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**Granular Resources Investigation**

**Teslin Area, Yukon, 2008**



**Prepared For:** Teslin Tlingit Council

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## TABLE OF CONTENTS

Granular Resource Investigation  
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<b>SECTION</b>		<b>PAGE</b>
<b>1.0</b>	<b>INTRODUCTION</b>	<b>1</b>
<b>2.0</b>	<b>METHODOLOGY</b>	<b>2</b>
2.1	Literature Review	2
2.1.1	<i>Surficial &amp; Bedrock Geology Maps</i>	3
2.1.2	<i>Geomorphological Studies</i>	3
2.1.3	<i>Aerial Photos</i>	4
2.1.4	<i>Topographical Maps</i>	4
2.1.5	<i>Granular Pit Applications</i>	5
2.1.6	<i>Geotechnical Reports &amp; Lists of YTG Gravel/Reserves</i>	5
2.2	Field Reconnaissance	6
2.3	Laboratory Program	7
<b>3.0</b>	<b>SITE CONDITIONS</b>	<b>8</b>
3.1	Study Area	8
3.2	Physiographic Region	8
3.3	Regional Geology	8
3.4	Local Geology	9
3.5	Local Geomorphology	9
3.5.1	<i>Glaciation</i>	9
3.5.2	<i>Permafrost</i>	9
3.5.3	<i>Watercourses</i>	10
3.5.4	<i>Groundwater</i>	10
3.6	Surficial Geology and Local Deposits	10
3.6.1	<i>Glaciofluvial Deposits</i>	11
3.6.2	<i>Alluvial Deposits</i>	11
3.6.3	<i>Morainal Deposits</i>	11



## TABLE OF CONTENTS

**Granular Resource Investigation  
Teslin, Yukon, 2008**

SECTION	PAGE
3.6.4 <i>Complex Deposits</i>	12
3.6.5 <i>Bedrock</i>	12
4.0 <b>Discussions</b>	13
4.1 <b>General</b>	13
4.2 <b>Potential Granular Deposits (Selected Areas)</b>	14
4.3 <b>Recommended Areas for Future Development</b>	25
4.4 <b>Geotechnical Investigations</b>	26
4.5 <b>Pit Development</b>	26
4.5.1 <i>Quantity &amp; Quality of Reserves</i>	26
4.5.2 <i>Permafrost</i>	27
4.5.3 <i>Quartz and Placer Claims</i>	27
4.5.4 <i>Surface and Groundwater</i>	27
4.5.5 <i>Deleterious Materials</i>	28
4.5.6 <i>Natural Hazards</i>	28
4.5.7 <i>Construction Monitoring</i>	28
5.0 <b>REPORT LIMITATIONS</b>	29
TABLE 1 - <b>Summary of Selected Areas</b>	
APPENDIX A - <b>Limits of Study</b>	
APPENDIX B - <b>Surficial Geology</b>	
APPENDIX C - <b>Bedrock Geology</b>	
APPENDIX D - <b>Selected Areas</b>	
APPENDIX E - <b>Topographical Maps</b>	
APPENDIX F - <b>Area Disposition</b>	
APPENDIX G - <b>Related Information</b>	



## 1.0 INTRODUCTION

*Chilkoot Geological Engineers Ltd.* was retained by *Teslin Tlingit Council* to compile information and identify potential granular and topsoil resources located within 30 kilometers of Teslin, Yukon. Particular emphasis was placed on exploring *Teslin Tlingit Settlement Lands* that were readily accessible within the region.

The study concentrated on identifying potential granular resources that would allow for medium to large scale borrow operations, however, as it became apparent that these deposits were limited, some small scale deposits were also identified. While a total of twenty-eight (28) areas that may contain potential granular deposits were identified, the overall potential was considered low given the regional depositional setting and ownership of the deposits by other parties.

The development feasibility of the potential granular deposits was assessed on a case-by-case basis and rated subjectively as noted in Table 1, attached. The presence of granular resources within these areas should be confirmed (or refuted) through subsequent geotechnical investigation conducted by qualified personnel.

The presence of topsoil deposits was not readily apparent during our study and as such no reference to these types of deposits was made.

The study was conducted by the undersigned in accordance with our proposal dated August 20, 2008.

Authorization to proceed was granted by Mr. Bert Goodvin, *TTC - Director of Capital*, on September 2, 2008.



## 2.0 METHODOLOGY

Our work programs were comprised of the following four (4) phases:

- Literature Review
- Field Reconnaissance
- Laboratory Program
- Geotechnical Report

A detailed description of the work conducted during each phase has been provided below.

### 2.1 Literature Review

The study consisted of a literature review which was comprised of reviewing airphotos, maps, geomorphological studies, geotechnical reports and related databases associated with the study area.

The information obtained was collated and potential resource areas were identified.

The limits of the study area was identified as being reasonably accessible terrain located approximately 35 kilometers on either side of Teslin, Yukon. These limits have been presented in Appendix A and denote the approximate extent of the airphotos reviewed.

The approximate locations of the areas identified as potential granular deposits have been marked on the Surficial Geology Maps, Airphotos, 1:50,000 scale topographical maps and Area Disposition maps enclosed in the Appendices. Given the limitations due to scale of mapping, the areas identified on the airphoto overlays should be considered the most representative .



### **2.1.1 Surficial & Bedrock Geology Maps**

The following information was reviewed to assess soil and bedrock conditions.

*Surficial Geology of Teslin, Yukon Territory, Map 1891A*

by S.R.Morison and R.W.Klassen, 1997, Scale 1:125,000

*Geology of Teslin Map Area (105 C) – Map 1125A - GSC Memoir 326*

by R.Mulligan, 1963, Scale 1:253,440

*Bedrock Geology of the Yukon, GSC Open File D3826*

by S.Gordey and A.J.Makepeace, 1999, Scale 1:1,000,000

The information was obtained from YTG - Energy, Mines and Resources library.

The surficial geology map identified landform terrain types and indicated generic composition with textural, morphological and erosional modifiers as described in the attached legend.

A copy of the surficial and bedrock geology maps have been provided in Appendix B and C, respectively.

### **2.1.2 Geomorphological Studies**

The following geomorphological study was reviewed to aid in the assessment;

*Geological Survey of Canada, Memoir 326, 1963*

The G.S.C. publication written by Robert Mulligan, details the geology of the Teslin area. In brief the paper provides an understanding of the tectonic and geological framework of the region and discusses glaciation and geomorphology of the Teslin area.

The study was obtained through YTG - Energy, Mines and Resources library.



