the undisturbed terrain type and the buildings of this mode of construction.
3. Water tables are considered only where permafrost is absent; a perched water table is generally present where permafrost present. Only a limited and easily controlled amount of water exists in this perched water table.
4. Ice contents given in percent volume excess ice: low <-10%; medium 10-20%; high >20%.
5. Hazards such as flooding and failures due to man-induced thawing of permafrost are considered in Flood Hazard (fl) and Permafrost and ice contents (pf).
6. Due to frost heaving, terrain units having significant contents of silt and clay in areas of imperfect and poor drainage should be altered to one less degree of suitability if material is the limiting factor; where the highway is to be surfac by asphalt the suitability should be more severely altered.
7. Stones are defined as clasts having a diameter greater than 6 cm, i.e., cobbles, coarse rubble, boulders, blocks.

6.0 SUITABILITY FOR PIPELINE CONSTRUCTION

The suitability maps (Maps 6.1-6.7) assume that the pipeline is of large diameter, carries fluid or gas whose temperature is generally greater than $0^{o}C$, and is buried below ground surface where possible; that minimal disturbance of the terrain is required and that construction is such that right-of-way maintenance is minimal; that differential subsidence of the pipe and right-of-way surface is undesirable.

The terrain factors were evaluated on the basis of how they affect the initial construction, the continued integrity of the pipeline and the maintenance of the right-of-way. Slope, drainage, permafrost, bedrock depth, and material composition and stoniness primarily affect construction, whereas flood hazard, ice contents, and hazards due to mass wastage, faulting, liquefaction, and rock glaciers primarily affect maintenance. The terrain property guidelines for assessing suitability for pipeline construction and maintenance are defined in Table 6.1.

Table 6.1 Terrain Property Guidelines for Assessing Suitability for Pipeline Construction

Different states of individual terrain factors are established that allow the suitability of the undisturbe terrain type to be evaluated for installation and maintenance of a gas or oil pipeline.

Terrain Factor (symbol)	Degree of Terrain Suitability				
	Good - G	Fairly Good - FG	Fair (Marginal) - F	Poor - P	Unsuitable - U (very poor)
Slope (sl)[1,2]	Less than 3 degrees	Less than 5 degrees	Less than 8 to 10 degrees	Between 10 to 15 degrees	Greater than 15 degrees
Drainage (wt)[3,4]	Rapid to well; greater than 2.5 m to water table	Well to moderately well; greater than 1.5 m to water table	Moderately well to imperfect; 0.5 to 1.5 m to water table	Poor to imperfect; less than 0.5 m to water table	Poor; water table continuously near-surface
Flood Hazard (fl)	None	Very rare flooding by small creeks	Occasional; subject to once in 5 years or less	Frequent; subject to annual or semi-annual flooding	Continuous flooding
Permafrost and ice contents[5] (pf)	No permafrost or active layer greater than 2 m thick	Scattered permafrost with low ice contents; active layer greater than 1.5 m thick; low ice contents	Permafrost generally present, but only few areas having shallow (<1 m) sediments with medium to high ice contents	Permafrost with up to 2.5 m of near-surface sediment having medium to high ice contents; isolated sediments with high ground-ice contents at depth	Continuous permafro with greater than 2.5 m of sediments having high ground-ice contents
Hazards due to[6] mass wastage, fault activity, rock glaciers, etc.	No hazards	No hazards	Slow near-surface soil creep; within 1 km of postglacial active fault	Moderate solifluction or soil creep, within 0.5 km of postglacial fault; within 0.5 km downslope of rock glacier	Possibility of land slide, fault-induce surface rupture, or sediment liquefaction; rapid solifluction, nivation or soil creep; within 0.25 km downslope of rock glacier
Bedrock Depth (br)	Always greater than 2.5 m	Usually greater than 2.0 m	Between 1 and 2 m	Less than 1 m	Generally at surface
Material composition and stoniness [7,8] (mt)	Gravel and sand, sandy till; stones less than 3 percent	Silty sand, clayey till, clayey silt; stones less than 10 percent	Fine sand, silty clay; stones less than 25 percent	Peat organic silts to 2.5 m depth; stones greater than 25 percent	Peat and organic silts greater than 2.5 m thick

1. Sideslopes are considered the limiting factor; thus terrain unit suitability governing pipeline right-of-ways that trend perpendicular to slope should be altered to one less degree of suitability if slope is the limiting factor.
2. Slopes become a more severe limitation in areas of ice-rich permafrost; however, this is generally covered in the permafros terrain factor.
3. For drainage characterization see Canada Soil Information System (Canada Soil Survey Committee, 1978).
4. Water tables are considered only where permafrost is absent; a perched water table is generally present where permafrost is present. Only a limited and easily controlled amount of water would be introduced from most excavations from this perched water table.
5. Ice contents given in percent volumes excess ice: low <10%; medium 10-20%; high >20%.
6. Hazards such as flooding and failures due to man-induced thawing of permafrost are considered in Flood Hazards (fl) and Permafrost and ice contents (pf).
7. Stones are defined as clasts having a diameter greater than 6 cm, i.e., cobbles, coarse rubble, boulders, blocks.
8. In cases where pipelines are to be chilled, terrain units containing sediments containing thawed silt or clay within 10 m of surface would be relegated to a poor suitability, within 15 metres of surface to a fair suitability.

7.0 SUITABILITY FOR CONSTRUCTION OF TEMPORARY FACILITIES OR LIGHT USE OF TERRAIN

The suitability maps (Maps 7.1-7.7) assume that the terrain is to be used in a virtually undisturbed state except for some clearing of underbrush and trees, that only limited vehicular traffic will occur on the site, but that foot traffic may increase significantly. The land use is assumed to be seasonal and will generally require little ground preparation; and that buildings will not have a foundation and if heated will be well insulated from the ground. The suitabilities may be applied to such land use activities as campgrounds, hiking trails, temporary stock piles, temporary lodging (trailer) sites, winter roads, etc. No allowance is made for water supply or sewage disposal.

The terrain factors were evaluated on how they affect direct use of the terrain and how they affect maintenance of the site. Slope, drainage, permafrost, flood hazard, hazards such as landslides, rock glaciers, etc., bedrock depth and stoniness affect site utilization, whereas ice contents and material composition affect site maintenance and long term effects after abandonment. The terrain property guidelines for assessing suitability for the construction of temporary facilities or light use of terrain are defined in Table 7.1.

Table 7.1 Terrain Property Guidelines for Assessing Suitability for Construction of Temporary Facilities or Light Us of Terrain

Different states of individual terrain factors are established that allow the suitability of the undisturb terrain type to be evaluated for construction and maintenance of temporary facilities or light use of the terrain.

Terrain Factor (symbol)	Degree of Terrain Suitability				
	Good - G	Fairly Good - FG	Fair (Marginal) - F	Poor - P	Unsuitable - U (very poor)
Slope (sl)	Less than 5 degrees	5 - 10 degrees	10 - 15 degrees	15 - 20 degrees	Greater than 20 degrees
Drainage [1,2] (wt)	Rapid to well drained; no surface ponding; water table below 1 m during thaw season	Moderately well drained; water table below 0.5 m during thaw season	Moderately well to imperfectly drained (occasional seepage and ponding); water table generally below 0.5 m during thawed season	Imperfectly to poorly drained (ponding and seepage common); water table generally above 0.5 m during thawed season	Poorly drained; permanently wet
Flood Hazard (fl)	None	Very rare subject to once in 100 years or less	Occasional; subject to once in 5 years	Possible annual flooding	Possible flooding more than once pe year or prolonged flooding
Permafrost and [2] ice contents (pf)	No permafrost, scattered permafrost or permafrost with negligible ice contents and active layers thicker than 3 m.	Scattered permafrost or permafrost with active layer thicker than 2 m, low to medium ice contents near surface	Permafrost with active layer 1-2 m thick; medium to high ice contents near surface	Permafrost with active layer less than 0.5 m thick; high ice contents near surface	Permafrost with active layer less than 0.3 m thick; massive ice near surface
Hazards due [4] to mass wastage, fault activity, rock glaciers, etc. (hz)	No hazards	Slow surface soil creep; rare skin flows	Moderate surface soil creep; common skin flows; rock falls present; within 0.5 km downslope of rock glacier	Rapid solifluction or soil creep; area of potential rotation slumps abundant skin flows; rock falls common; within 0.25 km downslope of rock glacier	Very rapid surfac mass movements of types. High pote tial for future f ures. Within 0.2 of rock glacier
Bedrock Depth (br)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Material [5] composition and stoniness (mt)	Gravel and sand; sandy till; stones less than 10%; smooth bedrock surface	Fine sands, sandy silt, clayey silt; stones less than 15%; smooth to rolling bedrock surface	Clayey till, fine sand, sandy silt; clayey silt, stones less than 25%; rolling to hummocky bedrock surface	Clay; organic silt; thin organics; stones 25-50%; hummocky to rugged bedrock surface	Thick organics, stones greater th 50%; very rugged bedrock surface

1. For drainage characterization see Canada Soil Information System (Canada Soil Survey Committee, 1978).

2. Water tables are considered only where permafrost is absent; a perched water table is generally present where permafrost present. Only a limited and easily controlled amount of water exists in the perched water table. Note also that most terrain will have the characteristics of poor drainage early in the thaw season.

3. Ice contents given in percent volume excess ice: low <-10%; medium 10-20%; high >20%.

4. Hazards such as flooding and failures due to man-induced thawing of permafrost are considered in Flood Hazard (fl) and Permafrost and ice contents (pf).

5. Stones are defined as clasts having a diameter greater than 6 cm, i.e., cobbles, coarse rubble, boulders, blocks.

8.0 SUITABILITY FOR SEWAGE LAGOONS AND SANITARY LANDFILLS

The suitability maps (Maps 8.1-8.7) assumes that the sewage lagoons and sanitary landfills are to be constructed as shallow excavations or as basins confined by berms built on the undisturbed ground surface. The prevention of pollution through the movement of surface or ground water to terrain surrounding the facilities was considered to be of prime importance in their location. Minimal maintenance of berms and other confinements to the movement of pollutants was also considered paramount.

The guidelines for sanitary landfills are generally less severe than for sewage lagoons as no fluid pollutants are initially introduced. Thus the suitability maps give a more conservative evaluation of terrain for use of sanitary landfills than is necessary; in many cases the suitability classification for sanitary landfills can be adjusted to the next higher suitability classification to that which is shown on the suitability maps for sewage lagoons and sanitary landfills.

The terrain factors were evaluated on how they affect initial construction, mainly excavation and berm emplacement and how they affect continued berm stability and prevention of pollution. Slope; flood hazard; permafrost; hazards due to mass wastage, rock glaciers, faulting and liquefaction; bedrock depth; and material composition were considered primarily for their influence on pollutant confinement. In addition to drainage and material stoniness, many of the above terrain factors would also affect lagoon and landfill construction and maintenance. The terrain property guidelines for assessing suitability for sewage lagoons and sanitary landfills are defined in Table 8.1.

Table 8.1 Terrain Property Guidelines for Assessing Suitability for Sewage Lagoons and Sanitary Landfills

Different states of individual terrain factors are established that allow the suitability of the undistur terrain type to impound water, sewage, and leachate to be evaluated.

