PRELIMINARY REPORT ON AGGREGATE POTENTIAL INVESTIGATION OF FORT NELSON AIRPORT AREA, FORT NELSON, BRITHSH COLUMBIA

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1.0 SUMMARY

During the period 12-14 December, 2003, a reconnaissance-scale test pit program was conducted by the British Columbia Ministry of Energy and Mines (MEM) to investigate the aggregate potential of the Fort Nelson Airport Area. Based on test pit program and laboratory results, three areas have been identified as having potential to host an aggregate deposit. The type and quality of material varies between these areas, as do potential volumes. Additional areas in the region may also have aggregate potential such as the area northeast of Area 3. These areas were not investigated due to insufficient frozen ground conditions. Detailed air photo mapping, ground surveys, and a high density test pit program are required to further asses quality and volumes of granular material present in these areas.

2.0 PURPOSE

The purpose of this preliminary report is to distribute data collected during this investigation to the Northern Rockies Regional District (NRRD) and Fort Nelson Airport Authority and to briefly summarize preliminary results. It is intended that these data and results be used by NRRD while assessing their current and future aggregate needs. A more detailed report on this aggregate potential investigation is currently in progress. This report will be made available to NRRD upon completion.

3.0 METHODS

3.1 FIELD

Test pit sites were selected based on MEM field stations from summer 2003 field work, and those from work conducted by Atco Airports personnel (Figure 1). Two to five metre deep pits were excavated at 18 sites on Fort Nelson Airport property using a Kobelco 220LC tracked excavator. Detailed descriptions of sediments were completed at each test pit site. Sediments were classified using both the Wentworth grain size scale and the Modified Unified Soil Classification System (MUSCS). Granular material was sampled at select test pit sites. When encountered, depth to water table was noted. These data were recorded in test pit logs. These logs, and Wentworth grain size scale and MUSCS keys, are included in this preliminary report.

3.2 LABORATORY

Granular material samples were sent to Thurber Engineering Ltd., Victoria, BC, for laboratory analyses. Following procedures set by Cunningham (1990), gradation analyses (grain size distribution), degradation (susceptibility of aggregates to mechanical breakdown) and sand equivalent tests (presence or absence of plastic fines) were conducted on these samples. The reader is directed to his manual for a detailed discussion on the purpose of, and methods used for, these tests. Laboratory test results for samples collected on Fort Nelson Airport property are included in this preliminary report.

3.3 DATA ANALYSIS

Gradation curves for select samples were plotted against British Columbia Ministry of Transportation (MoT) gradation requirements for granular surfacing, base, and sub-base classifications (Ministry of Transportation, 2000). Results from degradation and sand equivalent tests were also compared against MoT specifications for granular road building materials (Ministry of Transportation, 2000). These comparisons were conducted in an effort to assess the quality of aggregate material encountered on Fort Nelson Airport property against provincially recognized standards. Only those classifications whose gradation requirements were met, or closely met, by Fort Nelson Airport sample gradation curves are presented in this report. According to MoT standards, granular material is classified on the mean of any four consecutive gradation results. In classifying the granular material present on Fort Nelson Airport property, this standard was only met once (see section 4.1 Area 1) due to the low number of test pits.

The reader is directed to Ministry of Transportation (2000) for a detailed discussion on class definitions, gradation requirements, and appropriate use of material for specific aspects of road building.

4.0 RESULTS

Figure 1 categorizes test pits into those with granular material, and those with non-granular material or granular material <1 m thick. Three areas are identified in Figure 1 that are believed have potential to host an aggregate deposit. Area boundaries were drawn based on test pit results and air photo and field interpretations of elevated landforms. Granular material within these three areas is characterized in the following discussion.

4.1 Area 1

Granular material was encountered at TPAP-03-09, 11, 12, and 53. Results from degradation and sand equivalent tests indicate that material in TPAP-03-11 meets MoT specifications for all granular materials (Table 1). In Figures 2a-c, gradation curves of materials collected in Area 1

are plotted against MoT granular surfacing, base, and sub-base gradation limits. Based on four gradation curves, the granular material in Area 1 is best suited for use as select granular sub-base (SBSG; Figure 2a). Further testing, and additional gradation results, may prove Area 1 sediments appropriate for other aggregate uses (e.g. high fines granular surfacing aggregate (HFGSA) or 25 mm well graded base coarse aggregate (WGBCA); see Figures 2 b and c).

During the early 1940's the United States Army and Air Force used the Fort Nelson Airport for various staging and training exercises. Many disturbed areas on Fort Nelson Airport property have been linked to these activities. Within Area 1 is a network of overgrown roads that were used to access test pit sites. Also within Area 1, 10 m east of TPAP-03-11, is what appears to be a steep, overgrown, ~2.5 m gravel pit face. This pit face and two rectangular areas adjacent to Area 1 that also appears to be overgrown (see Figure 1), and their proximity to test pits with granular material, suggests that portions of Area 1 may have already been mined for gravel. Due to these disturbances it is difficult to provide a volume estimate of granular material in Area 1.

4.2 Area 2

Granular material was encountered at TPAP-03-20, 54, and 56. Results from degradation and sand equivalent tests indicate that material in TPAP-03-20 meets MoT specifications for all granular materials (Table 1). In Figures 3a-c, gradation curves of material collected at two sites are plotted against MoT granular surfacing, base, and sub-base gradation limits. Based on two gradation curves, the granular material in Area 2 appears best suited for use as SBSG (Figure 3a). This classification is based on only two gradation curves, not the mean of four as required by MoT specifications. Further testing, and additional gradation results, may prove Area 2 sediments appropriate for other aggregate uses (e.g. HFGSA or 25 mm WGBCA; see Figures 3 b and c).

Fracture count data (i.e. the number of fractured or naturally angular clasts in specific grain-size fractions) is not required for classifying SGSB material as this material can be produced by direct excavation (i.e. pit-run). However, other MoT granular material classifications such as HFGSA or WGCBA require a minimum 50% fracture count after processing. Fracture count tests were not conducted on Area 2 samples. It is therefore not known if Area 2 sediments would meet this minimum fracture count requirement for these other granular material classifications.

A preliminary granular material volume estimate of 20 000 m^3 has been calculated for Area 2. This volume estimate was calculated using:

1. The average thickness of granular material encountered at TPAP-03-20, 54, and 56; and
2. A conservative area estimate (see Figure 1).

There are limitations to this preliminary granular material volume estimate that should be recognized. These limitations include:

1. Seasonal fluctuations of the water table which could increase or decrease the depth to which material could be extracted;
2. A low density of test pits in Area 2 which could result in an over or under-estimation of the aerial extent of granular material; and
3. The absence of a detailed topographic survey which could further refine the volume estimate.

It should be noted that this volume estimate was not calculated using the area of the Area 2 polygon (see Figure 1). This polygon delineates an area that is believed to have potential to host a granular deposit. It is recommended that any future aggregate potential investigations in Area 2 be concentrated within this polygon.

