

**GEOTECHNICAL SERVICES  
ROCK QUARRY INVESTIGATION  
km 134.5 Dempster Highway # 5  
Yukon, 1998**



*J. R. Paine & Associates Ltd.*

CONSULTING AND TESTING ENGINEERS

*J.R. Paine & Associates Ltd.*

**GEOTECHNICAL SERVICES  
ROCK QUARRY INVESTIGATION  
km 134.5 Dempster Highway # 5  
Yukon, 1998**

***J.R. Paine & Associates Ltd.***

**REPORT NO: 8002-251**

**GEOTECHNICAL SERVICES  
ROCK QUARRY INVESTIGATION  
km 134.5 Dempster Highway # 5  
Yukon, 1998**

**June 16, 1998**

**J.R.Paine & Associates Ltd.  
14 Burns Road  
Whitehorse, Yukon  
Y1A 4Y9**

**REPORT NO: 8002-251**

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***J.R. Paine & Associates Ltd.***

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Enclosed

- Appendix A – Site Location & Topographical Map
- Appendix B – Site Sketch
- Appendix C – Laboratory Test Results
- Appendix D – Site Development Plan
- Appendix E – Photographic Documentation

## **1.0 INTRODUCTION**

This report presents the results of the geotechnical services conducted at km 134.5 LHS, Dempster Highway # 5, Yukon. Research was conducted according to conditions outlined in the proposal call, developed by the Government of Yukon, Community and Transportation Services (C&TS), Transportation Engineering Branch. The basis of investigation was to provide sufficient information with which to base future development considerations for a proposed rock quarry located left of km 134.5, Dempster Highway # 5 (Please see Appendix A – Site Location). Specifically, the objective was to develop a site work plan in order to produce up to 10,000 m<sup>3</sup> of Class II rip-rap for placement in the Blackstone River between km 142 to km 143 this year.

Authorization to proceed was received from Mr. Walter Gutowski, YTG, Community and Transportation Services on June 5, 1998. Field work was conducted on June 7, 1998 & June 8, 1998.

## **2.0 OBJECTIVES**

As required by the Client, three objectives were delineated for the surficial investigation parameters, namely;

- Provide geological mapping of the site to determine rock type, extent of outcrop and provide quantity availability estimates.

- Provision of sample collection and laboratory testing to determine suitability of the site as a source area for Class II rip-rap.

- Provide photographic documentation of the site investigation area.

Upon the conclusion of J.R.Paine & Associates Ltd.'s geotechnical investigation of the site, all objectives as stated in the Clients proposal call were meet.

### **3.0 SCOPE OF WORK & PROJECT METHODOLOGY**

In order to satisfy the services required by the Client, it was necessary to conduct four phases of investigation.

- Phase 1: Project Familiarization**
- Phase 2: Field Work Program**
- Phase 3: Laboratory Testing Program**
- Phase 4: Final Report Preparation and Submission**

#### **3.1 Project Familiarization**

This phase of work involved liaison with your department to obtain airphotos and previous information regarding the site as well as review of other literature sources.

Following collection of available information, data was thoroughly reviewed by our firm to ensure that a well planned field program had been established and that all portions of the designated site was investigated to assess development potential.

The data review incorporated past geological, geotechnical and future site specific planning reports in conjunction with relevant surficial and bedrock geology information to gain a deeper understanding of the area. Furthermore, an airphoto terrain analysis was conducted confirming the information garnered from the initial components of the geotechnical investigation. All relevant information gathered provided a basis for future site development and recommendations.

#### **3.2 Field Work Program**

Following our review of the available data and confirmation of our field investigation methodology with the Client, our firm mobilized to the Klondike Maintenance Camp, located at km 64.0, Dempster Highway # 5, Yukon to initiate the field work program.

The field work program consisted of establishing a survey control in order to determine the locations of field observations. The survey control was established through the use of a hip chain and hand held compass, marking the middle of the existing slope at 100 meter intervals (from approximately east to west) with survey lathe.

Following the establishment of the survey control, a site reconnaissance was conducted noting pertinent field observations and confirming information gathered during Phase1 - Project Familiarization.

Ground truthing was conducted by hand excavating a total of 8 test pits with 9 soil samples obtained. In addition, 13 rock hand samples and 4 bulk rock samples were obtained during the investigation. The bulk samples of rock were collected from rock talus located along the slope and from an exposed rock outcrop southeast of the study area.

All test pits, samples and field observations were located relative to the established survey control and other prominent site features as shown in Appendix B- Site Sketch.

Photographic records of the site investigation areas were obtained as requested by the Client and are enclosed in Appendix F – Photographic Documentation.

All work conducted complied with the Land Use Permit.

### **3.3 Laboratory Testing Program**

The samples obtained during the field testing program were tested in the laboratory to determine a series of index properties including moisture content, particle size and gradation. The bulk samples obtained were suitable for Trial Crush & L.A. Abrasion tests. A total of two Trial Crushes, two L.A. Abrasion tests, nine moisture tests and four grainsize analysis were conducted.

A total of four bulk samples of rock were collected from the site for evaluation of potential rock quarry sources. Three samples were obtained by collecting rock talus from various locations along the

exposed slope, while the fourth sample was obtained directly from an exposed rock outcrop southeast of the site along an exposed rock face. All bulk samples obtained were suitable for Trial Crush & L.A. Abrasion tests. However, based upon the variability of the source material, it was determined that test samples should be reflective of material type. As such, the three rock talus samples were combined to obtain a single rock sample of metamorphosed sandstone, Sample A. The fourth sample was comprised of metamorphosed mudstone (Argillite), Sample B.

The results of the grainsize analysis are summated on individual test sheets enclosed in Appendix C – Laboratory Test Results. Trial Crush and L.A. Abrasion test results are enclosed in the evaluations, interpretations & conclusions.

With the exception of the sample crushing and L.A. Abrasion tests, all laboratory testing was undertaken by J.R.Paine & Associates Ltd.'s Whitehorse personnel in our local laboratory. The two Trial Crushes and L.A. Abrasion tests were conducted by our staff in Y.T.G. laboratory facilities.

### **3.4 Final Report Preparation and Submission**

The final report enclosed contains the following information;

#### **Surficial Investigation**

- site location, access, description**
- vegetation and drainage**
- rock type, extent of outcropping, geological structure & overburden material terrain classification & evaluation**

#### **Development Plan**

- Pit Development**
- Proposed Access**
- Site Aesthetics**
- Assessment of proposed access**
- Quantities & Development Requirements**  
**(including basis for calculations, i.e., source depth, overburden, etc.)**

#### **Photographic Documentation**

**Closure**

**Appendices**

Additional information may be included in the final report containing information regarding background, methodology and similar site specific project information.

## ROCK QUARRY INVESTIGATION

### **km 134.5 LHS Dempster Highway # 5, Yukon**

Research was conducted according to conditions outlined in the proposal call, developed by the Government of Yukon, Community and Transportation Services (C&TS), Transportation Engineering Branch. The basis of the investigation was to provide sufficient information with which to base future development considerations for a potential rock quarry source at this location.

### **Surficial Investigation**

A surficial investigation of the site on June 6 and June 7, 1998 by Mr. Tares Dhara determined the following;

#### *Site Location, Access and Description*

The site is located on the left hand side of the Dempster Highway # 5 at km 134.5 as shown in Appendix A -Site Location. Vehicle access to the sites eastern boundary can be achieved by utilizing an existing trail as shown in Appendix B - Site Sketch. The site is approximately 550 meters deep by 200 meters wide. A moderate to steeply sloping hill, rising to the south, occupies the southern portion of the site. The southeastern portion of the site broadens to an upper terrace formation that appears to be influenced by the underlying rock structure. Rock talus is present throughout the sloped areas. The northern portion of the site is comprised of a lower terrace and alluvial fan with the western portion of the lower terrace exhibiting bog conditions.

A 1:50000 scale, topographical map is enclosed in Appendix A – Topographical Map.

#### *Vegetation and Drainage*

A limited amount of vegetation along the exposed slope was noted as shown in photo # 1-98. Traversing west across mid-slope, very limited vegetation was encountered until approximately 175 meters into the site. At this location, lichen and a limited amount of moss was encountered. At 380 meters into the site, established grasses, shrubs and mosses were encountered to the western edge

of the site. Vegetation along the eastern portion of the lower terrace consisted of similar vegetation. Vegetative conditions along the western portion of the lower terrace consisted of sphagnum and free standing water over frozen materials extending to unknown depths. A sparse to medium dense ancient growth pine forest, with a surficial organic mat (approximately 0.2 meters thick) and odd bush, was located within the alluvial fan as shown in photo # 2-98.

Surficial drainage along the slope propagates down slope to the north and then eastward along the toe of the slope. Standing water was encountered throughout the western portion of the lower terrace. Towards the southern portion of the lower terrace, drainage appears to be towards the northeast. Finally within the alluvial fan formation, drainage tends towards the east along remnant fluvial channels.

No evidence of seepage zones from the slope were encountered. However, sample # 1, obtained from test pit # 8 along the slope, was noted to be wet and saturated. This may possibly be attributed to the thaw of seasonal frost or else ingress of surficial run-off and/or precipitation.