Terrain Factor (symbol)	Degree of Terrain Suitability				
	Good - G	Fairly Good - FG	Fair (Marginal) - F	Poor - P	Unsuitable - U (very poor)
Slope (sl)[1]	Less than 1.5 degrees	Less than 3 degrees	Less than 8 degrees	Less than 15 degrees	Greater than 15 degrees
Drainage [2,3] (wt)	Rapid to well drained; water table 1.5 m plus	Moderately well drained; water table generally 1.0 m plus	Imperfectly drained; water table generally 0.5 to 1.0 m	Poorly drained; water table generally less than 0.5 m	Permanently wet; water table continuously near surface
Flood Hazard (fl)	No flooding	Very rare; subject to once in 100 years or less	Rare; subject to once in 50 years to 100 years	Occasional; subject to once in 5 to 50 years	Frequent; subject to at least once a year
Permafrost and[4] ice contents (pf)	No permafrost or active layer greater than 3 m thick	Scattered permafrost with low ice contents; active layer greater than 2 m thick	Permafrost generally present, but only rare areas having shallow (<0.5 m) sediments with medium to high ice contents	Permafrost with up to 1 m of near-surface sediment having medium to high ice contents	Continuous permafrost with sedimer having high ground ice contents to depths greater tha 1 m
Hazards due to[5] mass wastage, fault activity, rock glaciers, etc. (hz)	No hazards	No hazards	Slow near surface soil creep	Evidence of faulting within last 10,000 years; rock fall; within 0.5 m downslope of rock glacier	Rapid soil creep c solifluction preva possibility of lar slide, fault induc surface rupture, s ment liquification within 0.25 m down slope of rock glacier
Bedrock Depth (br)	Greater than 1.5 metres	Greater than 1.0 metres	Between 0.5 and 1.0 metres	Less than 0.5 metres	Generally at surfa
Material [6] composition and stoniness (mt)	Silty clay; less than 3% stones	Clayey silt and silt; clayey till and compact till; 3 to 10% stones	Silt with some organic content; sandy or gravelly silt or clay; loose till; 10-25% stones	Silty sand and silty gravel; thin organics; less than 25-50% stones	Sand and gravel; greater than 50% stones; thick organics

1. Slopes are a more limiting factor to the construction of viable sewage lagoons than sanitary landfills. Thus terrain unit suitability for sanitary landfills should be altered to one less severe degree of suitability if slope is the limiting terrain factor.

2. For drainage characterization see Canada Soil Information System (Canada Soil Survey Committee, 1978).

3. Water tables are considered only where permafrost is absent; a perched water table is generally present where permafrost i present. Only a limited and easily controlled amount of water would be introduced from most excavations from this perched water table.

4. Ice contents given in percent volume excess ice: low <-10%; medium 10-20%; high >20%.

5. Hazards such as flooding and failures due to man-induced thawing of permafrost are considered in Flood Hazard (fl) and Permafrost and ice contents (pf).

6. Stones are defined as clasts having a diameter greater than 6 cm, i.e., cobbles, coarse rubble, boulders, blocks.

9.0 CONSTRUCTION MATERIALS

9.1 Suitability

The suitability maps (Maps 9.1-9.7) assume that the construction materials are to be used as aggregate or fill. The suitability of the different terrain types are evaluated according to the quality and quantity of the surficial materials within them, and the workability and ease of extraction of those materials. Materials that are required to be impermeable such as dikes are excluded from consideration; the suitability for sewage lagoons and sanitary landfills give a partial assessment of suitability for impermeable materials. The suitability of bedrock as a construction material has not been evaluated. Terrain types containing gravel and sand with potential as aggregate are given the highest suitability classification as they can easily be adapted to most construction purposes. Other terrain types are evaluated on the basis of the compressibility, compactibility, susceptibility to frost action and surface trafficability of the surficial materials within them.

The terrain factors were evaluated on the basis of their usefulness and versatility as a construction material, the ease or difficulty of extraction, and the volumes that could be extracted from a unit area. Material composition and stoniness primarily affects usefulness as a construction material, whereas slope, drainage, permafrost, flood hazard, miscellaneous hazards, and bedrock depth affect the extractable volumes per unit area and the ease or difficulty of extraction. The terrain property guidelines are defined in Table 9.1.

9.2 Evaluation of Major Accessible Sand and Gravel Sources

A number of major sources of aggregate that are easily accessible from the Dempster Highway have been identified on maps

Table 9.1 Terrain Property Guidelines for Assessing Suitability for Construction Materials including Workability and Usefulness as General Fill and Source of Gravel and Sand

Different states of individual terrain factors are established that allow the suitability of the undisturbed terrain type to be evaluated as a potential source of construction materials, including sand and gravel.

Terrain Factor (symbol)	Degree of Terrain Suitability				
	Good - G	Fairly Good - FG	Fair (Marginal) - F	Poor - P	Unsuitable - U (very poor)
Slope (sl)	Less than 5 degrees	Between 5 and 12 degrees	Between 12 and 20 degrees	Between 20 and 30 degrees	Greater than 30 degrees
Drainage[1,2] (wt)	Rapid to well; water table 2 m	Well to moderately well; water table 1.0 to 2m	Imperfect to moderately well; water table 0.5 to 1.0 m	Imperfect to poor; water table less than 0.5 m	Permanently wet; water table near surface
Flood Hazard (fl)	None	Very rare; subject once in 100 years or less	Occasional to rare; subject to once in 5 to 100 years	Frequent; subject to annual flooding	Very frequent; flooded more than once per year
Permafrost and[3] ice contents (pf)	None	Scattered permafrost with low ground-ice contents	Permafrost generally present, but only rare; areas having shallow (<0.5 m) sediment with medium to high ice contents	Permafrost with up to 1 m of near-surface sediment having medium to high ice contents	Continuous permafr with sediments hav high ground-ice co tents to depths greater than 1 m
Hazards due to[4] mass wastage, fault activity, rock glaciers, etc. (hz)	No hazards	Slow near-surface soil creep	Rapid soil creep or solifluction; evidence of faulting within last 10,000 years	Possibility of landslide, surface rupture or sediment liquification within next 100 years; within 0.25 km of rock glacier	Imminent possibili of landslide and sediment liquifica tion; rock glacier
Bedrock Depth (br)	Greater than 2 m	Between 1.5 and 2 m	Greater than 1.0 m (blanket)	Between 0.5 and 1.0 m (veneer)	Less than 0.5 m
Material[5] composition and stoniness (mt)	Gravel and sand; stones less than 3%	Silty sand, silty gravel, sandy till; thin cover (veneer) over sand or gravel; stones less than 10%	Till, silty fine sand; stones less than 25%	Silt, clay, clayey silt, thick cover (blanket) over sand and gravel; 25 to 50% stones	Peat, organic silt greater than 50% stones

1. For drainage characterization see Canada Soil Information System (Canada Soil Survey Committee, 1978).
2. Ice contents given in percent volume excess ice: low <-10%; medium 10-20%; high >20%.
3. Water tables are considered only where permafrost is absent; a perched water table is generally present where permafrost i present. Only a limited and easily controlled amount of water would be introduced from most excavations from this perched water table.
4. Hazards such as flooding and failures due to man-induced thawing of permafrost are considered in Flood Hazard (fl) and Permafrost and ice contents (pf).
5. Stones are defined as clasts having a diameter greater than 6 cm, i.e., cobbles, coarse rubble, boulders, blocks.

9.1-9.7. (Many smaller sources are present that have not been investigated or discussed). Gravel:sand:fines ratio (based on grain size distribution obtained by field estimates) and the probable minimum cubic metres per hectare of deposits (based on our estimate of minimal extractable thicknesses) are estimated for viable sources as shown on maps 9.1-9.7. Total volumes can be estimated by multiplying the estimates by total hectarage, but further test pitting and drilling is required to determine quantities, qualities and overburden thicknesses more accurately. No attempt has been made to assess the sources as potential concrete aggregates.

9.2.1 Tintina Trench - Map 9.1

Large sources of sand and gravel are available along the side of the Dempster Highway throughout this mapsheet. The best source is from the glaciofluvial terrace (①) which has been used extensively during highway construction. In places the gravel is covered by up to 2 m of silt, but these areas can be easily stripped or avoided. A similar deposit exists on the east side of the North Klondike River at source ②.

The alluvial terraces along the Klondike River have been used for gravel during highway construction, however they are limited by high water tables to an extractable depth of 2 metres (③).

9.2.2 North Klondike River - Map 9.2

The best sources of gravel and sand are the glaciofluvial terraces (①, ④, ⑤, ⑥, ⑦, ⑧ and ⑨) and the glaciofluvial fans (⑩ and ⑪). The glaciofluvial terrace deposits may have up to one metre of silt rich material at the surface which may require stripping. Generally this gravel is of good quality, although only those deposits along the Dempster Highway (①, ⑥ and ⑧) were investigated; those on the east side of the Klondike

River (④ , ⑤ , ⑦ and ⑨) are genetically similar and should be of comparable quality. The glaciofluvial fan deposits (⑩ and ⑪) are also rated as GOOD, however they may contain pockets of very silt rich material. The usual maximum grain size is 30 cm with most of the material less than 10 cm diameter in all of these sources, although isolated boulders up to 50 cm diameter may occur.

FAIRLY GOOD sources include drift plain (⑫), and alluvial fans (⑬ and ⑭). The drift plain was only investigated south of the Klondike River where it is composed of a good grade of sand and gravel; however up to 2 metres of silt, which would have to be stripped, commonly overlie the gravel and therefore the occurrence is only rated as FAIRLY GOOD. The alluvial fan deposits are quite variable both in thickness (1 - 3 metres), and in composition from pure shale fragments to silty sandy gravel. As a result it is perferrable that each of these units be individually assessed before it is considered as a source of construction materials. Many small fans occur along both sides of the North Klondike Valley and in most of the tributary stream valleys: even though these deposits are too small to map, they are FAIRLY GOOD as a local source of construction material.

Other sources of materials used for the construction of the Dempster Highway included alluvial aprons, till, colluvium and rock. These materials are generally FAIR to POOR due to high content of fines and the possible occurrence of permafrost. Isolated areas within these units may be suitable for construction materials, particularly if the material is treated; however each deposit should be assessed individually. The alluvial plain deposits are another potential source of gravel and sand although the quality is quite variable and the quantity is restricted by high water tables and flood hazards.

9.2.3 North Fork Pass - Blackstone River System - Map 9.3

The best gravel deposits in this area are rated as FAIRLY GOOD, are mainly limited by permafrost and drainage, and

are located in glaciofluvial terraces ((15) , (17) , (18) , (19) , (20) , (22) , (24) and (25)) and in hummocky glaciofluvial material ((23)). Many of these sources are of variable composition (eg. (15)), and are commonly overlain by 1 - 2 metres of silt or silty sand (eg. (24)), which would require stripping. Generally the material is smaller than 10 cm diameter although rare boulders over 30 cm occurred at sources (15) , (18) and (24) .

Two areas of glaciofluvial terraces have been downrated to POOR due to permafrost and drainage, based on individual assessment during fieldwork. These areas have thick surface covers of organics and fine grained material and are poorly drained. Moreover, they are ice rich as indicated by the occurrence of palsen and by the degradation occurring along an old section of the Dempster Highway.

Other sources of construction materials within this map are some alluvial and morainal deposits. Alluvial plains are variable in composition from silty sand to cobble gravel; moreover extractable volume is limited because the water table is commonly high and they are prone to annual flooding. Alluvial terrace deposits are commonly composed of gravel with an overlying peat cover, which would indicate that permafrost could be a problem. The material of alluvial deposits is probably of high quality, but the limited volume would render them usable only as local sources.