Petrographic analysis of granular material sampled at TPAP-03-20 is currently underway. Results from this analysis will provide an indication of whether granular material in Area 2 is suitable for concrete or asphalt mixes. These data will be made available upon completion of the analysis.

4.3 Area 3

Granular material was encountered at TPAP-03-32 and 57. As seen in laboratory test results, granular material at TPAP-03-32 is a fine to medium sand. As there was no gravel in this sample degradation and sand equivalent tests were not run. Figure 4 is a gradation curve of material collected at TPAP-03-32 plotted against MoT SGSB gradation requirements. Based on this one gradation curve, the granular material in Area 3 is not suitable for use as SBSG. This classification is based on only one gradation curve, not the mean of four as required by MoT specifications. Further testing, and additional gradation results, may therefore prove Area 3 sediments appropriate for use as SGSB material.

A preliminary granular material volume estimate of 50 000 m^3 has been calculated for Area 3. This volume estimate was calculated using:

1. The average thickness of granular material encountered at TPAP-03-32 and 57; and
2. A conservative area estimate (see Figure 1).

There are limitations to this preliminary granular material volume estimate that should be recognized. These limitations include:

1. Seasonal fluctuations of the water table which could increase or decrease the depth to which material could be extracted;
2. A low density of test pits in Area 3 which could result in an over or under-estimation of the aerial extent of granular material; and
3. The absence of a detailed topographic survey which could further refine the volume estimate.

It should be noted that this volume estimate was not calculated using the area of the Area 3 polygon (see Figure 1). This polygon delineates an area that is believed to have potential to host a granular deposit. It is recommended that any future aggregate potential investigations in Area 3 be concentrated within this polygon.

5.0 CONCLUSIONS

Granular material was encountered in test pits on Fort Nelson Airport property. Based on test pit results and air photo and field interpretations of elevated landforms, three areas have been identified on Fort Nelson Airport property as having potential to host an aggregate deposit (see Figure 1).

A comparison of laboratory results against MoT granular material specifications, and a comparison of the physical characteristics of the three areas with aggregate potential, suggests that Area 2 has the greatest potential to host an economic aggregate deposit. A potential granular material volume estimate of 20 000 m^3 has been calculated for Area 2. Area 2 sediments appears best suited for use as select granular sub-base (SBSG) material. Further testing and additional gradation results may prove Area 2 sediments appropriate for other aggregate uses such as a high fines surfacing aggregate (HFGSA) or a well graded coarse base aggregate (WGCBA). To justify a more detailed aggregate potential investigation of Area 2, this preliminary volume estimate, and preliminary granular material classification, should meet an aggregate need of NRRD.

Area 1 has potential to host aggregates of similar quality to those found in Area 2. Field observations and air photo interpretations suggest that this area may have previously been mined for gravel. An estimation of undisturbed ground in Area 1 would help determine whether there is enough potential granular material left to justify a more detailed aggregate potential investigation.

Fine to medium sands were encountered in Area 3 test pits. Based on data collected to date Area 3 sediments appears unsuitable for use as granular surfacing, base, and sub-base material

as defined by MoT. As with Area 2, additional sample collection and laboratory analyses may produce gradation results that meet SBSG gradation requirements. A potential granular material volume estimate of 50 000 m^3 has been calculated for Area 3. Although not meeting SBSG gradation requirements, this material may be appropriate for other infrastructure and structural development projects.

6.0 RECOMMENDATIONS FOR FURTHER WORK

Further aggregate potential investigations are required in Area 1, 2, and 3 to refine preliminary volume estimates and preliminary granular material classifications. Should preliminary data presented here for Area 1, 2, or 3 meet an aggregate need of NRRD the following future work is recommended.

Detailed air photo mapping and ground survey should be conducted in Area 1 to determine whether or not this area as been previously mined for granular material. A review of air photos flown from 1940 to 1950, if they exist, would be particularly useful. If previously mined, the area of undisturbed ground within Area 1 should be estimated. This estimation would help determine whether there is enough potential granular material left to justify a more detailed aggregate potential investigation

A high density test pit program, and detailed topographic survey, should be conducted within the aggregate potential areas outlined in Figure 1. Granular material should be sampled and tested following a standard set of procedures to asses quality and volumes (e.g. Cunningham, 1990).

Based on airphoto interpretations and shallow hand-auger testing, there are other areas within Fort Nelson Airport property that warrant an aggregate potential investigation. One such area is located between Area 3 and the sewage lagoons. Another area is located the river terrace, below Area 3, that is cut by the sewage outfall cutline.

REFERENCES

Cunningham, D., Editor (1990): Manual of test procedures, soils and mineral aggregates; British Columbia Ministry of Transportation and Highways.

Ministry of Transportation (2000): Section 202 - granular surfacing, base, and sub-bases; *in* Standard Specifications for Highway Construction, Volume 1, 586 pages.

Figure 2a - Gradation curves against MoT table 202-G select granular sub- base (SGSB) specifications