***Rock Type***

According to bedrock geology map interpretation, the site is located entirely within an area comprised primarily of Silurian to Middle Devonian aged black, thin bedded, platy limestone and interbedded chert. The material noted during the site reconnaissance was comprised of low-grade metamorphosed shale, limestone and similar argillaceous rocks.

***Extent of Outcropping***

Confirmed rock outcropping was limited at the site. Major rock outcrops were noted at the upper portion of the slope and southeast of the proposed limit of the source area along the Dempster Highway # 5. Due to the wide extent of rock talus (which extended from the toe to the top of slope throughout the site), no confirmed rock outcrops were noted elsewhere along the slope. Please refer to Appendix B – Site Sketch.

***Geological Structure***

The presence of the existing rock outcrops near the top of the slope, as well as the exposed rock face adjacent to the Dempster Highway # 5, southeast of the site, provided the opportunity to obtain detailed information regarding the geological structure of the rock present.

In general the rock noted at along the exposed rock face showed a series of interbedded units with noted strikes ranging from 56 to 80 degrees and dips between 26 and 34 degrees to the south. Lithofacies noted along the approximately 100 meters long face, from south to north, were comprised of slate, sandstone and argillite. The latter sequence being approximately 40 meters thick. Varying degrees of weathering were noted throughout the face, with oxidation being common along discontinuities.

All the rock outcrops noted near the top of the slope appeared to be comprised of slate. The outcrops were commonly bedded with discontinuities propagating both vertically and horizontally, as shown in photos # 3-98 & # 4-98. From field observations, it was noted that the most commonly oriented joint set were those striking approximately east-west and dipping to the south at approximately 18 to 30 degrees. Joints spacing in some locations was as frequent as 1 per 0.005 meters with 0.2 meters being nominal. Infilling was not observed at the site with the exception of toppling failures where the infilling consisted of voids near the surface with a small amount of detritus at the base of the fracture. Three major discontinuities were recognized within the rock outcropping forming a block jointed structure. Generally the steep sloping faces of the outcrops had strikes east/west and dips ranging from 70 to 90 degrees to the north. The top surface of the block joints generally had strikes east/west with dip angles ranging from 18 to 30 degrees to the south. The exposed eastern and western faces of the outcrops had southern strikes (+/- 15 degrees) with dips approximately vertical.

***Overburden Material Terrain Classification and Evaluation***

As depicted in the surficial geology maps and confirmed through airphoto interpretation and site reconnaissance, the site lies in two distinct regions, colluvium in the southern portion and an alluvial fan in the northern portion. Overburden material covering the southern portion of the site was described as rock rubble and/or reworked glacial deposits. The colluvium was noted as being

widespread and indicative of the underlying morphology. The northern portion of the site was described as an alluvial fan deposit consisting of silt, sand and gravel deposits.

From field observations, overburden located in the southern portion of the site was comprised of rock talus varying in size from 0.15 meters to 1.0 meters with 0.3 meters to 0.5 meters nominal. Generally, the smaller size talus was noted near the base of the slope. Talus composition varied widely throughout the area. Some areas of the western portion of the slope, as well as along the upper terrace formation in the eastern portion, were covered with a thin layer of surficial organics overlying fine grained soils to depths of 0.5 meters, noted.

Overburden located in the northern portion of the site could be separated into three distinct areas. An area exhibiting bog characteristics was encountered in the western portion of the lower terrace with free standing water and sphagnum overlying frozen fine grained and organic materials extending to unknown depths, please see photo # 5-98. The overburden along the eastern extent of the lower terrace appeared to consist of a thin veneer (0.0 to 0.3 meters) of surficial organics and fine grained soils overlying rock talus, please see photos # 6-98 & # 7-98. Along the alluvial fan, overburden consisted of on average 0.2 meters of surficial organics overlying 0.1 to 0.5 meter thick layer of fine grained soils (sandy silts to clayey silts), as shown in photo # 8-98. A dense gravel stratum with cobbles was encountered at approximately 0.60 meters depth. Visible ice in size to 2 cm. was noted in several test pits with refusal due to encountering frozen material common, please refer to photo # 9-98. Laboratory moisture contents on the frozen material ranged to 112.5 percent.

Visual logging of the exposed gravel pit located along the northeastern boundary of the site indicated the a thin (0.2 meter to 0.3 meter) layer of surficial organics and fine grained materials overlying a sandy gravel stratum with cobbles and boulders in size to 0.4 meters present to the exposed depth of approximately 3.0 meters.

All overburden encountered was considered unsuitable for use as staging and stockpile base materials.

## **Developmental Plan**

Upon review of the existing data collected to date, it appears that the site may be suitable for use as a rock quarry source provided that the area is properly developed.

The following observations should be noted;

### ***Pit Development***

Based upon information gathered during our firms investigation of the site, there appears to be two locations that may be suitable for rock quarry development. The first site (Area 1) is located on the upper bench formation along the southeastern portion of the rock slope, while the second site (Area 2) is located immediately adjacent to the Dempster Highway outside of the proposed site development area (please see Appendix D – Site Development Plan).

### ***Source Area 1***

Site topography in Area 1 appears to be controlled by the underlying structure. Rock talus is present throughout the area to unknown depths. No confirmed bedrock outcrops were noted within this area.

Development may consist of further investigation by a tracked backhoe of sufficient size to excavate talus to determine depth to bedrock and further classify rock characteristics. Should the amount of talus be excessive, consideration should be given to screening the existing talus to meet Class II – rip-rap specifications. This may be carried out until underlying bedrock is exposed (if present) or sufficient quantities are realized. Should bedrock be encountered at shallow depths, operations may consist of either ripping and/or blasting to obtain a workable source product. Following this, screening of the blasted material may be required to obtain the desired specifications for Class II – rip-rap.

Should Class II rip-rap production require blasting techniques in order to obtain source material, care should be exercised such that blasting charges are not excessive (in order to minimize the

production of minus 300 mm. material). Where competent bedrock is encountered, slopes should be scaled at two (2) vertical to one (1) horizontal. Otherwise where fractured rock is encountered, slopes should be scaled at one (1) vertical to one (1) horizontal or as conditions warrant. Development of the quarry should progress such that future development operations will not be affected. Surficial drainage should be controlled such that any potential quarry development, within the source, staging and stockpile areas, will not be adversely affected.

Care should be exercised when conducting operations in this area to minimize the potential for rock fall from upslope.

*Source Area 2*

Although the location of Area 2 is outside the proposed rip-rap source area, the location may prove suitable for development. The area is located immediately adjacent to the Dempster Highway # 5, providing minimal need for access development. Rock talus the area noted was minimal with rock outcropping present throughout the area.

Class II rip-rap production will require blasting techniques in order to obtain source material. Care should be exercised such that blasting charges are not excessive (in order to minimize the production of minus 300 mm. material). Where competent bedrock is encountered, slopes should be scaled at two (2) vertical to one (1) horizontal. Otherwise where fractured rock is encountered slopes should be scaled at one (1) vertical to one (1) horizontal or as conditions warrant. Development of the quarry should progress such that future development operations will not be affected. Surficial drainage should be controlled such that any potential quarry development will not be adversely affected.

Care should be exercised when conducting operations in this area to minimize the potential for rock fall from upslope.

*Staging Area*

Depending upon the location of the source area, the staging area for pit operations may be located either immediately adjacent to the source area (Area 1) or else immediately adjacent to the stockpile area.

*Stockpile Area*

The area noted for the proposed stockpile area will prove suitable. Additional stockpile areas may be required adjacent to the proposed stockpile to store excess screened material for subsequent crushing for granular resources and grubbing and stripping stockpiles.

*Proposed Access*

Access to the site may be gained through the existing trail as well as through development of new trails as shown in Appendix D – Site Development Plan. Access routes should be designed such that drainage considerations are addressed.

*Site Aesthetics*

*Staging and Stockpile Areas-*

The presence of trees, vegetation and local highs in the topography immediately adjacent to the existing trail should provide an adequate amount of visual screening for the staging and stockpile areas.

*Source Area 1-*

Site aesthetics would be of minor concern as most portions of the upper bench are not visible from the highway to the north, as shown in photo # 10-98. Viewed from the south and east, the site would likewise be screened from the highway by presence of highs in the local topography, as shown in photo # 11-98.

*Source Area 2-*

Due to possible development of the area immediately adjacent to the existing highway, visual screening of this area is not possible, as shown in photo # 11-98.

***Quantities & Development Requirements***

For the purposes of this report we have estimated a 2.0 hectare site will be required. This size of the site should accommodate;

- Grubbing & Stripping Stockpile
- Reject blast and source screening material (-300 mm.)
- Class II rip-rap Stockpile
- Production staging area and access

Evaluation of potential quantities were determined as follows;

***Staging and Stockpile Areas-***

**Clearing /Grubbing-**

Due to the presence of a sparse to medium dense, ancient growth pine forest at the site, efforts should be made to salvaged available materials. In general the trees noted on the site can be considered of good quality.

