

FILE COPY

REPORT

GEOTECHNICAL INVESTIGATIONS
OF CONSTRUCTION MATERIALS
KM 139 TO 243, DEMPSTER HIGHWAY, YUKON

FOR

YUKON COMMUNITY AND TRANSPORTATION SERVICES

PA 2290

OCTOBER 1986



KLOHN LEONOFF
CONSULTING ENGINEERS



KLOHN LEONOFF YUKON LTD.

CONSULTING ENGINEERS

OUR FILE: PA 2290.01.01

October 15, 1986

Yukon Community and Transportation Services
Box 2703
Whitehorse, Yukon
Y1A 2C6

Mr. J.A. deRaadt, P.Eng.
A/Director, Highway Engineering

Geotechnical Investigation of Construction Materials
Km 139 to 243, Dempster Highway, Yukon

Dear Sirs:

Attached is Klohn Leonoff's report entitled "Geotechnical Investigations of Construction Materials, Km 139 to 243, Dempster Highway, Yukon." Data and source descriptions are presented for embankment and rip rap/filter materials sites.

If there are questions concerning the contents of this report, Klohn Leonoff would be pleased to discuss them upon request.

Thank you for the opportunity of performing these services.

Yours very truly,

KLOHN LEONOFF YUKON LTD.

ROBERT T. TAPE, M.E., P.Eng.
Project Manager
Yukon Professional Engineers
Registration No. 485

RTT/sh
Enclosure

REPORT

GEOTECHNICAL INVESTIGATIONS
OF CONSTRUCTION MATERIALS
Km 139 to 243, DEMPSTER HIGHWAY, YUKON

for

YUKON COMMUNITY AND TRANSPORTATION SERVICES

PA 2290

October 1986

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
2.0 MATERIAL REQUIREMENTS	1
3.0 SELECTION CRITERIA	3
4.0 METHODOLOGY AND DATA PROCESSING	5
5.0 EMBANKMENT MATERIAL	6
5.1 General	6
5.2 Borrow Site Descriptions	8
5.2.1 Embankment Borrow EB 137.9	8
5.2.2 Embankment Borrow EB 140.6	8
5.2.3 Embankment Borrow EB 154.0	8
5.2.4 Embankment Borrow EB 194.8	9
5.2.5 Embankment Borrow EB 197.7	9
5.2.6 Embankment Borrow EB 225.6	9
5.2.7 Embankment Borrow EB 238.2	10
5.3 Alternate Borrow Sites	10
6.0 RIP RAP AND FILTER MATERIALS	11
6.1 General	11
6.2 Rip Rap/Filter Material Site Description	11
6.3 Alternate Rip Rap/Filter Sites	14
6.4 Filter Material Gradation Recommendations	14

LIST OF APPENDICES

APPENDIX I	Klohn Leonoff Technical Proposal
APPENDIX II	Test Pit Logs
APPENDIX III	Grain Size Curves
APPENDIX IV	Rip Rap/Filter Material, Summary Sheets
DRAWINGS	

1.0 INTRODUCTION

The Dempster Highway provides vehicle access from Dawson City, Yukon to Inuvik in the Northwest Territories. Between Km's 139 to 243 (see Figure 1), the highway has experienced some erosion caused by river migrations of the Blackstone River, Engineer Creek and Ogilvie River. This report presents the results of geotechnical investigations to locate and evaluate sources of construction materials to repair the damaged sections of road.

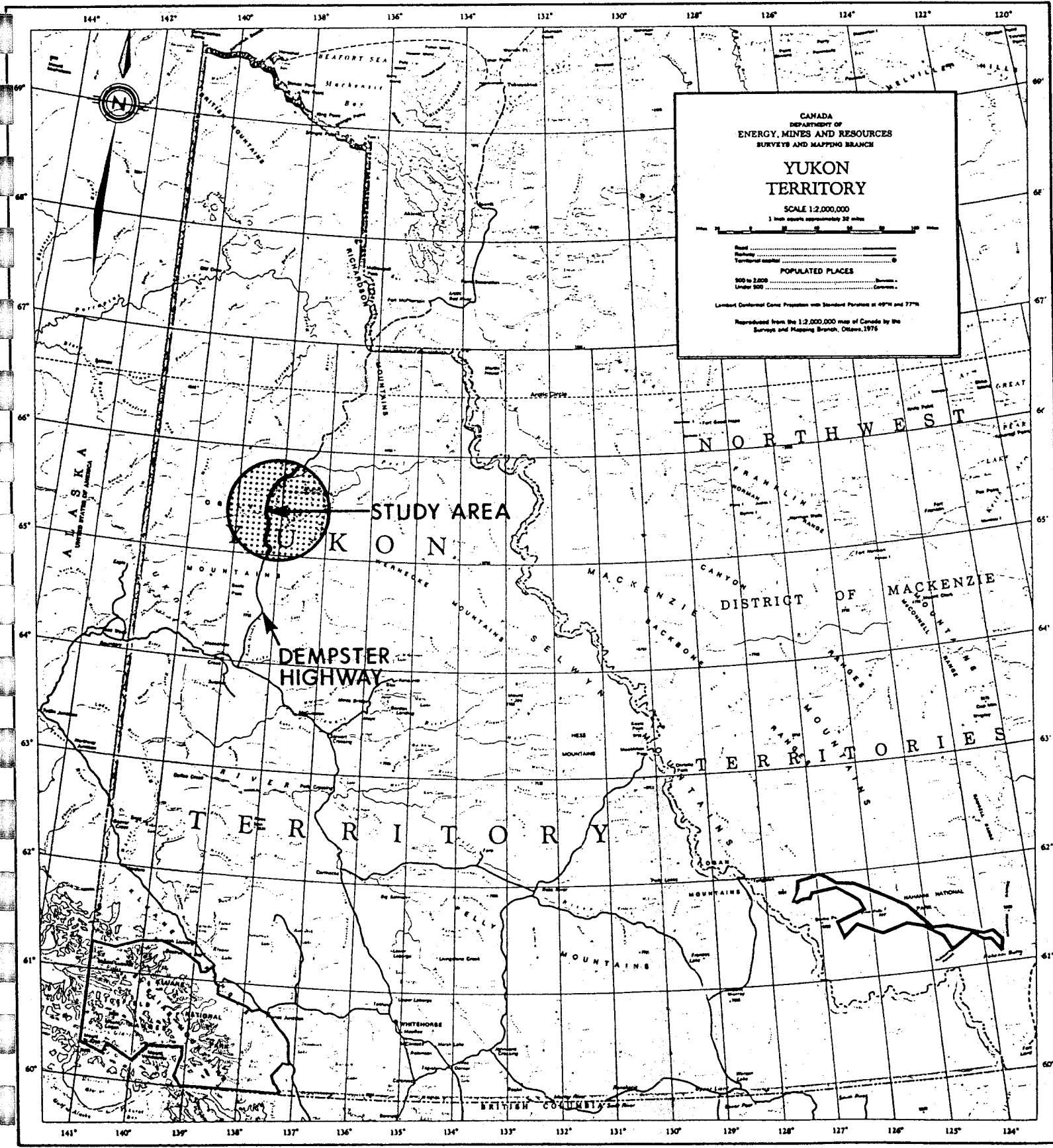
Klohn Leonoff Yukon Ltd.'s assignment was authorized by the Yukon Territorial Government, Department of Community and Transportation Services, Contract No. S-6-0933. Details concerning the description of work and scope of services provided are defined in our technical proposal dated August 11, 1986 and reproduced in Appendix I of this report.

2.0 MATERIAL REQUIREMENTS

Three material types, embankment fill, filter material and rip rap, are to be used in the repairs. The damaged segments of road along with preliminary quantities of materials needed at each location are presented in Section 2.0 "Description of Work and Scope of Services", of the attached technical proposal. Rip rap is to be Class II material (Yukon Department of Community and Transportation Services' classification) graded as follows:

100% smaller than 800 mm or 700 kg
at least 20% larger than 600 mm or 300 kg
at least 50% larger than 500 mm or 200 kg
at least 80% larger than 300 mm or 30 kg

FIGURE 1: KEY PLAN



It is to consist of hard, dense, angular quarry stone, free from seams, cracks and other structural defects. Neither breadth nor thickness of any individual stone is to be less than one third of its length. Round stones or boulders are not acceptable.

Detailed specifications were not provided for embankment fill or filter materials. Mr. John Murray, Project Manager for Yukon Territorial Government, indicated verbally, however, that any granular material with generally less than 15 percent passing the No. 200 sieve has been found to be satisfactory for embankment fill in the past. Such materials were fairly easy to place and if frozen insitu they usually contained little excess ice contents. Mr. Murray further requested that Klohn Leonoff provide some guidance for filter material gradations.

3.0

SELECTION CRITERIA

The selection of potential source areas for both embankment and rip rap/filter materials was guided by a variety of considerations. Some criteria tended to be complimentary while others were mutually exclusive or at least in opposition to one another; hence, a certain amount of judgement was used in making final selections. Following is a list, not necessarily in order of priority, of the primary criteria used in making the final selections of potential source areas:

- . availability of materials in sufficient volumes with physical properties suitable for the purposes intended;
- . proximity to segments of road needing repair;
- . economics of developing access and of extracting borrow;
- . avoid river borrow sites for which extraction tended to enhance the potential for further damage to the highway in future;

October 15, 1986

- . employ, where possible, previously used sites for which access, ease of extraction, etc. had already been developed. This criteria was expressed verbally by Mr. John Murray;

- . avoid locations of land claims and habitat conflict such as
 - a) Land Claims selection Dawson Band S-34 Blackstone River Area
 - b) Land Claims selection Old Crow Band S-44 Ogilvie River/Sapper Hill Area
 - c) critical sheep licks as identified in the Dempster Highway Planning Project Km 178.8 to 185.3 and Km 185.7 to 187.2
 - d) the cliffs on the east bank of Engineer Creek commencing at a point nearest to 65°21'29" north latitude and 138°14'41" west longitude and extending to a point nearest to 65°21'37" north latitude and 138°17'06" west longitude, also known as Sapper Hill
 - e) the cliffs in the vicinity of Km 205 on Dempster Highway, commencing at a point nearest to 65°24'32" north latitude and 138°13'50" west longitude and extending to a point nearest to 65°24'35" north latitude and 138°15'38" west longitude
 - f) the cliffs on the west side of Ogilvie River commencing at a point nearest to 65°34'03" north latitude and 138°10'55" west longitude and extending to a point nearest to 65°33'47" north latitude and 138°11'24" west longitude, also known as Churchward Hill
 - g) crest of knob like feature on east side of Dempster Highway and Engineer Creek with a good view up and down valley, 65°18'28" north latitude and 138°12'50" west longitude.

- . avoid as much as possible areas readily visible from the Dempster Highway;

- . avoid areas of high watertable with very shallow (less than 1 metre) borrow depths above water level, especially if stripping ratios exceed 1.0; that is, more waste than borrow is produced;
- . avoid areas containing much ice-rich materials subject to appreciable degradation following borrow source developments;
- . avoid active floodplains. Mr. John Murray expressed this criteria verbally on the basis of conflicts with fisheries interests.

4.0 METHODOLOGY AND DATA PROCESSING

Potential sites for embankment borrow were first determined in the office from observations of aerial photographs. Similarly, potential rip rap and filter material borrow sites were identified from studies of aerial photographs and bedrock geology maps. Later, when information on land claim and habitat conflict areas became available, it was transferred to the aerial photographs to identify those areas affected.

These studies were then followed up by field reconnaissances conducted jointly by the project engineer and field technician. Embankment borrow sites identified by office studies were further evaluated, including the use of hand-dug explorations, to determine stripping requirements, borrow material gradations, practicable borrow depths, lateral extent of useable materials and, hence, rough estimates of volumes available. A few additional sites located in the field were added to the list. Reconnaissances of sites positioned within fossil floodplains also entailed a review of river migration and erosion potential. Information gained from this aspect of the field program was correlated with the Yukon Territorial Government's list of repair locations and volume requirements to develop a short list of sites designated for test pit explorations as well as a few alternate locations. Site selections emphasized the use of previously developed sites where appropriate.

Upon completing the first phase of embankment borrow studies, the field technician directed a clearing crew to develop access where necessary for a truck-mounted backhoe. The project engineer simultaneously conducted reconnaissances of rip rap and filter material borrow sites. Selected locations were photographed, sampled and measurements of structures, orientations, etc. were recorded. The final phase of field studies, test pit explorations, were conducted by the field technician.

Logs of the stratigraphies encountered in the test pits are presented in Appendix II along with an explanation of the terms and symbols used. Embankment borrow samples obtained from the test pits were tested in the laboratory for grain size analyses. The test results are presented in Appendix III. Rock samples obtained from potential rip rap and filter material sites were classified in the laboratory and subjected to point-load tests. Results of both field and laboratory test data obtained from bedrock materials are presented in Appendix IV.

5.0 EMBANKMENT MATERIAL

5.1 General

The selected embankment material borrow sites are fairly well spaced and contain quality materials except along Engineer Creek where useable borrow material is scarce and generally of poor quality. The fossil floodplains along Engineer Creek are low-lying wet areas requiring extensive stripping. Alluvial fan or terrace deposits typically are well covered with high ice-rich organics. Also, all source materials observed in this area consist of fine gravels and sand including significant quantities of soft shaly material with high fines (silt and clay) contents.

A total of seven borrow locations were selected. Three others including one alternate site were rejected when test pit explorations revealed unsatisfactory material. Three more alternate sites are identified but test pits were not dug at these locations. Of the ten sites identified (seven selected and three alternates), five are

within fossil floodplains and five are alluvial terrace or fan deposits positioned on the west side of the highway. Their locations relative to the Dempster Highway are shown on Drawing No. B-2290.01. Individual site details including test pit locations of the selected borrow areas (complete with two rejected sites) are presented on sketch plans, Drawing Nos. A-2290.01 to .09.

Generally, embankment borrow materials derived from floodplain deposits consist of graded gravels and sands with less than 5 percent fines and occasional cobbles and boulders. They have little overburden cover and much of the extractable material is thawed during late summer and fall. Groundwater levels, however, are directly affected by river levels such that borrow operations during high flood levels could be prohibitive. Winter extraction is possible, but much higher percentages of the materials will be frozen requiring ripping.

The alluvial fan and terrace deposits tend to be coarse grained containing mixtures of cobble and gravel size materials with a little sand and traces of boulder sizes. This applies particularly to the relatively steep sloping alluvial deposit at Km 154.0. Two sites were rejected at Km's 176.0 and 211.0. At Km 176.0 material contained in the actively developed area is reserved for highway surfacing. Unsatisfactory, fine grained material was encountered behind the developed area. Similarly an alternate source at Km 177.1 was rejected because of unsatisfactory material. At Km 211.0 the remains of previous borrow activities consists only of reclaimed (gravel covered) spoil material and the talis material off to one side contained large amounts of unsatisfactory fine grained material. Development of the alluvial fan and terrace deposits, EB 137.9, EB 140.6, EB 154.0, EB 176.6(A) and EB 198.5(A), is not restricted by high river flows.

5.2 Borrow Site Descriptions

Much of the essential details concerning each of the embankment borrow sites is summarized on the sketch plan drawings for ease of reference.

5.2.1 Embankment Borrow EB 137.9

This is an elevated alluvial deposit positioned along the west side of the highway. It contains predominately cobble and gravel size materials which, having little overburden cover, thaws to the maximum depth of exploration, 3.5 m. Jointly with EB 140.6, there is sufficient material to service repair sections between Km's 139.0 and 147.4.

5.2.2 Embankment Borrow EB 140.6

A similar deposit to EB 137.9 but slightly finer grained. With somewhat thicker overburden cover, however, more material remains frozen. The area around Test Pit B has less cover and consequently a deeper active zone. Both EB 137.9 and EB 140.6 are immediately adjacent to and therefore visible from the highway.

5.2.3 Embankment Borrow EB 154.0

This borrow site, on the south side of the highway, is located on a bare strip of a relatively steeply sloping alluvial fan. The area, used previously, has crushed gravel stockpiled on site. Since the borrow material is already completely exposed to the ground surface, extraction would cause little change in visual impact from the highway. Also, the material thaws during summer months. It contains the coarsest material, primarily cobbles and gravel, selected for embankment borrow. This site may be used to service repairs needed between Km 170.0 and 170.4. Additionally, it has the potential to provide much more material either in future or for use instead of other borrow sites should they be considered undesirable.

5.2.4 Embankment Borrow EB 194.8

This is a small floodplain borrow source suggested for use at Km 195.0 to 195.4. It requires no stripping, only removal of some light bush. The material is mostly gravel size and thawed during summer months. A watertable at about 2 m restricts extraction depths. The site, bordering along side the highway, is highly visible, but little reclaim (some grading) would be necessary. The site does, however, border on Land Claim S-44. Should this site be considered undesirable, the material can easily be replaced at EB 197.7.

5.2.5 Embankment Borrow EB 197.7

This is a large fossil floodplain borrow source, east of the highway, consisting of gravels and sands deposited by the Ogilvie River. Also, a fairly large borrow area was previously developed immediately north of the proposed new area. Stripping requirements are typically 20 cm thick east of an old cut line, but increase to about 40 and 100 cm to the west. Clearing of small timber and underbrush is required. The extractable depth is limited to approximately 2.0 m by a groundwater table.

Material more than sufficient to make repairs needed between Km's 180.5 and 205.3 is available.

5.2.6 Embankment Borrow EB 225.6

This is a fossil floodplain deposit, east of the highway, which already has access developed for an adjoining previous borrow area. The gravel, covered by about 50 cm of overburden as well as trees and underbrush which require clearing and stripping, may be mined to a depth of about 1.7 m. Permafrost occurs less than 1 m below the top of the gravel. If desired, the surface area could be enlarged to reduce extraction depths. Material to make repairs between Km's 209.3 and 223.8 may be obtained from this site. Also, there is potential for enlarged future requirements.

5.2.7 Embankment Borrow EB 238.2

Similar to EB 225.6, this is another fossil floodplain gravel deposit, east of the highway, which has access developed from previous borrow operations. The area immediately north of the previous borrow site in the vicinity of Test Pits A and B is slightly higher containing less overburden and greater extractable depths. Frost was not encountered in any of the test pits. Clearing of small trees and underbrush is required. Stripping requirements vary from 5 to 15 cm on the east side of the proposed development to approximately 45 cm to the west. The average depth of extraction limited by a groundwater table is 2 m. More than enough material is available for repairs needed between Km's 241.4 and 242.2.

5.3 Alternate Borrow Sites

Three alternate borrow sites, identified on Drawing No. B-2290.01 are located at Km's 160.1, 176.6 and 198.5.

Km 198.5 is an alluvial terrace deposit immediately adjacent to the west side of the highway. Good looking gravel material is exposed in a 7 m high cut. Significant quantities of embankment borrow are likely available there. Stripping and clearing is required. It would be clearly visible from the road, although there is some possibility that a ridge of undisturbed material could be left in place to reduce visual impact.