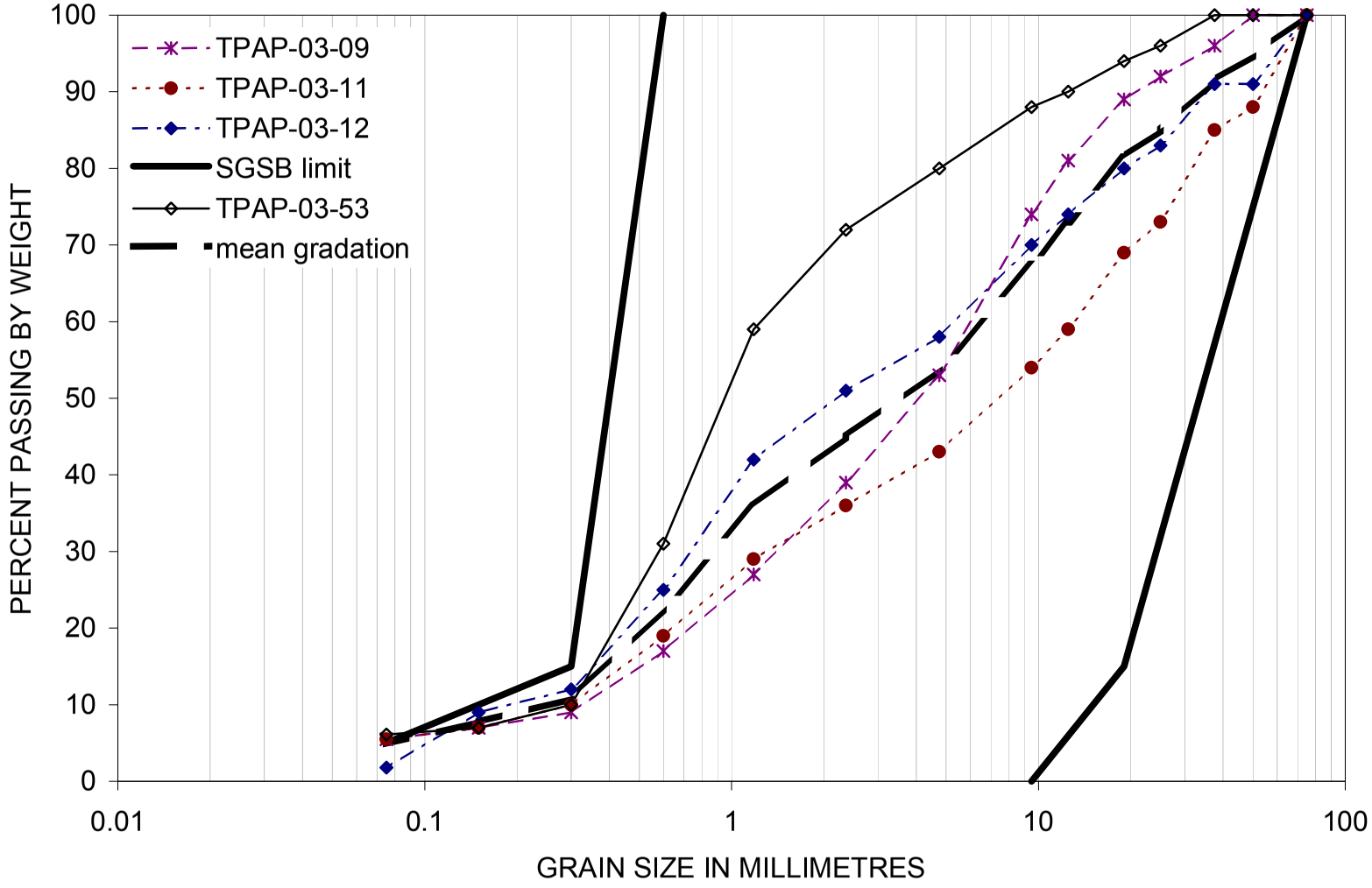


Figure 2b - Gradation curves against MoT table 202-B high fines granular surfacing aggregate (HFGSA) specifications

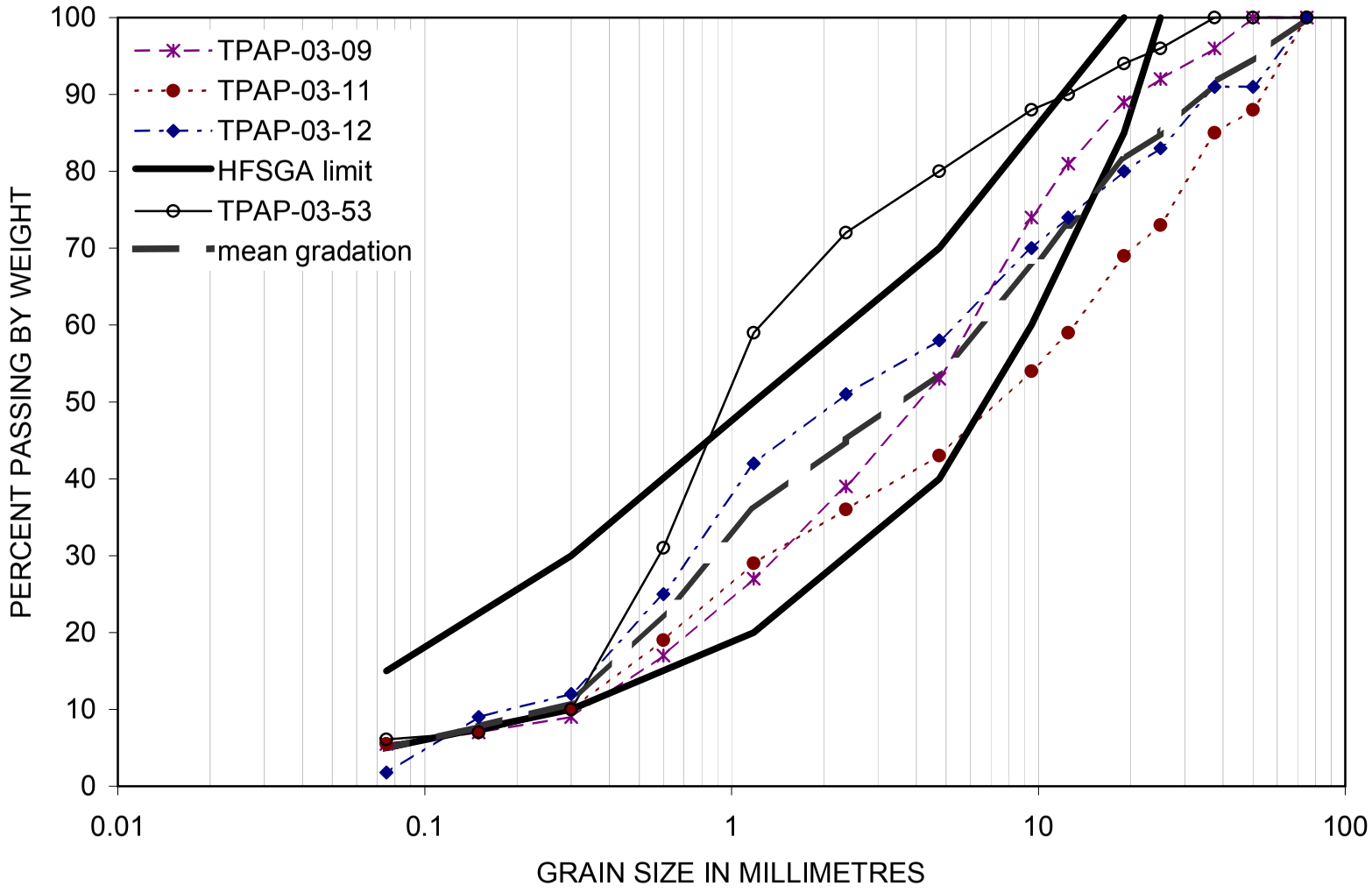


Figure 2c - Gradation curves against MoT table 202-C well graded base coarse aggregate (WGBCA) specifications