Grubbing of the area will be required for approximately 1.5 ha. The surficial organic cover consisted of, on average, a 0.2 meter thick layer extending throughout the site. Some localized variations in this thickness may occur. The quantity for Grubbing materials has been calculated as approximately 3000 m<sup>3</sup>.

**Stripping -**

The overburden material encountered throughout the site would be considered unsuitable for use as base material for staging and stockpiles. The overburden material would be incapable of supporting production traffic and may induce wastage of the stockpile bottom course. As such, this material should be stripped prior to quarry development.

Alternately, a staging and stockpile area base may be constructed with reject screening from rip-rap production and rock talus.

Overburden thickness averaged 0.5 meters excluding the surficial organic cover. Thickness of overburden ranged from near zero in locations of near surface gravel and cobble exposure to undetermined depths. Based upon staging and stockpile areas covering a total of 1.5 ha, the following quantity for Stripping materials has been calculated as approximately 7500 m<sup>3</sup>

*Rock Quarry*

*Source Area 1 -*

*Clearing, Grubbing & Stripping -*

No clearing will be required in source area 1. Grubbing and stripping within Area 1 should be undertaken to minimize fines content within the source material. Minimal amounts (0.0 – 0.3 meters) of organics and overburden was present within the source area, as such, quantity estimates are not provided.

*Source Rock -* In general, the surface topography noted may be influenced by underlying bedrock.

Elevation of the pit base may be similar in elevation to the existing Dempster Highway # 5. Quantities of suitable source material during quarry development will be heavily dependent upon pit operations and procedures as well as quality of source material.

L.A. Abrasion test results (Grading A) following trial sample crush on the source material indicated a 18.3 percent loss. Crushed material was noted to be platy and elongated.

Source Area 1 would have potential for a minimum of 10000 m<sup>3</sup> of Class II rip-rap material. Quantities of rip-rap produced will be highly dependent upon quality of source rock. With no bedrock outcropping noted within this area, estimates of the source area size can not be provided. The source area would be dependent upon depth to bedrock and depth and quality of rock talus overburden.

*Source Area 2-*

**Clearing, Grubbing & Stripping -**

No clearing will be required in Source Area 2.

Due to minimal amounts of surficial organics and overburden, grubbing and stripping within Area 2 will not be required. Minimal amounts (0.0 – 0.3 meters) of organics and overburden was present within the source area, as such, quantity estimates are not provided.

**Source Rock -** Elevation of the pit base may be similar in elevation to the existing Dempster Highway # 5. Quantities of suitable source material during quarry development will be heavily dependent upon pit operations and procedures as well as quality of source material.

L.A. Abrasion test results (Grading A) following trial sample crush on the source material indicated a 15.2 percent loss. Crushed material was noted to be platy and elongated.

Source Area 2 would have potential for a minimum of 10000 m<sup>3</sup> of Class II rip-rap material. Quantities of rip-rap produced will be highly dependent upon quality of source rock. Estimates of source size are as follows;

Height x Width x Depth

$$15.0 \text{ m} \times 45.0 \text{ m} \times 15.0 \text{ m} = 10125 \text{ m}^3$$

An increase in this size may be required to accommodate rejected (minus 300 mm.) material. Also dimensions of the source area can be altered to minimize visual impact from Dempster Highway # 5 traffic.

**Photographic Documentation**



Photos were taken during the field program for documentation purposes. A selection of these photos are presented in Appendix E - Photographic Documentation. A summary sheet providing captions, and a site sketch indicating the locations of the photos, are also enclosed.

**Closure**


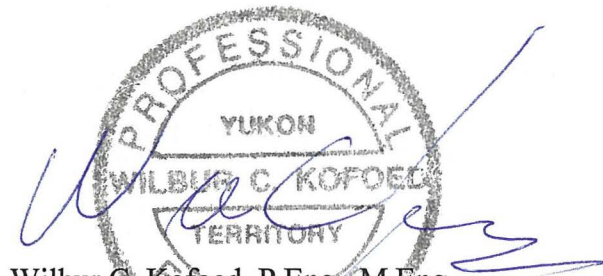
The geotechnical investigation report has been prepared for the exclusive and confidential use of Government of Yukon, Community and Transportation Services, Transportation Engineering Branch and applies only to the project mentioned above. The recommendations given are based on the subsurface soil conditions encountered during the field investigation program, current construction techniques, and generally accepted engineering practices. No other warrantee, expressed or implied, is used. Due to geological randomness of many soil formations, the interpolations of material conditions between testholes and site observations are for illustrative purposes only and may not represent actual material conditions. Material conditions are known only at the testhole locations and where data has been collected and interpreted. Furthermore, due to the location of this site within a discontinuous permafrost zone and given the sensitive nature of frozen soils, consideration should be given to minimize activities that may disturb the underlying materials. Should other soils be encountered during construction or future investigations or other information pertinent to the study become available, the recommendations may be altered or modified in writing by J.R.Paine & Associates Ltd..

We trust the above information is satisfactory for your purpose. If you should have any questions or comments on the information presented herein, please do not hesitate to contact the undersigned.

Yours truly,



Tares Dhara, P.Eng.  
Project Engineer



Wilbur C. Kofoed, P.Eng., M.Eng.  
Office Manager

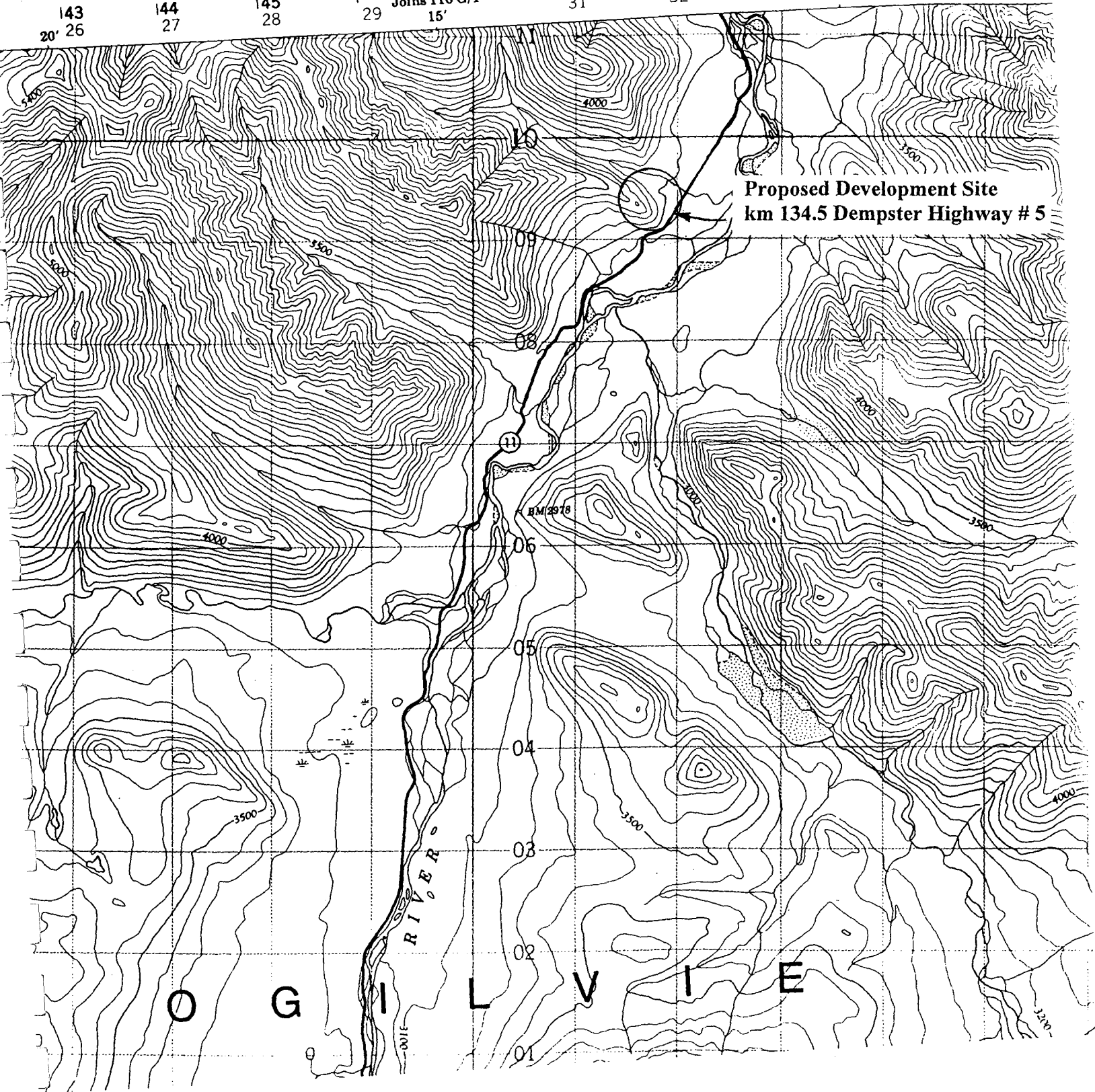
TD/td

*J.R. Paine & Associates Ltd.*

**APPENDIX A**  
**SITE LOCATION**  
**& TOPOGRAPHICAL MAP**

# CANADA

143 144 145 148 149 150 151 152 EDIT.  
20' 26 27 28 29 Joins 116 G/1 31 32 33 34 35  
15'