The nature of the deposit at Km 176.6 is not well defined. It was encountered by the field technician during test pitting operations after potential sources at Km's 176.0 and 177.1 were found to be unsatisfactory. Two test pits (see Appendix II) were dug from the roadside revealing shaly material similar to that being extracted from Km 176.0. It may provide an additional source of highway surfacing material.

Km 160.1 consists of mostly barren alluvial floodplain cobbly gravels positioned along the west side of the highway. They are deposits originating from the headwaters of Engineer Creek which display much better quality than materials farther downstream. The area may be described as active floodplain, but surface flow is intermittent so fisheries conflicts may be minimal. Previous borrow operations have already taken material from this area. If acceptable, it would provide a lesser haul distance for repairs between Km's 170.0 and 170.4, compared to obtaining material from Km 154.0.

6.0 RIP RAP AND FILTER MATERIALS

6.1 General

Five bedrock sources of rip rap and filter materials are identified on Drawing No. B-2290.01. One towards the southern end of the project at Km 160.0, is not well suited for rip rap but may be desirable for filter material. Two are together near Ogilvie Maintenance Camp, Km 195.5, near the center of the repair locations. The remaining two sites are at Km's 210.8 and 216.3 where previous activities have occurred. Two alternate locations close to selected sites are discussed. No other sites removed some distance from these locations were identified that were both accessible to the highway without developing long (generally greater than 1 Km) access roads and contained suitable material.

6.2 Rip Rap/Filter Material Site Descriptions

Of the six potential rip rap sources examined and sampled, including an alternate site at Km 205.0, five are outcrops of the Ogilvie formation and one, RF 160.0, is an outcrop of the Road River formation.

Site RF 160.0 consists of a white to pale grey, slightly weathered, strong, medium to coarse grained crystalline limestone. The Unconfined Compressive Strength has been estimated at 275 mPa based on Point Load index test data. The discontinuity spacing is expected to generate rock blocks 400 mm and smaller, making it of little value for rip rap but an excellent source of filter material.

Site RF 194.9 comprises a dark grey, carbonaceous, fine grained, slightly weathered limestone. The Uniaxial Compressive Strength has been estimated at 175 mPa. Substantial recrystallization has occurred along fracture surfaces accounting for the lower strengths. The formation is medium to thickly bedded and is expected to generate rock blocks 700 mm and larger.

Site RF 196.1 is located on the northern limb of the Sapper Hill Anticline. The rock is very similar to that exposed at RF 194.9. Recrystallization is less well developed at this site resulting in an estimated strength of 275 mPa. The rock is medium to thickly bedded and is expected to generate blocks 700 mm and larger.

Site RF 205.0 (A) is located on the northern limb of the Jeckelly Anticline and comprises a dark grey, strong, slightly weathered limestone. The Unconfined Strength is estimated to be 175 mPa. The formation is thickly bedded and is expected to generate rock blocks approximately 1 m size. Its proximity of Dempster Highway may detract from the desirability of developing this site.

Site RF 210.8 is located on the southern limb of the Blackstone Anticline. The outcrop comprises a moderate to thickly bedded, slightly weathered, strong, dark grey limestone overlain by a similar, but thinly bedded limestone. The Uniaxial Compressive Strength of both rocks is estimated to be 275 mPa. The lower limestone is expected to produce rock blocks approximately 500 mm in size but blocks from the upper limestone are expected to be very much smaller.

Site RF 216.3 is located on the northern limb of the Blackstone Anticline and consists of a strong, slightly weathered dark grey limestone with an estimated Uniaxial strength of 250 mPa. In the lower part of the outcrop bedding spacing is 1.5 m to 2 m reducing to 150 mm in the upper part of the outcrop.

SUMMARY OF MATERIALS AVAILABLE

<u>Site</u>	<u>Rip Rap</u>	<u>Filter</u>
RF 160.0	No	Yes
RF 194.9	Yes	Yes
RF 196.1	Yes	Yes
RF 205.0	Yes	Yes
RF 210.8	No	Yes
RF 216.3	Yes*	Yes

* Lower Part Only

Considerable wastage of material should be expected in rip rap and filters production. Rip rap volumes are expected to be 20% of in-ground volumes. Filter material volumes are expected to be 30 - 50% when produced in conjunction with rip rap and 50-70% if produced alone.

In order to produce the 133 000 m³ of rip rap required, up to 660 000 m³ of material will be required. Adequate sources of filter will be available as a by product of rip rap production.

Sites RF 194.9, 196.1 and 205.0 (A) together appear to have adequate supplies of suitable material for rip rap and filters. Sites RF 194.9 and 196.1 are located adjacent to a land claim and RF 205.0 (A) is very close to the road which may have serious drawbacks for production.

Site RF 216.3 could also be used for rip rap production but large quantities of waste would be generated as the upper part of the outcrop is unsuitable for rip rap.

Although adequate supplies of filter material will be generated by rip rap sites a small quarry could be developed at site RF 160.0 to supply the 6000 m³ of filter materials required between Km 139.0 and 170.4. Substantial savings in haulage costs would be made by development of such a quarry.

Summary sheets of these sites are found in Appendix IV.

6.3 Alternate Rip Rap/Filter Sites

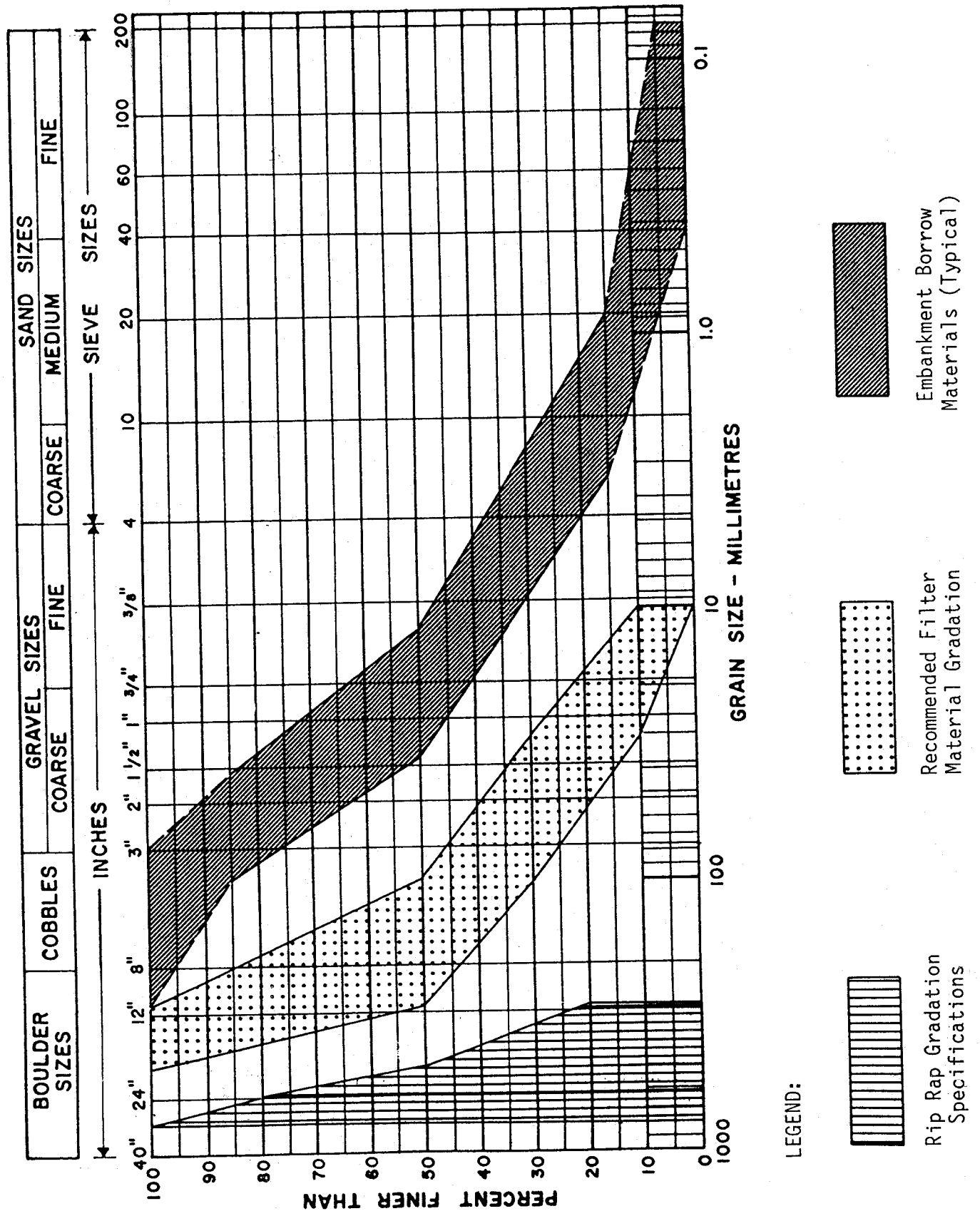
Both sites at Km's 194.9 and 196.1 border on Land Claim S-44; therefore, some question may arise concerning their development. Should this be the case, an alternate site composed of similar materials is available at Km 195.3 on the north side of the road, just before Ogilvie River bridge. It was not chosen because it is very close to and visible from the highway and river bridge. Also, it lies at the far west extremity of Sapper Hill, another restricted area.

A second alternate site is located adjacent to the west side of Dempster Highway at Km 205.0. It would be somewhat troublesome and difficult to develop because of the high steep slope immediately next to the highway. Otherwise, it would make a good source of rip rap material.

6.4 Filter Material Gradation Recommendations

Filter gradation requirements are dependent upon rip rap sizes and embankment material gradations. Rip rap is specified in Section 2.0, Material Requirements. Typical embankment borrow material characteristics may be obtained from the gradation curves presented in Appendix III. Gradation bands for both these materials are presented on Figure 2. Recommended filter material gradation limits, as shown on Figure 2 are, as follows:

FIGURE 2: FILTER MATERIAL GRADATION RECOMMENDATIONS



<u>Particle Size</u>	<u>% Passing</u>
500 mm	100
300 mm	50 - 100
100 mm	30 - 50
30 mm	10 - 30
10 mm	0 - 10

Some materials from the alluvial fan deposits especially at Km 154.0 are coarser grained than is typical of other embankment borrow sources as presented on Figure 2. The recommended gradations for filter material, designed to allow the passage of water while holding embankment material in place, are not compromised by coarser grained material. Finer grained embankment materials, however, could be troublesome and should be avoided.

APPENDIX I
Klohn Leonoff Technical Proposal



KLOHN LEONOFF YUKON LTD.

CONSULTING ENGINEERS

OUR FILE: PA 2290.Z1.01

August 11, 1986

Yukon Department of Community
and Transportation Services
Box 2703
Whitehorse, Yukon
Y1A 2C6

J.A. de Raadt, P. Eng.
A/Director, Highway Engineering

Geotechnical Investigation, Km 139 to 243,
Dempster Highway, Yukon, 1986, Technical Proposal

Dear Mr. de Raadt:

Klohn Leonoff Yukon Ltd. is pleased to submit this proposal for Geotechnical Investigation of Km's 139 to 243 along the Dempster Highway, Yukon. This submission is in response to your letter of July 29, 1986. As requested, cost estimates are submitted in a separate sealed envelope.

Klohn Leonoff Yukon Ltd., incorporated in the Yukon, is jointly owned by Klohn Leonoff Ltd. of Richmond, British Columbia and Thomson and Iles of Whitehorse, Yukon. We propose to carry out the work from our Whitehorse office, under the direction of Mr. Robert T. Tape, P. Eng., our proposed project manager.

We are proposing a technically strong project team with substantial experience in both geotechnical investigations and northern projects. Klohn Leonoff conducted a geotechnical investigation on behalf of Foothills Pipe Lines (Yukon) Ltd. for the Dempster Lateral which paralleled the Dempster Highway. We are therefore familiar with the terrain involved in this project. Recently Klohn Leonoff with Thomson and Iles jointly completed a report on "Preliminary Design and Economic Analysis" for the Dawson City Dykes Improvement Project, which led to the formation of Klohn Leonoff Yukon Ltd.

August 11, 1986

With our understanding of the project requirements and past experience in the area, we are confident of completing this assignment on schedule and within the estimated cost. We look forward to being of service on this project. Thank you for giving us the opportunity to submit this proposal.

Yours very truly,

KLOHN LEONOFF YUKON LTD.

J.C. ILES, P. Eng.
President

RTT/JCI/ajs
Encl.

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
2.0 DESCRIPTION OF WORK AND SCOPE OF SERVICES	1
3.0 PROJECT APPROACH	3
4.0 PERSONNEL	5
5.0 TIMING	6
6.0 PAYMENT	6
7.0 CLOSURE	8

1.0 INTRODUCTION

Yukon Community and Transportation Services are requesting proposals for a geotechnical investigation to locate and evaluate borrow material and rip rap sources for repairs to the Dempster highway between km's 139 to 143. Presented within this response are statements concerning Klohn Leonoff Yukon's understanding of the assignment and our approach to carrying out the work complete with personnel identification and scheduling. Our information is organized according to the headings contained in the general notes regarding proposals. Also, as requested, an estimate of our costs to complete this assignment is submitted in a separate, sealed envelope.

2.0 DESCRIPTION OF WORK AND SCOPE OF SERVICES

The intended purpose of the geotechnical investigation is to locate and evaluate material source areas for repairs to the Dempster Highway. More specifically, preliminary quantities of material requirements for embankment restoration fills, filter material and rip rap based on 1985 ground surveys are as follows:

<u>Location</u> (km)		<u>Section Length</u> (m)	<u>Embankment Restoration</u> (m ³)	<u>Filter Material</u> (m ³)	<u>Rip Rap</u> (m ³)
139+000	140+105	1105	4350	2250	10840
144+885	145+025	140	410	250	1135
145+765	146+524	759	6440	1615	7345
146+918	147+388	470	2760	890	4745
169+985	170+435	450	2680	710	3695
180+455	181+295	850	2950	1160	7370
184+605	184+799	194	1640	315	1830
194+995	195+375	380	785	760	3685
197+758	198+868	1110	8675	4030	15895
199+949	200+699	750	3740	3065	10770
201+109	201+349	240	1240	725	2530
201+700	201+750	50	735	65	340
202+015	202+165	150	1050	250	1320
203+536	203+986	450	1200	1250	5360
204+885	205+303	418	1975	1110	4765
209+259	209+609	350	5335	635	3660
212+200	212+650	450	675	1005	4700
213+731	213+954	223	515	615	2680
		Section	Embankment	Filter	

<u>Location</u> (km)		<u>Length</u> (m)	<u>Restoration</u> (m ³)	<u>Material</u> (m ³)	<u>Rip Rap</u> (m ³)
218+406	218+571	165	445	355	1730
219+598	219+777	179	640	410	1715
220+985	221+330	345	1970	1250	4910
223+602	223+842	240	430	975	3490
241+447	242+227	780	3975*	2280	9820
Maintenance Stockpile (centrally located)					10000
TOTALS		10758	55880	28120	132870

* This figure was corrected (substantially reduced) according to a telephone discussion with Mr. John Murray of Yukon Community and Transportation Services.

Engineering services to be provided include the following:

- location and evaluation of embankment fill material sources for slope restoration;
- location and evaluation of filter material and Class II rip rap sources;
- review of the proposed borrow areas for potential problems to the highway caused by the rapidly changing river beds;
- checking of proposed sites for land claims and habitat conflicts.

Evaluation of embankment fill borrow sources is expected to include subsurface explorations either by drilling or backhoe test pits, sampling and laboratory testing. Evaluation of filter material (if derived from blasted rock) and rip rap sources will be limited to examination of surface exposures. All materials, manpower, equipment and services required to complete the assignment must be provided by Klohn Leonoff Yukon; however, Yukon Community and Transportation Services will provide to us all permits and authorizations required for permission to operate equipment off the road surface in order to carry out subsurface explorations. Also, Klohn Leonoff Yukon will be provided with as-built plans of the highway, aerial photographs, and the Fenco Report for review. Information concerning land claim and habitat conflict areas is available to us in Whitehorse.

3.0 PROJECT APPROACH

Task 1 - Office Studies

Upon being awarded the contract to perform this assignment and receiving the agreed documentation, Klohn Leonoff Yukon will combine this information with geological maps and other terrain information contained in our files for review and preliminary identification of potential borrow sources. Considerations such as ease or complexity of source development, haul distances, land claim and habitat conflicts, sensitivity of permafrost to degradation, previous borrow utilizations, etc. will guide our initial selections. Particular attention will be given to avoiding river source locations that are likely to cause negative impacts to the highway.

Previously, most embankment fill was derived from river gravels. Although these borrow areas influence river regime characteristics which could adversely affect the highway, they are still likely to constitute the bulk of available resources. Alternate source types will, however, be considered and investigated, if considered promising. We anticipate approximately six source areas for embankment fill, with the bulk of the volume location near Km 242, will need to be identified.

Rip rap is to be derived from blasting of sound, durable rock. One source presently exists within the project area but it has been extensively mined and may require a certain amount of development in order to accommodate further mining. Various other bedrock outcrops occur along the area of interest but a number of these contain unsuitable, friable shales. Hopefully a total of 2 to 4 source areas can be identified.

Filter material may be derived from either soil deposits or rock blasted in association with rip rap development. Previously, soil deposits identified as possible source areas have been too fine grained to qualify; therefore, filter material requirements will likely need to be developed from rock blasted in association with rip rap source areas.

Task 2 - Field Studies

Following the office studies, we plan to carry out a two-phased field program. Phase I is to consist of a site reconnaissance by the project engineer and field technician. Together they will inspect the potential borrow source areas, make reassessments based on field observations and stake out locations for test pit excavations of embankment fill source areas. Some portions of active river flood plains may have changed from that indicated on documents studied in the office. An important aspect, therefore, of the field reconnaissance is to determine whether existing river configurations may adversely affect the desirability of developing sites selected in the office.

Potential rip rap and filter borrow sources identified in the office study will be examined in the field. Bedding and joint spacing will be measured to determine maximum rip rap sizing. Bed dip, azimuth and dip angle will be measured to determine optimum quarry development direction. Samples of potentially suitable rock will be obtained for identification and possible laboratory determination of point load strength and soundness.

Phase II of the field operations will consist of subsurface explorations. We propose to dig test pits using a track-mounted backhoe, supplied and operated by Klondike Transport Ltd. A truck and lo-bed will be on constant standby to transport the backhoe along the highway between exploration sites. Since the project area is treed, some time will be necessary for hand clearing (tree falling) to provide the backhoe access to test sites. Also a limited amount of hand clearing as well as backhoe time is anticipated to de-limb trees sufficiently that they may be re-aligned and made to lay flat on the ground. The test pits will be logged for stratigraphy and samples retained for laboratory analyses of grain sizes.

Only essential surveying; that is, chaining distances to determine approximate limits of borrow sites and relative positioning of test pits, etc. is proposed. At one or two sites surveyed topography

(elevations) might be especially valuable for evaluation of quantities. In this event, some locally referenced levels will be taken.

Task 3 - Laboratory Testing

Soil samples retained from the field will be analysed for grain size distribution and the results compared to standards of acceptability. It may also be desirable to test the soundness of certain rock samples collected for potential rip rap sources.