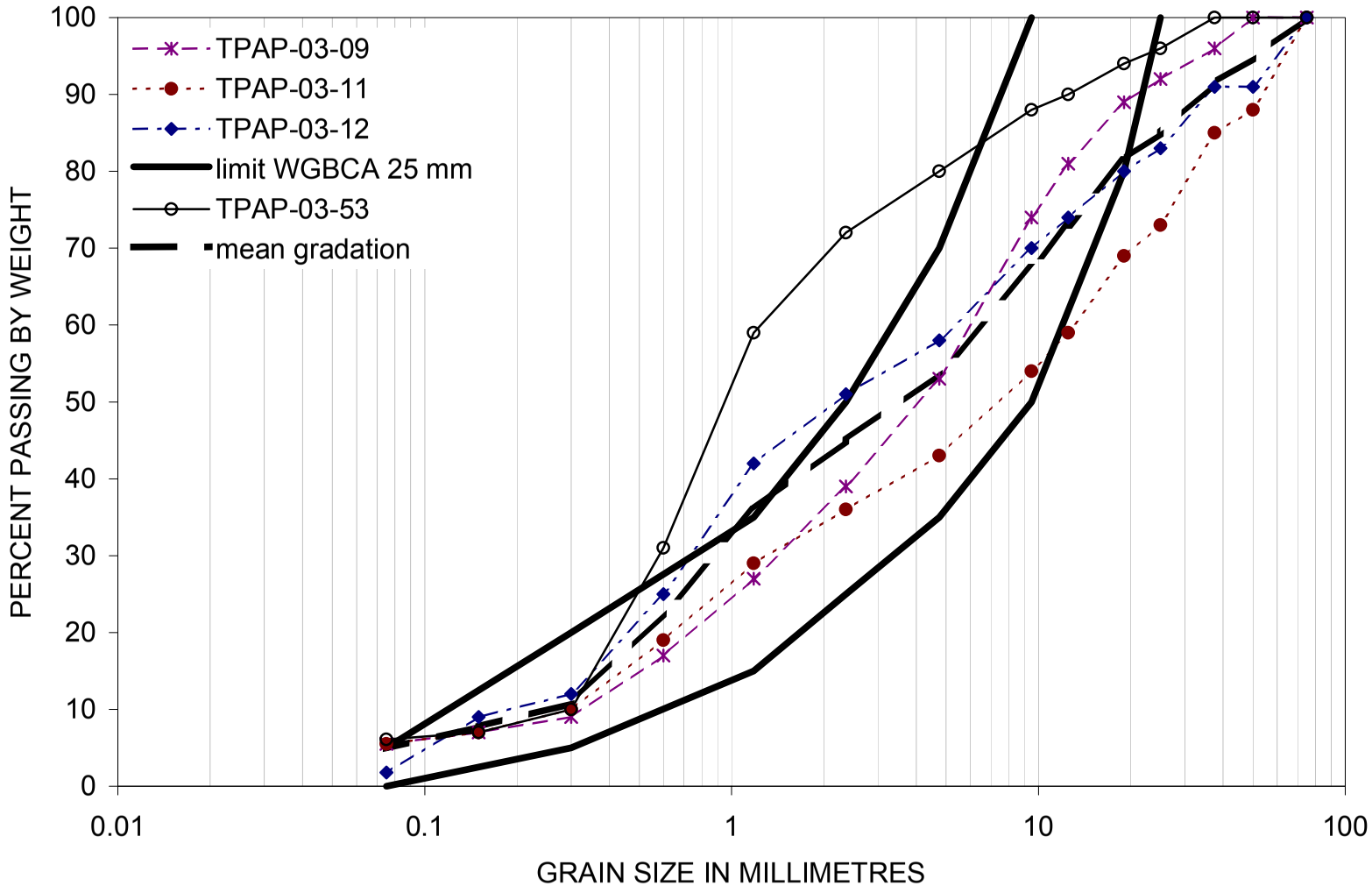


Figure 3a - Gradation curves against MoT table 202-G select granular sub-base (SGSB) specifications

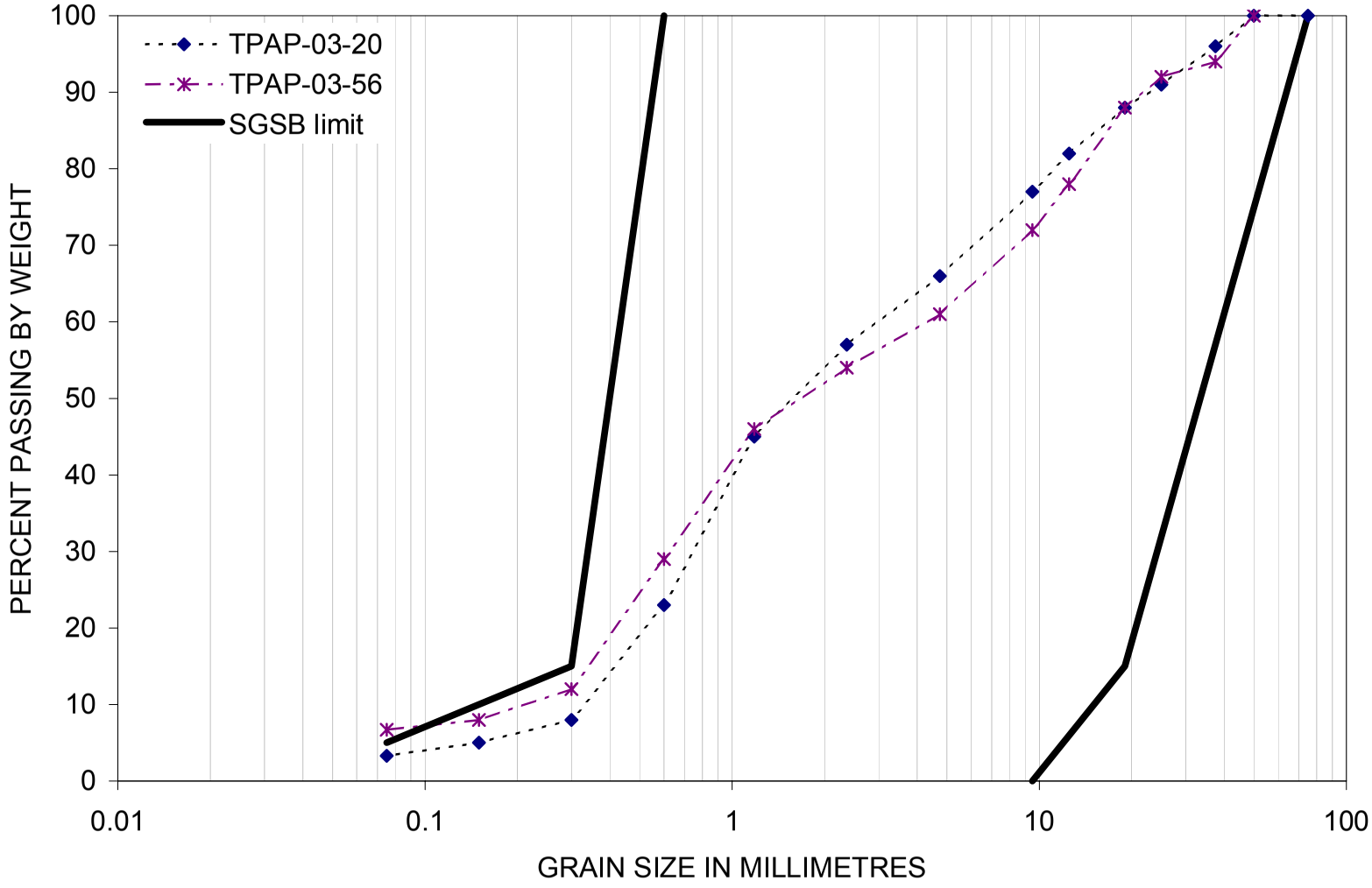


Figure 3b - Gradation curves against MoT table 202-B high fines granular surfacing aggregate (HFGSA) specifications