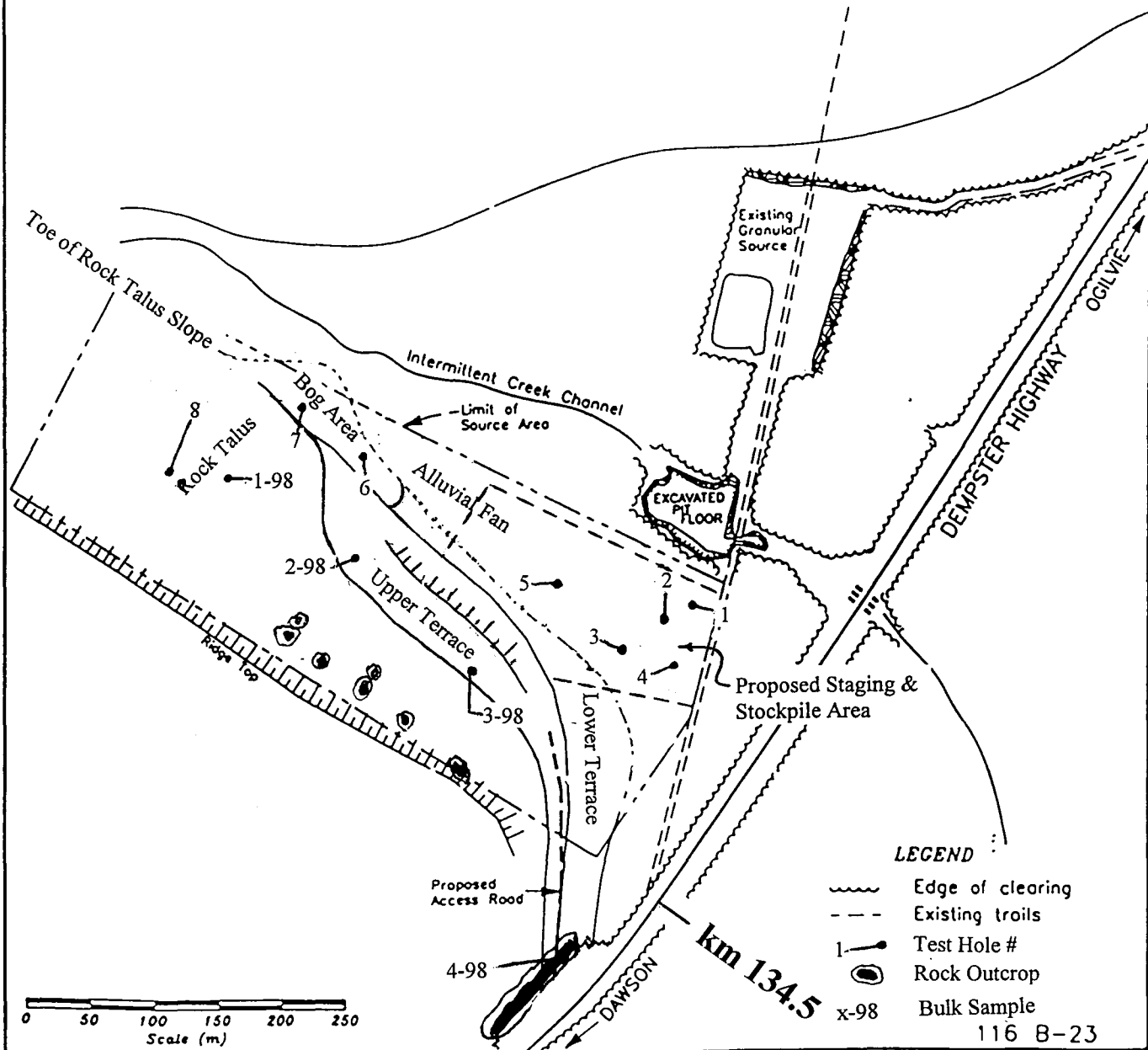
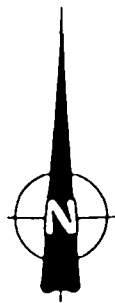
Site Location & Topographical Map