Task 4 - Data Processing and Report

After completion of field explorations, laboratory testing and data processing, the information obtained will be presented in a single report. The report text will contain individual descriptions of borrow sources, general and specific comments about each and a summary of the data obtained. Also comments about additional quantities available will be included. Drawings will include a route map identifying all borrow sources, aerial photographs showing each source area and sketch plans of each site including test pit locations.

4.0

PERSONNEL

Klohn Leonoff Yukon propose to use Robert T. Tape, P.Eng., both as Project Manager and Project Engineer. Mr. Tape's training and experience is predominantly geotechnical engineering but his background also includes river engineering. We consider this dual expertise of special benefit to this assignment. Mr. Tape is a registered engineer in Yukon Territory, Registration No. 485. Mr. J. Andrew Leach, P. Geol., will review bedrock geology data to identify potential rip rap and filter material source locations. Dr. Leach's training and experience are particularly well suited to geological and engineering assessments of rock materials. Our field technician will be either of Messrs. Jim Zabachenski or John Odermatt depending on their availability at the time required. Laboratory technicians, draftspersons, secretarial and word processing personnel will be

August 11, 1986

assigned as needed. All key staff have many years of relevant project experience, including substantial northern project experience. Their resumes are attached.

5.0 TIMING

The completion of this assignment will be carried out according to the bar charts presented on Figure 1. Assuming project authorization is granted approximately two weeks or less following submission of our proposal, the beginning of week 1 corresponds to August 25, 1986. The report will then be submitted by September 25, 1986 during week 5, as requested. The necessary authorizations/permits required for off-road work will be needed on or before September 2, 1986. Examination of the bar charts reveals that the projected schedule is fairly tight such that delays in authorizations would likely result in a corresponding delay of the project completion date.

6.0 PAYMENT

Our cost estimate for completing this assignment is submitted in a separate sealed envelope as directed. The figures are based on hourly rates and units costs extended according to the time expected to perform the various services.

We understand that the project budget will be considered a firm maximum price to be written into the contract. With this in mind, Klohn Leonoff Yukon will neither carry out additional work nor increase costs without prior authorizations.

FIGURE 1 - PROJECT SCHEDULING

<u>Week</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
<u>Task Description</u>					
1) Office Studies	xxx				
2) Field Studies					
- site reconnaissance		xxxxx			
- access clearing			xxx		
- backhoe test pitting			xxxxxxxxx		
3) Laboratory Testing				xxxxxxx	
4) Data Processing - Report Preparation					xxxxxxxxxxxxx

August 11, 1986

7.0 CLOSURE

It is possible that a potential borrow source type, for one or more of the three materials sought, which is different from those anticipated, may be identified. Within the confines of this assignment, however, it may not be possible to adequately evaluate that potential. Should this occur, we will draw attention to it (them) but would not attempt any evaluation without prior discussion and authorization from Yukon Community and Transportation Services.

Thank you for considering Klohn Leonoff Yukon for this assignment. We look forward to the opportunity of serving you.

Respectfully Submitted,

KLOHN LEONOFF YUKON LTD.

ROBERT T. TAPE, M.E., P.Eng.
Senior Geotechnical Engineer

RTT/ajs

APPENDIX II
Test Pit Logs

SYMBOLS AND TERMS - SOIL

CLASSIFICATION OF SOILS				
MAJOR DIVISION	Group SYMBOL	Graph SYMBOL	TYPICAL DESCRIPTION	
COARSE-GRAINED SOILS more than half by weight larger than 0.075mm (#200 sieve); based on material finer than 75mm (3 in.)	BOULDERS		N/A	LARGER THAN 200 mm (8 in.) DIAMETER
	COBBLES		N/A	75 TO 200 mm (3 to 8 in.) DIAMETER
	GRAVELS more than half coarse fraction larger than No. 4 sieve (4.75mm)	CLEAN GRAVELS	G W	WELL GRADED GRAVELS, GRAVEL AND SAND MIXTURES, TRACE OR NO FINES
			G P	POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, TRACE OR NO FINES
	GRAVELS WITH FINES		G M	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			G C	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	CLEAN SANDS		S W	WELL GRADED SANDS, GRAVELLY SANDS, TRACE OR NO FINES
			S P	POORLY GRADED SANDS, GRAVELLY SANDS, TRACE OR NO FINES
	SANDS WITH FINES		S M	SILTY SANDS, SAND-SILT MIXTURES
			S C	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS more than half by weight smaller than 0.075mm (#200 sieve) (based on material finer than 75mm (3 in.))	SILTS below "A" line, negligible organic content	$W_L < 50\%$	M L	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS
		$W_L > 50\%$	M H	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS
	CLAYS above "A" line on plasticity chart, negligible organic content	$W_L < 50\%$	C L	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS
		$W_L > 50\%$	C H	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
	ORGANIC SILTS & CLAYS below "A" line on plasticity chart	$W_L < 50\%$	O L	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
		$W_L > 50\%$	O H	ORGANIC CLAYS OF HIGH PLASTICITY
HIGHLY ORGANIC SOILS	P T		PEAT AND OTHER HIGHLY ORGANIC SOILS	

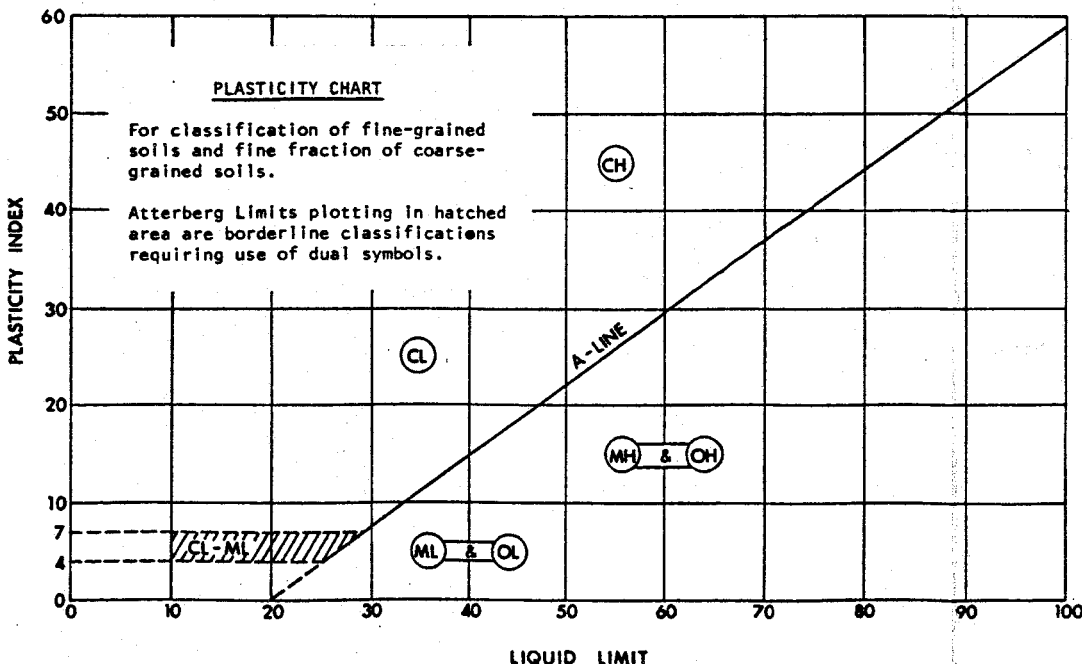
SAMPLING AND TESTING SYMBOLS

- ▽ Water level in test hole
- Moisture content
- x-----x Atterberg Limits (plastic limit) (liquid limit)
- Unconfined compressive strength by spring calibrated pocket penetrometer
- B Bag sample (disturbed cuttings)
- SY Thin-wall Shelby tube sample
- PSY Thin-wall piston sample
- HW Heavy-wall tube sample
- SPT Standard Penetration Test
50mm O.D. sampler driven by 64 Kg hammer falling 0.76m. Sampler driven 0.45m; blows for last .30m used for comparison

SOIL STRENGTH

POCKET PENETROMETER FOR COHESIVE SOILS	
UNCONFINED COMPRESSIVE STRENGTH kPa	CONSISTENCY
25	Very Soft
25 - 50	Soft
50 - 100	Firm
100 - 200	Stiff
200 - 400	Very Stiff
> 400	Hard


STANDARD PENETRATION TEST FOR COHESIONLESS SOILS	
BLOWS / 30 cm	DENSITY
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Med. Dense
30 - 50	Dense
> 50	Very Dense



PROPORTIONS OF MINOR CONSTITUENTS OF SOIL STRATA ARE DESCRIBED AS FOLLOWS:

and	35% - 50%
some	20% - 35%
little	10% - 20%
trace	0% - 10%

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR	UNCONFINED COMPRESSION kPa										
WEIGHT HAMMER 63.5 Kg					ELEV GROUND	100	200	300	400							
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	● FIELD VANE		△ LAB VANE		■ UNCONF.						
DEPTH ELEV	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL	PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT						
(m)				X		---	0	---	X	10	30	50	70	90%		
1					COBBLES & GRAVEL - little sand - trace of boulders to 35 cm - trace of fines - angular - brown - damp											
2																
3																
4					END OF PIT AT 3.0 m NOTES: . No organic cover . Not frozen											
5																



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01.01
PROJECT Dempster Highway
LOCATION EB 137.9
HOLE No. TPA
DATE September 8/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV. COLLAR		UNCONFINED COMPRESSION kPa				
WEIGHT HAMMER 63.5 Kg					ELEV. GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.				
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT
DEPTH ELEV.	O.D. T.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL		X	0	0	0	X
(m)						10	30	50	70	90%	
				0.1 m ORGANIC COVER							
1				COBBLES & GRAVEL - little sand - trace of boulders to 30 cm - trace of fines - angular - brown - damp							
2											
3											
4				END OF PIT AT 3.5 m Notes: . Not frozen							
5											



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 137.9
HOLE No.	TPB
DATE	September 8/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa				
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400				
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		● FIELD VANE		△ LAB VANE		■ UNCONF.
DEPTH ELEV	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL		PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT	
(m)				X			0		X		
						10	30	50	70	90%	
				0.3 m	PEAT-MOSS COVER - roots - brown						
1				0.7 m	SILT & SAND - little organics - 4 to 30 mm thick ice lenses at 0.6 m						
					GRAVEL - some cobbles - little sand - trace of fines - occasional boulder < 30 cm - brown - ice inclusions						
2					END OF PIT AT 1.5 m						
					Notes: · Frozen below 0.3 m · Unable to dig below 1.5 m, hard						
3											
4											
5											



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01.01
 PROJECT Dempster Highway
 LOCATION EB 140.7
 HOLE No. TPA
 DATE September 8/86 PLATE

TEST HOLE LOG


SAMPLE DATA				SYMBOL	ELEV COLLAR	UNCONFINED COMPRESSION kPa														
WEIGHT HAMMER 63.5 Kg					ELEV GROUND	100	200	300	400											
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	● FIELD VANE	△ LAB VANE	■ UNCONF.												
DEPTH ELEV	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL	PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT											
X	X	0	X	10		30	50	70	90	%										
(m)				ORGANIC COVER																
1				COBBLES & GRAVEL																
				- little sand																
				- trace boulders < 30 cm																
				- trace fines																
				- angular																
2				- frozen below 2.0 m																
3				- hard digging, refusal																
				END OF PIT AT 3.0 m																
4																				



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 140.7
HOLE No.	TPB
DATE	September 8/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa						
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.						
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT			
DEPTH ELEV	O.D. I.D.	BLOWS 15m	NO.	DESCRIPTION OF MATERIAL			X	0		X			
							10	30	50	70	90%		
(m)					GRAVEL - some cobbles - little sand - trace of boulders 25 cm - trace of fines - angular to sub-angular								
1			1										
2													
3					END OF PIT AT 3.0 m								
					NOTES: . Not frozen								
4													



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01.01
 PROJECT Dempster Highway
 LOCATION EP 154.0
 HOLE No. TPA
 DATE September 8/86 PLATE

TEST HOLE LOG


SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa									
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.									
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT					
DEPTH ELEV.	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL						X	0	X			
(m)										10	30	50	70	90%		
1				●	GRAVEL & COBBLES - little sand - trace of boulders to 45 cm - angular to subangular - brown - damp											
2				●												
3				●												
4				●	END OF PIT AT 3.5 m Note: . Not frozen											



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 154.0
HOLE No.	TPB
DATE	September 8/86 PLATE

TEST HOLE LOG



SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa				
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.				
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT
DEPTH ELEV.	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL		X	0	0	70	X
(m)						10	30	50	70	90%	
1					GRAVEL & COBBLES - little sand - trace of boulders < 45 cm - trace of fines - angular to subangular - brown - damp						
2											
3											
4				END OF PIT AT 3.5 m Notes: . Not frozen . Pit walls sloughing							



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 154
HOLE No.	TPC
DATE	September 8/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR	UNCONFINED COMPRESSION kPa													
WEIGHT HAMMER 63.5 Kg					ELEV GROUND	100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.													
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT										
DEPTH ELEV.	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL	X	0		X										
				10		30	50	70	90%										
(m)					GRAVEL & SAND - trace of fines - trace of cobbles - shales - angular - black														
1					1 m BEDROCK - platy shale - angular - brown														
2																			
3					END OF PIT AT 3.0 m														
4																			



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 176.0 (R)
HOLE No.	TPB
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR	UNCONFINED COMPRESSION kPa															
WEIGHT HAMMER 63.5 Kg					ELEV GROUND	100	200	300	400												
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	● FIELD VANE		△ LAB VANE		■ UNCONF.											
DEPTH ELEV.	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL	PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT												
(m)					X	0		X													
					10	30	50	70	80%												
				0.4 m	PEAT-MOSS COVER - fibrous																
1					CLAY - some silt - little fibrous organics - frozen - 2 m to 50 mm ice lenses																
2					END OF PIT AT 2.0 m																
3					Notes: . Very hard and icy at 2 m . Refusal at 2 m . No gravel																
4																					



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 176.0 (R)
HOLE No.	TPC
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR	UNCONFINED COMPRESSION kPa													
WEIGHT HAMMER 63.5 Kg					ELEV GROUND	100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.													
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	PLASTIC LIMIT	WATER CONTENT			LIQUID LIMIT									
DEPTH	O.D.	BLOWS	NO.		DESCRIPTION OF MATERIAL	X	O			X									
ELEV.	I.D.	15m		10		30	50	70	90%										
(m)					PEAT - fibrous 0.5 m - frozen below 0.5 m														
1					SILT & CLAY - trace of fibrous organics - frozen, visible ice														
2																			
3					END OF PIT AT 2.6 m														
4																			



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 177.1 (A-R)
HOLE No.	TPA
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa																
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100	200	300	400													
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT												
DEPTH	O.D.	BLOWS	NO.		DESCRIPTION OF MATERIAL		X-----X		0-----0		-----X												
ELEV	I.D.	15m		10			30	50	70	90	%												
(m)					PEAT & FIBEROUS ORGANICS																		
					0.5 m																		
1					SILT & CLAY - trace of fibrous organics - frozen below 0.5 m - 30 cm ice lenses at 1.5 m																		
2																							
					END OF PIT AT 2.6 m																		
3																							
4																							



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 177 (A-R)
HOLE No.	TPB
DATE	September 7/86 PLATE

TEST HOLE LOG

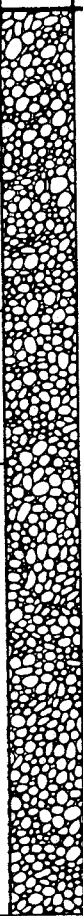
SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa														
WEIGHT HAMMER		63.5 Kg			ELEV GROUND		100	200	300	400											
HEIGHT DROP		0.76 m			CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT										
DEPTH	O.D.	BLOWS	NO.		DESCRIPTION OF MATERIAL																
ELEV	I.D.	15m																			
(m)				1	GRAVEL - little sand - trace of cobbles - rounded - dark grey																
1				1																	
2							2														
3							3														
4					END OF PIT AT 3.0 m Note: . Not frozen . Water level at 2.0 m																



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 194.8
HOLE No.	TPA
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa																			
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.																			
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT															
DEPTH ELEV	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL																					
				X-----X 10 30 50 70 90%																						
(m)					GRAVEL - some sand - trace of cobbles - occasional boulders - rounded - dark grey																					
1			1																							
2												▼														
3													END OF PIT AT 3.0 m Notes: . Water level at 2.3 m . Not frozen													
4																										



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 194.8
HOLE No.	TPB
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR	UNCONFINED COMPRESSION kPa								
WEIGHT HAMMER 63.5 Kg					ELEV GROUND	100 200 300 400								
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	● FIELD VANE Δ LAB VANE ■ UNCONF.								
DEPTH ELEV.	O.D. I.D.	BLOWS 1.5m	NO.		DESCRIPTION OF MATERIAL					PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT		
(m)									X	0	X			
									10	30	50	70	90%	
				0.4 m	PEAT - roots, fibrous - trace of silts and sands									
1			1		GRAVEL - some sand - trace of cobbles - occasional boulder to 30 cm - rounded - dark grey to black									
2					▼ - frozen below 2.7 m - no visible ice									
3										END OF PIT AT 3.0 m Note: . Water level at 2.6 m				
4														



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 197.7
HOLE No.	TPA
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa									
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.									
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT					
DEPTH	O.D.	BLOWS	NO.		DESCRIPTION OF MATERIAL							X	0	X		
ELEV	I.D.	15m									10	30	50	70	90%	
(m)				●	0.15 m	ORGANICS										
				●		- some sand and silt										
				●		- roots, fibrous										
				●		- brown										
1				●		GRAVEL										
				●		- some sand										
			1	●		- trace of cobbles										
				●		- occasional boulders to 30 cm										
				●		- trace of fines										
				●		- rounded										
2				●		- dark grey to black										
				●												
				●												
3				●												
				●		END OF PIT AT 3.0 m										
				●		Notes:										
				●		. Water level at 2.2 m										
				●		. Not frozen										
4				●												
				●												
				●												



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 197.7
HOLE No.	TPB
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa							
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100	200	300	400				
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		● FIELD VANE		△ LAB VANE		■ UNCONF.			
DEPTH ELEV	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL			PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT				
(m)							X	0	X	10	30	50	70	90%
				0.2 m	ORGANICS - roots, fibrous - brown									
1					GRAVEL - some sand - trace of cobbles - trace of fines - occasional boulders to 25 cm - rounded - dark grey to black									
2					- frozen below 2.7 m - no visible ice									
3					END OF PIT AT 3.0 m Note: . Water level at 2.7 m									
4														



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 197.7
HOLE No.	TPC
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa				
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100	200	300	400	
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		● FIELD VANE		△ LAB VANE		■ UNCONF.
DEPTH ELEV	O.D. I.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL		PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT	
X				X						X	
						10	30	50	70	90%	
(m)					ORGANICS - peaty, roots - some silt and sand - brown - frozen below 1.0 m						
1					1.0 m GRAVEL - some sand - trace of fines - rounded - dark grey to black - visible ice lenses < 25 mm - ice inclusions at 2.0 m						
2											
3					END OF PIT AT 2.5 m						
4											