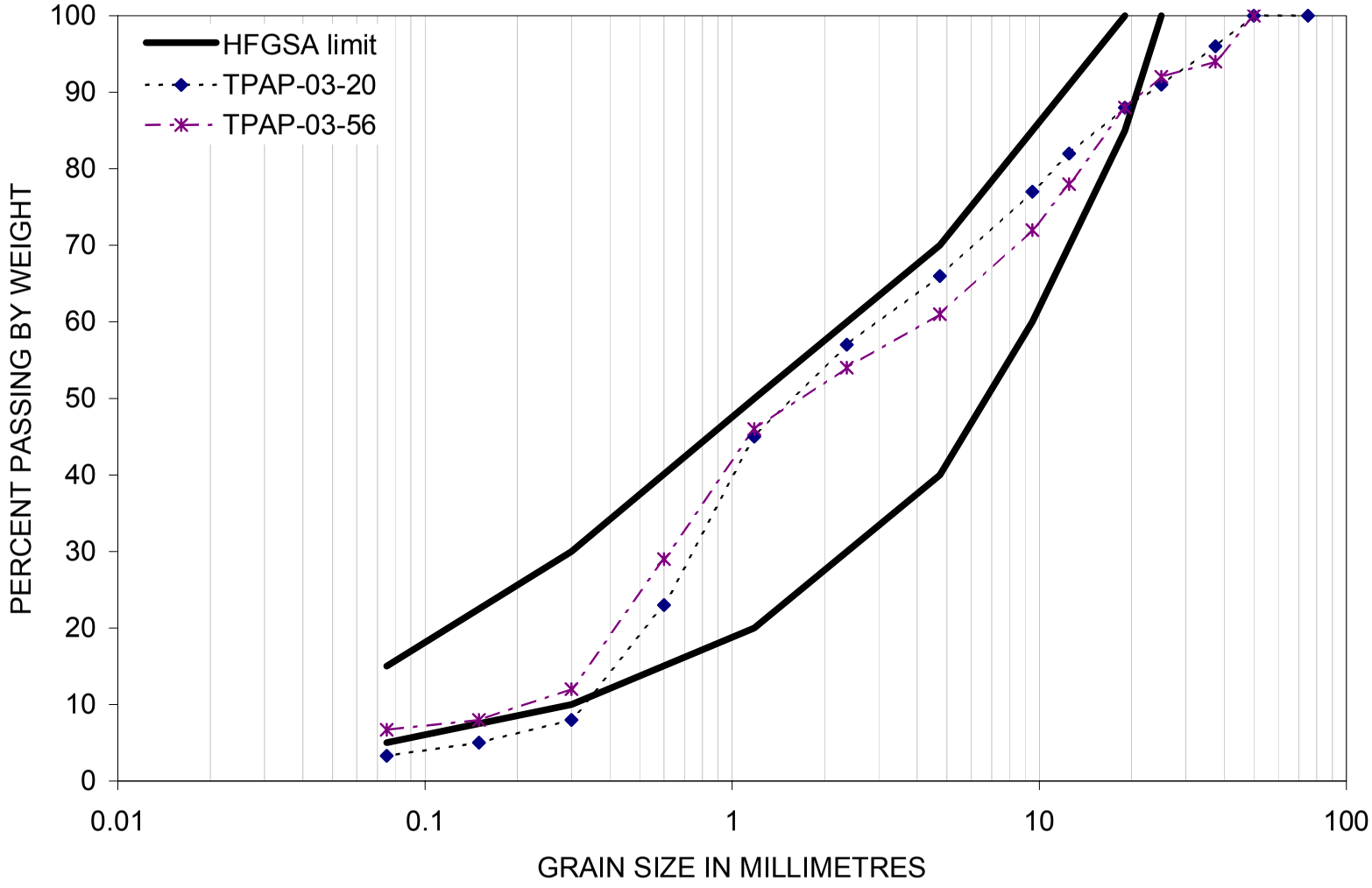


Figure 3c - Gradation curves against MoT table 202-C well graded base coarse aggregate (WGBCA) specifications