Scale ~ 1:50000

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# **APPENDIX B**

## **SITE SKETCH**



**LEGEND**

- ~~~~~ Edge of clearing
- - - Existing trails
- 1- Test Hole #
- Rock Outcrop
- x-98 Bulk Sample

116 B-23

**Site Sketch**  
**km 134.5 Dempster Highway # 5**

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**APPENDIX C**  
**LABORATORY TEST RESULTS**



# J. R. Paine & Associates Ltd.

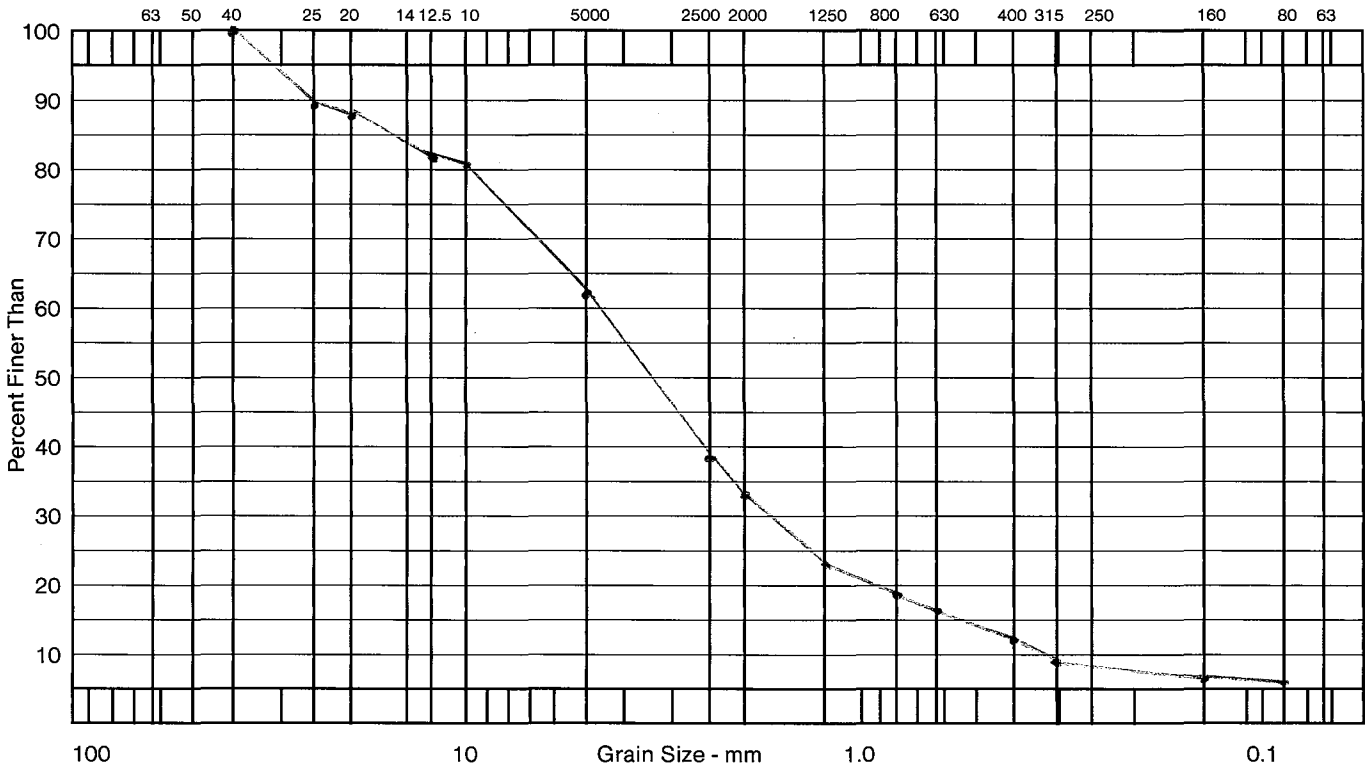
CONSULTING AND TESTING ENGINEERS

## SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING  
 Sample: #5 Depth: 0.15m Project: Rock Quarry Investigation, Km 134.5  
 Location: TH#1-98 Made by: GK Job No.: 8002-251  
 Ck'd by: \_\_\_\_\_ Date: 1998/06/14

Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				89.4
20,000	20.0				87.7
12,500	12.5				83.3
10,000	10.0				81.2
5,000	5.0				62.4
2,500	2.5				38.6
2,000	2.0				34.1
1,250	1.25				23.9
800	0.800				19.1
630	0.630				16.5
400	0.400				12.0
315	0.315				09.7
160	0.160				06.7
80	0.080				05.6

Description of Sample \_\_\_\_\_ Method of Preparation \_\_\_\_\_ Dry \_\_\_\_\_ Washed X  
 Remarks \_\_\_\_\_  
Gravelly sand - trace to some silt  
SM  
 Time of Sieving \_\_\_\_\_ Min. 15  
 Gravel: 37.6%  
 Sand: 56.8%  
 Fines: 5.6%  
 Moisture: 9.4%