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 197.7
HOLE No.	TPD
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa										
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.										
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT						
DEPTH ELEV	O.D. T.D.	BLOWS	NO.		DESCRIPTION OF MATERIAL							X	0	X			
(m)		15m									10	30	50	70	90%		
				0.2 m	ORGANIC - some silt and sand - roots, fibrous												
1			1		GRAVEL - some sand - trace of cobbles - trace of fines - rounded - dark grey to black												
2																	
3				▼	END OF PIT AT 3.0 m												
4					Notes: . Water level at 2.6 m . Not frozen												



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 197.7
HOLE No.	TPE
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV. COLLAR		UNCONFINED COMPRESSION kPa				
WEIGHT HAMMER 63.5 Kg					ELEV. GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.				
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT
DEPTH ELEV	O.D. I.D.	BLOWS 1.5m	NO.		DESCRIPTION OF MATERIAL		X	0	0	0	X
(m)				- generally 0.0 to 0.75 m of gravel fill overlying organic waste pile - roots, peat		10	30	50	70	90%	
1											
2											
3											
4											



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01.01
 PROJECT Dempster Highway
 LOCATION EB 211.0
 HOLE No. Test Pits A-D (R)
 DATE September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa								
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100	200	300	400					
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		● FIELD VANE		△ LAB VANE		■ UNCONF.				
DEPTH ELEV	O.D. I.D.	BLOWS 1.5m	NO.		DESCRIPTION OF MATERIAL			PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT					
(m)							X	0	---	X	10	30	50	70	90%
1					PEAT - fibrous, roots - moss cover - brown - saturated at 1 m										
					1.0 m										
2					ORGANICS - some silt and sand - roots, fibrous - brown - frozen, no visible ice										
					1.0 m										
3					END OF PIT AT 3.0 m										
					Note: . Hard digging below 2.0 m										
4					END OF PIT AT 3.0 m										



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01.01
 PROJECT Dempster Highway
 LOCATION EB 211.0 (R)
 HOLE No. TPE
 DATE September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa												
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400 ● FIELD VANE Δ LAB VANE ■ UNCONF.												
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC	WATER		LIQUID									
DEPTH	O.D.	BLOWS	NO.	DESCRIPTION OF MATERIAL			LMNT	CONTENT		LIMIT									
ELEV	T.D.	15m					X	0		X									
(m)							10	30	50	70	90%								
1				[Symbol]	PEAT - fibrous - roots, moss cover - saturated at 1 m - brown - frozen below 1.0 m														
2				[Symbol]	1.0 m ORGANICS - some silt and sand - roots, fibrous - brown - frozen, no visible ice														
3				[Symbol]	END OF PIT AT 3.0 m Note: . Hard digging below 2.0 m														
4				[Symbol]															



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 211.0 (R)
HOLE No.	TPF
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV COLLAR		UNCONFINED COMPRESSION kPa												
WEIGHT HAMMER 63.5 Kg					ELEV GROUND		100 200 300 400 ● FIELD VANE △ LAB VANE ■ UNCONF.												
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT								
DEPTH ELEV	O.D. I.D.	BLOWS	NO.		DESCRIPTION OF MATERIAL			X	0	---	X								
		15m					10	30	50	70	90%								
(m)				0.5 m	PEAT - fibrous, roots - brown														
1			1		GRAVEL - some sand - trace of cobbles - trace of fines - rounded - dark grey - frozen below 1.2 m - visible ice lenses < 25 mm thick														
2					END OF PIT AT 2.5 m Note: . Very hard digging below 1.2 m														
3																			
4																			

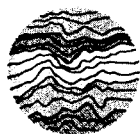


KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01,01
 PROJECT Dempster Highway
 LOCATION EB 225,6
 HOLE No. TPA
 DATE September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV. COLLAR	UNCONFINED COMPRESSION kPa										
WEIGHT HAMMER 63.5 Kg					ELEV. GROUND	100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.										
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT							
DEPTH ELEV.	O.D. I.D.	BLOWS	NO.	DESCRIPTION OF MATERIAL							X	0	X			
(m)		15m									10	30	50	70	90%	
				0.5 m	PEAT & ORGANIC SILTS - little sand - roots - brown											
1			1		GRAVEL - some sand - trace of cobbles - trace of fines - rounded - occasional boulder - dark grey - frozen below 1.2 m - ice inclusions and <25 mm thick lenses											
2					END OF PIT AT 2.0 m Notes: . Hard digging below 1.2 m . Refusal at 2.0 m											
3																
4																



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01.01
 PROJECT Dempster Highway
 LOCATION EB 225.6
 HOLE No. TPC
 DATE September 7/86 PLATE

TEST HOLE LOG


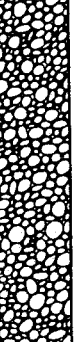


SAMPLE DATA				SYMBOL	ELEV COLLAR	UNCONFINED COMPRESSION kPa				
WEIGHT HAMMER 63.5 Kg					ELEV GROUND	100 200 300 400 ● FIELD VANE Δ LAB VANE ■ UNCONF.				
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT	
DEPTH ELEV.	O.D. I.D.	BLOWS	NO.	DESCRIPTION OF MATERIAL		X	0		X	
		15m				10	30	50	70	90%
(m)				●	ORGANICS - 0.5 cm thick - roots, grass - brown					
1			1	●	GRAVEL - some sand - trace of fines - rounded - dark grey to black - 15 cm thick lens of organic peat (2 m long) on one wall at 1 m					
2				●						
3				●						
				●	END OF PIT AT 3.0 m Note: . Water level at 2.4 m . Not frozen					

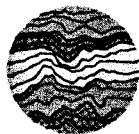


KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01.01
 PROJECT Dempster Highway
 LOCATION EB 238.2
 HOLE No. TPA
 DATE September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV. COLLAR		UNCONFINED COMPRESSION kPa													
WEIGHT HAMMER 63.5 Kg					ELEV. GROUND		100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.													
HEIGHT DROP 0.76 m					CO-ORD. LOCATION		PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT										
DEPTH ELEV (m)	O.D. I.D.	BLOWS	NO.	DESCRIPTION OF MATERIAL			X	0		X										
							10	30	50	70	90 %									
					ORGANICS - 15 cm - grass, roots, brown															
1			1		GRAVEL - some sand - trace of fines - rounded - dark grey to black															
2					END OF PIT AT 3.0 m Notes: . Water level at 2.4 m . Not frozen															
3																				
4																				



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA 2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 238.2
HOLE No.	TPB
DATE	September 7/86 PLATE

TEST HOLE LOG

SAMPLE DATA				SYMBOL	ELEV. COLLAR	UNCONFINED COMPRESSION kPa				
WEIGHT HAMMER 63.5 Kg					ELEV. GROUND	100 200 300 400 ● FIELD VANE ▲ LAB VANE ■ UNCONF.				
HEIGHT DROP 0.76 m					CO-ORD. LOCATION	PLASTIC LIMIT	WATER CONTENT		LIQUID LIMIT	
DEPTH ELEV.	O.D. T.D.	BLOWS 15m	NO.		DESCRIPTION OF MATERIAL	X	0	0	X	X
(m)						10	30	50	70	90%
				0.5 m	ORGANICS - some peat, roots, brush - brown					
1			1							
2					GRAVEL - some sand - trace of fines - rounded - dark grey to black					
3				▼						
					END OF PIT AT 3.0 m Notes: . Water level at 2.7 m . Not frozen					
4										

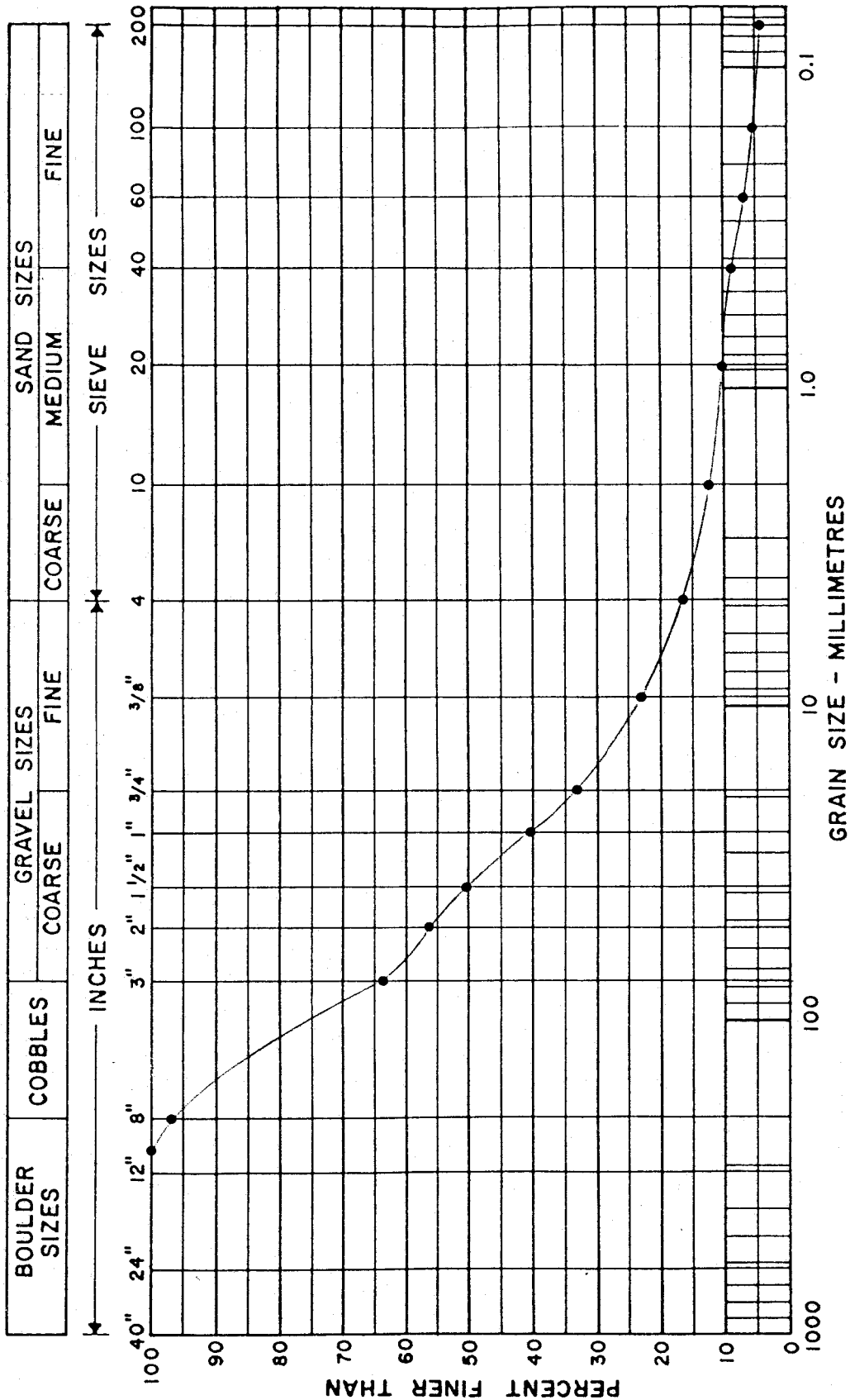


KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. PA 2290.01.01
 PROJECT Dempster Highway
 LOCATION EB 238.2
 HOLE No. TPD
 DATE September 7/86 PLATE

APPENDIX III
Grain Size Curves

GRAIN SIZE CURVE GRANULAR SOILS



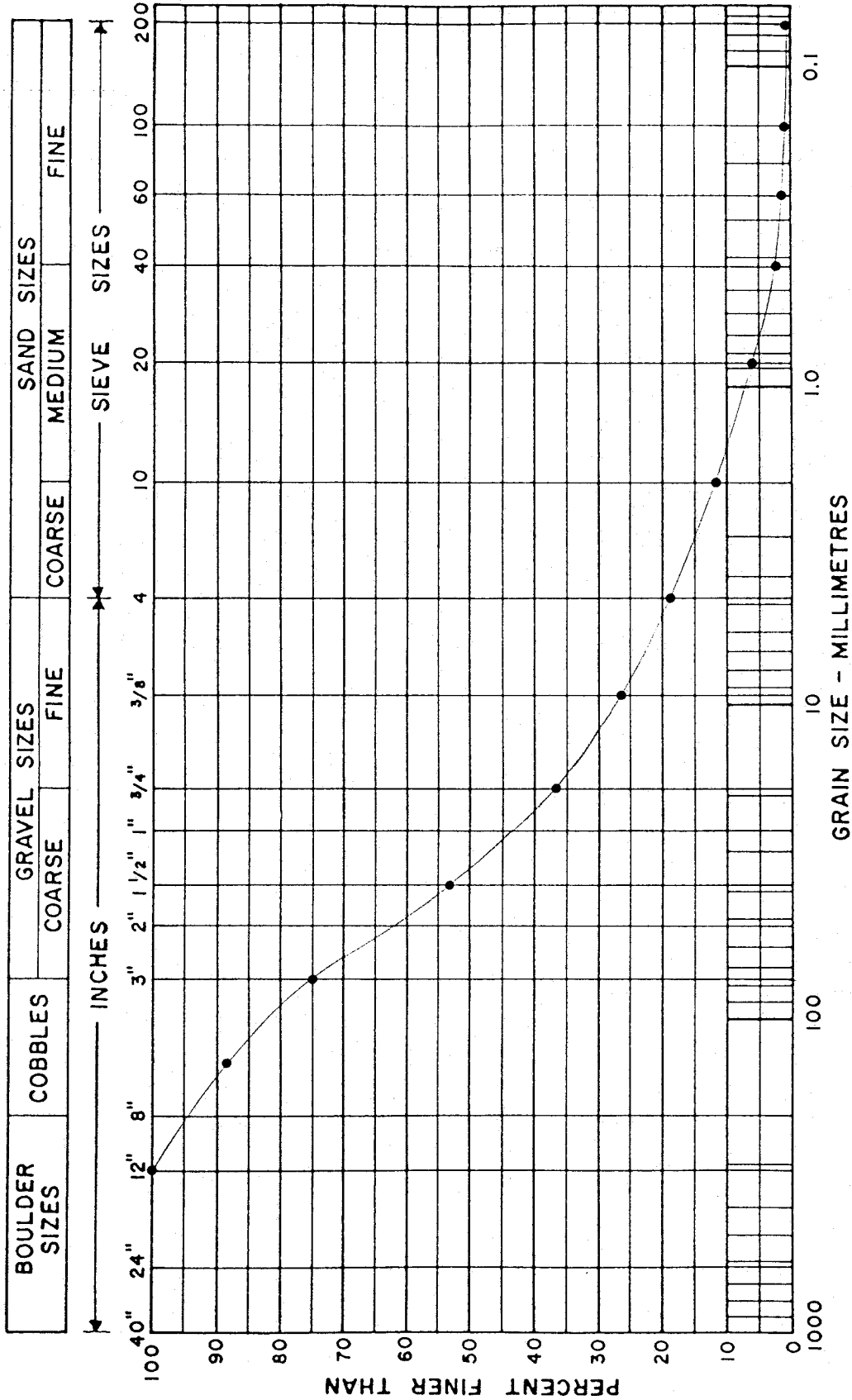
REMARKS: GRAVEL - some cobbles, trace fines and trace boulders



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 154.0
HOLE No.	TPA DEPTH 1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



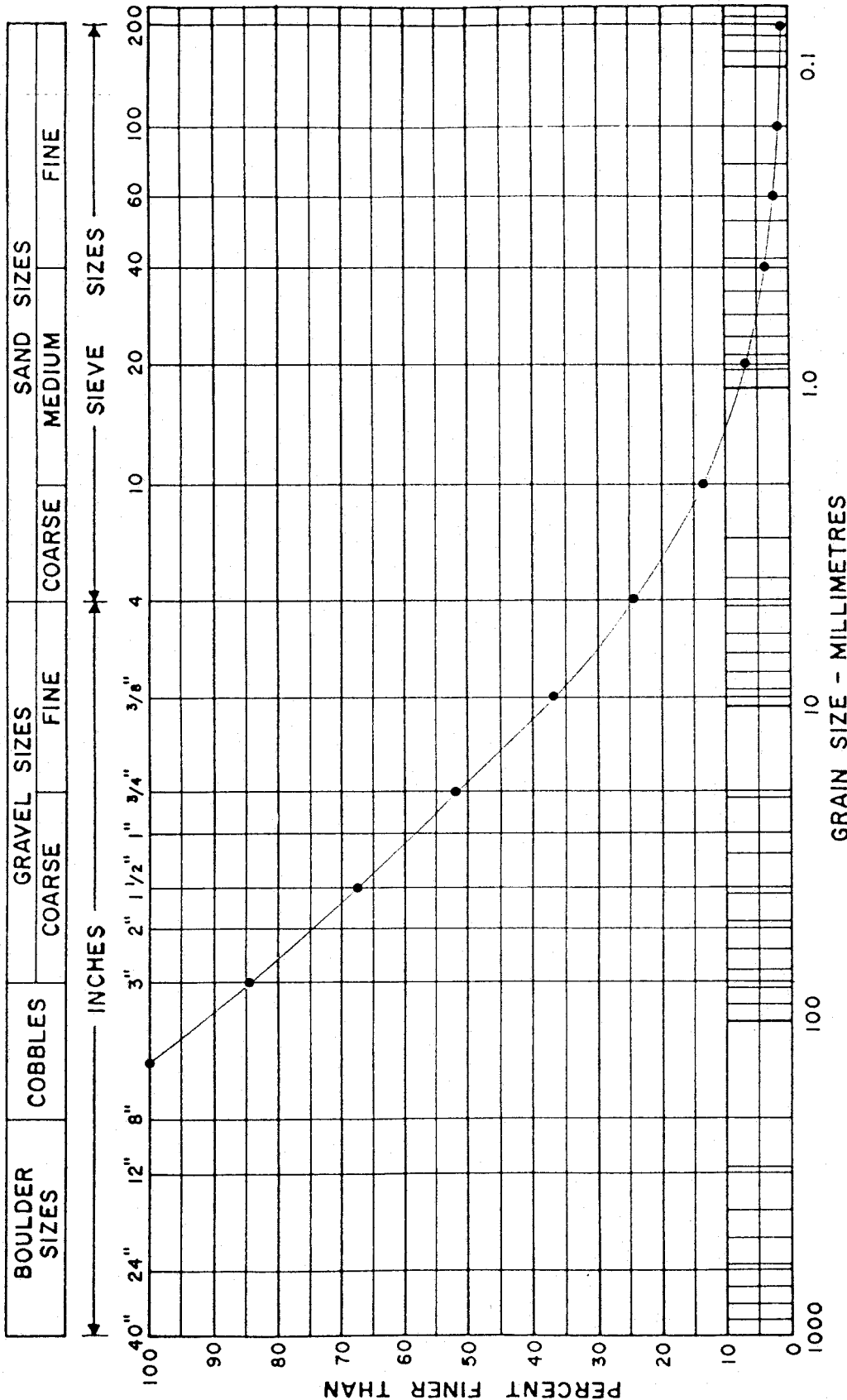
REMARKS: GRAVEL - some cobbles, little sand, trace boulders, trace fines