### 2.1.3 Aerial Photos

Where possible, the most recent aerial photos of the study area were obtained from the following *Yukon Territorial Government* departments;

<i>Highways &amp; Public Works - Transportation Engineering Branch</i>	<i>(TEB)</i>
<i>Community Services Land Planning Department</i>	<i>(YTG)</i>
<i>Energy, Mines and Resources Library</i>	<i>(EMR)</i>

The following airphotos were reviewed;

<i>A27871 # 186-222</i>	<i>Aug.28,1992</i>	<i>Scale 1:15,000</i>	<i>TEB</i>
<i>A27871 # 257-274</i>	<i>May 9, 1992</i>	<i>Scale 1:15,000</i>	<i>TEB</i>
<i>A27872 # 041-074</i>	<i>June 7, 1992</i>	<i>Scale 1:15,000</i>	<i>TEB</i>
<i>A27977 # 009-018</i>	<i>Aug. 29, 1993</i>	<i>Scale 1:15,000</i>	<i>TEB</i>
<i>A28257 # 039-077</i>	<i>Sept.16, 1995</i>	<i>Scale 1:10,000</i>	<i>YTG</i>
<i>A28257 # 156-171</i>	<i>Sept.16, 1995</i>	<i>Scale 1:40,000</i>	<i>YTG</i>
<i>A28124 # 001-031</i>	<i>Aug.27, 1994</i>	<i>Scale 1:20,000</i>	<i>EMR</i>
<i>A27521 # 165-169</i>	<i>Aug.18,1989</i>	<i>25,500 feet ASL</i>	<i>EMR</i>

Following review, potential granular deposits were denoted on overlays attached to the airphotos. These areas have been enclosed in Appendix D.

### 2.1.4 Topographical Maps

The following topographical maps were reviewed;

<i>105 C</i>	<i>Teslin</i>	<i>Scale 1:250,000</i>
<i>105 C/1</i>	<i>Morley Lake</i>	<i>Scale 1:50,000</i>
<i>105 C/2</i>	<i>Teslin</i>	<i>Scale 1:50,000</i>
<i>105 C/6</i>	<i>Brooks Brook</i>	<i>Scale 1:50,000</i>
<i>105 C/7</i>	<i>Lone Tree Creek</i>	<i>Scale 1:50,000</i>
<i>105 C/8</i>	<i>English Creek</i>	<i>Scale 1:50,000</i>

Copies of the topographical maps have been enclosed in Appendix E.



### **2.1.5 Granular Pit Applications**

Information regarding granular pit applications was assessed through the *Yukon Territorial Government - Energy, Mines and Resources, Lands Branch* website.

The website (*Mining & Lands Map Viewer*) did not indicate the presence of any pending granular pit applications but highlighted the presence of approximately twenty-two (22) granular reserves that are located within the study region as noted in Table 1 – Summary of Selected Areas.

A list regarding the details of the land dispositions was compiled by the Lands Branch staff and has been enclosed in Appendix G.

The website was utilized to generate local (1:100,000 scale) maps within the study area to present the spatial distribution of the selected areas relative land claim selections, easements, trails and other key features of interest. These maps have been enclosed in Appendix F – Area Disposition. The easement that is present on the maps denotes the location of the ‘proposed’ Foothills Pipeline.

A search of the database highlighted one quarry lease # 2003-0309 located at km 1270.0 RHS, within Area 5.

A number of Quartz Claims were also noted on some of the selected areas. For ease of viewing, these claims were not included on the generated maps but have been referenced in Table 1 - Summary of Selected Areas.

### **2.1.6 Geotechnical Reports & Lists of YTG Gravel Pits/Reserves**

The Department of Highways and Public Works provided a list of available geotechnical reports and YTG gravel pits located within TTC lands. In brief, their lists included a selection of two (2) geotechnical reports and a number of gravel pits located along the Alaska Highway and Canol Road.



A second list denoting all YTG gravel pits located outside of TTC lands between Brooks Brook and Morley Lake was requested from the department. The list was provided by Mr.J.Marynowski, C.E.T. and included a list of Highways and Public Works (Transportation Maintenance, Transportation Engineering and Airport) gravel pits located within the delineated area.

Only one of the reports, entitled 'Geotechnical Investigation – Alaska Highway, Kilometer 1322, Right, Yukon Territory, April 1992' conducted by *Hoggan Engineering & Testing (1980) Ltd.* (a.k.a. *J.R.Paine & Associates Ltd.*) was located within the study area. A copy of the report was obtained for review. The kilometer posts have since been adjusted and the report corresponds to the existing gravel pit located at km 1271.7 – Deadman Creek.

A copy of the e-mail correspondence, gravel pit lists and geotechnical report have been provided in Appendix G – Related Information.

## 2.2 Field Reconnaissance

Given the onset of winter conditions, our firm was unable to complete the field reconnaissance portion of work. Our firm however, conducted a preliminary field reconnaissance on August 31, 2008 to obtain additional data with respect to potential deposits. In general, this included noting the conditions of existing/abandoned gravel pits and local terrain features such as bedrock outcrops and surface waters along the Alaska Highway corridor. The information obtained was incorporated into our Summary of Selected Areas which has been presented as Table 1.

We envision that the field reconnaissance aspect of the work can be completed in the spring of 2009 following discussions with *Teslin Tlingit Council (TTC)* regarding the finding of this study. This aspect of work could also be incorporated into a field test-pit program to prove selected areas of granular reserves.



### 2.3 Laboratory Program

While it was originally envisioned that a laboratory program would be conducted following completion of the field reconnaissance, given the onset of winter, we have delayed this aspect of work until such time that field reconnaissance of potential sites has been completed.

This program may be adjusted to suit the project requirements and may be incorporated into future subsurface geotechnical work.



### **3.0 SITE CONDITIONS**

#### **3.1 Study Area**

The study area encompasses road accessible terrain within approximately 35 kilometers of Teslin, Yukon. The primary roadway, which was utilized to reference the study area, was the Alaska Highway. The northern limit of the study correlated to km 1278 of the Alaska Highway. The bridge at Teslin is centrally located at km 1243. The southern limit of the study (Morley Lake) is located at km 1204.

The limits of the study have been presented in Appendix A. The limits show the approximate extent of airphoto coverage that was reviewed.

#### **3.2 Physiographic Region**

The study area is located along the eastern side of Teslin Lake along the Alaska Highway corridor and extends along the Morley River until Morley Lake. The Village of Teslin is centrally located in the study area at the approximate southern limits of the Big Salmon Range (Pelly Mountains) which rise to elevations in the order of 6000 feet. Teslin Lake elevation is approximately 2239± feet. The southern half of the study area is dominated by lower lying topography of the Yukon Plateau.

#### **3.3 Regional Geology**

Teslin Lake lies above the Teslin fault which separates two distinct bedrock units.

The north side of the fault (north of Teslin) is predominately comprised of the Shonektaw Formation (Gordey and Makepeace, 1999). The formation consists of metamorphosed sediments including greywacke, siltstone, shale and volcanics.



at any location and can vary from poorly bonded non-visible ice to massive ice lenses ranging in size to tens of meters.