Morainal deposits are of variable composition and ice contents. The material is generally silty sand with pebbles, cobbles and boulders up to 50 cm diameter, but pockets of well sorted sand and/or gravel are common; treatment will improve the quality of this material significantly. Ice contents may be very high, particularly in the areas where thermokarst pits are present and these areas should be avoided. The ice contents of other areas are quite variable, but probably low in much of the area. Individual assessment is therefore recommended in order to assess the usefulness

of this material. Much borrow used to construct the Dempster Highway was the morainal deposits adjacent to the highway.

9.2.4 Blackstone River - Engineer Creek - Ogilvie River - Map 9.4

Only the glaciofluvial deposits ((26)) in the headwaters of Engineer Creek are rated as FAIRLY GOOD. These units are relatively small and are somewhat inaccessible as they are located partway up a steep hill.

The next best material is probably the alluvial plain ((28)), fans and lowest level of terrace deposits ((29)), although the composition of these units is quite variable from sand to cobble gravel. The main limiting terrain factors are flood hazard near streams, and permafrost particularly under accumulations of organics. It should be noted that the intermediate level terrace is UNSUITABLE, primarily because it is covered with up to 3 metres of peat. The high level terraces may have up to 1 metre of peat at the surface and are generally less accessible. In the vicinity of the sulphurous geothermal springs, the gravels are somewhat cemented and many of the igneous clasts are rotten; this may lower the suitability of these materials for some uses.

The morainal units ((27)) are a reasonable source of material, particularly if treated. Some areas of these units may be ice rich and should be avoided.

Rubble and boulder colluvium may be usable in places, but treatment will be required. The fine grained colluvium is generally too rich in fines to be useable. Gravel may occur beneath the colluvium on pediment surfaces, but this source will only be of use where the colluvium is thin and its ice contents are low.

9.2.5 Ogilvie River - Eagle Plain - Map 9.5

On this map (9.5), except for small areas classified as UNSUITABLE due to steep slopes, all of the terrain is either of FAIR or POOR suitability for the exploitation of construction materials. Of these the most favourable deposits are the alluvial flood plains and terraces and some of the coarse grained (rubbley or bouldery) colluvial blankets.

Alluvial flood plains ((30)), particularly along the Ogilvie River are a viable source of material for construction and were used in the construction of the Dempster Highway. The main concerns in using this source is flood hazard particularly in and near to the active flood plain, and ice rich permafrost away from the river, particularly at the foot of slopes and in areas of thick organics. Generally the material is either sand and/or gravel (up to cobble size) with very little silt. The composition may be quite variable within a short distance, and this may detract from its usefulness.

Alluvial terrace deposits ((31)) are generally composed of sand and/or gravel, but may be capped by up to 2 metres of silt and/or organics, which would require stripping. In places these units are ice rich and may be difficult to extract; thermokarst lakes are present on some terraces and subsidence of up to 2 metres on winter roads indicates ice rich soils.

Alluvial fans or aprons may be suitable material for some uses in places: however, they tend to be rich in fines and will require treatment.

Generally colluvium is not suitable for construction material as it is too rich in fines and unstable when saturated. Gravel may occur beneath the colluvium on the rock pediment surface in places; this may be a sizable source of gravel where

the colluvium can be economically stripped. Some coarse-grained colluviums may be suitable for some purposes when treated.

On the Eagle Plain, the best source of construction material is the bedrock. This has not been evaluated as a source on these maps. Care should be taken in selecting suitable lithologies as many of these weathered rock units have little strength when crushed or thawed.

9.2.6 Eagle Plain - Map 9.6

The only sources of gravel and sand in this map area (9.6) are the terraces ((32)), and flood plain ((33)) of the Eagle River. The deposits, which are of variable thickness (3 - 6 metres) and composition (gravel:sand:fines ratios of 50:50:0 to 70:20:10), are not very accessible as they are overlain by 1 - 7 metres of organics. The materials are frozen and difficult to work. Small gravel deposits occur on some pediment surfaces beneath the colluvial cover, but would only be viable where the cover is thin, the material is proven and the use is local.

In the rest of the area, only the rubbly colluvium, developed on sandstone, could be considered as a source of construction materials. Other deposits are generally too fine grained, plastic and have very little shear strength.

Bedrock is not evaluated on this map as a source of construction material. It has a benefit over unconsolidated material in that once a suitable rock type is found, the reserve is virtually unlimited. Bedrock was used exclusively for the construction of the Dempster Highway across this map area. It should be noted that some lithologies, namely shale units in the Eagle Plain and the Hart River Formations, were very unstable when

saturated and thawed. Outcrops of these lithologies can be identified by the abundance of landslides, slumps and flow features on slopes in them.

9.2.7 Eagle Plain - Richardson Mountains - Map 9.7

The materials of this map area (9.7) are generally FAIR and POOR mainly due to slope, permafrost and material factors. Much of the area is covered by silt and clay rich colluvium with high ice contents. Such material generally cannot be improved with treatment and should only be considered where there is no alternative. In places, gravel may occur beneath the colluvial blanket on the pediment surface. These deposits are very limited in size, would require much overburden stripping to exploit them, and should only be considered if a very small supply of gravel is required locally.

Probably the best source of gravel and sand is alluvial deposits although they are generally less than 2 metres thick and would require some treatment. Alluvial terrace deposits ((34)) are of small areal extent and of variable composition, and treatment will be required in many cases. The gravel in these terraces may be overlain by up to 2 metres of peat, which would have to be stripped. Alluvial flood plains and some low level terraces ((35)) are a good source of gravel, these deposits may require treatment before use. Many streams appear to have periodic high discharges; hence flooding is a major hazard. Alluvial fans and aprons are generally too rich in fines to be economically treated, although small pockets of usable material may be found and of use locally. Generally these units have high ice contents with shallow active layers due to organic covers greater than 50 cm thick.

The main source of materials used for the construction of this stretch of the Dempster Highway was the local bedrock,

generally shale and sandstone. Bedrock has not been considered as a source of construction materials in this report. The particular shale used in this area for highway construction produces very sharp angular fragments, which produces much wear on vehicle tires, and would therefore be most unsuitable for other uses (e.g. air strips). However, this does help to emphasize the general lack of suitable construction materials within this area.

10.0 UNIQUE AREAS

Unique and typical Quaternary geologic features are outlined on maps 10.1 - 10.7. Most features are related to glacial, periglacial, mass wasting and fluvial activities. Although some features are relatively unique, many are only spectacular or particularly good examples of Quaternary geologic features. Some features have been identified because they are good examples and visible or accessible from the road.

In the southern part of the area, the moraines formed by the different ages of ice advances along the highway have been identified (Maps 10.2 - 10.4). The northern most moraines (Map 10.4) mark the known limit of valley glaciation in the area; the area to the north being unglaciated except for the area in the Richardson Mountains glaciated by the Laurentide Ice (10.7). The hummocky moraines around Chapman Lake and along the East Blackstone River valley (Map 10.3) are not only good examples of moraines, but are good examples of thermokarst development. The moraines at North Fork Pass (Map 10.3) are a spectacular example of the effects of a glacier flowing down a tributary valley and spreading out in both directions in the main valley. The Tombstone Range contains the best example of glacial cirques, horns and arêtes in the area. Outwash deposits are not particularly spectacular, but are best developed and most easily seen along the Ogilvie River (Map 10.5).

Examples of periglacial activity can be seen throughout the area, including thermokarst topography (Map 10.3), altiplanation terraces (Map 10.7) and rock glaciers (Map 10.2). Palsen occur on the valley floor in the North Fork Pass area (Map 10.3) and three pingos have been identified along the Blackstone River just outside the corridor (Map 10.3).

The effects of mass wasting from solifluction lobes (Map 10.7) to various types of landslides can be seen throughout the area. Some areas are particularly active (for example the active layer

detachment slides on Engineer Creek (Map 10.4)), whereas others are spectacular just because of their size and abundances (Map 10.1 and 10.2). One of the most interesting aspects of the highway is the contrast in landscapes due to the various processes, principally mass wasting, which has eroded the terrain. In the Southern Ogilvie Mountains, valleys are U-shaped due to the glaciers, and competant bedrock is exposed in most of the valley sides and ridge crests. In the Northern Ogilvies, valleys are V-shaped, the bedrock has been weathered and eroded for some time and the slopes are covered with angular blocks right to the summits. Bedrock exposures are rare even at the tops of the mountains and only the most resistant rocks crop out in the form of tors or castellated outcrops (Map 10.4). Further north on the Eagle Plain, the long term effects of weathering and erosion can be seen in the subdued topography, the great thickness of weathered rock, and the pediment surface (Map 10.7).

Alluvial features include the terrace systems along most of the rivers particularly the Eagle and Ogilvie Rivers, and the variability of flow as shown by some "dry" river beds, which must have high discharges during part of the year but flow principally through the gravel bed during the late summer (Map 10.4). Also of note are the river icings which may last until August (Map 10.3).

Other points of geological interest are the Tertiary sediments in the Tintina Trench (Map 10.1); the sulphurous geothermal springs (Map 10.4), which are relatively cold because they flow through the permafrost; some caves produced by solution of limestone (Map 10.5); and the large red gossan patches which are visible from some distance.

Of historical interest, but related to geology are the ditch and powerhouse (Map 10.1 and 10.2), which supplied the power to the gold dredges; the flumes which supplied water to the hydraulicking operations; the coal mine which supplied coal to Dawson; and the placer workings along Hunker, Allgold, Goldbottom and other creeks in the area (Map 10.1).

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12.0 GLOSSARY OF GEOTECHNICAL TERMS

Active layer:	the top layer of ground in areas underlain by permafrost that thaws each summer and refreezes each fall.
Aggregate:	hard, inert construction materials such as sand, gravel or crushed stone.
Alluvial:	pertaining to rivers, streams or running water.
Altiplanation:	a group of erosion processes which tend to produce flat surfaces. Such processes are especially active at high elevations or latitudes where periglacial processes predominate.
Arête:	a narrow, jagged, serrate mountain crest between the headwalls of two cirques.
Bearing capacity:	the load per unit area which the ground can safely support without excessive yield.
Berm:	narrow, man-made embankment.
Braided drainage pattern:	pattern having interlacing or tangled network of several, small, branching and reuniting shallow channels separated by islands and bars.
Castellated:	displaying a towering or battlement-like structure.
Cirque:	a deep, steep-walled, flat- or gentle-floored, half-bowl-like recess or hollow produced by the erosive activity of mountain glaciers.
Colluvium:	loose soil and rock fragments deposited chiefly by mass wasting on and at the base of slopes.
Compactibility:	the ease with which a soil may be worked in order that it attains its maximum density.
Compressibility:	the ease with which the volume of body of soil decreases due to an applied load.
Deglaciation:	the uncovering of land from beneath a glacier by the withdrawal of ice due to shrinkage by melting.

Detachment slide:	a landslide in which part of the surface (generally part of the active layer) separates from the whole.
Earth works:	the extraction and utilization in construction of unlithified earth materials.
Effluent:	liquid waste which will render groundwater or surface water supplies unsuitable for human consumption.
Embankment:	an artificially built earth body which has a length considerably greater than its width or height.
Erratic:	a relatively large rock fragment lithologically different from the bedrock on which it lies and that has been transported over considerable distance from its place of origin.
Faulting:	fracturing and displacement of rock along a surface or zone.
Fill:	an artificially built earth body which has a height relatively small in comparison with its other dimensions.
Frost creep:	soil slowly creeping downslope because of annual freezing and thawing.
Frost heave:	the uneven upward movement of surface soil, rock, vegetation or structures resulting from the subsurface freezing of water and growth of ice masses.
Frost shattering:	mechanical disintegration of rock due to pressure exerted by freezing of water in cracks and pores.
Frost sorting:	sorting of unconsolidated material through ice movement as caused by freezing and thawing.
Frost-susceptible soil:	soil in which significant detrimental ice forms when the requisite moisture and freezing conditions are present.
Frost table:	the upper limit of frozen ground.
Foundation:	the lower, man-made, supporting part of an engineering structure in contact with the underlying soil to which it transmits the weight of the structure.
Geology:	the study of the planet Earth; its composing materials; its morphology; its history; and the forces that are acting upon it.