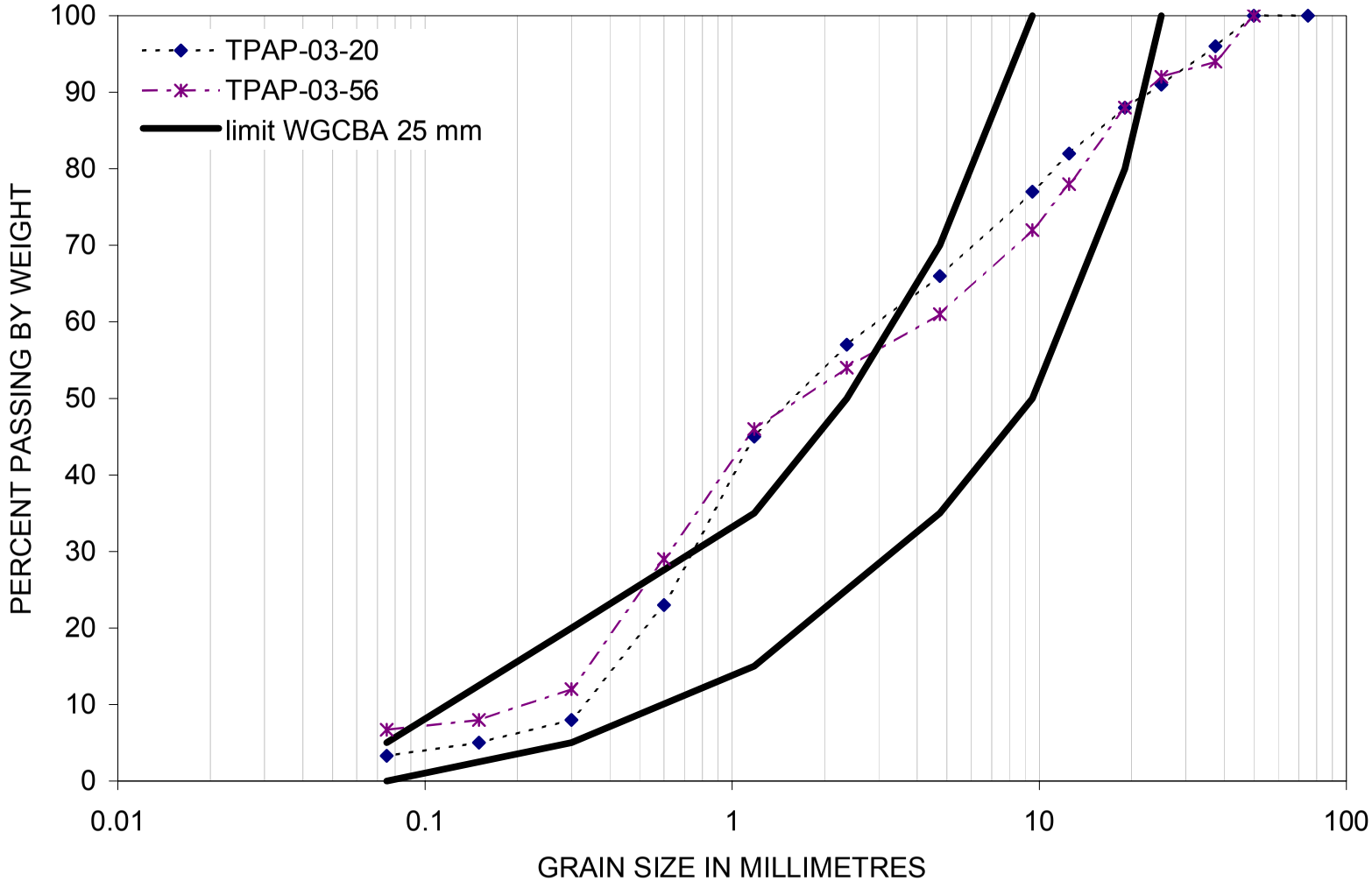
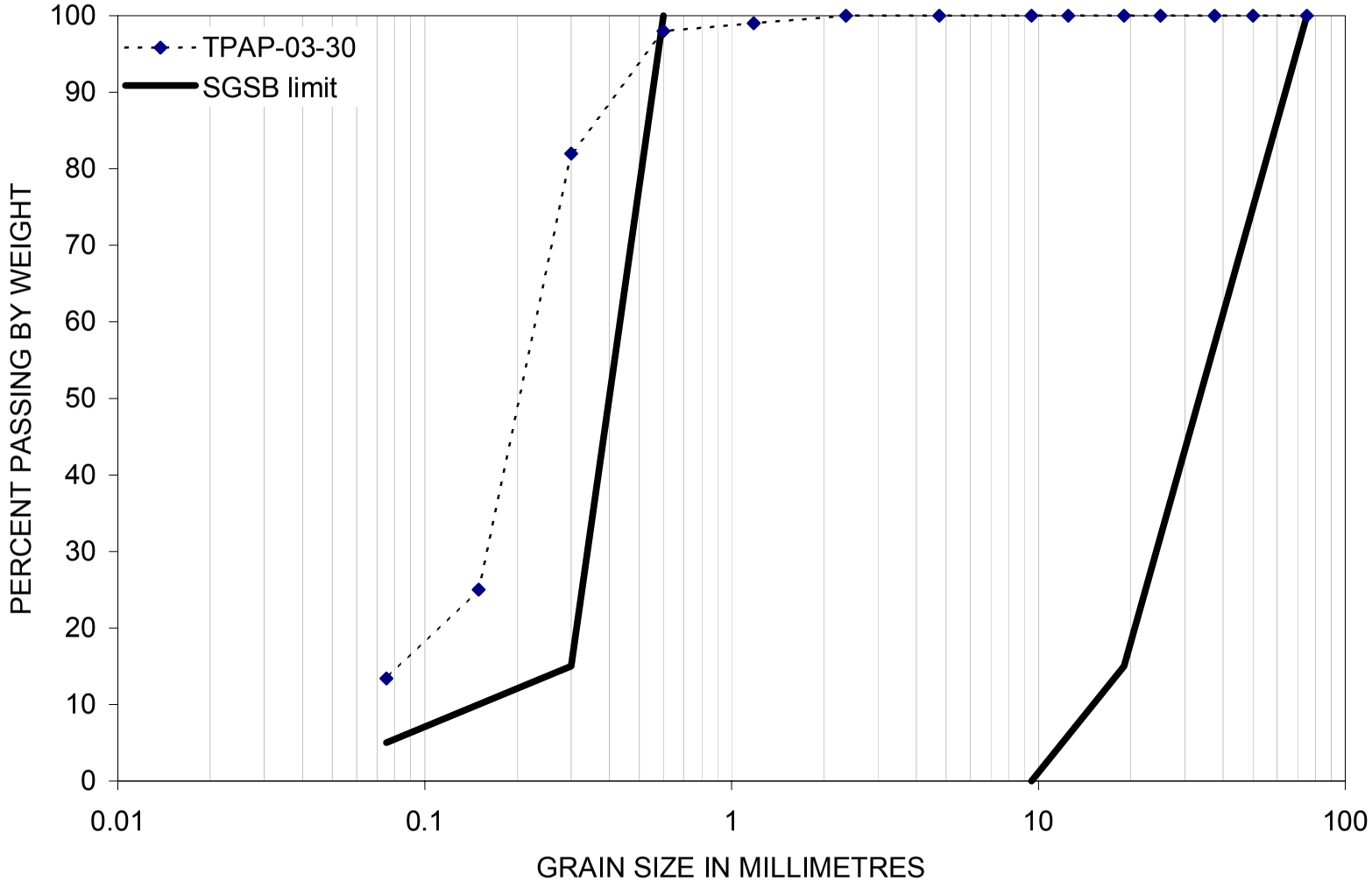


Figure 4 - Gradation curve againts MoT table 202-G select granular sub-base (SGSB) specifications



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TEST PIT NO. TPAP-03-01

Date	12 DEC 03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	30m off gate road towards north	
Area	SW end of property	**Weather**	Clear, -25 deg C		
Northing	6520285 **Easting** 521321			Start time: 8:00, finish: 8:54	
Elevation	373m	**Logged By**	TF	**Marked in Field:**	Flagging

Depth (m)		Material Type		Estimated Gradation (%)			Oversize	Max	Water Table
Top	Bottom	Description	MUSCS	Fines	Sand	Gravel	(%)	(cm)	(m)
0	0.2	soil							
0.2	1.5	zDmm	CL	70-80				15	
1.5	2.5	zcDmm	CL	60-70				20	
2.5	4	czDmm	CL	70-80				15	N/A

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TEST PIT NO. TPAP-03-03

Date	12-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	40 m off Dump Road towards west	
Area	West end of property (w. of road)	**Weather**	clear; -25 deg C		
Northing	6520078 **Easting** 521563			Start time: 9:05, finish: 10:10	
Elevation	404m	**Logged By**	TF	**Marked in Field:**	Flagging

Depth (m)		Material Type		Estimated Gradation (%)			Oversize	Max	Water Table
Top	Bottom	Description	MUSCS	Fines	Sand	Gravel	(%)	(cm)	(m)
0	0.3	soil							
0.3	0.8	szG	CL-GM	20	20	50	10	20	
0.8	4	czDmm	CL	80				15	N/A