Generally, ice would occur as ice-wedge polygons in moderately to poor drained fine grained sediments; small ice wedges and ice lenses in peat, several meters of massive ice in low-lying areas and the base of slopes and non-visible well-bonded ice in most deposits and top few meters of bedrock.

Seasonal frost penetration would be variable dependent upon ground and site conditions. The variable conditions would include air temperature, snow cover, traffic, soil and vegetation types and groundwater conditions.

### ***3.5.3 Watercourses***

The watercourses within the region drain to the Yukon River and are dominated by Teslin Lake, Morley River and Deadman, Fox, Hays and various tributary creeks.

### ***3.5.4 Groundwater***

Groundwater conditions throughout the low lying valley regions would be consistent with the water level of Teslin Lake.

Groundwater conditions at higher elevations would be located at depth although the potential for perched groundwater may exist due to the presence of underlying fine grained materials and other impermeable boundaries (i.e. bedrock).

## **3.6 Surficial Geology and Local Deposits**

The distribution of surficial deposits is denoted in the Surficial Geology map compiled by S.R.Morison and R.W.Klassen. A portion of this map, which lies within the study area, has been enclosed in Appendix B.



The nature of material, genetic description and morphological expression of the deposits have been adapted from the Surficial Geology map legend and are comprised of the following;

### ***3.6.1 Glaciofluvial Deposits***

Glaciofluvial deposits of outwash plains (Gp) are comprised of 5 to 20 m of silt, sand and gravel that are gently irregular or nearly flat terrain marked by shallow channel patterns or locally pitted surfaces. Given the depositional nature of glacial terrace deposits, subsurface materials will generally consist of well stratified to massive, poorly to well sorted sand and gravel with local regions of silt and fine grained materials.

The development potential of these deposits will vary dependent upon their composition and depth to bedrock.

### ***3.6.2 Alluvial Deposits***

Alluvial deposits comprised of alluvial fans and deltas (Af, Ad) generally consist of 5 to 20 m of silt, sand and gravel that are gently irregular or nearly flat terrain (Af) or gently irregular, channeled surfaces with marked slope towards the valley bottom (Ad).

The development potential of these deposits will vary due to their nature of deposition and presence of groundwater. Where good quality source materials (comprised of coarse sand and gravel with minor silt and fine sands) are encountered, their material usage will generally be unrestricted.

### ***3.6.3 Morainal Deposits***

Morainal (Glacial Till) deposits comprised of morainal blankets (Mb) or morainal veneers (Mv).



Morainal blankets consist of lodgment and ablation till with a silty to sandy matrix 1 to 30 meters thick. The morphological expression is described as gently irregular to strongly irregular bedrock controlled topography blanketed by till.

Morainal veneers consist of ablation and lodgment till with a silty to sandy matrix; bouldery; generally less than 1 meter thick. The morphological expression is described as gently irregular to strongly irregular bedrock terrain.

Morainal veneers and blankets (Mv & Mb), will generally have low development potential due to the shallow depth to bedrock and high fines content. Potential deposits may be found near tributary creeks.

#### ***3.6.4 Complex Deposits***

These deposits consist of valley bottom deposits of alluvial, colluvial and glacial materials (A + Mx), which are comprised of gravel, sand and silt of variable thickness. The morphological expression is described as nearly flat to strongly irregular terrain with up to 30 meters relief.

The development potential of these deposits is variable dependent upon their fines content.

#### ***3.6.5 Bedrock***

The bedrock noted within the Teslin area may be utilized for granular aggregate production but would depend upon their specific composition. Production would require blasting and crushing material to meet gradational requirements.

The high costs typically associated with these methods generally prohibits the development of bedrock sources in order to produce granular aggregate.

## 4.0 DISCUSSIONS

### 4.1 General

The Teslin area is located in a low-energy depositional environment and thus the overall potential for the presence of granular resources would be considered low. However, based upon our findings, there appears to be twenty-eight (28) potential granular resources areas identified within the limits of the study. In the majority of cases (17 of 28), these areas coincide with existing gravel pits/reserves which are held by other parties (namely the *Government of Yukon* and *Northern Pipeline Agency*). While ownership by others generally limits the feasibility of development, consideration should be given to approaching these parties such that the resources are developed in a responsible manner to everyone's benefit.

Our discussions of the deposits development potential are based upon the overall suitability (which factors in site access, overall quantities and other field conditions). Given the scale of the study, the development and granular potential may vary dependent upon field conditions encountered. It should be emphasized that given the age of the airphotos, the existing conditions of the denoted areas may differ from those noted during our assessment.

As utilization of the deposits would be dependent upon the application and subsurface conditions, each potential deposit would have to be assessed on a case-by-case basis, in order to determine their development potential. The application of the granular deposits may include, but is not limited to, concrete aggregate, bedding sands and structural/non-structural fill.



## 4.2 Potential Granular Deposits (Selected Areas)

The following provides discussions regarding the specific areas identified as potential granular deposits.

For ease of reference, each deposit has been numbered consecutively to allow for identification during our discussions. The selected areas have been outlined on the Surficial Geology Maps, Airphotos, Topographical Maps and Area Disposition Maps included in Appendices B, D, E & F, respectively. Additional information regarding the selected Areas can be found in Table 1 – Summary of Selected Areas.

The areas have been given a subjective rating of their development and granular resource potentials based upon our past experience. The ratings scale between Very Low, Low, Moderate and High.

The development potential takes into account various criteria that may affect overall development such as ownership, site access, estimated reserve quantities and distance to Teslin. The granular resource potential provides a geotechnical assessment as to the probable occurrence of granular reserves.

The quantity and quality of granular deposits within the potential granular reserves would have to be assessed on a case-by-case basis through intensive subsurface geotechnical investigations or through query in the case where ownership is held by others.

Area # 1

Deposit: *Alluvial Fan (Af) and Morainal Blanket/Glaciolacustrine Deposits (Mb/Lp)*

Development Potential: *Low*

Granular Potential: *High (Af) & Low (Mb/Lp)*

Reserve No.: *105C06-020,026 & 027- Northern Pipeline Agency*

The low development potential is due to the areas ownership by the Northern Pipeline Agency (NPA). The alluvial fan areas may harbor good quality reserves. An existing pit is noted within the northernmost area. The thin sliver quarry located south of the highway is typical throughout the study area. In general, these gravel pits are likely small in reserve quantity and were likely depleted during construction/re-alignment of the Alaska Highway in the region. The morainal blanket deposit would be of lesser quality and potential given the likely presence of shallow bedrock.

Area # 2

Deposit: *Glaciofluvial Plain (Gp)*

Development Potential: *Low*

Granular Potential: *Moderate*

Reserve No.: *105C06-006 – YTG – Highways & Public Works*

The low development potential is due to the areas ownership by the YTG. Based upon the undersigned's past experience with this granular reserve, the southern-most area is general sandy in nature with little to no gravel. The incidence of silt/fines is variable. Access to the northern source areas would be difficult.