Geomorphology:	the study of the shape of the earth's surface and the processes which act upon it.
Glacially over-steepened:	a valley wall whose slopes have been steepened due to erosive force of a glacier.
Glaciation:	(a) the covering of land by glaciers; (b) a part of geologic time during which glaciers were more extensive than at present.
Glaciofluvial:	pertaining to rivers and streams resulting from the melting of glaciers.
Glaciolacustrine:	pertaining to or deposited in glacial lakes.
Gossan:	an iron bearing weathering product overlying a sulphide deposit.
Ground ice:	ice in pores and other openings in soil or rock.
Horn:	a high, rocky, sharp-pointed, steep sided pyramidal mountain peak bound by the intersecting walls of three or more cirques.
Hydrogeology:	scientific study of the chemistry, supply potential and flow characteristics of water in surficial geological materials and near-surface bedrock.
Igneous:	said of a rock or mineral that solidified from molten or partly molten material.
Illinoian:	the time interval during which the penultimate Pleistocene glaciation occurred.
Interglacial:	pertaining to or formed during the time interval between two glaciations.
Lacustrine (deposit):	deposited in a lake.
Liquefaction:	the sudden large decrease of the shear strength of a soil caused by a shock or strain and associated with sudden, temporary increases in porefluid pressure.
Loess:	windblown, homogeneous, commonly nonstratified, unconsolidated silt and fine sand.
Mass movement:	see mass wasting.

Mass wasting:	the process by which the dislodgement and down-slope transport of soil and rock occurs through gravitational stresses primarily.
Meltwater:	water derived from the melting of a glacier.
Moraine:	mound, ridge or distinct accumulation of unsorted unstratified material (till) deposited directly by a glacier.
Nivation:	erosion of soil and rock beneath a snowbank and around its margin, caused mainly by frost action and meltwater transport.
Nivation terraces:	a bench or terrace formed by the process of nivation.
Nunatak:	an isolated hill or mountain that projects prominantly above the surface of a glacier (past or present).
Organics:	material composed of peat or finely decomposed plant and animal remains (muck).
Outwash:	stratified sand and gravel deposited near the front of a glacier by meltwater streams.
Pad:	a fill constructed to protect the underlying terrain.
Palsa (pl. palsen):	round or elongated hillock or mound less than 10 m high composed of peat overlying frozen soil.
Peat:	unconsolidated, compressible soil consisting of partially decomposed semi-carbonized remains of plants, some animal residues and minor mineral soil.
Pediment:	a broad flat or gently sloping, rock-floored erosion surface or plain of low relief, typically developed by subaerial agents.
Periglacial processes:	processes occuring in cold regions due to frost action.
Permafrost:	the thermal condition in soil or rock having temperatures below $0^{o}C$ persist over two or more years.
Permafrost, discontinuous:	permafrost occuring in some areas beneath the ground surface throughout a regional zone where other areas are free of permafrost.

Permafrost, dry:	perennially frozen soil or rock without ice.
Permeability:	the ability of a porous or fractured medium to transmit water.
Physiography:	description of the surface features of the Earth such as water and land bodies.
Pile:	a long slender member driven into the ground in order to transmit the load of a structure to a material at depth.
Pingo:	a conical hill with circular or oval base which has a core of massive ground ice covered with soil and vegetation and exists for two winters.
Plastic:	said of a body which may be continuously, permanently deformed without rupturing.
Pleistocene:	the part of the Quaternary when glaciers repetitively expanded much beyond their present limits (covering most of Canada) and retracted to near their present positions.
Pollutants:	any dissolved chemical or suspended contaminant which degrades the potability of a water supply.
Polygonal ground, frost polygons:	patterned ground marked by polygon-like arrangements of rock fragments, soil, vegetation or ice-wedge network.
Postglacial:	pertaining to the time interval since the last major glaciation of the Pleistocene (approximately the last 10,000 years).
Quaternary:	the period of time encompassing the last two or three million years.
Retrogressive thaw flow slide:	a landslide which retreats in a retrogressive fashion through melting of permafrost.
Rock glacier:	a mass of rock fragments and soil cemented by ice and/or underlain by ice that moves slowly downslope in a manner similar to glacier flow.
Rotational slump:	a landslide, generally involving a large, block of material which fails by backward rotation along a deep, curved failure plane.

Seismic activity:	the phenomena of Earth movements including earthquakes.
Shear Strength:	is the ability of a soil to resist rupture.
Skin flow:	a landslide involving only the surface material.
Solifluction:	slow, viscous downslope movement of water-logged surficial material underlain by frozen ground.
Sorted:	a well sorted sediment has uniform grainsize; a poorly sorted sediment contains a wide variety of grain sizes.
Stratigraphy:	the arrangement of sedimentary units within the earth.
Subaerial:	Occurring beneath the atmosphere or in the open air.
Subgrade:	the surface immediately below a structure that is levelled off to receive the foundation of an engineering structure.
Tectonic:	said of or pertaining to the forces involved in major deformations of the earths crust (eg. mountain building).
Terrace:	a level or gently inclined surface bounded on one edge by a steep descending slope and on the other by a steep ascending slope.
Terrain type:	a landscape or terrain unit characterized by a unique morphology and underlain by a defined surficial materials.
Tor:	a high, isolated, craggy hill, pinnacle, or rock peak.
Thermokarst:	the process of differential thaw settlement because of the melting of ground ice in an area of permafrost.
Thermokarst depressions:	depressions in the land surface formed by thermokarst.
Thermokarst lakes:	lakes within depressions in the land surface formed by thermokarst.
Trafficability:	the quality or suitability of a soil or a terrain to permit and support moving vehicles.

Utilidor:	an above- or below-ground conduit that acts as an enclosed corridor for a network of pipes and cables which supply community services to individual homes.
Water table:	the upper limit of saturated soil.
(Late) Wisconsinan:	the time interval during which the last great Pleistocene glaciation occurred, approximately between 30,000 and 10,000 years ago.
Workability:	the ease with which a material may be put to use (eg. extracted, crushed, screened, moved, formed, etc.).

APPENDIX A

Suitability Evaluations
of
Terrain Typing

Table A.5.1 Evaluation of Terrain Type Suitability for Construction of Permanent Facilities or Intensive Use of Terrain in the Dempster Highway
Note special conditions indicated where phases of terrain units are present and if phases have significantly different suitabilities.

Terrain Factors: G - Good, FG - Fairly Good, F - Fair (marginal), P - Poor,
U - Unsuitable (very poor), I.A. - Individual Assessment preferrable, N/A - Non Applicable

Terrain Unit Symbol and Special Conditions		Slope (sl)	Drainage (wt)	Flood Hazard (fl)	Permafrost and Ice (pf)	Hazards (hz)	Bedrock Depth (br)	Materials; Stoniness (mt)	Terrain Unit Rating	Limiting Factors
A_p-A		G	FG	U	G	G	G	P	U	fl
A_p		G	FG	P-U	G	G	G	F	P	fl
Af	north of lat. 65°00'	F	FG	F	P	FG	G	FG-F	P	pf
Af-R	north of lat. 65°00'	F	FG	F	P	FG	G	FG-F	P	pf
gAf	north of lat. 65°00'	F-P	FG	F	P	FG	G	FG	P	pf
gAf-A	north of lat. 65°00'	F-P	FG	P-U	P	FG	G	FG	P	fl,pf
fAf	north of lat. 65°00'	FG	F	F	P	FG	G	F	P	pf
Af	south of lat. 65°00'	F	FG	F	FG	FG	G	FG-F	F	sl,fl
Af-R	south of lat. 65°00'	F	FG	F	FG	FG	G	FG-F	F	sl,fl
gAf	south of lat. 65°00'	F-P	FG	F	FG	FG	G	FG-F	F	sl,fl
gAf-A	south of lat. 65°00'	F-P	FG	P-U	FG	FG	G	FG-F	P	fl
fAf	south of lat. 65°00'	FG	F	F	FG	FG	G	FG-F	F	wt,fl
Aa	Eagle Plains	G	F	FG-F	P	P-solifluction	G	F	P	pf,hz
bAa	Eagle Plains	F-P	FG	FG-F	P	F	G	P	P	pf,mt
fAa	Eagle Plains	G	F	FG-F	P	P-solifluction	G	F-P	P	pf,hz
fAa-A	Eagle Plains	G	F	P	P	F	G	F-P	P	fl,pf
fAa-R	Eagle Plains	G	P	F	P	F	G	F-P	P	wt,pf
gAa	Eagle Plains	G	FG	FG-F	P	F	G	F	P	pf
Aa	Ogilvie Mtns	F-P	F	FG-F	F	F	G-FG	F	F	sl,wt,pf,hz, mt
bAa	Ogilvie Mtns	F-P	FG-F	FG-F	F	F	G-FG	P	P	mt
fAa	Ogilvie Mtns	F-P	F	FG-F	F	F	G-FG	F-P	F	sl,mt
fAa-A	Ogilvie Mtns	F-P	F	P	F	F	G-FG	F-P	P	fl
fAa-R	Ogilvie Mtns	F-P	P	F	P	F	G-FG	F-P	P	wt,pf
gAa	Ogilvie Mtns	F-P	FG	FG-F	F	F	G-FG	F	F	sl,pf,hz
At'		G	FG-F	FG-F	F-P	FG	G	FG	F	pf
At²	Engineer Creek	G	FG	FG	P	FG	G	U	U	mt
At²	Everywhere else	G	FG	FG	P	FG	G	P-U	P	pf,mt
At³	Tintina Trench	G	FG	G	G	FG	G	F	F	mt
At³	Everywhere else	G	FG	G	P	FG	G	FG	P	pf
$\frac{fCb}{Rp}$		FG	F	G	F-P	F	G	F	F	pf
$\frac{fCb}{Rp}$-R		FG	F	G	P	F	G	F	P	pf
$\frac{fEb}{Rp}$		FG	F	G	F-P	F	G	F	F	pf

Table A.5.1 (cont'd)