# J. R. Paine & Associates Ltd.

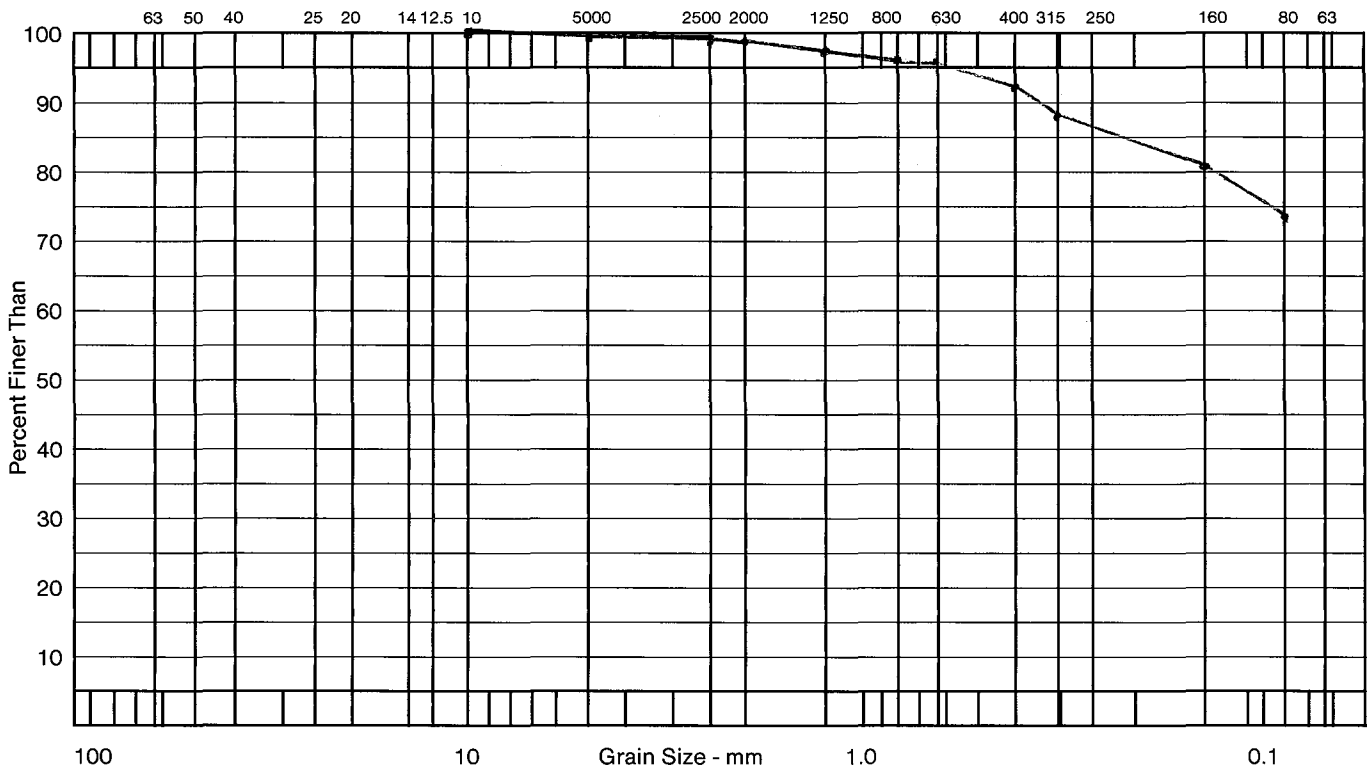
CONSULTING AND TESTING ENGINEERS

## SCREEN ANALYSIS

Client: YTG, TRANSPORTATION ENGINEERING  
 Sample: #8 Depth: 0.3m Project: Rock Quarry Investigation, Km 134.5  
 Location: TH#4-98 Made by: GK Job No.: 8002-251  
 Ck'd by: \_\_\_\_\_ Date: 1998/06/14

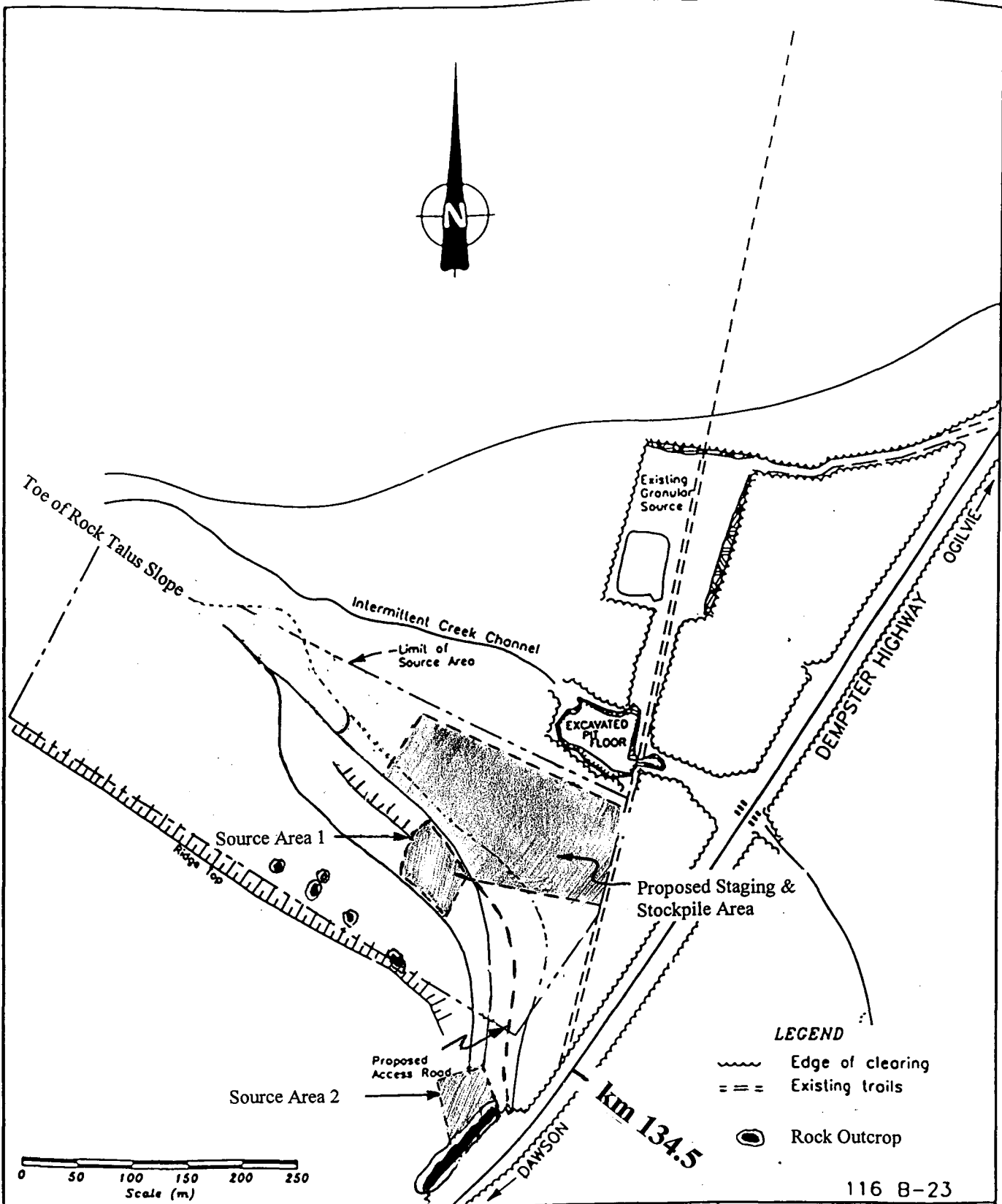
Sieve No.	Size of Opening MM	Weight Retained gms	Total Wt. Finer Than gms	Percent Finer Than	% Finer Than Basis Orig. Sample
50,000	50.0				
40,000	40.0				
25,000	25.0				
20,000	20.0				
12,500	12.5				
10,000	10.0				
5,000	5.0				99.9
2,500	2.5				99.6
2,000	2.0				99.3
1,250	1.25				97.8
800	0.800				96.5
630	0.630				95.4
400	0.400				92.1
315	0.315				88.8
160	0.160				81.0
80	0.080				74.2

Description of Sample Sandy silt Method of Preparation \_\_\_\_\_ Dry \_\_\_\_\_ Washed  ML  
 Remarks Gravel: 0.4%  
Sand: 25.4%  
Fines: 74.2%  
Moisture: 38.1%  
 Time of Sieving \_\_\_\_\_ Min. 15



*J.R. Paine & Associates Ltd.*

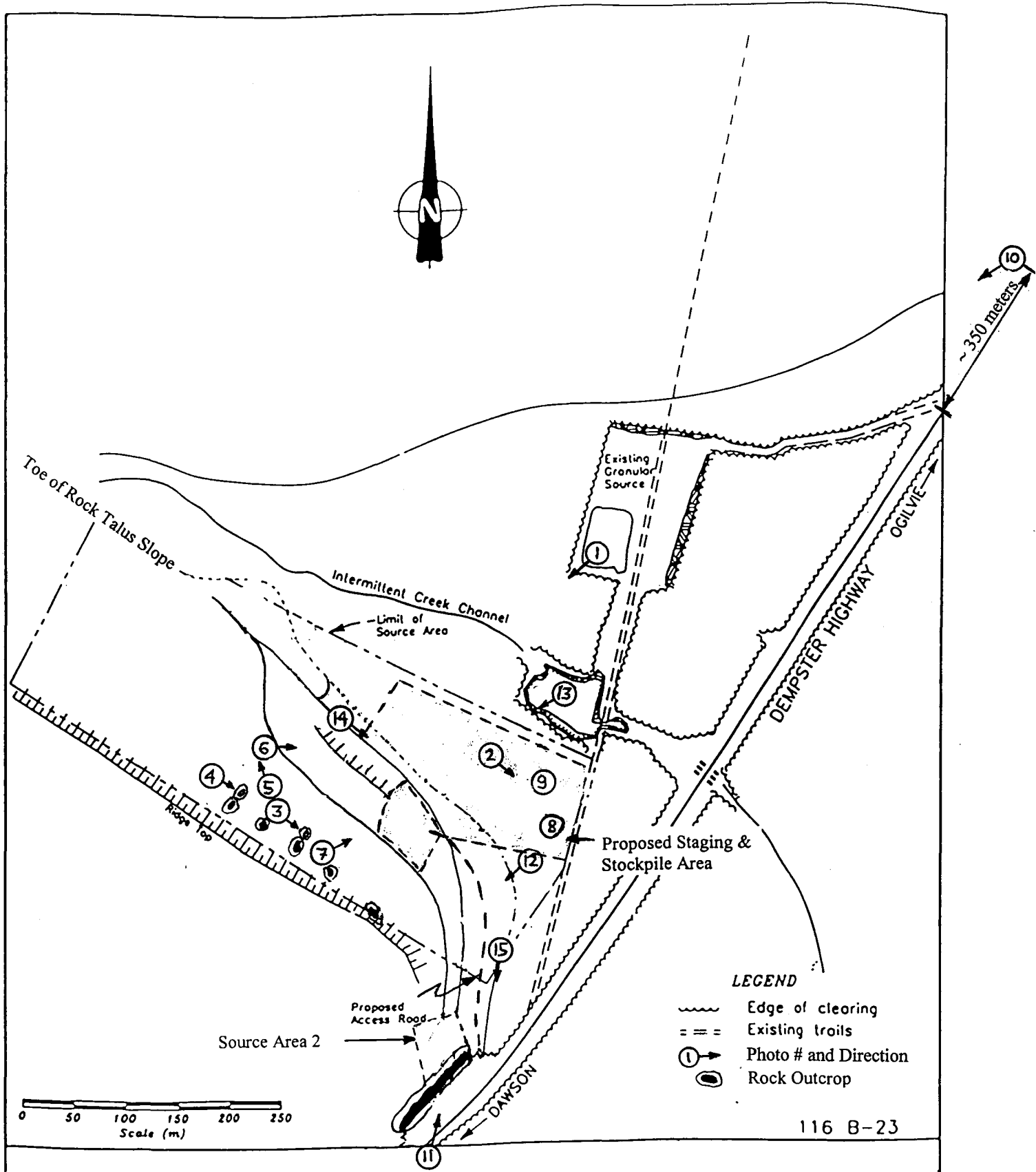
**APPENDIX D**  
**SITE DEVELOPMENT PLAN**



**Site Development Plan  
km 134.5 Dempster Highway # 5**

*J.R. Paine & Associates Ltd.*

**APPENDIX E**  
**PHOTOGRAPHIC DOCUMENTATION**



- LEGEND**
- ~~~~~ Edge of clearing
  - === Existing trails
  - ① → Photo # and Direction
  - Rock Outcrop