Area # 3

Deposit: *Alluvial Delta (Ad)*  
Development Potential: *Very Low*  
Granular Potential: *Very Low*  
Reserve No.: *105C06-017 – NA*

This area was originally developed by YTG. It is understood that the source in this area has been depleted. The *Hoggan Engineering and Testing (1980) Ltd.* report was conducted on this area.

Area # 4

Deposit: *Alluvial Delta (Ad)*  
Development Potential: *Low*  
Granular Potential: *High*  
Reserve No.: *105C06-033 – - Northern Pipeline Agency & Private*

The low development potential is due to NPA and private ownership. The alluvial delta areas generally harbor good quality reserves. An existing pit is noted within the area.

Area # 5

Deposit: *Morainal Blanket/Glaciolacustrine Deposits (Mb/Lp)*  
Development Potential: *Low*  
Granular Potential: *Moderate*  
Reserve No.: *105C06-029 - Northern Pipeline Agency & Lease*

The low development potential is due to ownership by NPA and an existing lease. An existing pit is noted within the area. Some potential exists for limited development north of the denoted area but the area may be limited in size.

Area # 6

Deposit:	<i>Morainal Blanket/Glaciolacustrine Deposits (Mb/Lp)</i>
Development Potential:	<i>Low</i>
Granular Potential:	<i>Low</i>
Reserve No.:	<i>NA</i>

Two areas of pre-existing pits were noted within the area. It is likely that any good quality source materials have been depleted, otherwise, one would expect the area to have been maintained as an active granular reserve.

Area # 7

Deposit:	<i>Morainal Blanket/Glaciolacustrine Deposits (Mb/Lp)</i>
Development Potential:	<i>Low</i>
Granular Potential:	<i>Low</i>
Reserve No.:	<i>105C07-003 - Northern Pipeline Agency</i>

The low development potential is due to ownership by NPA. A pre-existing pit was noted within the area. Some potential exists for limited development north of the denoted area although given the potential for shallow bedrock would be considerable within this region.

Area # 8

Deposit:	<i>Morainal Blanket/Glaciolacustrine Deposits (Mb/Lp)</i>
Development Potential:	<i>Low</i>
Granular Potential:	<i>Low</i>
Reserve No.:	<i>NA</i>

A pre-existing pit was noted within the area. It is likely that any good quality source materials have been depleted, otherwise, one would expect the area to have been maintained as an active granular reserve.

Area # 21

Deposit: *Morainal Blanket (channeled) Deposits (Mb-c)*  
Development Potential: *Low*  
Granular Potential: *Moderate*  
Reserve No.: *105C01-018 - Northern Pipeline Agency*

The low development potential is due to the presence of a pre-existing pit, partial ownership by NPA and small scale. The southern portion of the area should be explored in greater detail.

Area # 22

Deposit: *Morainal Blanket (channeled) Deposits (Mb-c)*  
Development Potential: *Low to Moderate*  
Granular Potential: *Low to Moderate*  
Reserve No.: *NA*

Several pre-existing pits were noted within the area. The low to moderate development potential would be due to the isolated nature of the deposits and till digenesis. Some medium scale deposits were noted (particularly to the northeast) but they will be difficult to access.

Area # 23

Deposit: *Morainal Blanket Deposits (Mb)*  
Development Potential: *Low*  
Granular Potential: *Low*  
Reserve No.: *NA*

Several pre-existing pits were noted within the area. The low development potential would be due to the isolated nature of the deposits, till digenesis and likely depletion of good quality source materials.

Area # 24

Deposit: *Morainal Blanket Deposits (Mb)*  
Development Potential: *Low to Moderate*  
Granular Potential: *Moderate*  
Reserve No.: *105C01-004- YTG*

The low development potential is due to ownership by YTG. The terrain east of the reserve and south of the creek should be explored in greater detail. As this area may harbor available granular reserves the region was given a moderate development potential.

Area # 25

Deposit: *Morainal Blanket Deposits (Mb)*  
Development Potential: *Low*  
Granular Potential: *Moderate*  
Reserve No.: *105C01-011,019 & 020 - YTG & NPA*

The low development potential is due to ownership by YTG and NPA. An existing pit is located within the area. Visual inspection of the pit noted it to be generally depleted with only sand remaining.

Area # 26

Deposit: *Morainal Blanket Deposits (Mb)*  
Development Potential: *Low*  
Granular Potential: *Low*  
Reserve No.: *NA*

Two pre-existing pits, which are likely depleted are located within the area.

Area # 27

Deposit: *Morainal Blanket Deposits (Mb)*  
Development Potential: *Low to Moderate*  
Granular Potential: *High*  
Reserve No.: *105C01-020 - NPA*

The low to moderate development potential is due to ownership NPA and poor site access. The deposit however, is large scale and warrants discussion for potential long-term development/agreements. The area is however 34 km from Teslin.

Area # 28

Deposit: *Morainal Blanket (channeled) Deposits (Mb-c) and Alluvial Plain (Ap)*  
Development Potential: *Low*  
Granular Potential: *Low to Moderate (Mb-c)*  
Reserve No.: *NA*

The low development potential is due to the distance from Teslin and small scale nature of deposits. Several existing granular pits were noted within the area.

### 4.3 Recommended Areas for Future Investigation

As ownership of most of the deposits identified are held by others, it would be prudent to conduct field reconnaissance of areas that are not entirely restricted by this criteria, namely Areas 6, 8, 9, 11, 13, 14, 15, 18, 20, 22, 23, 26 and 28. For purposes of discussion, of these areas, only Areas 13, 14, 18, 20, 22 and 28 have (up to) a moderate rating for granular potential. The deposits within Area 28 would be considered too small in scale and remote to be viable. Thus five sites (13, 14, 18, 20 & 22) with a moderate rating for granular potential should be explored through field reconnaissance. A sixth area (Area 15), may be worth exploring given its close proximity to Teslin, however, the area was given a low rating for granular potential, primarily due to the likely presence of shallow bedrock.

In some areas, the identified regions extended beyond the delineated reserves (that are held by others) and so these regions should also be explored for the presence of granular deposits. Other than granular presence, the limiting factor will be the quantity of reserves available. Areas 5, 10, 11, 12, 17, 19 and 21 all have regions identified outside of existing reserves. Of these, Areas 5, 10, 11 and 21 would be considered too small in size for reasonable pit development. Therefore, Areas 12, 17 and 19 may warrant further investigation. The deposits in Area 19 would however be difficult to access.

The respective agreements (for ownership of the land dispositions) should be investigated in greater detail to confirm that they have been maintained in good standing. In particular, their applicability should be assessed where they are located within TTC lands where TTC subsurface rights have been identified. This would include portions of Areas 1, 2, 17, 19, 20.

Therefore in summary, nine Areas 12-15, 17-20 & 22 should be investigated in greater detail.