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 194.8
HOLE No.	TPA DEPTH 1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



BOULDER SIZES	GRAVEL SIZES	SAND SIZES	FINE
12" 24"	COARSE 3" 2" 1 1/2" 1" 3/4"	COARSE 4" 10" 20" 40" 60" 100"	FINE
8"	FINE 3/8"	MEDIUM	
		SIEVE SIZES	

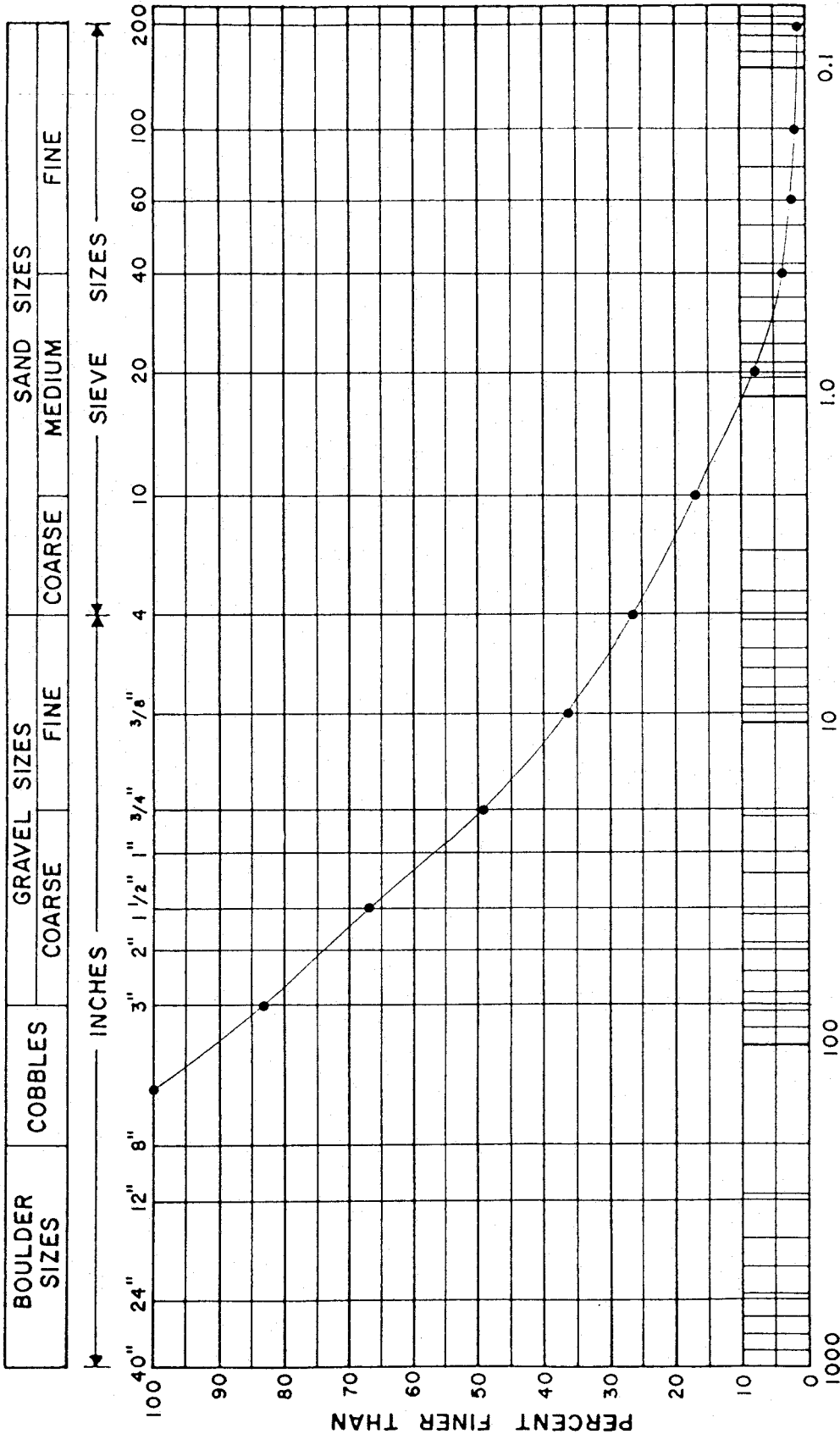
REMARKS: GRAVEL - some sand, little cobbles, trace fines



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 194.8
HOLE No.	TPB
DEPTH	1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



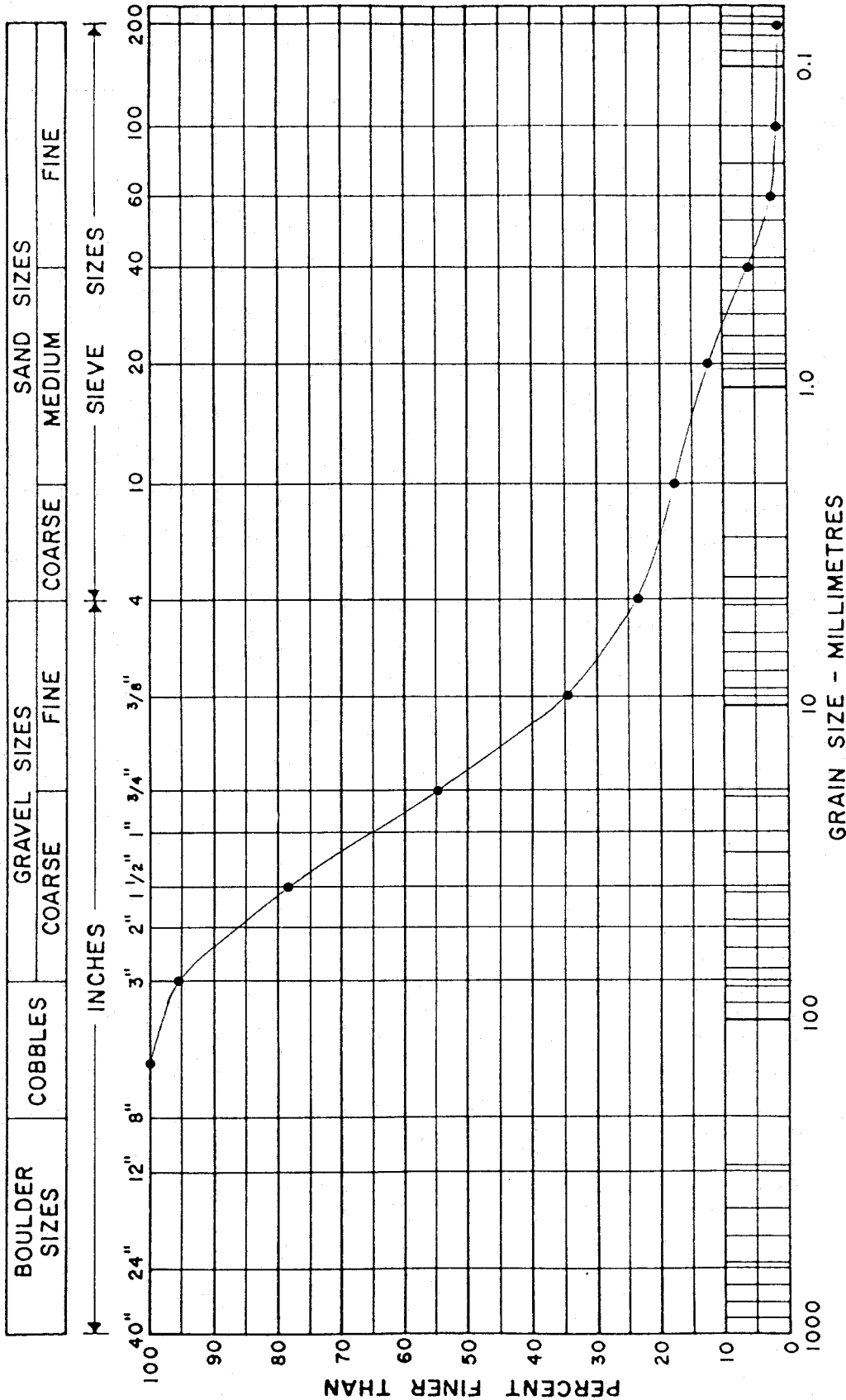
REMARKS: GRAVEL - some sand, little cobbles, trace fines



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 197.7
HOLE No.	TPB
DEPTH	1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



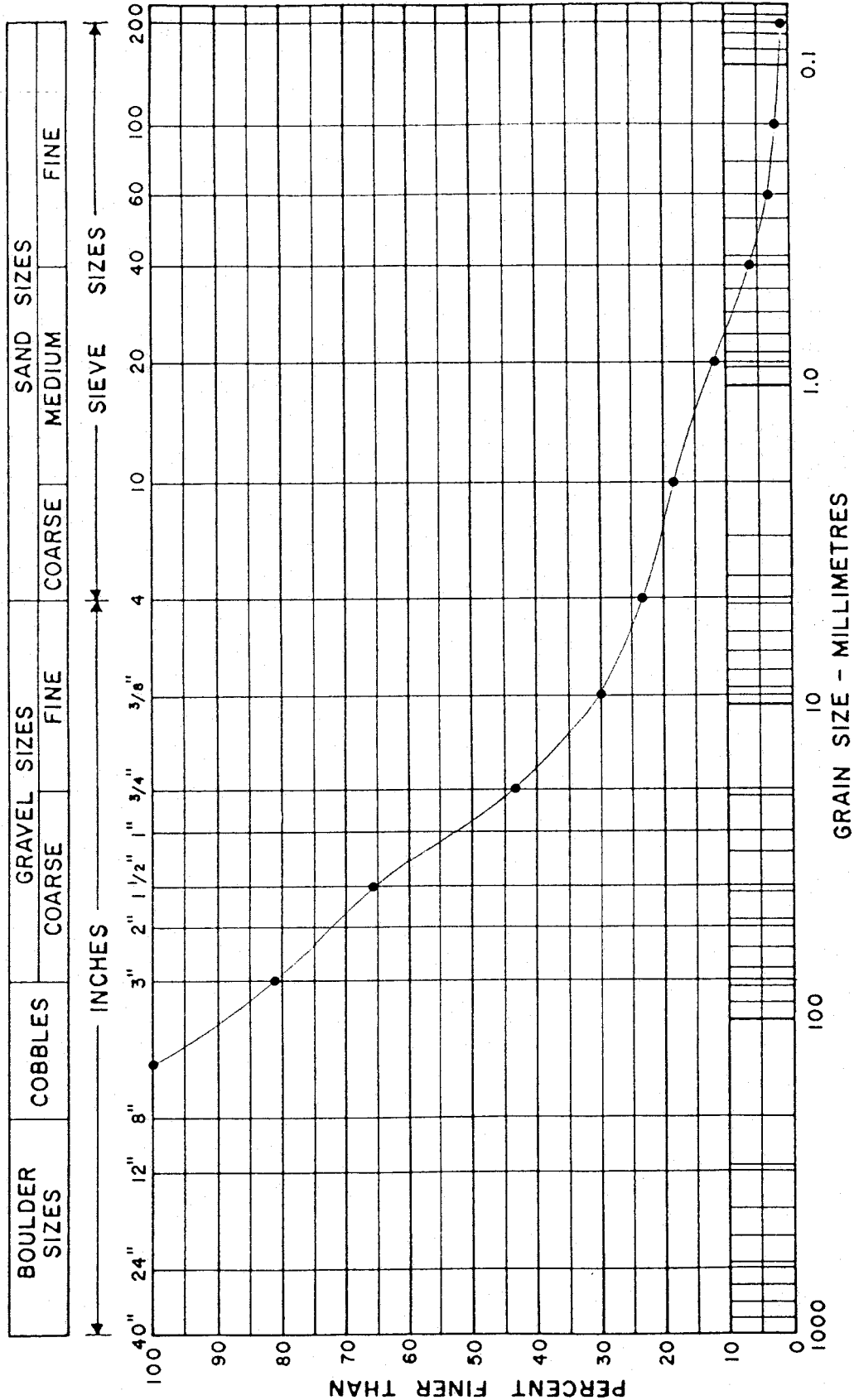
REMARKS: GRAVEL - some sand, trace cobbles, trace fines



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 197.7
HOLE No.	TPE
DEPTH	1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



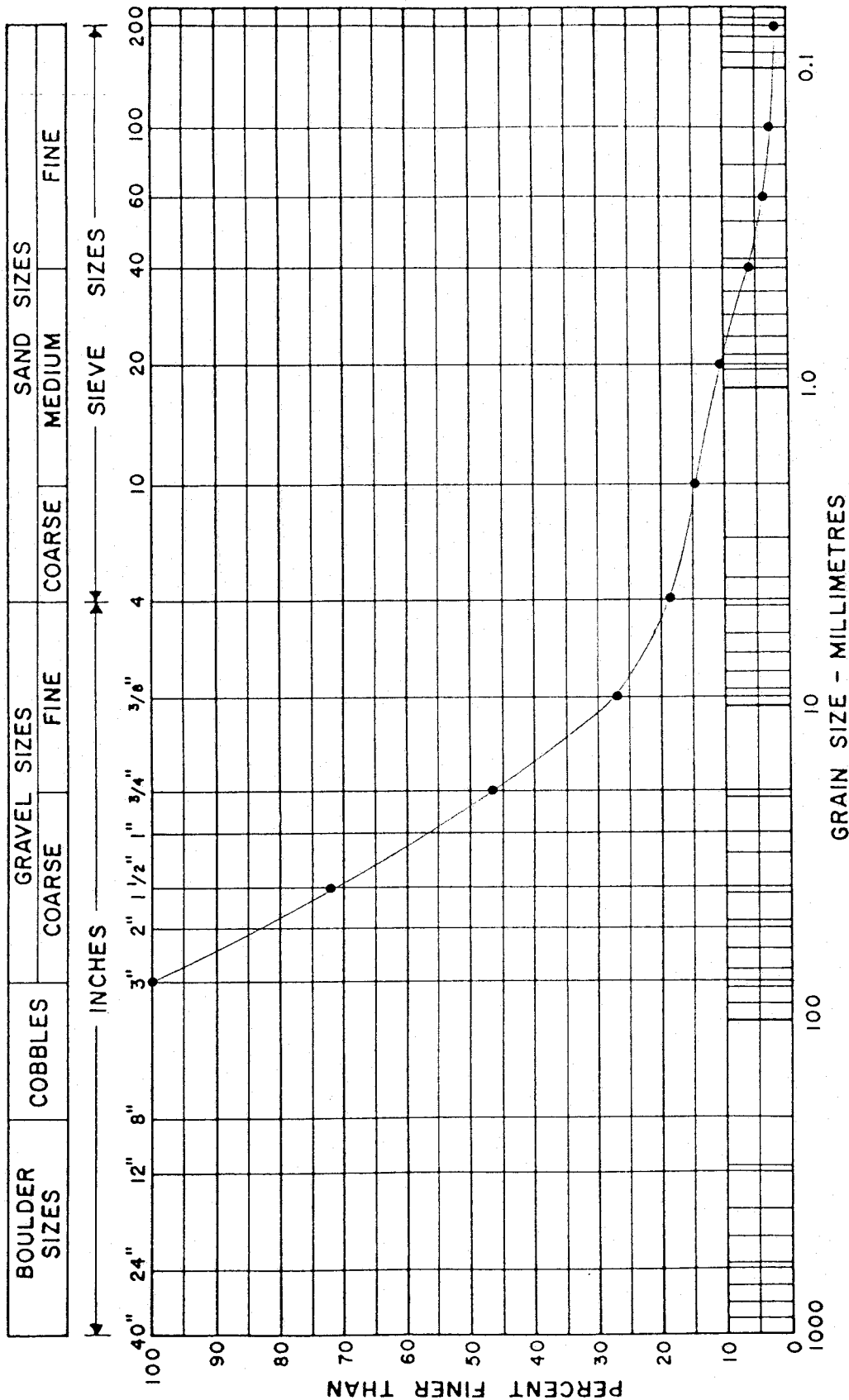
REMARKS: GRAVEL - some sand, little cobbles, trace fines



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 225.6
HOLE No.	TPA DEPTH 1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



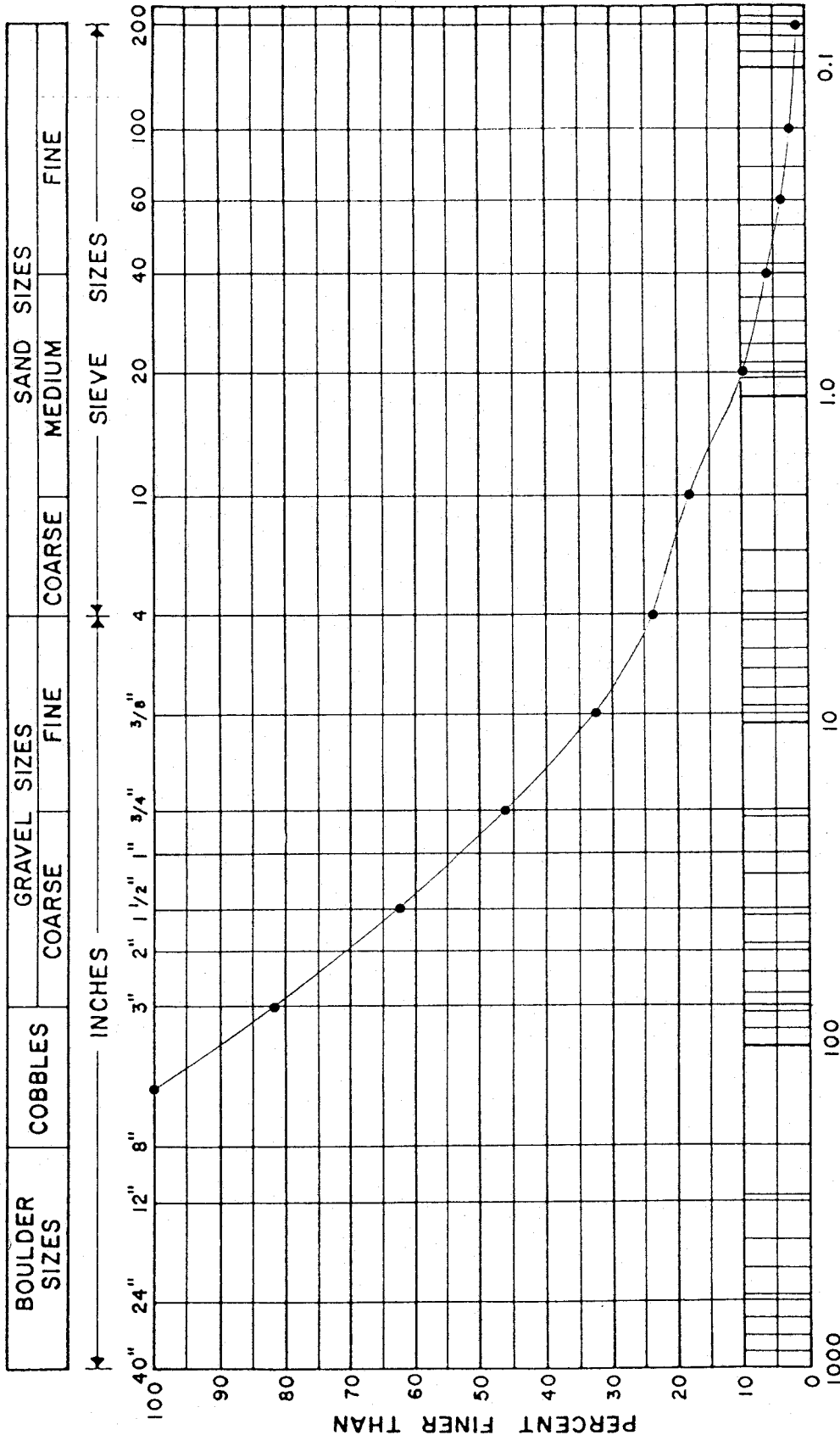
REMARKS: GRAVEL - little sand, trace fines.