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**Photograph Locations  
km 134.5 Dempster Highway # 5**

**Photo Summary Sheet**

<b><u>Photo</u></b>	<b><u>Comment</u></b>
1	Vegetation conditions along the exposed slope
2	Site conditions at the proposed stockpile location]
3	Rock outcrop
4	Rock outcrop
5	Site conditions along the western slope and lower terrace
6	Site conditions along the eastern slope and lower/upper terrace
7	Site conditions along the eastern slope and lower/upper terrace
8	T.P. # 4-98
9	T.P. # 2-98 Note visible ice mid-photo
10	View of site investigated area from km 135.6
11	View of site investigated area from km 134.5
12	Site conditions of stockpile area with lower/upper terrace in background
13	Site conditions of existing granular source area
14	Site conditions along lower terrace area
15	Site conditions along potential access trail

Photo # 1 - Below



Photo # 2 - Left





**Photo # 3**



**Photo # 4**

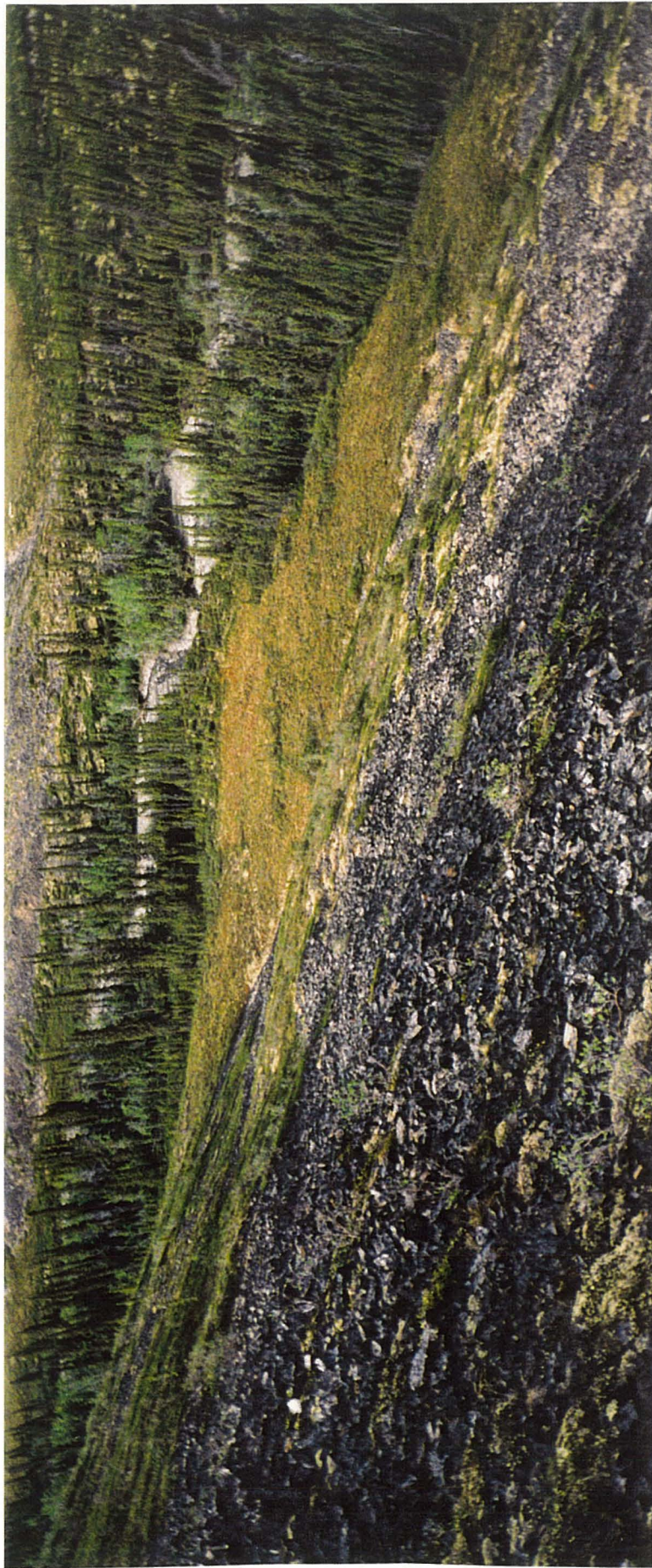


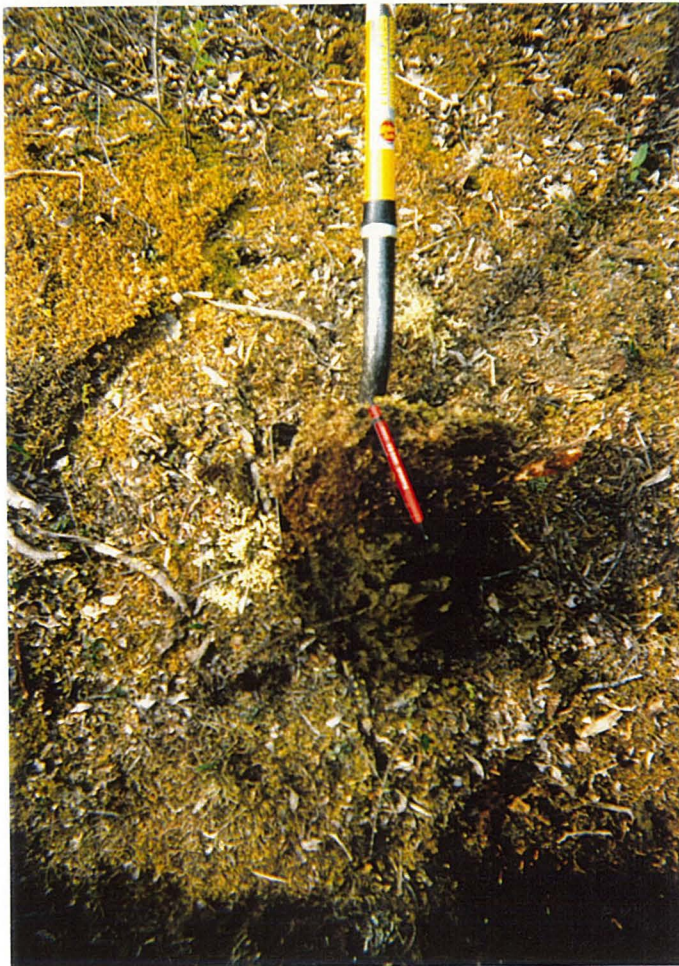
Photo # 5



Photo # 6



**Photo # 7**



**Photo # 8**

Photo # 10 - Below

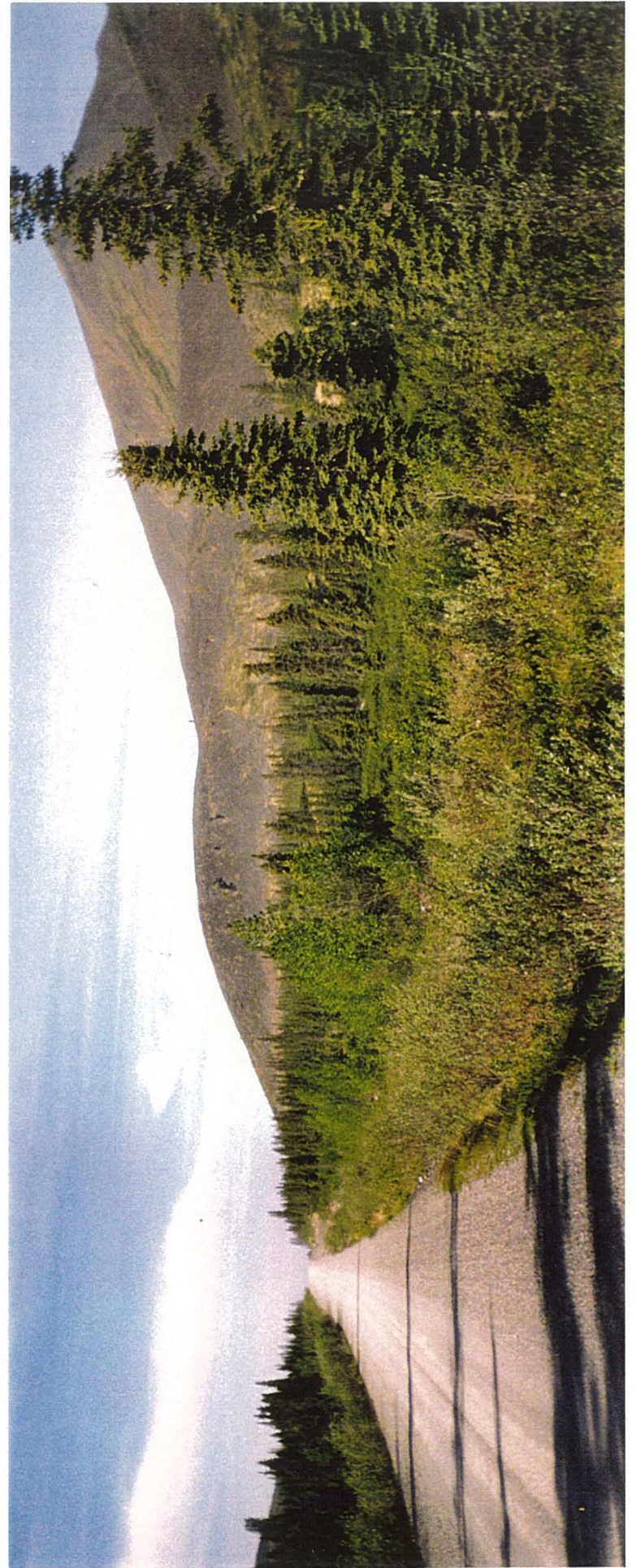


Photo # 9 - Left





**Photo # 12 – Left**



**Photo # 11 – Below**



**Photo # 13**



**Photo # 14**



**Photo # 15**

# PRELIMINARY REPORT



# *J.R. Paine & Associates Ltd.*

CONSULTING AND TESTING ENGINEERS

EDMONTON — GRANDE PRAIRIE — WHITEHORSE — PEACE RIVER

ADDRESS ALL CORRESPONDENCE TO:

14 Burns Rd.  
Whitehorse, YT  
Y1A 4Y9

June 12, 1998

File No.8002-251

GOVERNMENT OF YUKON  
Community & Transportation Services  
Transportation and Engineering Branch  
201 Range Road  
Whitehorse, YT

**ATTENTION: Mr. Walter Gutowski**

**Re:GEOTECHNICAL SERVICES  
Rip-Rap Quarry Investigation  
km 134.5 Dempster Highway # 5  
YUKON 1998**

Dear Sir;

The following letter report briefly describes our firms preliminary findings to date regarding the above noted site. Our final report will be submitted upon completion of sample testing.

Research was conducted according to conditions outlined in the proposal call, developed by the Government of Yukon, Community and Transportation Services (C&TS), Transportation Engineering Branch. The basis of investigation was to provide sufficient information with which to base future development considerations for a proposed rock quarry located left of km 134.5, Dempster Highway #5 . Specifically, the objective was to develop a site work plan in order to produce up to 10,000 m<sup>3</sup> of Class II Rip-Rap for placement in the Blackstone River between km 142 to km 143 this year.

A site reconnaissance was conducted by Mr. Tares Dhara, P.Eng. on June 6 and June 7, 1998. All aspects of our site investigation have been conducted as outlined in our Price Quote Submission of June 3, 1998 and office meeting on June 4, 1998.

## **DISCUSSION**

### **Rock Type & Sample Collection**

Based upon regional bedrock geology maps, the material present is comprised primarily of Silurian to Middle Devonian aged black, thin bedded, platy limestone. The materials noted, had undergone varying degrees of metamorphism, with slate and argillite being common. Local geology indicates a series of interbedded units consisting of sandstone, slate and argillite striking approximately east-west and dipping up to 25 degrees to the south.

Rock outcropping was quite limited at the site. Major rock outcrops were only noted at the upper portion of the slope and southeast of the site investigation along the exposed road cut (Area 1). Due to the extent of rock talus (which extended from the toe of the slope to the top of slope throughout the site), no further rock outcrops were confirmed. Rock talus noted varied in size from 0.15 meters to 1.0 meters with 0.3 meters to 0.5 meters nominal. Generally, the smaller size talus was noted near the base of the slope. Talus composition varied widely, with slate, sandstone, argillite and rhyolite, being interspersed together throughout the site.

Ground truthing was conducted at the site by hand excavating test pits. A total of 8 test pits were excavated with 9 soil samples obtained. In addition, 13 hand rock samples and 4 bulk rock samples were obtained during the investigation. The bulk samples of rock were collected from talus located along the slope and from an exposed rock outcrop southeast of the study area. The bulk rock samples collected are considered suitable for Trial Crush & L.A. Abrasion Tests.

Material testing is currently ongoing. Sample test results will be included in our final report submission.

Based upon information gathered during our firms investigation of the site and analysis to date, there appears to be two source areas that may be suitable for rock quarry development. The first site (Area 1) is located on an upper and lower bench formation along the southeastern portion of the existing rock slope, while the second site (Area 2) is located immediately adjacent to the Dempster Highway # 5, southeast of the proposed site development area (please see the attached site plan).

**Source Area 1**

Site topography in Area 1 appears to be controlled by the underlying structure. Rock talus is present throughout the entire area to unknown depths. A limited amount (approximately 50 percent) of surficial cover consisting of mosses, lichen and grasses overlies existing overburden consisting of limited depths (less than one meter) of sandy silt and organics over rock talus. Other areas had exposed rock talus on the surface. No bedrock outcrops were noted within this area.

Development may consist of further investigation by a tracked backhoe of sufficient size to excavate rock talus to determine depth to bedrock and further classify rock characteristics. Should the amount of talus be excessive, consideration may be given to screening the existing talus to meet Class II – Rip-Rap specifications. Operations may be conducted along a bench until underlying bedrock is exposed (if present) or sufficient quantities are realized. Should bedrock be encountered at shallow depths, operations may consist of either ripping and/or blasting to obtain a workable product. Following this, screening may be required to obtain the desired specifications for Class II – Rip-Rap.