#### 4.4 Geotechnical Investigations

A detailed geotechnical investigation should be conducted prior to development of any potential granular resource.

Specifically, the presence, quality and quantity of granular materials, within areas identified as potential granular reserves, should be confirmed (or refuted) through field reconnaissance and work programs. The reconnaissance should be conducted by qualified personnel prior to (and in conjunction with) implementation of comprehensive investigative test-pit and/or drilling field work programs and laboratory analysis.

A geotechnical report, which details the findings of the investigation and provides recommendations for pit development, should be prepared following the geotechnical investigation.

#### 4.5 Pit Development

The development of any proven granular resource should be conducted in accordance with regional development and land use plans and geotechnical reports. Construction methodologies will ultimately have to be adjusted in the field to accommodate actual site conditions.

As a minimum, the pit development plan should consider the following aspects;

##### *4.5.1 Quantity & Quality of Reserves*

The deposit should be well characterized such that pit development maximizes the use of available materials within the deposit.

In general, the regimes may vary considerably depending upon the time of season and variations in the local subsurface conditions. Consideration should be given to potential perched groundwater and inflow rates that may limit or prohibit development.

#### ***4.5.5 Deleterious Materials***

Consideration should be given to the presence of deleterious materials that may be found in the above noted deposits, given their dynamic geomorphology. This may include the presence of organics, boulders, ice lenses and other deleterious materials.

#### ***4.5.6 Natural Hazards***

Although indications of natural hazards that may affect the potential granular deposits were not evident, their potential should be assessed prior to development.

Due to the scale of the study, further geotechnical evaluation would be required to ascertain the risk potential associated with natural hazards. These hazards may include, but are not limited to mass wasting/creep, slope stability, debris flows, liquefaction and other similar type hazards

#### ***4.5.7 Construction Monitoring***

Where pit development of proven granular resources is initiated, construction monitoring should be conducted by qualified geotechnical personnel to confirm the quality of produced aggregate and suitability of the proposed development plan relative to production and actual field conditions.



## 5.0 REPORT LIMITATIONS

This report is intended for the sole use of *Teslin Tlingit Council*.

No portion of this report may be used as a separate entity; it is intended to be read in its entirety. Any use of this report by a third party, or any reliance or decisions based upon it, are the responsibilities of such third parties.

The comments contained within this report reflect our best judgment in light of the information available to *Chilkoot Geological Engineers Ltd.* at the time of report preparation. They are based upon a compilation of historical literature, current construction techniques and generally accepted engineering practices.

Due to the literary nature and scale of the study, it should be emphasized that the selected areas are terrain features that may harbor potential granular deposits. The presence, quality and quantity of granular materials, within these areas, should be confirmed (or refuted) through field reconnaissance and work programs. The reconnaissance should be conducted by qualified personnel prior to (and in conjunction with) implementation of comprehensive investigative test-pit and/or drilling field work programs and laboratory analysis.

Due to the dynamic geological and geomorphological nature of the deposits located within the study area, interpolations of the conditions, between the compiled information, has not been made or been implied.

Should any newly found geologic and/or geomorphic conditions, within the study area be encountered, our firm should be notified immediately in order to confirm the suitability of our discussions, which may be altered or modified in writing by the undersigned.



Thank you for providing *Chilkoot Geological Engineers Ltd.* with the opportunity to conduct the *Granular Resources Investigation*.

We trust that this report is sufficient for your purposes at this time. If you should have any questions or concerns, please feel free to contact the undersigned. We would be pleased to meet with you to discuss our findings at your convenience.

Respectfully submitted,

**CHILKOOT GEOLOGICAL ENGINEERS LTD.**

**TARES DHARA**  
Tares Dhara, P. Eng.  
Territory  
President  
ENGINEER

<b>PERMIT TO PRACTICE</b>
Signature
Date <u>Dec. 19, 2008</u>
<b>PERMIT NUMBER: PP025</b>
Association of Professional Engineers of Yukon

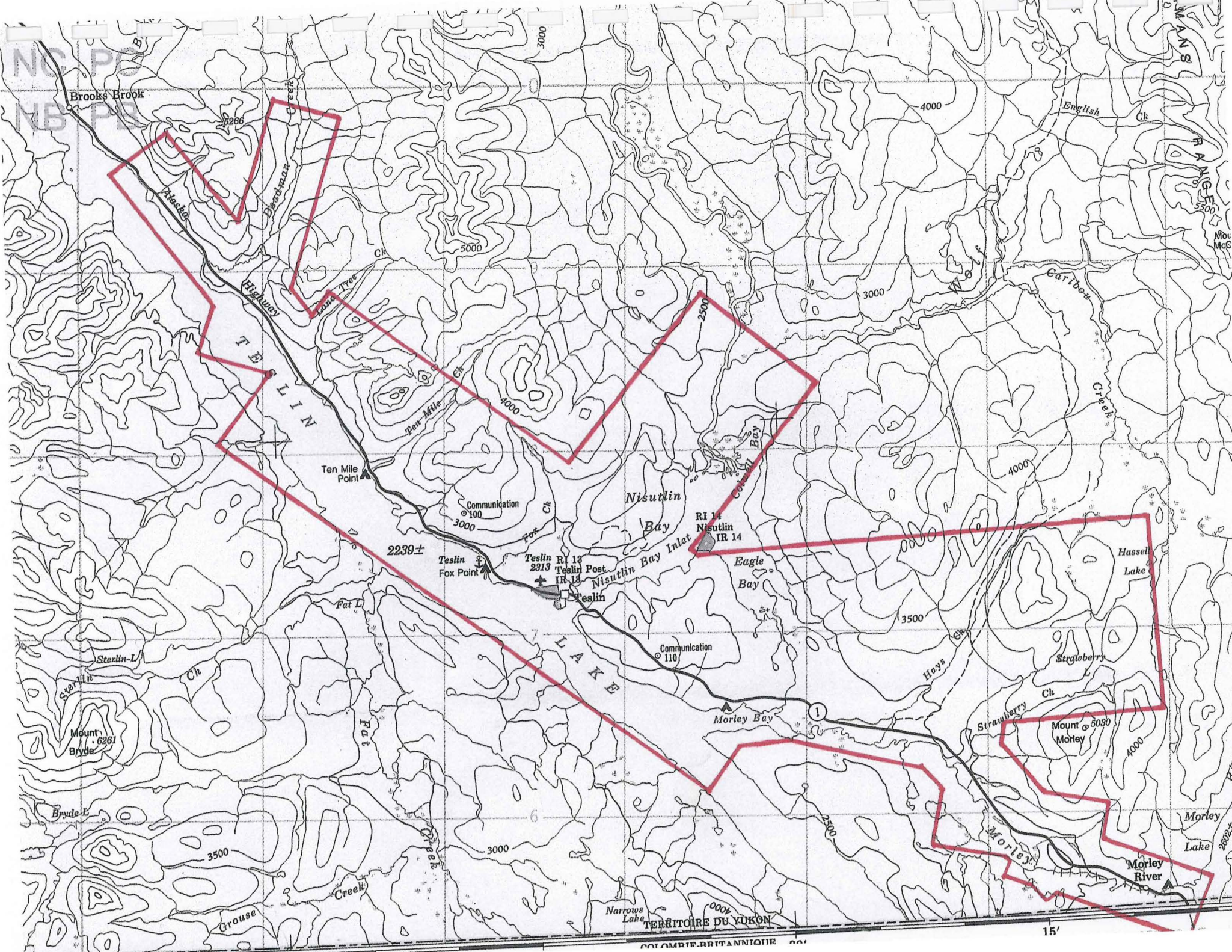
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# CHILKOOT GEOLOGICAL ENGINEERS LTD.