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 225.6
HOLE No.	TPB
DEPTH	1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



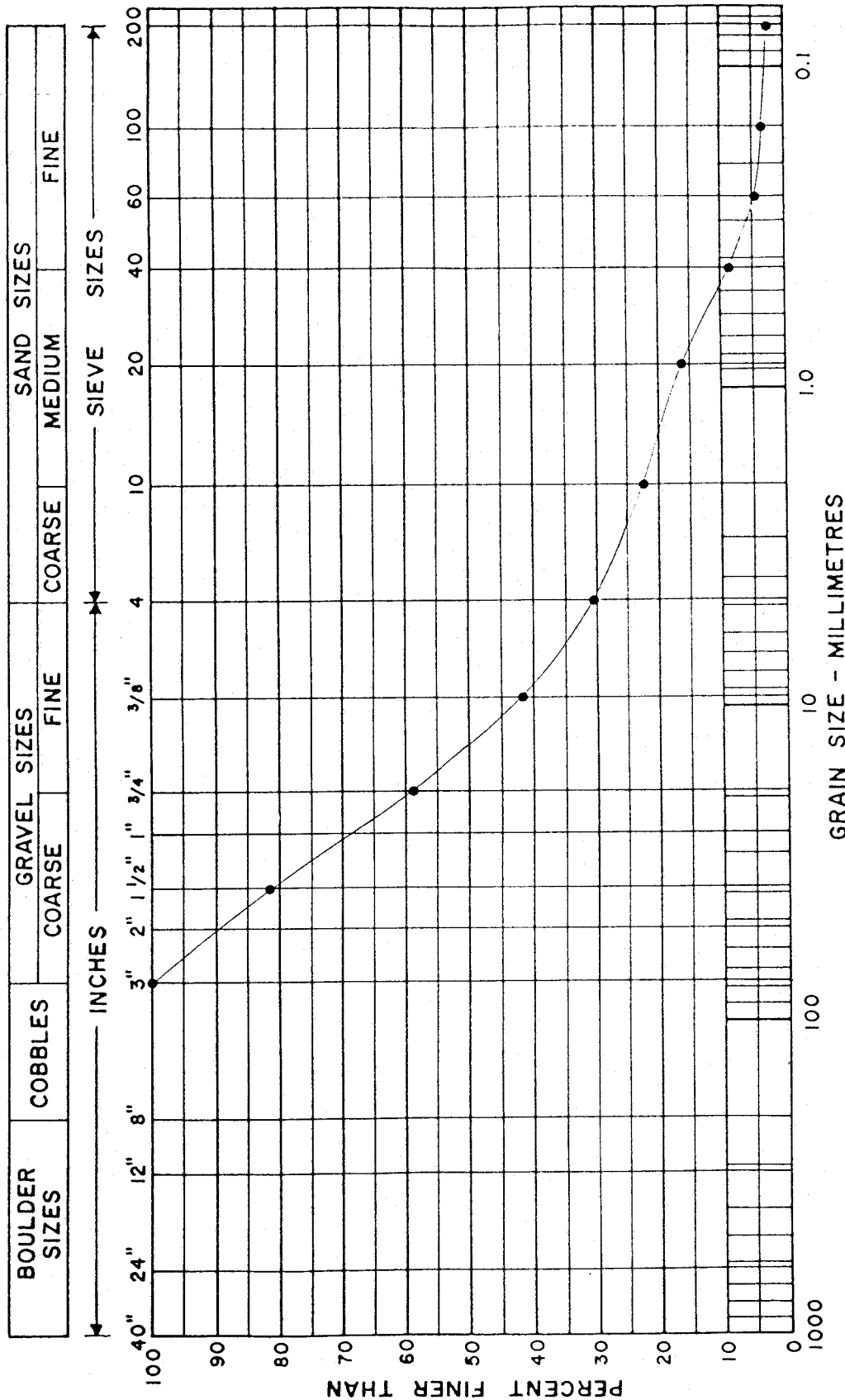
REMARKS: GRAVEL - some sand, little cobbles, trace fines



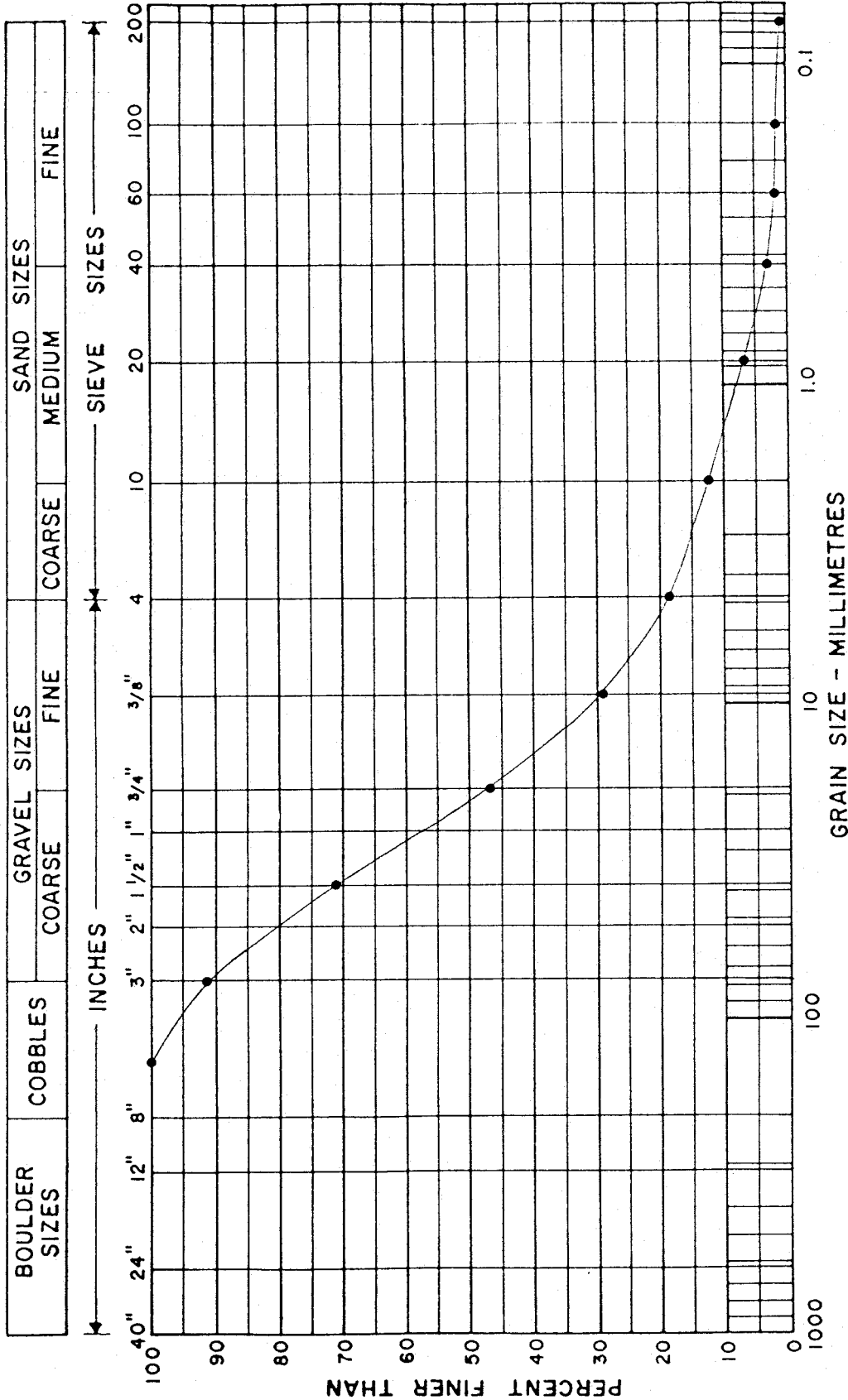
KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 225.6
HOLE No.	TPC
DEPTH	1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



GRAIN SIZE CURVE GRANULAR SOILS



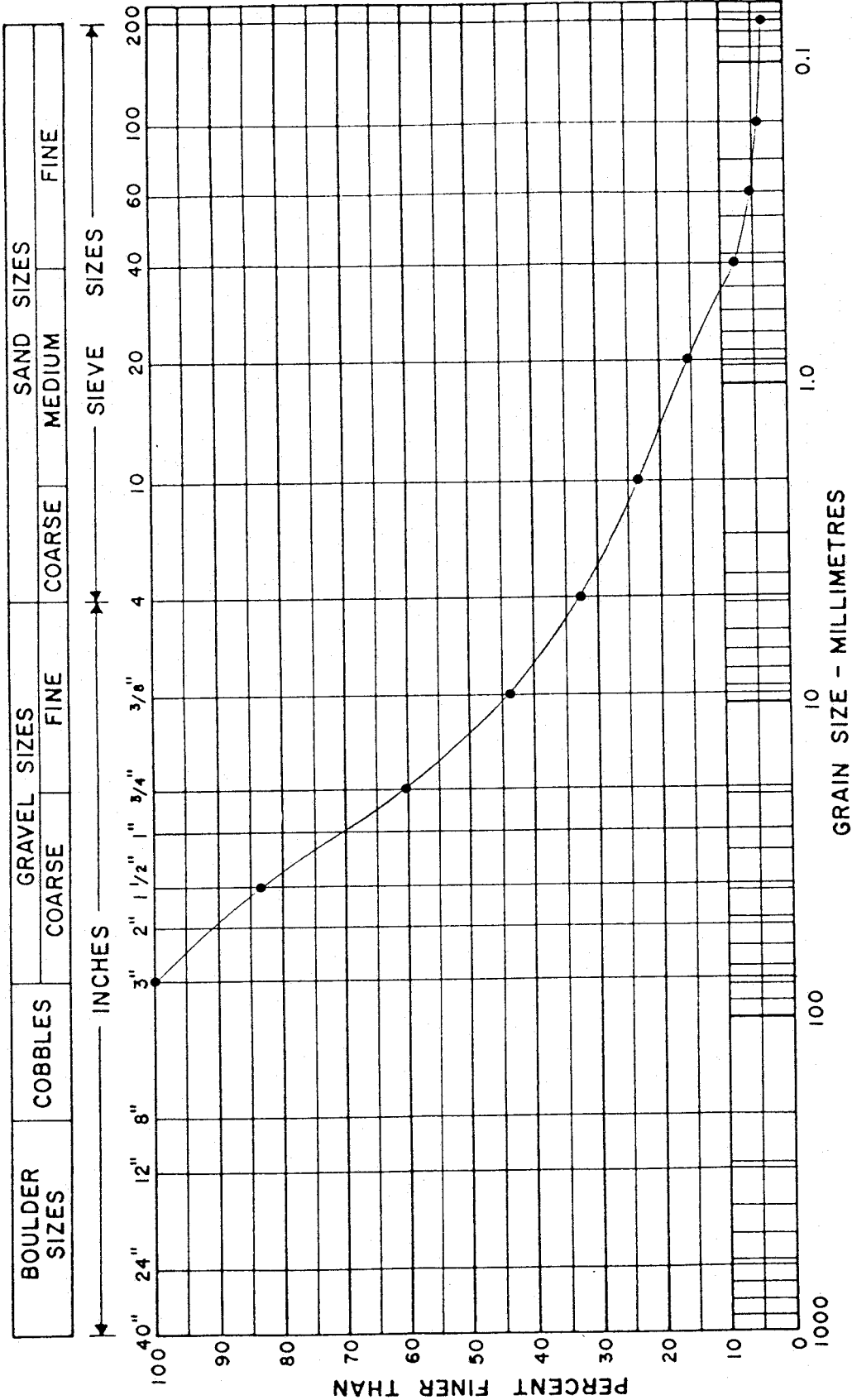
REMARKS: GRAVEL - little sand, trace cobbles, trace fines



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 238.2
HOLE No.	TPB
DEPTH	1 to 1.5 m
DATE	September 1986

GRAIN SIZE CURVE GRANULAR SOILS



REMARKS: GRAVEL - some sand, trace fines



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No.	PA2290.01.01
PROJECT	Dempster Highway
LOCATION	EB 238.2
HOLE No.	TPD
DEPTH	1 to 1.5 m
DATE	September 1986

APPENDIX IV
Rip Rap/Filter Material, Summary Sheets

SITE RF 160.0



Rock Description

Limestone

- white to pale grey
- medium/coarse grained crystalline limestone
- slightly weathered
- strong
- medium to thickly bedded
- point load index strength 11 mPa

Major Discontinuities

<u>Dip Angle</u>	<u>Dip Direction*</u>
38°	049°
65°	096°
53°	200°

* all dip directions presented in this report are referenced to magnetic north.

SITE RF 194.9



Rock Description

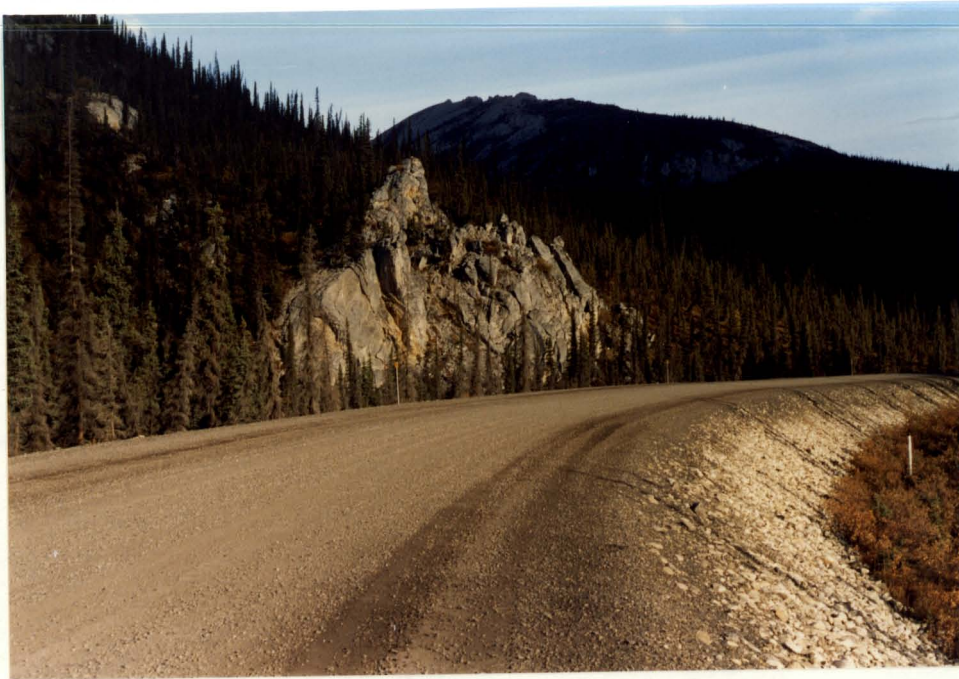
Limestone

- dark grey
- carbonaceous
- fine grained
- strong
- slightly weathered
- recrystallization on joint surfaces
- medium to thickly bedded
- point load index strength 7 mPa

Major Discontinuities

<u>Dip Angle</u>	<u>Dip Direction</u>
52°	040°
85°	080°

SITE RF 196.1



Rock Description

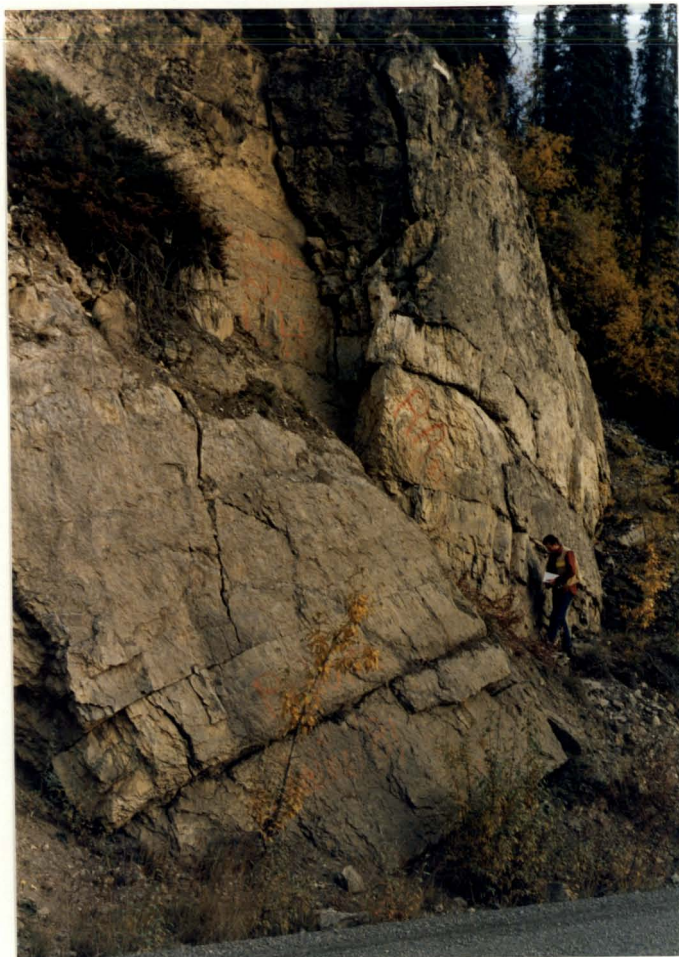
Limestone

- dark grey
- carbonaceous
- fine grained
- strong
- slightly weathered
- medium to thickly bedded
- point load index strength 11 mPa

Major Discontinuities

<u>Dip Angle</u>	<u>Dip Direction</u>
85°	340°
85°	250°
60°	255°

SITE RF 205.0 (A)



Rock Description

Limestone

- dark grey
- carbonaceous
- fine grained
- strong
- slightly weathered
- thickly bedded
- point load index strength 8 mPa

Major Discontinuities

<u>Dip Angle</u>	<u>Dip Direction</u>
75°	290°
60°	200°
10°	030°
90°	230°
60°	120°
75°	080°