$\frac{fE_p}{R_p}$	G	F	G	F	FG	G	F	F	wt,pf,mt
Cb	G	FG-F	G	F-P	F-solifluction	G	F	F	pf,hz,mt
aCb	G	FG-F	G	F-P	F-solifluction	G	F	F	pf,hz,mt
bCb	G	FG-F	G	F-P	F-solifluction	G	P	P	mt
fCb	G	F-P	G	P	F-solifluction	G	F-P	P	pf
fCb-R	G	F-P	G	P	F-solifluction	G	F-P	P	pf
rCb	G	FG-F	G	F-P	F-solifluction	G	F	F	pf,mt
Cb1	F	FG	G	F	F-P-solifluction	F	F	F	sl,pf,hz,br, mt
aCb1	F	FG	G	F	F-solifluction	F	F	F	sl,pf,hz,br, mt
bCb1	F	FG	G	F	F-solifluction	F	P	P	mt
fCb1	F	F	G	P	F-P-flows -solifluction	F	F-P	P	pf
fCb1-R	F	F	G	P	F-P-flows -solifluction	F	F-P	P	pf
rCb1	F	FG	G	F	F-solifluction	F	F	F	sl,pf,hz,mt
rCb1-R	F	P	G	P	F-solifluction	F	F	P	wt,pf
rfCb1	F	FG	G	F	F-solifluction	F	F	FG-F	sl,pf,hz
Cb2	U	FG	G	FG-F	F-P-flows solifluction	F-P	F	U	sl
aCb2	U	FG	G	FG	F-P-flows -solifluction	F-P	F	U	sl
bCb2	U	FG	G	FG	F-P-solifluction	F-P	P	U	sl
fCb2	U	FG	G	F	P-flows -solifluction	F-P	F-P	U	sl
fCb2-R	U	F	G	P	P-flows -solifluction	F-P	F-P	U	sl
rCb2	U	FG	G	FG	P-solifluction	F-P	F	U	sl
Cv	G	FG	G	F	P-mass movement	F	F	P	hz
bCv	G	G-FG	G	F	P-mass movement	F	P	P	hz,mt
rCv	G	FG	G	F	P-mass movement	F	F-P	P	hz
fCv	G	F	G	F-P	P-mass movement	F	F-P	P	hz
Cv1	F	G-FG	G	F	P-mass movement	P	F-P	P	hz,br
bCv1	F	G	G	F	P-rock fall	P	P	P	hz,br,mt
rCv1	F	G-FG	G	F	P-mass movement	P	F-P	P	hz,br
fCv1	F	FG-F	G	F-P	P-flows -mass movement	P	F	P	hz,br
Cv2	U	G-FG	G	F	P-rock falls	U	F-P	U	sl,br
bCv2	U	G	G	F	P-rock falls	U	P	U	sl,br
rCv2	U	G-FG	G	F	P-mass movement -rock falls	U	F-P	U	sl,br
fCv2	U	FG	G	F-P	P-flows -mass movement	U	F-P	U	sl,br
Cvs	U	G	G	F	P-rock falls	U	F-P	U	sl,br
rCvs	U	G	G	F	P-rock falls	U	P	U	sl,br
Ca	U	G	G	G	U-rock falls	G	U	U	sl,hz,mt

Table A.5.1 (cont'd)

Ct		F	P	G	F	P-nivation -solifluction	FG	F	P	wt,hz
bCt		F	P	G	F	P-nivation -solifluction	FG	F	P	wt,hz
aDp	Klondike Valley	G	G	G	G	G-I.A.	G	G-FG	G	
Gh	north of lat. 64°30'	F	FG	G	FG	FG	G	G	F	sl
Gh	South of lat. 64°30'	F	FG	G	G	G	G	G	F	sl
Gh-R		F	FG	G	F	FG	G	G	F	sl,pf
Gr		F	FG	G	FG	FG	G	G	F	sl
Gt	North of lat. 64°30'	G	G-FG	G	FG	FG	G	G	FG	pf,hz
Gt	south of lat. 64°30'	G	G-FG	G	G	G	G	G	G	
Gt-R		G	G-FG	G	F-P	FG	G	G	F	pf
Gp	north of lat. 64°30'	G	G-FG	G	FG	FG	G	G	FG	pf,hz
Gp	south of lat. 64°30'	G	G	G	G	G	G	G	G	
Gf	north of lat. 64°30'	G	G-FG	G	FG	FG	G	G	FG	pf,hz
Gf	south of lat. 64°30'	G	G	G	G	G	G	G	G	
Gb	north of lat. 64°30'	FG	FG	G	G	FG	FG	G	FG	sl,wt,hz,br
Gb	south of lat. 64°30'	FG	G	G	G	G	FG	G	FG	sl,br
Mh		F	F	G	FG-F	P-flows	G	FG-F	P	hz
Mh-R		F	F	G	F-P	P-flows	G	FG-F	P	pf,hz
Mr		FG	F	G	FG-F	FG	G	FG-F	F	wt
Mr-R		FG	F	G	F-P	FG	G	FG-F	F	wt,pf
Mm		FG	FG-F	G	F	F	G	FG-F	F	pf,hz
Mm-R		FG	FG-F	G	F-P	F	G	FG-F	F	pf,hz
Mp		G	FG	G	F	FG	G	FG-F	F	pf
Mp-R		G	FG	G	F-P	FG	G	FG-F	F	pf
MN		F	FG	G	F	P-solifluction	G	FG-F	P	hz
Mb		G	F	G	FG	FG	G	FG-F	F	wt
Mb1		FG-F	F-FG	G	FG	F-mass movement	FG-F	FG-F	F	hz
Mb2		P-U	FG	G	FG	P-mass movement	F	FG-F	P	sl,hz
Mv		G	FG	G	G	FG	F	FG-F	F	br
Mv1		FG-F	G-FG	G	G	F-mass movement	P	FG-F	P	br
Mv2		P-U	G	G	G	P-mass movement	U	FG-F	U	sl,br
Lp		G	F-P	G	F-P	F-slumps	G	F-P	F	wt,pf,mt
fLp		G	F-P	G	F-P	F-slumps	G	F-P	F	wt,pf,mt
Lp-R		G	F-P	G	P	F-slumps	G	F-P	P	pf
MR		F	G-FG	G	P	U-I.A.-moving	G	U	U	hz,mt
L	Ogilvie Mtns	P-U	FG	G	F	U-landlside	G	P	U	sl,hz
L	Tintina Trench	P-U	FG	G	F	U-landslide	G	G	U	sl,hz
		P-U	FG	G	F	U-landslide	G	P	U	sl,hz

Table A.5.1 (cont'd)

$\mathcal{L}_h$	P-U	FG	G	F	U-landslide	G	P	U	sl,hz
$\mathcal{L}_m$	P-U	FG	G	F	U-landslide	G	P	U	sl,hz
$\mathcal{L}_r$	U	G	G	F	P-rock falls	U	N/A	U	sl,br

Table A.6.1 Evaluation of Terrain Type Suitability for Pipeline Construction in the Dempster Highway Area. Note special conditions indicated where phases of terrain units are present and if phases have significantly different suitabilities.

Terrain Factors: G - Good, FG - Fairly Good, F - Fair (marginal), P - Poor, U - Unsuitable (very poor), I.A. - Individual Assessment preferrable, N/A - Not Applicable

Terrain Unit Symbol and Special Conditions		Slope (sl)	Drainage (wt)	Flood Hazard (fl)	Permafrost and Ice (pf)	Hazards (hz)	Bedrock Depth (br)	Materials; Stoniness (mt)	Terrain Unit Rating	Limiting Factors
A_{p}-A		G	G	P	G	P-shifting channel	F-G	G	P	pf,hz
A_{p}		G	G-FG	F	FG	G	G	F	fl	
Af	north of lat. 65°00'	FG	FG-F	F	F	FG	G	G	F	fl,pf
Af-R	north of lat. 65°00'	F	FG-F	F	P	FG	G	G	P	pf
gAf	north of lat. 65°00'	F	FG	F	F	FG	G	G	F	sl,fl,pf
gAf-A	north of lat. 65°00'	F	FG	F-P	FG-F	P-active	G	G	P	hz
fAf	north of lat. 65°00'	FG	F	F	F-P	FG	G	FG	F	wt,fl,pf
Af	south of lat. 65°00'	FG	FG-F	F	FG	FG	G	FG	F	fl
Af-R	south of lat. 65°00'	F	FG-F	F-P	P	FG	G	FG	P	pf
gAf	south of lat. 65°00'	F	FG	F	G	FG	G	F	F	sl,fl,mt
gAf-A	south of lat. 65°00'	F	FG	F	G	P-active	G	F	P	hz
fAf	south of lat. 65°00'	FG	F	F	FG	FG	G	FG	F	wt,fl
A_{a}	Eagle Plains	FG	F	G	P	FG	FG	F	P	pf
bA_{a}	Eagle Plains	P	FG	G	F	FG	FG	F	P	sl
fA_{a}	Eagle Plains	G-FG	F-P	G	P	FG	FG	F	P	pf
fA_{a}-A	Eagle Plains	G-FG	F	F	F	F-active	FG	F	F	wt,fl,pf,hz, mt
fA_{a}-R	Eagle Plains	G-FG	P	FG	U	F-mass movement	FG	F	U	pf
gA_{a}	Eagle Plains	F	FG	G	F	F-solifluction	FG	FG	F	sl,pf,hz
A_{a}	Ogilvie Mtns	P	F	G	FG	FG	FG	F	P	sl
bA_{a}	Ogilvie Mtns	P-U	FG	G	FG	FG	FG	P	P	sl,mt
fA_{a}	Ogilvie Mtns	P	F-P	G	FG	FG	FG	FG	P	sl
fA_{a}-A	Ogilvie Mtns	P	F	F	FG	F-active	FG	FG	P	sl
fA_{a}-R	Ogilvie Mtns	P	P	FG	F	FG	FG	FG	P	sl,wt
gA_{a}	Ogilvie Mtns	P-U	FG	G	FG	FG	FG	G	P	sl
At'		G	FG-F	F	F	F-slump	FG	FG	F	fl,pf,hz
At^{2}	Engineer Creek	G	FG	FG	F-P	FG	FG	U	U	mt
At^{2}	Everywhere else	G	FG	FG	F-P	FG	FG	P	P	mt
At^{3}	Tintina Trench	G	FG	G	G	FG	G	FG	FG	wt,hz,mt
At^{3}	Everywhere else	G	FG	G	P	FG	G	F	P	pf
$\frac{fCb}{R_{p}}$		F	FG	G	F	FG	FG	FG	F	sl,pf
$\frac{fCb}{R_{p}}$-R		F	F	G	P	FG	FG	FG	P	pf
$\frac{fCp}{R_{p}}$		F	FG	G	F	FG	G	FG	F	sl,pf

Table A.6.1 (cont'd)

fEb/Rp	G	F-P	G	G	FG	FG	FG	F	wt
fEp/Rp	G	F-P	G	G	FG	G	FG	F	wt
Cb	FG	F-P	G	F-P	FG	FG-F	FG-F	F	wt,pf
aCb	FG	F	G	F-P	FG	FG-F	FG-F	F	wt,pf,mt
bCb	FG	F	G	FG	FG	FG-F	F-P	F	wt,mt
fCb	FG	F-P	G	P	P-solifluction	FG-F	FG	P	pf,hz
fCb-R	FG	P	G	U	P-solifluction	FG-F	FG	U	pf
rCb	FG	F	G	FG-F	FG	FG-F	F	F	wt,mt
Cb1	F-P	FG-F	G	F	F-solifluciton	FG-F	FG-F	F	sl,pf,hz
aCb1	F-P	FG	G	F-P	F-solifluction	FG-F	F	F	sl,pf,mt
bCb1	F-P	FG	G	FG	FG	FG-F	F-P	F	sl,mt
fCb1	F-P	FG-F	G	P	P-U-solifluction -slides	FG-F	FG	P	pf,hz
fCb1-R	F-P	F	G	U	P-U-slides -solifluction	FG-F	FG	U	pf,hz
rCb1	F-P	FG	G	FG	FG	FG-F	F	F	sl,mt
rCb1-R	F-P	F	G	P	F	FG-F	F	P	pf
rfCb1	F-P	FG	G	F	FG	FG-F	FG-F	F	pf
Cb2	U	FG	G	FG-F	F-creep -solifluction	FG-F	FG-F	U	sl
aCb2	U	FG	G	F	F-creep -solifluction	FG-F	F	U	sl
bCb2	U	FG	G	FG	F-creep -solifluction	FG-F	F-P	U	sl
fCb2	U	FG	G	P	U-slides	FG-F	FG	U	sl
fCb2-R	U	FG-F	G	U	U-slides	FG-F	FG	U	sl
rCb2	U	FG	G	FG	F-creep -solifluction	FG-F	F	U	sl
Cv	FG	FG	G	F	F-creep	P-U	F	P	br
bCv	FG	FG	G	FG	F-creep	U	F	U	br
rCv	FG	FG	G	FG	F-creep	P-U	FG	P	br
fCv	FG	F	G	F-P	F-creep	P	F	P	br
Cv1	F-P	FG	G	F	P-solifluction creep	P-U	F	P	hz,br
bCv1	F-P	FG	G	FG	P-solifluction creep	U	F	U	br
rCv1	F-P	FG	G	FG	P-solifluction creep	P-U	FG	P	hz,br
fCv1	F-P	F	G	F-P	P-solifluction creep	P	F	P	hz,br
Cv2	U	FG	G	F	P-U-creep solifluction	P-U	F	U	sl
bCv2	U	FG	G	FG	P-U-creep solifluction	U	F	U	sl,br
rCv2	U	FG	G	FG	P-U-creep solifluction	P-U	FG	U	sl
fCv2	U	F	G	F-P	P-U-creep solifluction	P	F	U	sl
Cvs	U	FG	G	FG	U-creep rock falls	P-U	F	U	sl,hz
aCv2	U	FG	G	FG					