TABLE 1  
SUMMARY OF SELECTED AREAS

Area	Development Potential	Granular Potential	km	Side	Offset	Nearest Trail	Surficial Geology	Disposition Number	Land Use	Status	Held By	Quartz Claims
1	Low	High	1278.0	Rt	NA	NA	Af	105C06-020	Gravel Pit	Active	NPA	No
1	Low	High	1277.5	Rt	NA	NA	Af	105C06-026	Gravel Pit	Active	NPA	No
1	Low	Low	1276.5	Rt	NA	NA	Mb/Lp	105C06-027	Gravel Pit	Active	NPA	No
2	Low	Moderate	1271.7	Rt	4.2	0.0	Gp	105C07-006	Gravel Pit	Active	YTG	No
3	Very Low	Very Low	1271.7	Rt	NA	NA	Ad	105C06-017	Quarry	Active	none	No
4	Low	High	1272.0	Lt	NA	NA	Ad	105C06-033	Industrial	Active	NPA	Legal Parcel
5	Low	Moderate	1270.0	Rt	NA	NA	Mb/Lp	105C06-029	Gravel Pit	Active	NPA	Lease 2003-0309
6	Low	Low	1265.0	Lt & Rt	NA	NA	Mb/Lp	none	none	na	none	No
7	Low	Low	1263.5	Rt	NA	NA	Mb/Lp	105C07-003	Gravel Pit	Active	NPA	No
8	Low	Low	1260.0	Lt & Rt	NA	NA	Mb/Lp	none	none	na	none	No
9	Low	Low	1259.6	Rt	1.0	0.0	Mv/R	none	none	na	none	No
10	Low to Mod	Mod to High	1258.5	Rt	0.6	0.6	A+Mx	105C02-070	Gravel Pit	Active	NPA	Campground
11	Low	Low	1253.9	Rt	NA	NA	Ad	none	none	na	none	No
12	Low	Low to Mod	1249.0	Rt	2.5	0.0	Mb	105C02-069	Gravel Pit	Active	NPA	No
13	Low	Mod to High	1249.0	Rt	4.3	2.5	Af	none	none	na	none	No
14	Low	Low to Mod	1243.3	Rt	2.0	0.5	Mb	105C02-066	none	Active	NPA	Legal Parcel
15	Low	Low	1241.0	Rt	1.2	1.2	Mv	105C02-027	Gravel Pit	Active	NPA	Legal Parcel
16	Low	Low	1235.4	Rt	0.9	0.0	Mv	105C02-025	Gravel Pit	Active	NPA	No
17	Low to Mod	Low to Mod	1230.0	Rt	0.5	0.0	Mb/Lp	105C02-065	Industrial	Active	NPA	No
18	Low to Mod	Low to Mod	1228.0	Rt	NA	NA	Mb/Lp	none	none	na	none	No
19	Low to Mod	High	1222.7	Rt	1.0	0.0	Mb-c	105C01-007	Gravel Pit	Active	YTG	No
19	Low to Mod	High	1222.7	Rt	2.5	0.0	Mb-c	105C01-023	Gravel Pit	Active	YTG	No
19	Low to Mod	High	1222.7	Rt	NA	NA	Mb-c	105C01-021	Gravel Pit	Active	YTG	No
19	Low to Mod	High	1222.7	Rt	NA	NA	Mb-c	105C01-017	Gravel Pit	Active	NPA	No
20	Low to Mod	High	1222.7	Rt	4.5	0.0	Ad	none	none	na	none	No
21	Low	Moderate	1219.3	Rt	NA	NA	Mb-c	105C01-018	Gravel Pit	Active	NPA	No
22	Low to Mod	Low to Mod	1216-1218	Rt	0-2	2.0	Mb-c	none	none	na	none	No
23	Low	Low	1214.0	Lt	NA	0.0	Mb	none	none	na	none	No
24	Low to Mod	Moderate	1212.0	Lt & Rt	NA	NA	Mb	105C01-004	Gravel Pit	Active	YTG	Expired
25	Low	Moderate	1210.5	Lt	NA	NA	Mb	105C01-011	Gravel Pit	Active	YTG	No
25	Low	Moderate	1210.5	Lt	NA	NA	Mb	105C01-019	Gravel Pit	na	YTG	No
25	Low	Moderate	1210.5	Lt	NA	NA	Mb	105C01-020	Gravel Pit	Active	NPA	No
26	Low	Low	1208 & 1209	Lt	NA	NA	Mb	none	none	na	none	Yes
27	Low to Mod	High	1209.0	Lt	0.8	0.8	Mb	105C01-020	Gravel Pit	Active	NPA	Yes
28	Low	Low to Mod	1204.0	Lt	NA	NA	Mb-c & Ap	none	none	na	none	Yes