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TEST PIT NO. TPAP-03-05

Date	12-Dec-03		**Excavator Type**	Kobelco SK220LC	**Location Notes**
Project	Airport Test Pitting		**Contractor**	Chan-Chas	west of dump clearing ~70m in bush; edge of conifer stand
Area	West end of property (w. of dump)		**Weather**	clear, -25 deg C	adjacent to aspen stand; land gently slopes toward 180deg.
Northing	6519796	**Easting** 521544			Start time: 10:25, finish 11:25
Elevation	412m		**Logged By**	TJ	**Marked in Field:** Flagging

Depth (m)		Material Type		Estimated Gradation (%)			Oversize	Max	Water Table
Top	Bottom	Description	MUSCS	Fines	Sand	Gravel	(%)	(cm)	(m)
0	0.3	soil							
0.3	0.6	z-fs	MH						
0.6	1.6	p-cG	GP	10	25	50	15	15	
1.6	3.5	zcDmm	CL	90					N/A

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TEST PIT NO. TPAP-03-08

Date	12-Dec-03		**Excavator Type**	Kobelco SK220LC	**Location Notes**
Project	Airport Test Pitting		**Contractor**	Chan-Chas	On old road surface next to valley edge; build birms run along t
Area	West end of property		**Weather**		edge of terrace
Northing	6519803	**Easting** 521546			Start time: 11:55, finish 12:35
Elevation	422m		**Logged By**	TJ	**Marked in Field:** Flagging

Depth (m)		Material Type		Estimated Gradation (%)			Oversize	Max	Water Table
Top	Bottom	Description	MUSCS	Fines	Sand	Gravel	(%)	(cm)	(m)
0	0.5	SG	GW				0	10	
0.5	2	zcDmm	CL					30	N/A

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TEST PIT NO. TPAP-03-09

Date	12-Dec-03		**Excavator Type**	Kobelco SK220LC	**Location Notes**
Project	Airport Test Pitting		**Contractor**	Chan-Chas	old road bed - junction of 2 old roads; birms nearby;
Area	NE of old dump		**Weather**		old sml. Pits nearby
Northing	6520241	**Easting** 521846			Start time: 12:35, finish 1:25
Elevation			**Logged By**	TJ	**Marked in Field:** Flagging

Depth (m)		Material Type		Estimated Gradation (%)			Oversize	Max	Water Table
Top	Bottom	Description	MUSCS	Fines	Sand	Gravel	(%)	(cm)	(m)
0	0.3	G	GW						
0.3	1	O							
1	1.5	zsG	GP						
1.5	2.3	pG	GP		15	80	5	20	
2.3	3.4	czDmm	CL	80					2.3

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TEST PIT NO. TPAP-03-11

Date	12-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	north of old track through trees; just west of old pit (?)	
Area	West end of property	**Weather**			
Northing	6520235 **Easting** 521988			Start time: 13:50, finish 14:55	
Elevation		**Logged By**	TF	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.2	soil							
0.2	2.75	m-csG	GM	10	20	60	10	15	2.5
2.75	3	zcDmm	CL	80-90				8	N/A

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TEST PIT NO. TPAP-03-12

Date	12-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas		
Area	West end of property	**Weather**			
Northing	6520316 **Easting** 522007				
Elevation	377m	**Logged By**	TF	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.4	soil							
0.4	2.5	csG	GM	10	20	60	10		2.5

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TEST PIT NO. TPAP-03-53

Date	12-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas		
Area	West end of property	**Weather**		N of TP-03-12	
Northing	6520386 **Easting** 522010	dark, clear, -25 deg C			
Elevation	387m	**Logged By**	TJ	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	1.75	cZ	ML	100			0		
1.75	2.25	zsG	GM	20	30	50	0	6	2.25
2.25	2.75	zcDmm	CL	90			0	5	

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TEST PIT NO. TPAP-03-10

Date	12-Dec-03		**Excavator Type**	Kobelco SK220LC	**Location Notes**
Project	Airport Test Pitting		**Contractor**	Chan-Chas	In stand of large spruce, in behind old gravel pit (?)
Area	West end of property		**Weather**		
Northing	6520298	**Easting** 521762	Thick cloud cover, -22 deg C		
Elevation	381m		**Logged By**	TF	**Marked in Field:** Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.4	soil and road fill							
0.4	2.5	szDmm	CL	70-80				18	N/A

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TEST PIT NO. TPAP-03-13

Date	13-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	Pit 20m off road to south	
Area	West end of property	**Weather**			
Northing	6520539 **Easting** 521873				
Elevation	378m	**Logged By**	TJ	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.5	soil							
0.5	1	zsG	GM	20	30	48	2	4	
1	2	zcDmm	CL					8	N/A

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TEST PIT NO. TPAP-03-15

Date	13-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	30 m off road to south	
Area	West end of property	**Weather**			
Northing	6520697 **Easting** 521921				
Elevation	383m	**Logged By**	TF	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.5	soil							
0.5	1	sG	GM	20	30	50	0	5	
1	1.5	sgDmm	CL	50				8	
1.5	2.5	zcDmm	Cl-CL	90+				2	N/A

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TEST PIT NO. TPAP-03-54

Date	13-Dec-03		**Excavator Type**	Kobelco SK220LC	**Location Notes**
Project	Airport Test Pitting		**Contractor**	Chan-Chas	to the southwest of cut line, ~40m
Area	Central portion of property		**Weather**		
Northing	6520675	**Easting** 522355	clear, sunny, cold		
Elevation	404m		**Logged By**	TF	**Marked in Field:** Flagging

Depth (m)		Material Type		Estimated Gradation (%)			Oversize	Max	Water Table
Top	Bottom	Description	MUSCS	Fines	Sand	Gravel	(%)	(cm)	(m)
0	0.2	soil							
0.2	2.2	sG	GM	5	55	38	2	8	1.75
2.2	2.75	fs-z	SM						

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TEST PIT NO. TPAP-03-20

Date	13-Dec-03		**Excavator Type**	Kobelco SK220LC	**Location Notes**
Project	Airport Test Pitting		**Contractor**	Chan-Chas	on esker-like ridge that runs ~perp. to main access road; no
Area	Central portion of property		**Weather**		beads found to north although grav. in blowdowns
Northing	6520800	**Easting** 522444			coordunates 0522521, 6520877; 0522453, 6520850
Elevation	413m		**Logged By**	TJ	**Marked in Field:** Flagging

Depth (m)		Material Type		Estimated Gradation (%)			Oversize	Max	Water Table
Top	Bottom	Description	MUSCS	Fines	Sand	Gravel	(%)	(cm)	(m)
0	0.1	soil							
0.1	4.5	sG	GM	2	38	60	5	8	~3.5m