SITE RF 210.8



Rock Description

Upper Formation

Limestone

- dark grey
- carbonaceous
- fine grained
- surface staining
- strong
- moderately weathered
- thinly bedded
- point load index 11 mPa

Lower Formation

Limestone

- dark grey
- carbonaceous
- fine grained
- strong
- slightly weathered
- medium to thickly bedded
- point load index 11 mPa

Major Discontinuities

<u>Dip Angle</u>	<u>Dip Direction</u>
30°	010°
75°	300°
60°	200°

SITE RF 216.3



Rock Description

Limestone

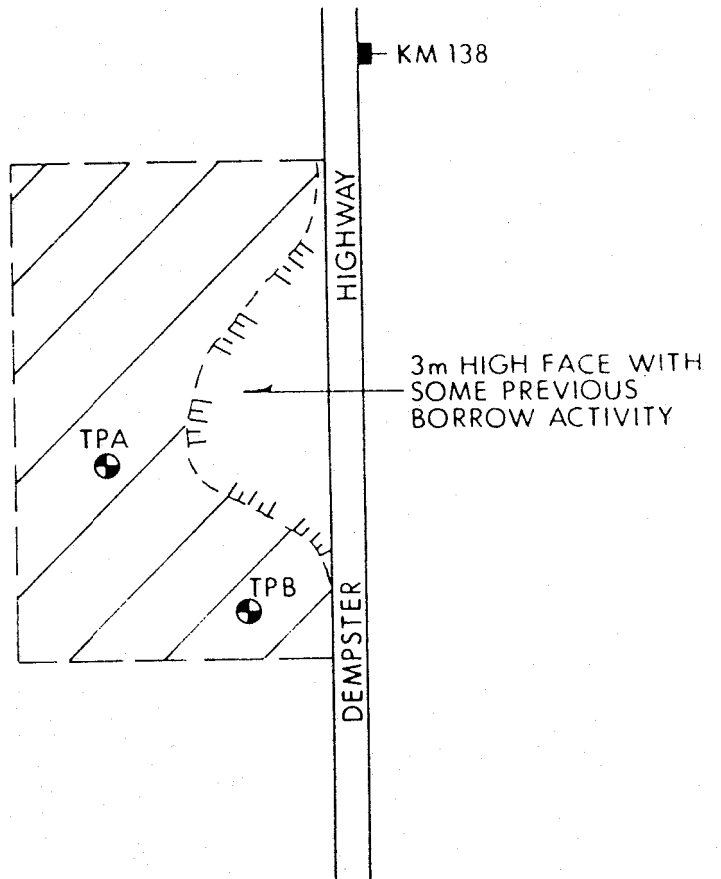
- dark grey
- carbonaceous
- fine grained
- strong
- slightly weathered
- thickly bedded
- point load index strength 10 mPa

Major Discontinuities

<u>Dip Angle</u>	<u>Dip Direction</u>
85°	030°
20°	310°
85°	045°
75°	110°
80°	240°

EMBANKMENT BORROW EB 137.9

Service Location: Km 139.0 to 147.4 (jointly with EB 140.6)
 Volume Required: 14,000 m³ (jointly with EB 140.6)
 Volume Available: 15,000 m³
 Surface Area: 5,000 m²
 Depth of Extraction: 3 m (average)
 Stripping Required: 0.1 m (average)



AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL

SCALE NTS



KLOHN LEONOFF
CONSULTING ENGINEERS

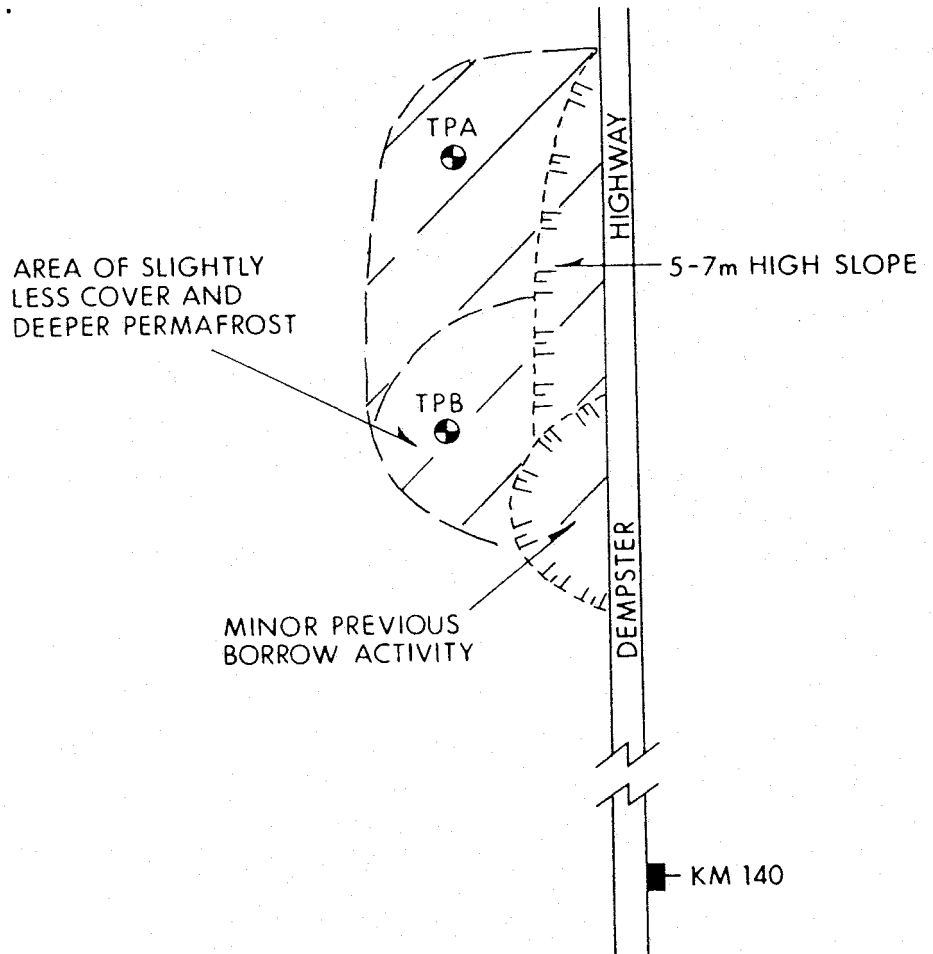
CLIENT: Yukon Territorial Government

PROJECT		Dempster Highway		
TITLE		Embankment Borrow Site Sketch Plan		
DATE OF ISSUE	PROJECT No.	DWG No.	REV	
Oct. 15/86	PA 2290	A-2290.01		
APPROVED				

EMBANKMENT BORROW EB 140.6

Service Location: Km 139.0 to 147.4 (jointly with EB 137.4)
 Volume Required: 14,000 m³ (jointly with EB 137.9)
 Volume Available: 7,200 m³ (possibly much more available if thawed)
 Surface Area: 2,400 m²
 Stripping Required: 0.2 m in vicinity of TPB and 0.3 m nearer to TPA

Note: Excavation of frozen material at depth may be difficult unless some thawing allowed.



AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL

SCALE NTS



KLOHN LEONOFF
CONSULTING ENGINEERS

CLIENT: Yukon Territorial Government

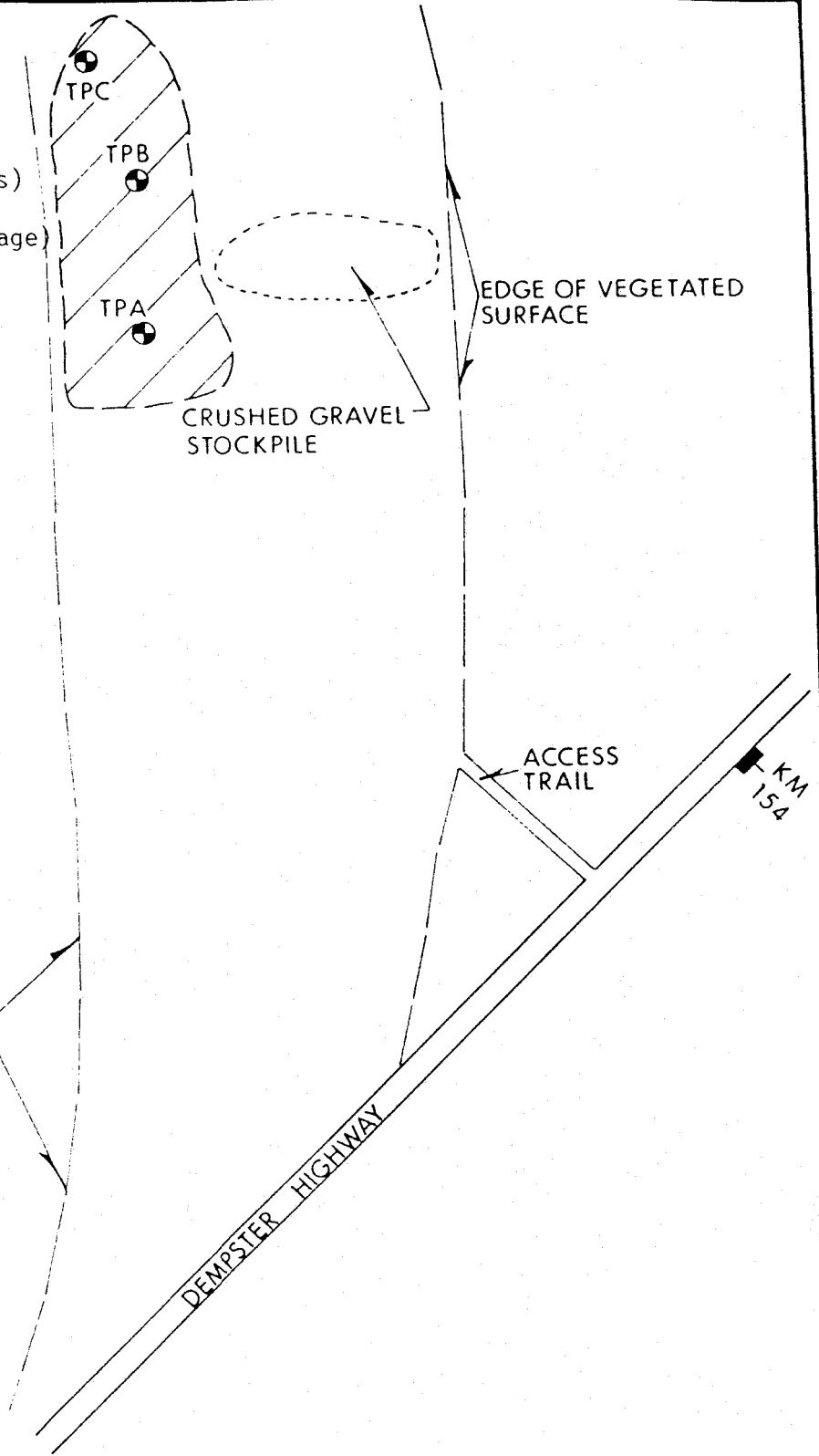
PROJECT		Dempster Highway		
TITLE		Embankment Borrow Site Sketch Plan		
DATE OF ISSUE	PROJECT No	DWG No	REV	
Oct. 15/86	PA 2290	A -2290.02		
APPROVED				

EMBANKMENT BORROW EB 154.0

Service Location: 170.0 to 170.4
 Volume Required: 2,700 m³
 Volume Available: 12,000 m³ (plus)
 Surface Area: 3,500 m²
 Depth of Extraction: 3 to 4 m (average)
 Stripping Required: nil

Note: An alternate emankment borrow site at Km 160.0 is closer to the segment at highway needing repair and therefore may be preferred.

EDGE OF VEGETATED SURFACE



AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.

SCALE NTS



KLOHN LEONOFF
 CONSULTING ENGINEERS

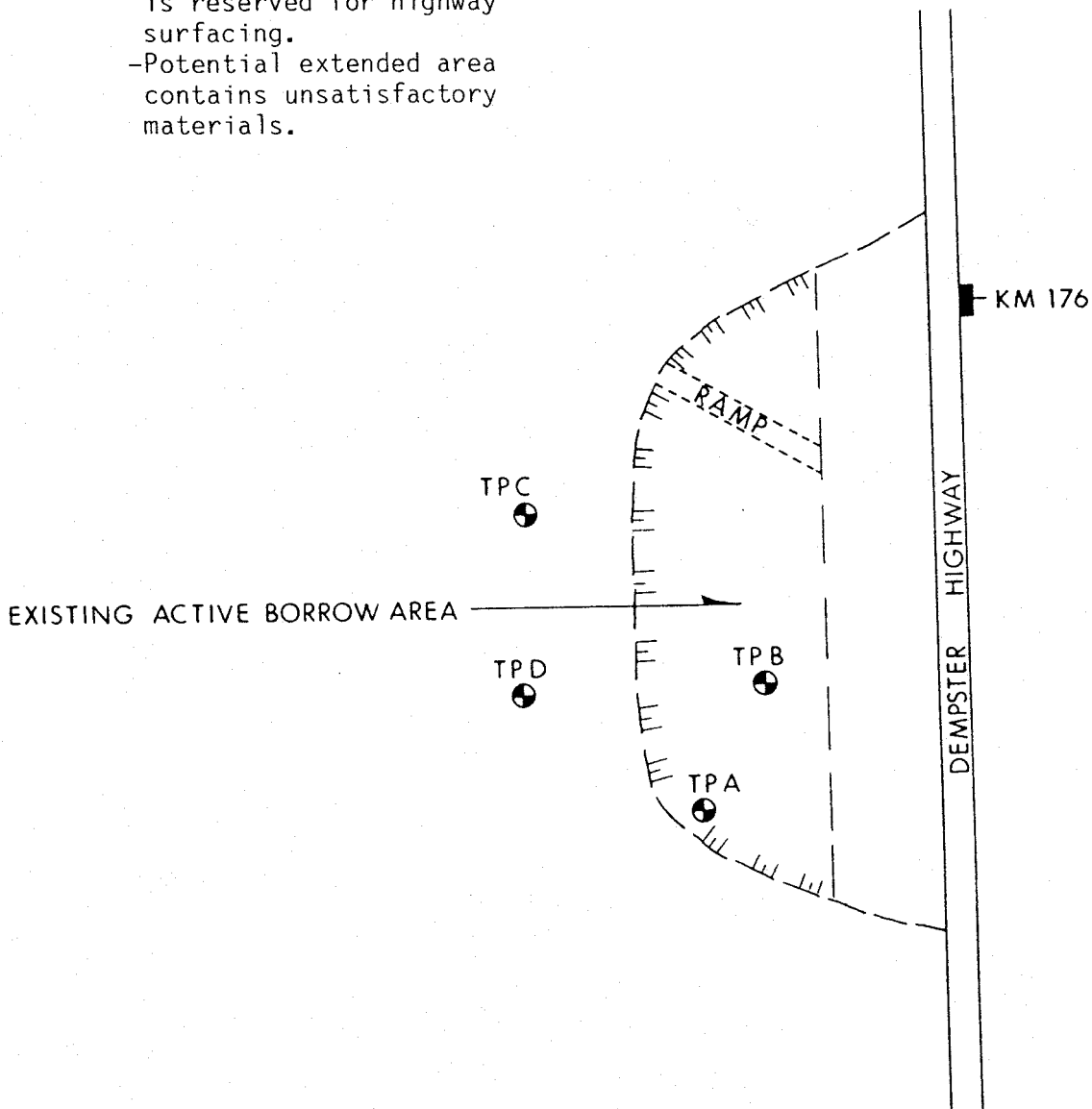
PROJECT		Dempster Highway		
TITLE		Embankment Borrow Site Sketch Plan		
DATE OF ISSUE	PROJECT No	DWG No.	REV	
Oct. 15/86	PA 2290	A-2290.03		
APPROVED				

CLIENT: Yukon Territorial Government

EMBANKMENT BORROW EB 176.6

REJECTED

Note: -Existing developed area is reserved for highway surfacing.
 -Potential extended area contains unsatisfactory materials.



AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL

SCALE NTS



KLOHN LEONOFF
CONSULTING ENGINEERS

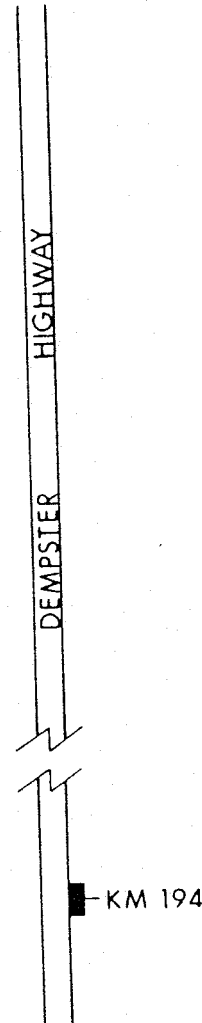
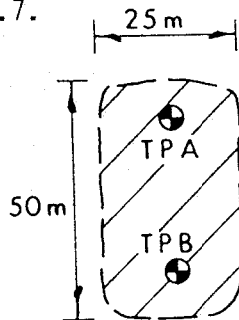
PROJECT		Dempster Highway	
TITLE		Embankment Borrow Site Sketch Plan	
DATE OF ISSUE	PROJECT No.	DWG No.	REV.
Oct. 15/86	PA 2290	A-2290.04	
APPROVED			

CLIENT: Yukon Territorial Government

EMBANKMENT BORROW EB 194.8

Service Location: Km 195.0 to 195.4
 Volume Required: 800 m³
 Volume Available: 1,500 m³ (plus)
 Surface Area: 1,200 m²
 Depth of Extraction: 1.5 m (variable)
 Stripping Required: nil

Note: If this site is considered undesirable material may be obtained from EB 197.7.