Brooks Brook

TESLIN

Nisutlin Bay

LAKE

Morley Bay

English Ck

Caribou Creek

Hoyas Ck

Strawberry Ck

Morley River

2239±

Teslin R.I. 13  
Teslin Post  
IR 13

RI 14  
Nisutlin  
IR 14

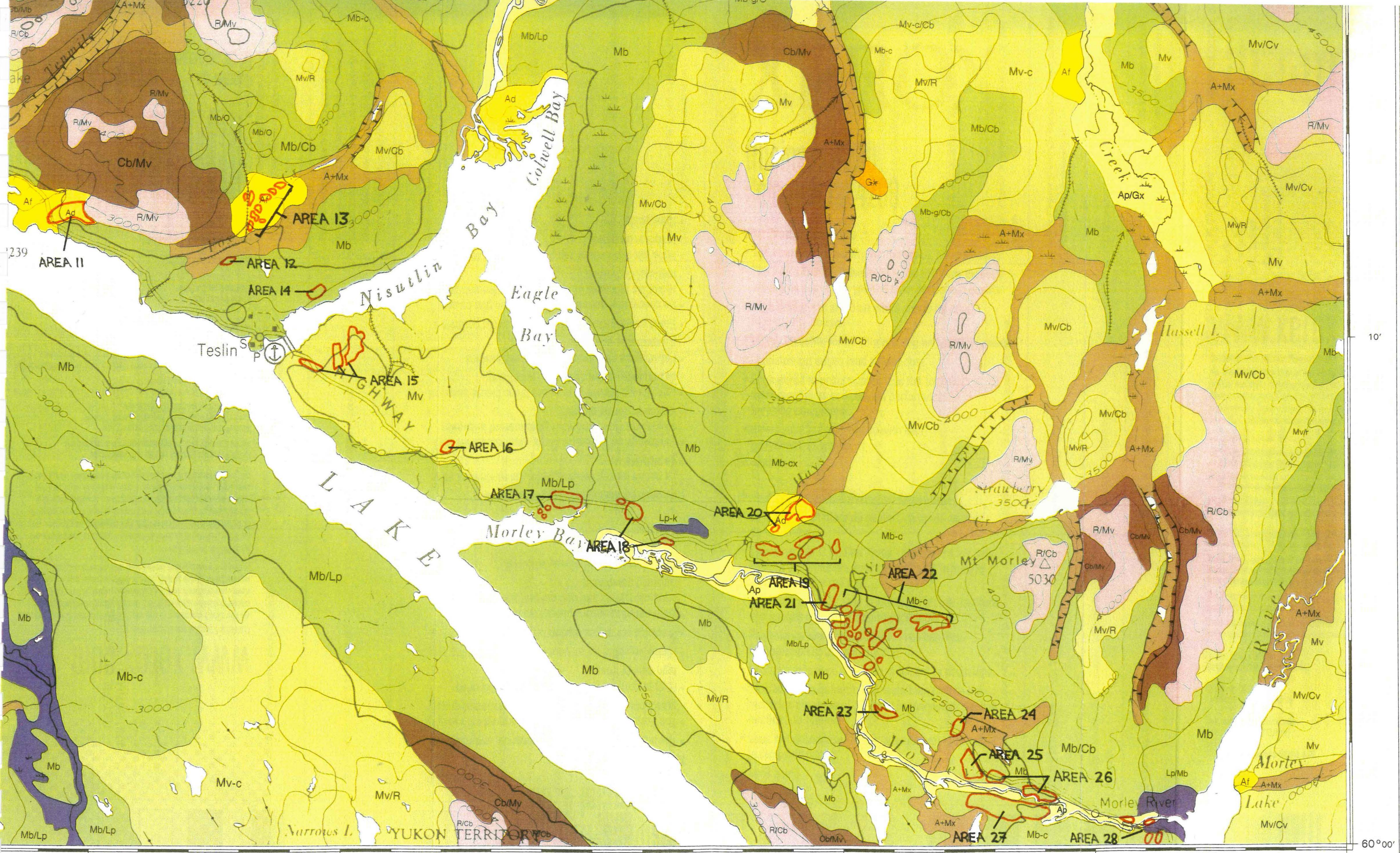
Mount Morley  
6030'

2000±

TERRITOIRE DU YUKON

COLUMBIE BRITANNIQUE





239

AREA 11

AREA 12

AREA 14

AREA 15

AREA 16

AREA 17

AREA 18

AREA 20

AREA 19

AREA 21

AREA 22

AREA 23

AREA 24

AREA 25

AREA 26

AREA 27

AREA 28

Teslin Sp

L A K E

YUKON TERRITORY

50'

40'

30'

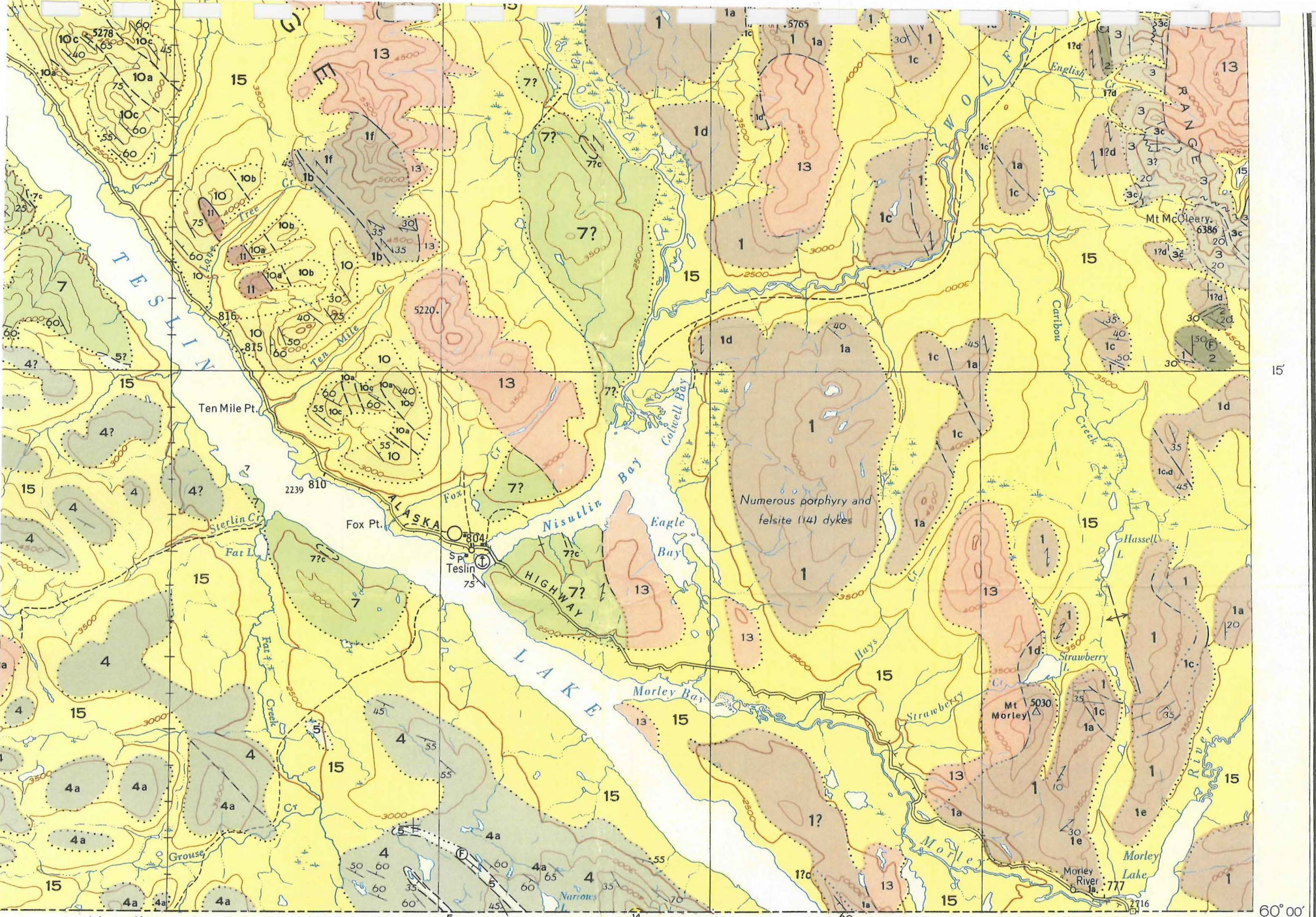
20'