Table A.6.1 (cont'd)

Ca		U	G	G	FG	U-creep rock falls	G	P	U	sl,hz
rCa		U	G	G	FG	U-creep rock falls	G	P	U	sl,hz
Ct		F	P	G	F-P	U-solifluction creep	F	F	U	hz
bCt		F	P	G	F-P	U-solifluction creep	F	F	U	hz
aDp	Klondike Valley	G	G	G	G	G-I.A.	G	G-FG	G	
Gh	north of lat. 64°30'	F-P	FG	G	G	FG	G	G	F	sl
Gh	south of lat. 64°30'	F-P	FG	G	FG	FG	G	G	F	sl
Gh-K		F-P	F	G	F	FG	G	G	F	sl,wt,pf
Gr		F	FG	G	FG	FG	G	G	F	sl
Gt	north of lat. 64°30'	G	FG	G	FG	FG	G	G	FG	wt,pf,hz
Gt	south of lat. 64°30'	G	FG	G	G	FG	G	G	FG	wt,hz
Gt-K		G	FG-F	G	F	FG	G	G	F	pf
Gp	north of lat. 64°30'	G	FG	G	FG	FG	G	G	FG	wt,pf,hz
Gp	south of lat. 64°30'	G	FG	G	G	FG	G	G	FG	wt,hz
Gf	north of lat. 64°30'	FG	FG-F	G	FG	G	G	G	FG	sl,wt,pf
Gf	south of lat. 64°30'	FG	FG-F	G	G	G	G	G	FG	sl,wt
Gb	north of lat. 64°30'	FG-F	G	G	FG	G	FG-F	G	FG	sl,pf,br
Gb	south of lat. 64°30'	FG-F	G	G	G	G	FG-F	G	FG	sl,br
Mh		F-P	F-P	G	F	G	G	F-FG	F	sl,wt,pf
Mh-K		F-P	F-P	G	F-P	G	G	F-FG	F	sl,wt,pf
Mr		F	F	G	F	G	G	F-FG	F	sl,wt,pf
Mr-K		F	F	G	F-P	G	G	G-FG	F	sl,wt,pf
Mm		FG	F	G	F-P	FG	G	G-FG	F	wt,pf
Mm-K		FG	F	G	P	FG	G	G-FG	P	pf
Mp		G	FG	G	F-P	FG	G	G-FG	F	pf
Mp-R		G	F	G	P	F-solifluction	G	G-FG	P	pf
Mw		F	FG	G	F-P	P-slumping -solifluction	G	G-FG	P	hz
Mb		FG	FG	G	FG	FG-creep - solifluction	FG-F	G-FG	FG	sl,wt,pf,hz, br
Mb1		F-P	FG	G	FG	P-solifluction creep	FG-F	G-FG	P	hz
Mb2		U	FG	G	FG	P-U-solifluction creep	FG-F	G-FG	U	sl
Mv		FG	FG	G	G	FG-creep	P-U	G-FG	P	br
Mv1		F-P	FG	G	G	P-creep solifluction	P-U	G-FG	P	hz,br
Mv2		U	FG	G	G	P-U-solifluction	P-U	G-FG	U	sl

Table A.6.1 (cont'd)

Lp		G	F	G	F	FG-F-slump	G	FG	F	wt,pf
fLp		G	F	G	F	FG-F-slump	G	FG	F	wt,pf
Lp-R		G	F	G	P	FG-F-slump	G	FG	P	pf
MR		P-U	FG	G	F	U-active	G	P	U	hz
Q	Ogilvie Mtns	U	FG-F	G	P	U-landslide	G	P	U	sl,hz
Q	Tintina Trench	U	FG-F	G	FG	U-landslide	G	G	U	sl,hz
Qh		U	FG-F	G	P	U-landslide	G	P	U	sl,hz
Qm		U	FG-F	G	P	U-landslide	G	P	U	sl,hz
Qc		U	FG-F	G	P	U-landslide	G	P	U	sl,hz
R		U	G	G	FG	G	U		U	sl,br

Table A.7.1 Evaluation of Terrain Type Suitabilities for Construction of Temporary Facilities or Light Use of Terrain in the Dempster Highway Area.
Note special conditions indicated where phases of terrain units are present and if phases have significantly different suitabilities.

Terrain Factors: G - Good, FG - Fairly Good, F - Fair (marginal), P - Poor,
U - Unsuitable (very poor), I.A. - Individual Assessment preferrable, N/A - Not Applicable

Terrain Unit Symbol and Special Conditions		Slope (sl)	Drainage (wt)	Flood Hazard (fl)	Permafrost and Ice (pf)	Hazards (hz)	Bedrock Depth (br)	Materials; Stoniness (mt)	Terrain Unit Rating	Limiting Factors
A_p-A		G	G	U	FG	G		G	U	fl
A_p		G	G	F	FG	G		G	F	fl
Af	north of lat. 65°00'	FG	F	G-FG	F	G		FG	F	wt,pf
Af-K	north of lat. 65°00'	FG	F	G-FG	P	G		FG	P	pf
gAf	north of lat. 65°00'	F	G	F-FG	FG	G		G	F	sl
gAf-A	north of lat. 65°00'	F	FG	F	F	G		G	F	sl,fl,pf
fAf	north of lat. 65°00'	FG	F-P	G-FG	F-P	G		FG	F	wt,pf
Af	south of lat. 65°00'	FG	F	G-FG	FG	G		FG	F	wt
Af-K	south of lat. 65°00'	FG	F	G-FG	P	G		FG	P	pf
gAf	south of lat. 65°00'	F	G	G-FG	G	G		G	F	sl
gAf-A	south of lat. 65°00'	F	FG	F	G	G		G	F	sl,fl
fAf	south of lat. 65°00'	FG	F-P	G-FG	FG	F		FG	F	wt
Aa	Eagle Plains	G	FG	G	F-P	F		FG	F	pf,hz
bAa	Eagle Plains	FG	G	G	F	FG		G	F	pf
fAa	Eagle Plains	G	FG	G	P	F		F	P	pf
fAa-A	Eagle Plains	G	F	FG	F-P	F		F	F	wt,pf,mt,hz
fAa-K	Eagle Plains	G	F	FG	U	F		F	U	pf
gAa	Eagle Plains	FG	G	G	F	FG		G	F	pf
Aa	Ogilvie Mtns	FG	G	G	F	FG		FG	F	pf
bAa	Ogilvie Mtns	F	G	G	FG	FG		G	F	sl
fAa	Ogilvie Mtns	FG	FG	G	F	FG		F	F	pf,mt
fAa-A	Ogilvie Mtns	FG	F	FG	FG	FG		F	F	wt,mt
fAa-R	Ogilvie Mtns	FG	F	FG	F	FG		F	F	wt,pf,mt
gAa	Ogilvie Mtns	F	G	G	FG	FG		G	F	sl
At^1		G	G-FG	G-FG	P	G		G-FG	P	pf
At^2	Engineer Creek	G	FG	G	P-U	G		U	U	mt
At^2	Everywhere else	G	G	G	F-P	G		P	P	mt
At^3	Tintina Trench	G	FG	G	G	G		F-P	F	mt
At^3	Everywhere else	G	FG	G	P	G		P	P	pf,mt
$\frac{fCk}{R_p}$		FG	FG	G	P	FG		F	P	pf

Table A.7.1 (cont'd)

fCb-R	FG	FG	G	P-U	FG	F	P	pf
fCP	FG	FG	G	P	FG	F	P	pf
RP fEb	FG	FG	G	G	G	F	F	mt
RP fEP	FG	FG	G	G	G	F	F	mt
RP Cb	G	F	G	P	F	FG-F	P	pf
aCb	G	FG	G	F-P	FG	F	F	pf,mt
bCb	G	G	G	F-P	FG	F	F	pf,mt
fCb	G	F	G	P	F	FG-F	P	pf
fCb-R	G	F-P	G	P	F	FG-F	P	pf
rCb	G	FG	G	F-P	FG	FG	F	pf
Cb1	FG-F	FG-F	G	F	F-P	F_-F	F	pf,hz
aCb1	FG-F	FG	G	FG-F	F	F	F	hz,mt
bCb1	FG-F	G	G	FG	F	F	F	hz,mt
fCb1	FG-F	FG-F	G	F	P	FG-F	P	pf,hz
fCb1-R	FG-F	F	G	F	P	FG-F	P	hz
rCb1	FG-F	FG-F	G	FG	F-P	FG	F	hz
rCb1-R	FG-F	F	G	F	F-P	FG	F	wt,pf
rfCb1	FG-F	FG-F	G	FG	F	FG	F	hz
Cb2	P-U	FG	G	FG	P	FG-F	P	sl,hz
aCb2	P-U	G	G	FG	F	F	P	sl
bCb2	P-U	G	G	FG	F	F	P	sl
fCb2-R	P-U	FG-F	G	F	P	FG-F	P	sl,hz
fCb2	P-U	FG	G	FG	P	FG-F	P	sl,hz
rCb2	P-U	G	G	FG	F	FG	P	sl
Cv	G	G-FG	G	FG-F	FG	F	F	mt
bCv	G	G	G	FG-F	FG	F	F	mt
rCv	G	G	G	FG-F	FG	FG	FG	pf,hz,mt
fCv	G	FG	G	F	FG	F	F	pf,mt
Cv'	FG-F	G	G	FG-F	F-mass movement	F	F	hz,mt
bCv'	FG-F	G	G	FG-F	F-mass movement	F	F	hz,mt
rCv'	FG-F	G	G	FG-F	F-mass movement	FG	F	hz
fCv'	FG-F	G	G	F	F-mass movement	F	F	pf,hz,mt
Cv2	P-U	G	G	FG-F	P-slides	F	P	sl,hz
bCv2	P-U	G	G	FG-F	P-slides	F	P	sl,hz
rCv2	P-U	G	G	FG-F	P-slides	FG	P	sl,hz
fCv2	P-U	G	G	FG-F	P-slides	F	P	sl,hz
Cvs	U	G	G	FG	U	F	U	sl,hz
rCvs	U	G	G	FG	U	F	U	sl,hz
Ca	U	G	G	G	P-falls	P-U	U	sl
rCa	U	G	G	G	P-falls	P-U	U	sl
Ct	G	P	G	F	P-solifluction	F	P	hz
bCt	G	P	G	F	P-solifluction	F	P	hz
rDp Klondike Valley	G	G	G	G	S-L-A			