It should be noted that screening of rock talus for use as Class II – Rip-Rap may be subject to unknown variability in material size and composition.

Future development may consist of subsequent work along exposed rock outcrops (if encountered) as well as switching to the lower/upper bench.

Site access would require the construction of a trail to the upper and lower bench areas to allow access for necessary equipment where required.

Site aesthetics would be of minor concern as most portions of the upper bench are not visible from the highway to the north. Viewed from the south and east, the site would likewise be screened from the highway by presence of highs in the local topography.

Quarry development will require blasting techniques in order to obtain source material. Care should be exercised such that blasting charges are not excessive (in order to minimize the loss of material due to a high fines content). Development of the quarry should progress such that future development operations will not be affected. Surficial drainage should be controlled such that any potential quarry development will not be adversely affected.

**Source Area 2**

Although the location of Area 2 is outside the proposed rip-rap source area, the location appears to be suitable for quarry development. Surficial cover consisted of sparse vegetation over rock talus. Bedrock outcropping was noted along the entire exposed rock slope, parallel to the existing highway.

Development may consist of blasting the exposed rock slope and screening the material to obtain the desired specifications for Class II – Rip-Rap. It should be noted that the use of this material for use as Class II – Rip-Rap may be subject to unknown variability in material size and composition.

Site access may require the construction of a trail to allow necessary equipment to access the backslope. Additional construction of access trails to staging and stockpile areas would require minimal work as the exiting trail may be utilized.

Screening of the source area will not be possible due to its location immediately adjacent to the Dempster Highway, hence site aesthetics may be a concern

Quarry development will require blasting techniques in order to obtain source material. Care should be exercised such that blasting charges are not excessive (in order to minimize the loss of material

due to a high fines content). Development of the quarry should progress such that future development operations will not be affected. Surficial drainage should be controlled such that any potential quarry development will not be adversely affected.

### **Staging and Stockpile Area**

Due to the requirements for screening/stockpiling material and associated pit development, work areas will be required on the alluvial fan as shown in the attached site sketch. Vegetation within the alluvial fan consisted of a sparse to medium dense, ancient growth pine forest with little to no understory. The trees may be considered of good quality and efforts should be made to salvage available timber. Stripping/Grubbing and removal of overburden will be required to prepare the areas. Surficial organic cover extended on average to 0.2 meters depths with overburden consisting of clayey silts, silty sands and other fine grained materials (some of which were frozen) to a depths of 0.60 meters. Some variation in these thicknesses will likely be encountered. Beneath the overburden a gravel stratum was encountered. This stratum was frozen in some locations with visible ice (in size to 1 cm.) noted.

### **Remaining Areas**

The entire southern portion of the site is comprised of loose rock talus that extends from the toe of the slope to the existing ridgeline to the south. The continuous slope aspect of the entire western portion of the site, in combination with the presence of the loose rock talus (to unknown depth), may make pit development in this area unfeasible.

### **Conclusions**

In general the site may be considered suitable for rock quarry development in the above noted areas. However, further investigative work should be required at the site to better characterize site conditions. This may include further exploratory work at the site by use of a tracked backhoe (to confirm presence of source rock in area 1) and a backslope stability analysis (to ensure competence of the overall rock mass).

Based upon our firms preliminary evaluation to date, there are several limiting factors that may affect pit development in the areas mentioned, namely; variability in size and composition of source material, slope aspects, extent of rock talus, lack of rock outcrops/bedrock and site aesthetics.

Quarry development will require blasting techniques in order to obtain source material. Care should be exercised such that blasting charges are not excessive (in order to minimize the loss of material due to a high fines content). Development of the quarry should progress such that future development operations will not be affected. Surficial drainage should be controlled such that any potential quarry development will not be adversely affected.

The entire western portion of the exposed slope was continuous with loose rock talus extending from the base to the top of the slope. No confirmed rock outcroppings or terrain features were noted along the lower portion of this area indicating a potential for development. Due to the difficulties associated with development given site conditions in this area, development potential was considered low.

**Closure**

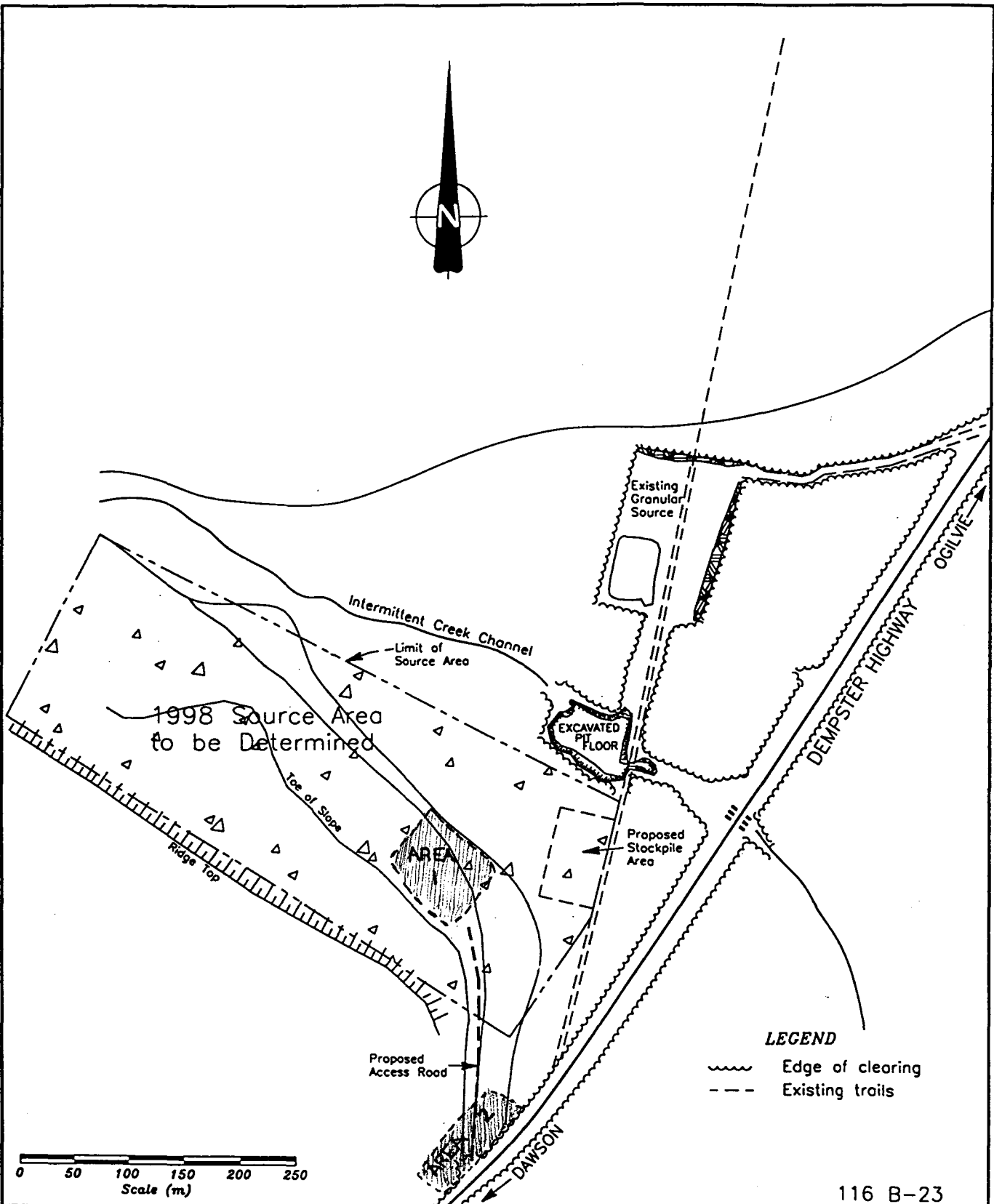
This preliminary geotechnical investigation report has been prepared for the exclusive and confidential use of Government of Yukon, Community and Transportation Services, Transportation Engineering Branch and applies only to the project mentioned above. The recommendations given are based on the conditions encountered during the field investigation program, current construction techniques, and generally accepted engineering practices. No other warrantee, expressed or implied, is used. Due to geological randomness of many soil formations, the interpolations of soil conditions between testpits and field observations are for illustrative purposes only and may not represent actual soil/rock conditions. Material conditions are known only at the testpit locations and where data has been collected and interpreted. Should other materials be encountered during construction or future investigations or other information pertinent to the study become available, our recommendations may be altered or modified in writing by J.R.Paine & Associated Ltd..

We trust the above information is satisfactory for your purpose. If you should have any questions or comments on the information presented herein, please do not hesitate to contact the undersigned.

Yours truly,



Tares Dhara, P.Eng.  
Project Engineer



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**Yukon**  
Community and Transportation Services

SITE PLAN  
PROPOSED RIP RAP  
SOURCE AREA  
km 134 L.H.S.  
DEMPSTER HWY, YUKON

designed:	W. Gutowski
drawn:	D.S.
app'd:	
date:	98-03-23
scale:	1: 5,000
drwg:	05-0134-SP

Transportation Engineering Branch