10'

132°00'

10'

60°00'



Adjoins Map 1082A, "Atlin"  
133°00'

45' 30' 60' 15' 132°00'

# LEGEND

**CENOZOIC**

**QUATERNARY  
PLEISTOCENE AND RECENT**

15 Drift and alluvium

**MESOZOIC**

**CRETACEOUS**

**COAST AND CASSIAR INTRUSIONS**  
13 Granite, granodiorite; diorite; 13a, gabbro, diorite; hornblendite, pyroxenite; granodiorite; 13b, syenite, monzonite, gabbro; granodiorite, diorite

**JURASSIC OR CRETACEOUS**

12 Diorite

11 Peridotite, pyroxenite; serpentine

**TRIASSIC AND/OR JURASSIC  
UPPER TRIASSIC AND/OR JURASSIC**

9 Argillaceous sandstone and siltstone, greywacke; 9a, conglomerate; 9b, black limestone; 9c, associated volcanic rocks

**TRIASSIC AND/OR JURASSIC (?)**

10 Undifferentiated volcanic and sedimentary rocks; 10a, mainly augite, hornblende, and feldspar porphyry flows; agglomerate, breccia, tuff; 10b, greenstone; 10c, argillaceous siltstone, sandstone, greywacke; banded chert

**TRIASSIC  
UPPER TRIASSIC  
LEWES RIVER GROUP**

8 Argillite and sandstone; 8a, limestone

**PERMIAN AND/OR TRIASSIC**

7 Volcanic and altered volcanic (?) rocks, chert; minor argillite and quartzite; 7a, intermediate lava and pyroclastic rocks; 7b, basic lava; 7c, limestone

**PERMIAN OR (?) LATER**

6 Conglomerate, greywacke, limestone

**PENNSYLVANIAN (?) AND PERMIAN  
CACHE CREEK GROUP (4,5)**

4 5  
5. Limestone; minor chert, argillite, slate, greenstone  
4. Argillaceous and quartzitic siltstone, sandstone, greywacke; chert; minor limestone; 4a, chiefly banded chert; 4b, limestone; 4c, conglomeratic greywacke; 4d, banded argillite and argillaceous quartzite

**PALAEZOIC**

**MISSISSIPPIAN**  
ENGLISHMANS GROUP (2,3)

2 3  
3. Argillaceous quartzite, slate; phyllite, chert; 3a, arkosic grit; 3b, conglomerate; 3c, limestone; 3d, greenstone  
3A, Quartzose and argillaceous schist and phyllite; minor limestone; mainly equivalent to 2 and 3, but in part to 1, and in part of uncertain age  
2. Limestone

**MISSISSIPPIAN OR EARLIER (MAINLY)  
BIG SALMON COMPLEX**

1 Schist, gneiss, quartzite, greenstone, limestone; may be in part equivalent to younger units; 1a, chiefly quartzite and quartz-mica schist and gneiss; 1b, chiefly dark argillaceous slate, schist, quartzite; 1c, limestone; 1d, chiefly green, chloritic and epidotic rocks, biotite schist, amphibolite; 1e, albite gneiss, chlorite-epidote amphibolite; 1f, quartz-biotite-amphibole-epidote-plagioclase-garnet

134°  
61°00'  
14?  
9a  
9a  
45'  
33A. "Whitehorse"

PALÆOZOIC

4 5

4. Argillaceous and quartzitic siltstone, sandstone, greywacke; chert; minor limestone; 4a, chiefly banded chert; 4b, limestone; 4c, conglomeratic greywacke; 4d, banded argillite and argillaceous quartzite

MISSISSIPPIAN

2 3

ENGLISHMANS GROUP (2,3)  
 3. Argillaceous quartzite, slate; phyllite, chert; 3a, arkosic grit; 3b, conglomerate; 3c, limestone; 3d, greenstone  
 3A, Quartzose and argillaceous schist and phyllite; minor limestone; mainly equivalent to 2 and 3, but in part to 1, and in part of uncertain age  
 2. Limestone

MISSISSIPPIAN OR EARLIER (MAINLY)

1

BIG SALMON COMPLEX  
 Schist, gneiss, quartzite, greenstone, limestone; may be in part equivalent to younger units; 1a, chiefly quartzite and quartz-mica schist and gneiss; 1b, chiefly dark argillaceous slate, schist, quartzite; 1c, limestone; 1d, chiefly green, chloritic and epidotic rocks, biotite schist, amphibolite; 1e, albite gneiss, chlorite-epidote amphibolite; 1f, quartz-biotite-amphibole-epidote-plagioclase-garnet gneiss

A

Quartz-hornblende and quartz-feldspar-hornblende gneiss and amphibolite; diorite (?); at least in part derived from 1

- Bedding (horizontal, inclined, vertical, dip unknown) . . . + / / / /
- Schistosity (inclined, vertical, dip unknown) . . . . . / / / / /
- Fault (defined, assumed) . . . . . ~ ~ ~ ~ ~
- Anticline (approximate) . . . . . ~ ~ ~ ~ ~
- Syncline (approximate) . . . . . ~ ~ ~ ~ ~
- Fossil locality . . . . . ⊕

Geology by R. Mulligan, 1950-1953

Geology of northwestern part of map-area in part adapted from Lees, 1936 map and field notes; including practically all the part north of the immediate valley of Sidney Creek, upper Swift River, and the trench through Swift Lake and Rosy Lake

To accompany G. S. C. Memoir 326 by R. Mulligan

Cartography by the Geological Survey of Canada, 1963

- Road, loose surface, all weather. . . . . = = = = =
- Trail and travelled route . . . . . - - - - -
- Milepost, Alaska Highway . . . . . 810
- Telephone, trunk line . . . . . + + + + +
- Building . . . . . ■
- Post Office . . . . . P
- Landing strip . . . . . ○
- Seaplane anchorage . . . . . ⊕
- Horizontal control point . . . . . △
- Boundary monument . . . . . □
- Provincial boundary . . . . . - - - - -
- Intermittent stream . . . . . ~ ~ ~ ~ ~
- Marsh . . . . . ~ ~ ~ ~ ~
- Sand or gravel . . . . . ~ ~ ~ ~ ~
- Contours (interval 500 feet) . . . . . 5000
- Height in feet above mean sea-level . . . . . 2262

Base-map prepared by the Surveys and Mapping Branch, 1950-1952

Mean magnetic declination, 32° 20' East, decreasing 3.7' annually.  
 Readings vary from 31° 20' in the S W corner to