Table A.7.1 (cont'd)

Gh	north of lat. 64°30'	FG	G	G	F	FG	G	F	pf
Gh	south of lat. 64°30'	FG	G	G	G	FG	G	FG	sl,hz
Gh-K		FG	G	G	F	FG	G	F	pf
Gr		FG	G	G	G	FG	G	FG	sl,hz
Gt	north of lat. 64°30'	G	G	G	FG	G	G	FG	pf
Gt	south of lat. 64°30'	G	G	G	G	G	F	F	mt
Gt-K		G	G	G	F	G	G	F	pf
Gp	north of lat. 64°30'	G	G	G	FG	G	G	FG	pf
Gp	south of lat. 64°30'	G	G	G	G	G	FG	FG	mt
Gf	north of lat. 64°30'	G	G	G	FG	G	G	FG	pf
Gf	south of lat. 64°30'	G	G	G	G	G	F	F	mt
Gb	north of lat. 64°30'	FG	G	G	G	G	G	FG	sl
Gb	south of lat. 64°30'	FG	G	G	G	G	G	FG	sl
Mh		FG-F	F	G	F	G	G	F	wt,pf
Mh-K		FG-F	F	G	P	G	G	P	pf
Mr		G-FG	FG-F	G	F	G	FG	F	pf
Mr-K		G-FG	FG-F	G	P	G	FG	P	pf
Mm		FG	FG	G	F	FG	FG	F	pf
Mm-K		FG	FG	G	P	FG	FG	P	pf
Mp		G	FG	G	F	FG	FG	F	pf
Mp-K		G	FG	G	P	FG	FG	P	pf
Mw		FG-F	FG	G	F	FG	FG	F	pf
Mb		G	FG	G	G	FG	FG	FG	wt,hz,mt
Mb1		FG-F	FG	G	G	F-mass movement	FG	F	hz
Mb2		P-U	G	G	G	P-mass movement	FG	P	sl,hz
Mv		G	FG	G	G	FG	FG	FG	wt,hz,mt
Mv1		FG-F	FG	G	G	F-mass movement	FG	F	hz
Mv2		P-U	FG	G	G	P-mass movement	FG	P	sl,hz
Lp		G	F	G	F	G	FG	P	pf
fLp		G	F	G	P	G	FG	P	wt,pf
Lp-K		G	F	G	P	F-slides	FG	P	pf
MR		P	G	G	F	U-rock glacier	P-U	U	hz
L	Ogilvie Mtns	P-U	FG	G	F	U - I.A.	P-U	U	hz
L	Tintina Trench	P-U	FG	G	F	U- I.A.	P-U	U	hz
Lh		P-U	FG	G	F	U - I.A.	P-U	U	hz
Lh		P-U	FG	G	F	U - I.A.	P-U	U	hz
Lm		P-U	FG	G	F	U - I.A.	P-U	U	hz
Lr		P-U	FG	G	F	U - I.A.	P-U	U	hz

Table A.8.1 Evaluation of Terrain Type Suitability for Sewage Lagoons and Sanitary Landfills in the Dempster Highway Area. Note special conditions indicated where phases of terrain units are present and if phases have significantly different suitabilities.

Terrain Factors: G - Good, FG - Fairly Good, F - Fair (marginal), P - Poor, U - Unsuitable (very poor), I.A. - Individual Assessment preferrable, N/A - Not Applicable

Terrain Unit Symbol and Special Conditions		Slope (sl)	Drainage (wt)	Flood Hazard (fl)	Permafrost and Ice (pf)	Hazards (hz)	Bedrock Depth (br)	Materials; Stoniness (mt)	Terrain Unit Rating	Limiting Factors
Ap-A		G	G	U	G	G	G	U	U	fl,mt
Ap		G	FG	P	G	G	G	U	U	mt
Af	north of lat. 65°00'	F	FG	FG	P	FG	G	P	P	pf,mt
Af-R	north of lat. 65°00'	F	FG	FG	P-U	FG	G	P	P	pf,mt
gAf	north of lat. 65°00'	P	G	FG	F-P	FG	G	U	U	mt
gAf-A	north of lat. 65°00'	P	G	F	F-P	FG	G	U	U	mt
fAf	north of lat. 65°00'	F	F	FG	P	FG	G	P	P	pf,mt
Af	south of lat. 65°00'	F	FG	FG	FG	FG	G	P	P	mt
Af-R	south of lat. 65°00'	F	FG	FG	FG	FG	G	P	P	mt
gAf	south of lat. 65°00'	P	G	FG	FG	FG	G	U	U	mt
gAf-A	south of lat. 65°00'	P	G	F	FG	FG	G	U	U	mt
fAf	south of lat. 65°00'	F	F	FG	FG	FG	G	P	P	mt
Aa	Eagle Plains	FG	F	G	F	F-creep	G	F	F	wt,pf,hz,mt
bAa	Eagle Plains	FG	FG	G	FG	F-creep	G	P	P	mt
fAa	Eagle Plains	FG	F	G	P	F-creep	G	FG	P	pf
fAa-A	Eagle Plains	FG	P	F	F	F-creep	G	FG	P	wt
fAa-R	Eagle Plains	FG	P	FG	U	F-creep	G	FG	U	pf
gAa	Eagle Plains	FG	FG	G	FG	F-creep	G	P	P	mt
Aa	Ogilvie Mtns	F	F	G	FG	F-creep	G	F	F	sl,wt,hz,mt
bAa	Ogilvie Mtns	P	FG	G	G	F-creep	G	P	P	sl,mt
fAa	Ogilvie Mtns	F	F	G	FG	F-creep	G	FG	F	sl,wt,hz
fAa-A	Ogilvie Mtns	F	P	F	FG	F-creep	G	FG	P	wt
fAa-R	Ogilvie Mtns	F	P	FG	F	F-creep	G	FG	P	wt
gAa	Ogilvie Mtns	P	FG	G	G	F-creep	G	P	P	sl,mt
At¹		G	G-FG	FG	F-P	G	G-FG	P	P	mt
At²	Engineer Creek	G	FG	G	F	G	G	U	U	mt
At²	Everywhere else	G	G	G	F	G	G	P-U	P	mt
At³	Tintina Trench	FG	FG	G	G	G	F	F	F	mt
At³	Everywhere else	FG	FG	G	P	G	G	U	U	mt
fCb/Rp		F	FG	G	F-P	FG	G	P	P	mt
fCb/Rp-R		F	FG	G	P-U	FG	G	P	P	pf,mt

Table A.8.1 (cont'd)

$\frac{fEb}{Rp}$		FG	F	G	FG	FG	G	F	F	wt,mt
$\frac{fEp}{Rp}$		FG	F	G	FG	FG	G	F	F	wt,mt
Cb		FG-F	F	G	P	F-creep	G	FG	P	pf
aCb		FG-F	F	G	P	F-creep	G	FG	P	pf
bCb		FG-F	FG-F	G	F-P	F-creep	G	F	F	pf,hz,mt
fCb		FG-F	F	G	P	F-creep	G	G	P	pf
fCb-R		FG-F	F	G	P-U	F-creep	G	G	P	pf
rCb		FG-F	FG-F	G	P	F-creep	G	P	P	pf,mt
Cb_1		P	FG-F	G	F	F-creep	G	FG	P	sl
aCb_1		P	FG-F	G	F	F-creep	G	FG	P	sl
bCb_1		P	FG	G	F	F-creep	G	F	P	sl
fCb_1		P	FG-F	G	F	F-creep	G	G	P	sl
fCb_1-R		P	F	G	P	F-creep	G	G	P	sl
rCb_1		P	FG-F	G	F	F-creep	G	P	P	sl,mt
rCb_1-R		P	F	G	P	F-creep	G	P	P	sl,pf,mt
$rfCb_1$		P	FG-F	G	F	F-creep	G	FG	P	sl
Cb_2		U	FG	G	F	P-creep	G	FG	U	sl
aCb_2		U	FG	G	F	P-creep	G	FG	U	sl
bCb_2		U	FG	G	F	P-creep	G	F	U	sl
fCb_2		U	FG	G	F	P-creep	G	G	U	sl
fCb_2-R		U	FG	G	F	P-creep	G	G	U	sl
rCb_2		U	FG	G	F	P-creep	G	P	U	sl
Cv		FG-F	G	G	F	F-creep	F	FG	F	pf,hz,br
bCv		FG-F	G	G	FG	F-creep	F	F	F	hz,br,mt
rCv		FG-F	G	G	FG	F-creep	F	P	P	mt
fCv		FG-F	FG	G	F	F-creep	F	G	F	pf,hz,br
Cv_1		P	G	G	F	F-creep	F	FG	P	sl
bCv_1		P	G	G	FG	F-creep	F	F	P	sl
rCv_1		P	G	G	FG	F-creep	F	P	P	sl,mt
fCv_1		P	FG	G	F	F-creep	F	G	P	sl
Cv_2		U	G	G	F	P-creep	F	FG	U	sl
bCv_2		U	G	G	FG	P-creep	F	F	U	sl
rCv_2		U	G	G	FG	P-creep	F	P	U	sl
fCv_2		U	FG	G	F	P-creep	F	G	U	sl
Cvs		U	G	G	FG	P-creep	F	FG	U	sl
rCvs		U	G	G	FG	P-creep	F	P	U	sl
Ca		U	G	G	FG	P-creep	G	U	U	sl,mt
rCa		U	G	G	FG	P-creep	G	U	U	sl,mt
Ct		F	P	G	P	P-creep	G	FG	P	wt,pf,hz
bCt		F	P	G	P	P-creep	G	FG	P	wt,pf,hz
aDp	Klondike Valley	G	G	G	G	G	G	U	U	mt
Gh	north of lat. $64^{0}30'$	P	G-FG	G	F	G	G	U	U	mt
	south of lat.	P	G-FG	G	G	G	G	U	U	mt

Table A.8.1 (cont'd)