AS A MUTUAL PROTECTION TO OUR CLIENT THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA STATEMENTS CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL

SCALE NTS



KLOHN LEONOFF
 CONSULTING ENGINEERS

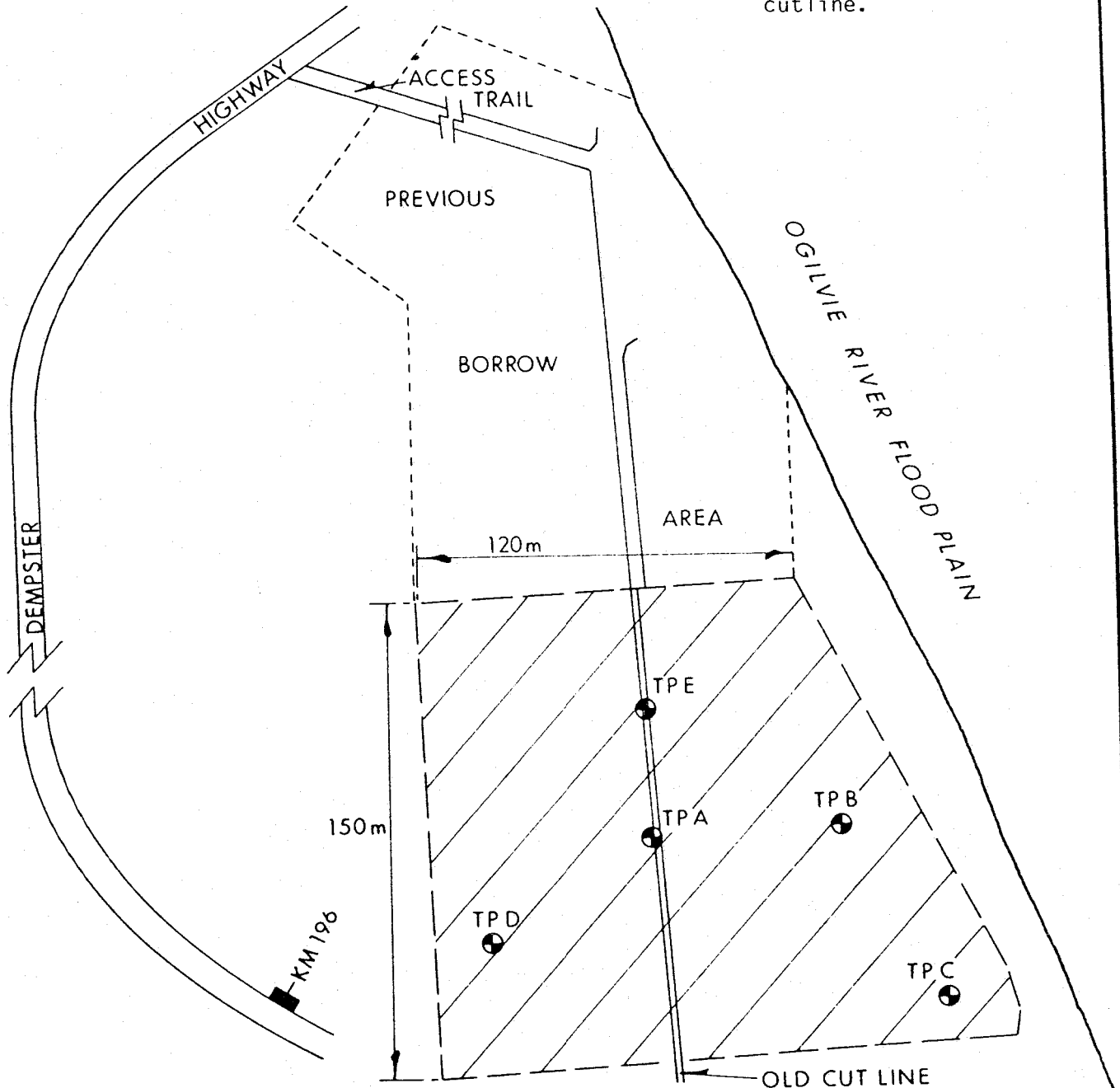
PROJECT		Dempster Highway		
TITLE		Embankment Borrow Site Sketch Plan		
DATE OF ISSUE	PROJECT No	DWG No	REV	
Oct. 15/86	PA 2290	A-2290.05		
APPROVED				

CLIENT: Yukon Territorial Government

EMBANKMENT BORROW EB 197.7

Service Location: Km 180.5 to 205.3
 Volume Required: 24,000 m³
 Volume Available: 45,000 m³

Surface Area: 22,000 m²
 Depth of Extraction: 2.2 m generally,
 1.5 m locally
 Stripping Required: 20 cm (typical) east of
 cutline, 40 to 100 cm
 (variable) west of
 cutline.



AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL

SCALE NTS



KLOHN LEONOFF
 CONSULTING ENGINEERS

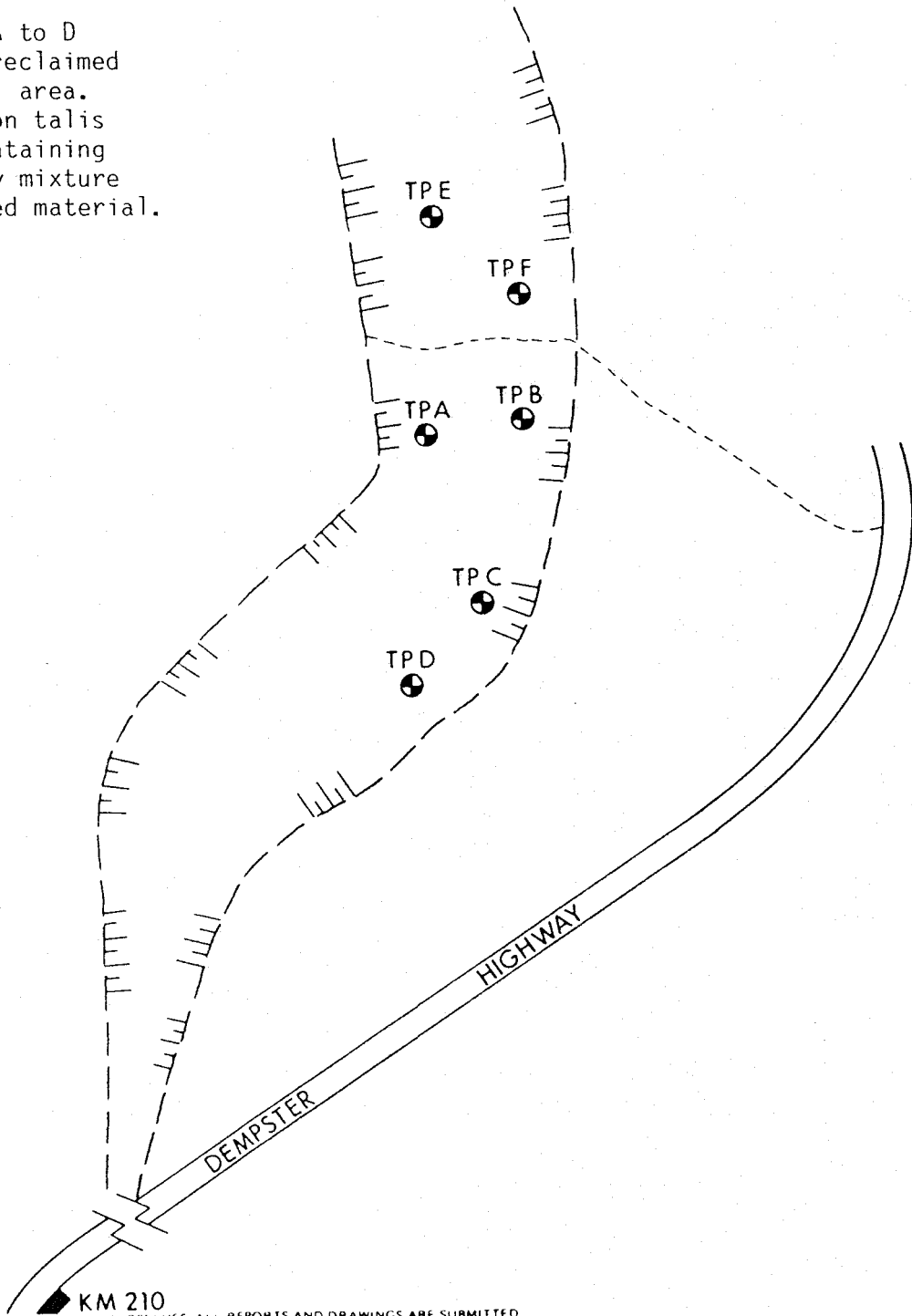
PROJECT		Dempster Highway		
TITLE		Embankment Borrow Stie Sketch Plan		
DATE OF ISSUE	PROJECT No.	DWG No.	REV.	
Oct. 15/86	PA 2290	A-2290.06		
APPROVED				

CLIENT: Yukon Territorial Government

EMBANKMENT BORROW EB 211.0

REJECTED

Note: -Area of TP's A to D inclusive is reclaimed waste material area.
 -TP's E and F on talis slope area containing unsatisfactory mixture of fine grained material.



AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL

SCALE NTS



KLOHN LEONOFF
CONSULTING ENGINEERS

PROJECT

Dempster Highway

TITLE

Embankment Borrow Site
Stekch Plan

CLIENT:

Yukon Territorial Government

DATE OF ISSUE

Oct. 15/86

APPROVED

PROJECT No.

PA 2290

DWG No.

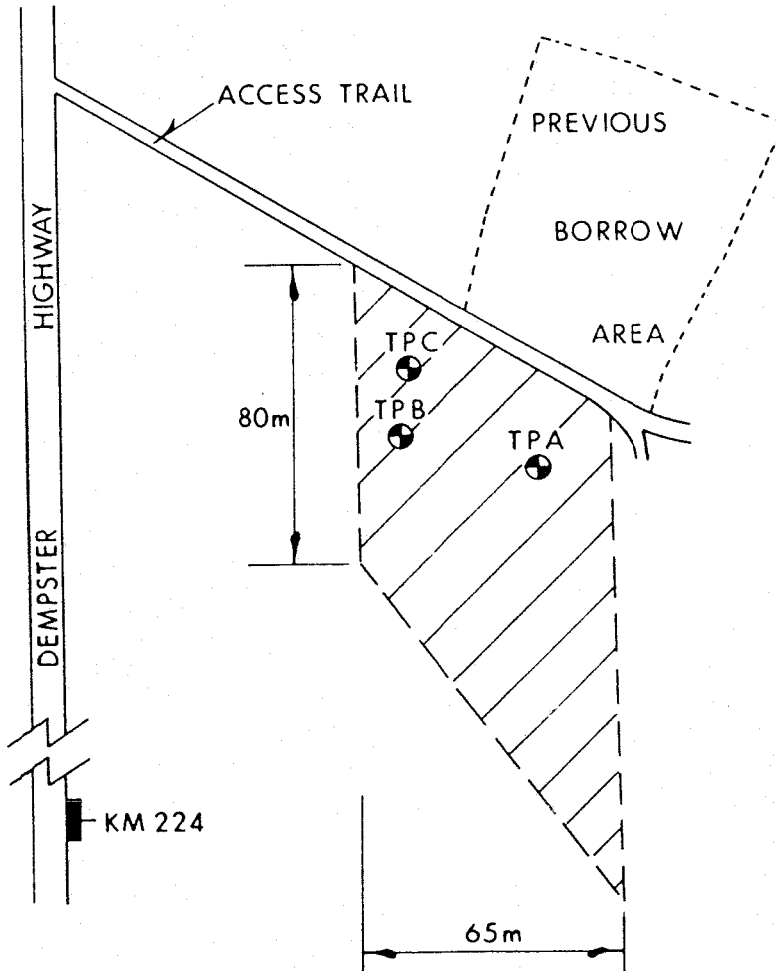
A-2290.07

REV

EMBANKMENT BORROW EB 225.6

Service Location: Km 209.3 to 223.8
 Volume Required: 10,000 m³
 Volume Available: 10,000 m³ (potential for 15,000 m³ plus)
 Surface Area: 5,800 m²
 Depth of Extraction: 1.7 m (average)
 Stripping Required: 50 cm (average)

Note: -Borrow area enlarged subsequent to test pitting to accommodate loss of potential borrow of Km 211.0.
 -May consider obtaining material for more southerly locations from EB 197.7.



AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL

SCALE NTS



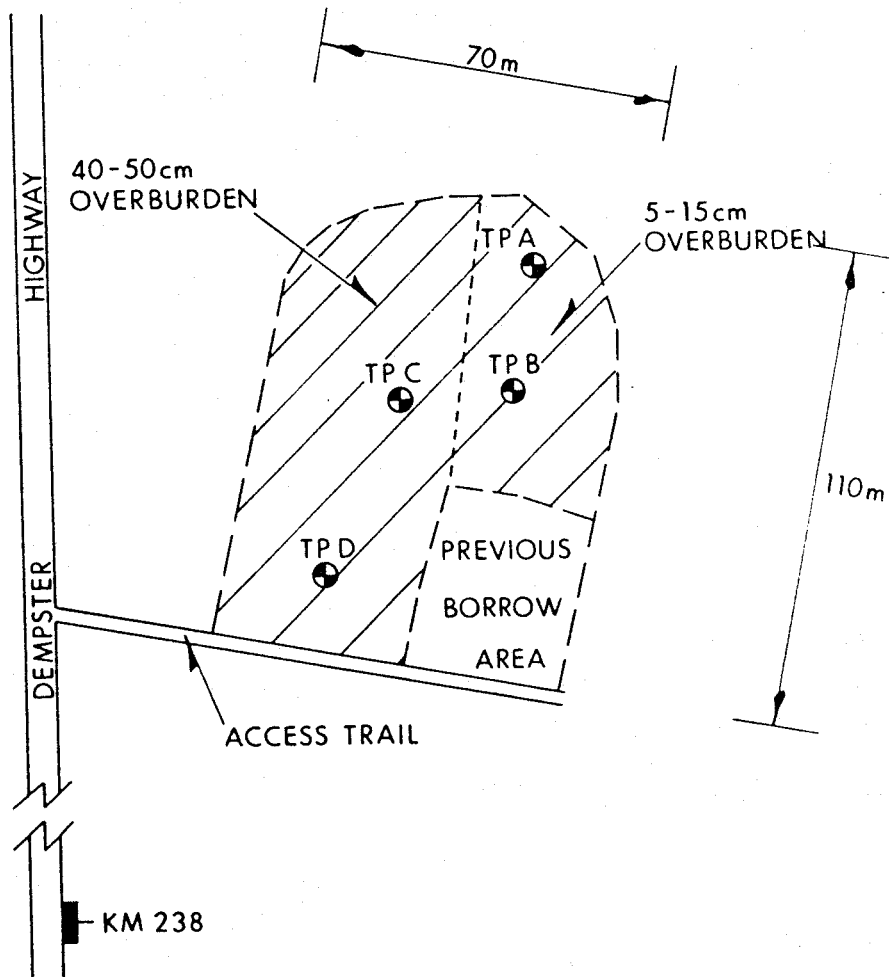
KLOHN LEONOFF
 CONSULTING ENGINEERS

PROJECT		Dempster Highway	
TITLE		Embankment Borrow Site Sketch Plan	
DATE OF ISSUE	PROJECT No.	DWG No.	REV.
Oct. 15/86	PA 2290	A-2290.08	
APPROVED			

CLIENT: Yukon Territorial Government

EMBANKMENT BORROW EB 238.2

Service Location: Km 241.4 to 242.2
 Volume Required: 4,000 m³
 Volume Available: 10,000 m³ (plus)
 Surface Area: 5,000 m²
 Depth of Extraction: 2 m (average)
 Stripping Required: 5 to 15 cm and 40 to 50 cm



AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL

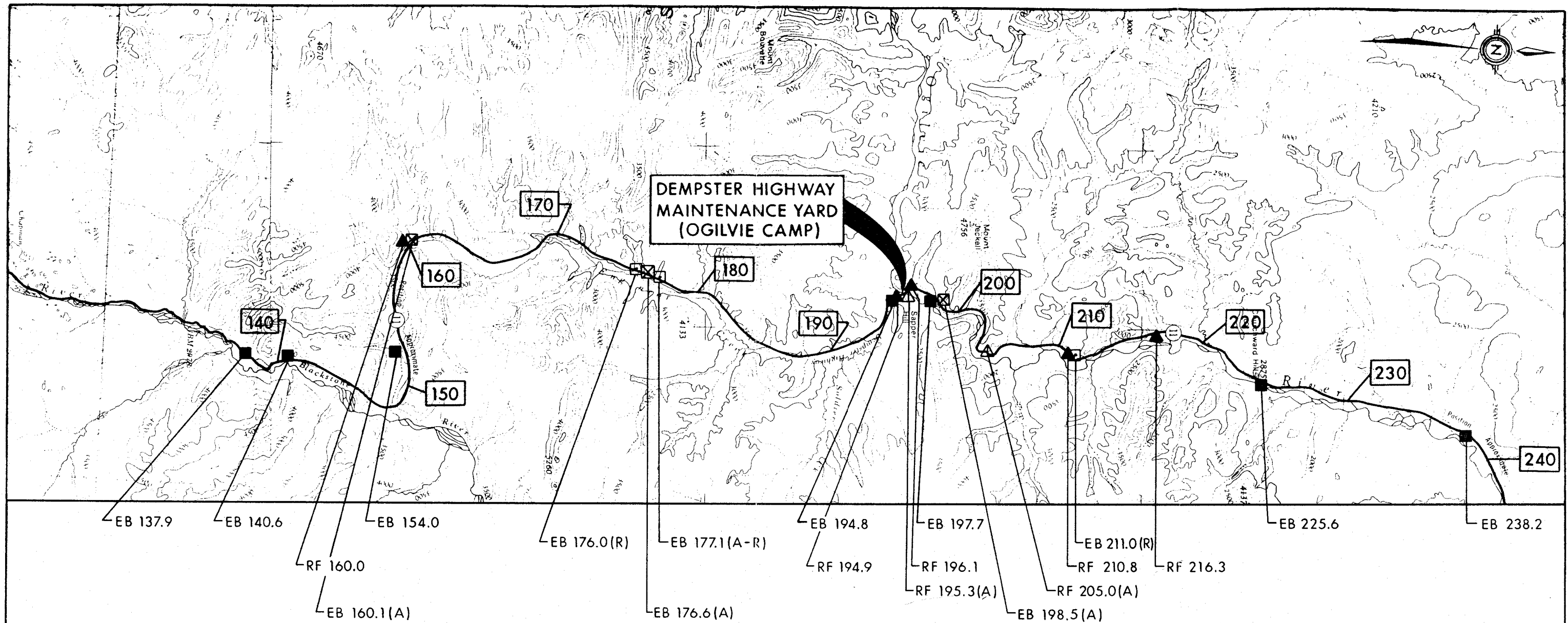
SCALE NTS



KLOHN LEONOFF
 CONSULTING ENGINEERS

PROJECT		Dempster Highway		
TITLE		Embankment Borrow Site Sketch Plan		
DATE OF ISSUE	PROJECT No.	DWG. No.	REV.	
Oct. 15/86	PA 2290	A-2290.09		
APPROVED				

CLIENT: Yukon Territorial Government




LEGEND

- 200 KILOMETRE POST
- EMBANKMENT BORROW SITE
- ⊗ ALTERNATE EMBANKMENT BORROW SITE
- REJECTED EMBANKMENT BORROW SITE
- ▲ RIP RAP/FILTER MATERIAL BORROW SITE
- △ ALTERNATE RIP RAP/FILTER MATERIAL BORROW SITE
- A - R ALTERNATE SOURCE AREA - REJECTED

AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.

TO BE READ WITH KLOHN LEONOFF REPORT DATED OCT. 15/86

SCALE 1:250 000

 <p>KLOHN LEONOFF CONSULTING ENGINEERS</p>	<p>PROJECT DEMPSTER HIGHWAY GEOTECHNICAL INVESTIGATIONS OF CONSTRUCTION MATERIALS KM 139 TO 243</p>			
	<p>TITLE BORROW SOURCE LOCATION PLAN</p>			
<p>CLIENT: YUKON TERRITORIAL GOVERNMENT</p>	<p>DATE OF ISSUE OCT. 15/86</p> <p>APPROVED <i>[Signature]</i></p>	<p>PROJECT No. PA 2290</p>	<p>DWG. No. B-2290.01</p>	<p>REV.</p>