Gh-K		P	G-FG	G	F-P	G	G	U	U	mt
Gr		P	G-FG	G	F	G	G	U	U	mt
Gt	north of lat. 64°30'	G	G-FG	G	F	G	G	U	U	mt
Gt	south of lat. 64°30'	G	G-FG	G	G	G	G	U	U	mt
Gt-K		G	G-FG	G	P	G	G	U	U	mt
Gp	north of lat. 64°30'	G-FG	G-FG	G	F	G	G	U	U	mt
Gp	south of lat. 64°30'	G-FG	G-FG	G	G	G	G	U	U	mt
Gf	north of lat. 64°30'	FG	G-FG	G	F	G	G	U	U	mt
Gf	south of lat. 64°30'	FG	G-FG	G	G	G	G	U	U	mt
Gb	north of lat. 64°30'	F	G	G	F	G	FG	U	U	mt
Gb	south of lat. 64°30'	F	G	G	G	G	FG	U	U	mt
Mh		F-P	F-I.A.	G	P	F-creep	G	F	P	pf
Mh-K		F-P	F-I.A.	G	P	F-creep	G	F	P	pf
Mr		F	FG-F	G	F	F-creep	G	P	P	mt
Mr-K		F	FG-F	G	P	F-creep	G	P	P	pf,mt
Mm		FG	FG	G	F	F-creep	G	P	P	mt
Mm-K		FG	FG	G	P	F-creep	G	P	P	pf,mt
Mp		G	FG	G	F	FG	G	P	P	mt
Mp-K		G	F	G	P	FG	G	P	P	pf,mt
Mn		F	FG	G	F	U-creep	G	P	U	hz
Mb		FG-F	FG	G	F	FG	FG	P	P	mt
Mb1		P	FG	G	F	F-creep	FG	P	P	sl,mt
Mb2		U	FG	G	F	P-creep	FG	P	U	sl
Mv		FG-F	FG	G	FG	F-creep	F	P	P	mt
Mv1		P	FG	G	FG	F-creep	F	P	P	ls,mt
Mv2		U	FG	G	FG	P-creep	F	P	U	sl
Lp		G	FG	G	P	F-flows	G	FG-F	P	pf
fLp		G	P	G	P	F-flows	G	FG-F	P	wt,pf
Lp-K		G	F	G	U	F-flows	G	FG-F	U	pf
MR		U	G	G	P	U-active	G	U	U	sl,hz,mt
QL	Ogilvie Mtns	U	FG	G	P	P-U-I.A.	G	U	U	sl,mt
QL	Tintina Trench	U	FG	G	P	P-U-I.A.	G	U	U	sl,mt
Qh		U	FG	G	P	P-U-I.A.	G	U	U	sl,mt
Qm		U	FG	G	P	P-U-I.A.	G	U	U	sl,mt
Qr		U	FG	G	P	P-U-I.A.	G	U	U	sl,mt
R		U	G	G	G	FG	U	N/A	U	sl.br

Table A.9.1 Evaluation of Terrain Type Suitability for Construction Materials in the Dempster Highway Area. Note special conditions indicated where phases of terrain units are present and if phases have significantly different suitabilities.

Terrain Factors: G - Good, FG - Fairly Good, F - Fair (marginal), P - Poor, U - Unsuitable (very poor), I.A. - Individual Assessment preferrable, N/A - Not Applicable

Terrain Unit Symbol and Special Conditions		Slope (sl)	Drainage (wt)	Flood Hazard (fl)	Permafrost and Ice (pf)	Hazards (hz)	Bedrock Depth (br)	Materials; Stoniness (mt)	Terrain Unit Rating	Limiting Factors
Ap-A		G	FG	P	G-FG	G	G	G	P	fl
Ap		G	FG	F-P	F	G	G	G	F	fl,pf
Af	north of lat. 65°00'	FG	FG-F	G	F	G	G	FG	F	pf
Af-R	north of lat. 65°00'	FG	FG-F	G	P	G	G	FG	P	pf
gAf	north of lat. 65°00'	FG-F	FG	g	f	fg	g	fg	f	pf
gAf-A	north of lat. 65°00'	FG-F	FG	F	F	FG	G	FG	F	fl,pf
fAf	north of lat. 65°00'	FG	F	G	F	G	G	FG	F	wt,pf
Af	south of lat. 65°00'	FG	FG-F	G	G	G	G	FG	FG	sl,wt,mt
Af-R	south of lat. 65°00'	FG	FG-F	G	F	G	G	FG	F	pf
gAf	south of lat. 65°00'	F	FG	G	G	FG	G	FG	F	sl
gAf-A	south of lat. 65°00'	F	FG	F	G	FG	G	FG	F	sl,fl
fAf	south of lat. 65°00'	FG	F	G	G	G	G	FG	F	wt
Aa	Eagle Plains	G	F	G	F	FG	G	F	F	wt,pf,mt
bAa	Eagle Plains	G	FG	G	F-P	FG	G	FG	F	pf
fAa	Eagle Plains	G	F	G	F-P	FG	G	F	F	wt,pf,mt
fAa-A	Eagle Plains	G	F	G	F	FG	G	F	F	wt,pf,mt
fAa-R	Eagle Plains	G	F	G	P	FG	G	F	P	pf
gAa	Eagle Plains	G	FG	G	F	FG	G	FG	F	pf
Aa	Ogilvie Mtns	FG-F	F	G	F	FG	G	FG	F	wt,pf
bAa	Ogilvie Mtns	FG-F	FG	G	F	FG	G	FG	F	pf
fAa	Ogilvie Mtns	FG-F	F	G	F	FG	G	F	F	wt,pf,mt
fAa-A	Ogilvie Mtns	FG-F	F	G	F	FG	G	F	F	wt,pf,mt
fAa-R	Ogilvie Mtns	FG-F	F	G	F	FG	G	F	F	wt,pf,mt
gAa	Ogilvie Mtns	FG-F	FG	G	F	FG	G	FG	F	pf,mt
At'		G	FG	F	F-P	G	G	F-FG	F	fl,pf
At²	Engineer Creek	G	FG	G	F	G	G	U	U	mt
At²	Everywhere else	G	FG	G	F	G	G	G	F	pf
At³	Tintina Trench	G	FG	G	F	G	G	G	F	pf
At³	Everywhere else	G	FG	G	G	G	G	P	P	mt
fCb / Rp		G-FG	FG	G	F-P	FG	G-FG	F	F	pf,mt
fCb -		G-FG	F	G	P	FG	G-FG	F	F	pf,mt

Table A.9.1 (cont'd)

$\frac{fCp}{Rp}$	G-FG	FG	G	F	FG	G	F	F	pf,mt
$\frac{fEb}{Rp}$	G	F	G	FG-F	G	G-FG	P	P	mt
$\frac{fEp}{Rp}$	G	F	G	FG-F	G	G	P	P	mt
Cb	G	F	G	P	FG	G-FG	F-P	P	pf
aCb	G	FG-F	G	P	FG	G-FG	F-P	P	pf
bCb	G	FG-F	G	P	FG	G-FG	F	P	pf
fCb	G	F	G	P	FG	G-FG	P	P	pf,mt
fCb-R	G	F	G	P	FG	G-FG	P	P	wt,pf,mt
rCb	G	FG-F	G	P	FG	FG-F	F	P	pf
Cb_1	FG	FG	G	P	FG-F-creep	FG-F	F-P	P	pf
aCb_1	FG	FG	G	F-P	FG-F-creep	FG-F	F-P	F	pf,mt
bCb_1	FG	FG	G	F-P	FG-F-creep	FG-F	F	F	pf,mt
fCb_1	FG	FG	G	F-P	FG-F-creep	FG-F	P	P	mt
fCb-R	FG	FG	G	F-P	FG-F-creep	FG-F	P	P	mt
rCb_1	FG	FG	G	F-P	FG-F-creep	FG-F	F	F	pf,mt
rCb-R	FG	FG	G	F-P	FG-F-creep	FG-F	F	F	pf,mt
rfCb1	FG	FG	G	F-P	FG-F-creep	FG-F	F-P	F	pf,mt
Cb_2	P	FG	G	F	F-creep	F	F-P	P	sl
aCb_2	P	FG	G	F	F-creep	F	F-P	P	sl
bCba	P	FG	G	F	F-creep	F	F	P	sl
fCba	P	FG	G	F	F-creep	F	P	P	sl,mt
fCba-R	P	FG	G	F	F-creep	F	P	P	sl,mt
rCb_2	P	FG	G	F	F-creep	F	F-P	P	sl
Cv	G	F	G	F	FG	P	P	P	br,mt
bCv	G	F	G	F	FG	P	F	P	br
rCv	G	F	G	F	FG	P	F	P	br
fCv	G	F	G	P	FG	P	P	P	pf,br,mt
Cv_1	FG	F	G	F	FG-F	P	P	P	br,mt
bCv_1	FG	F	G	F	FG-F	P	F	P	br
rCv_1	FG	F	G	F	FG-F	P	F	P	br
fCv_1	FG	F	G	P	FG-F	P	P	P	pf,br,mt
Cv_2	P	FG	G	FG	F-creep	P	P	P	sl,br,mt
bCv_2	P	FG	G	FG	F-creep	P	F	P	sl,br
rCv_2	P	FG	G	FG	F-creep	P	F	P	sl,br
fCv_2	P	FG	G	F	F-creep	P	P	P	sl,br,mt
Cv_3	U	FG	G	FG	F-P	P	P	U	sl
rCv_3	U	FG	G	FG	F-P	P	F	U	sl
Ca	U	G	G	FG	F-creep	G	F	U	sl
rCa	U	G	G	FG	F-creep	G	F	U	sl
Ct	G	F-P	G	F-P	F-creep	FG	P	P	mt
bCt	G	F-P	G	F-P	F-creep	FG	P	P	mt
aDp	G	G	G	G	G	G	FG	FG	mt
north of lat	FG	FG	G	FG	G	G	G	FG	

Table A.9.1 (cont'd)

Gh	south of lat. 64°30'	FG	FG	G	FG	G	G	G	FG	sl,wt,pf
Gh-K		FG	FG	G	F	G	G	G	F	pf
Gr		FG	FG	G	G	G	G	G	FG	sl,wt
Gt	north of lat. 64°30'	G	FG	G	FG	G	G	G	FG	wt,pf
Gt	south of lat. 64°30'	G	G	G	G	G	G	G	G	
Gt-K		G	FG	G	F	G	G	G	F	pf
Gp	north of lat. 64°30'	G	FG	G	FG	G	G	G	FG	wt,pf
Gp	south of lat. 64°30'	G	G	G	G	G	G	G	G	
Gf	north of lat. 64°30'	G	FG	G	FG	G	G	G	FG	wt,pf
Gf	south of lat. 64°30'	G	G	G	G	G	G	G	G	
Gb	north of lat. 64°30'	FG	G	G	G	G	F	G	F	br
Gb	south of lat. 64°30'	FG	G	G	G	G	F	G	F	br
Mh		FG	FG	G	FG	FG	G	F	F	mt
Mh-K		FG	FG	G	F	FG	G	F	F	pf,mt
Mr		FG	F	G	F-P	FG	G	FG	F	wt,pf
Mr-K		FG	F	G	P	FG	G	FG	P	pf
Mm		G	FG	G	F-P	FG	G	FG	F	pf
Mm-K		G	FG	G	P	FG	G	FG	P	pf
Mp		G	FG	G	F-P	FG	G	FG	F	pf
Mp-K		G	F	G	P	FG	G	FG	P	pf
MN		FG	FG	G	FG	F-creep	G	FG	F	pf,hz
Mb		G	F	G	F	FG	F	FG	F	wt,pf,br
Mb1		FG	FG	G	F	FG-F	F	FG	F	pf,br
Mb2		P	FG	G	F	F-creep	F	FG	P	sl
Mv		G	F	G	FG	FG	P	FG	P	br
Mv1		FG	FG	G	FG	FG-F	P	FG	P	br
Mv2		P	FG	G	FG	F-creep	P	FG	P	sl,br
Lp		G	F	G	F	G	G	P	P	mt
fLp		G	F	G	F	G	G	P	P	mt
Lp-K		G	F	G	P	G	G	P	P	pf,mt
MR		P	FG	G	F	U-active	G	U	U	hz,mt
QL	Ogilvie Mtns	F	FG	G	P	U-active	G	I.A.	U	hz
QL	Tintina Trench	F	FG	G	P	U-active	G	G	U	hz
Qh		F	FG	G	P	U-active	G	I.A.	U	hz
Qm		F	FG	G	P	U-active	G	I.A.	U	hz
Qr		F	FG	G	P	U-active	G	I.A.	U	hz