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TEST PIT NO. TPAP-03-23

Date	13-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	In bush, off to the SW of main cut; along old road cut	
Area	Central portion of property	**Weather**			
Northing 6520398	**Easting** 522545	clear, sunny, cold			
Elevation	380m	**Logged By**	TF	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.15	soil							
15	0.45	zfS	SM						
0.45	2.75	czDmm	CL	60-70				25	N/A

BRITISH COLUMBIA

Ministry of Energy and Mines
Oil and Gas Division
Resource Development and Geosciences Branch

TEST PIT NO. TPAP-03-55

Date	13-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	at end of old road that runs NE from plane wreck	
Area	Central portion of property	**Weather**			
Northing 6520600	**Easting** 522695	dark, cold			
Elevation	401m	**Logged By**	TF	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.4	soil							
0.4	2	gcS	SP	15	75	10	0	4	1.5

BRITISH COLUMBIA

Ministry of Energy and Mines
Oil and Gas Division
Resource Development and Geosciences Branch

TEST PIT NO. TPAP-03-56

Date	13-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	just off "seismic" line;	
Area	Central portion of property	**Weather**		south flank of ridge	
Northing	6520700 **Easting** 522419				
Elevation	371m	**Logged By**	TJ	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	1.3	spG	GP	15	30	50	5	5	
1.3	2	czDmm					0	3	N/A

BRITISH COLUMBIA

Ministry of Energy and Mines
Oil and Gas Division
Resource Development and Geosciences Branch

TEST PIT NO. TPAP-03-32

Date	14-Dec-03		**Excavator Type**	Kobelco SK220LC	**Location Notes**
Project	Airport Test Pitting		**Contractor**	Chan-Chas	on high point of land; 400-500m west of sewage lagoons
Area	East end of property		**Weather**		
Northing	6520875	**Easting** 522972	clear, sunny, very cold (-30 deg C.)		
Elevation			**Logged By**	TF	**Marked in Field:** Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.15	soil							
0.15	4.75	fS	SW	10	90	0	0		N/A

BRITISH COLUMBIA

Ministry of Energy and Mines
Oil and Gas Division
Resource Development and Geosciences Branch

TEST PIT NO. TPAP-03-57

Date	14-Dec-03	**Excavator Type**	Kobelco SK220LC	**Location Notes**	
Project	Airport Test Pitting	**Contractor**	Chan-Chas	just off cut trail towards SE	
Area	East end of property	**Weather**			
Northing 6520998	**Easting** 523074	clear, very cold			
Elevation	421m	**Logged By**	TF	**Marked in Field:**	Flagging

Depth (m) Top	Depth (m) Bottom	Material Type Description	Material Type MUSCS	Estimated Gradation (%) Fines	Estimated Gradation (%) Sand	Estimated Gradation (%) Gravel	Oversize (%)	Max (cm)	Water Table (m)
0	0.25	soil							
0.25	2.25	fS	SP-GM	5	93	2	0	3	
2.25	2.5	czDmm	CL	60-70				8	N/A

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THURBER

SIEVE ANALYSIS REPORT

TO: **Mr. W. MacKenzie, P.Eng.**

ND LEA Consultants Ltd.
600 - 1455 W. Georgia Street
Vancouver, BC
V6G 2T3

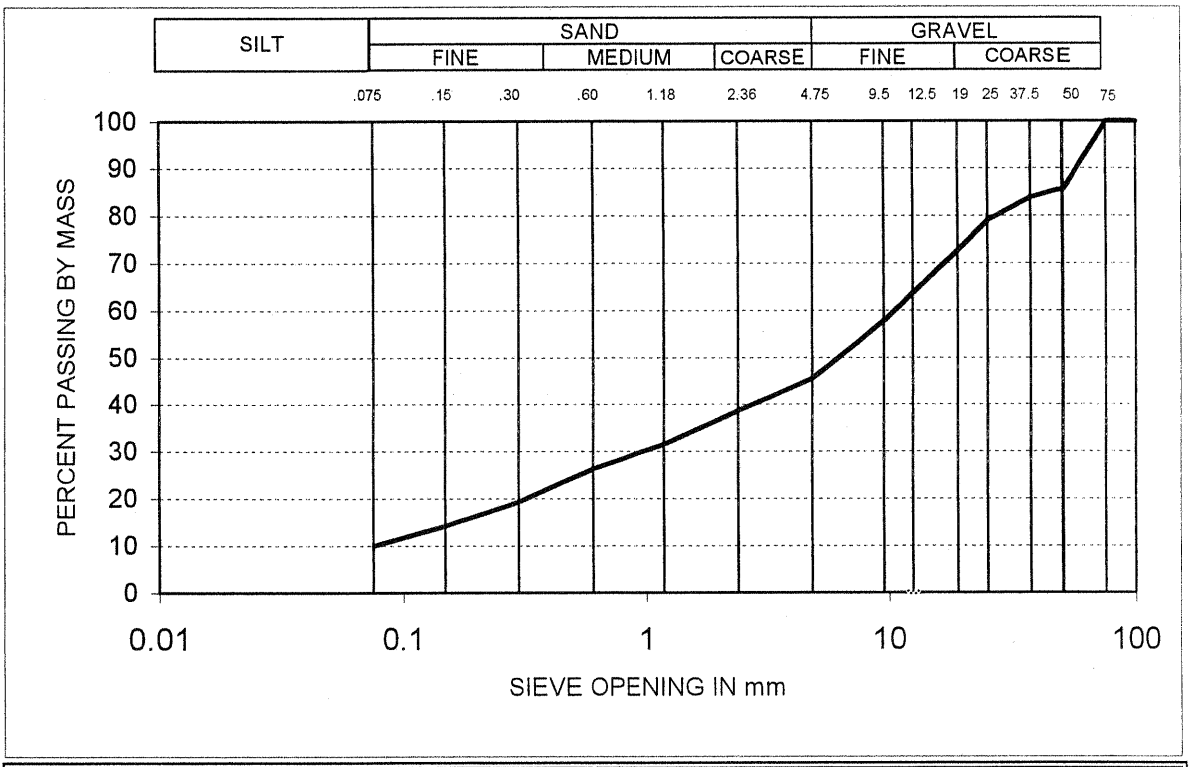
PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

			DATE	BY
IDENTIFICATION:	**TP AP 03-03**	SAMPLED:		
DESCRIPTION:	**Silty Sandy GRAVEL**	RECEIVED:	**23-Dec-03**	**BRE**
SAMPLE SOURCE:		TESTED:	**12-Jan-04**	**AGW**

TEST METHOD: **ASTM C 136, C 117**
REMARKS:



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**46**		
50.0	**86**			2.36	**39**		
37.5	**84**			1.18	**32**		
25.0	**79**			0.6	**26**		
19.0	**73**			0.3	**19**		
12.5	**64**			0.15	**14**		
9.5	**58**			0.075	**10.0**		

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PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

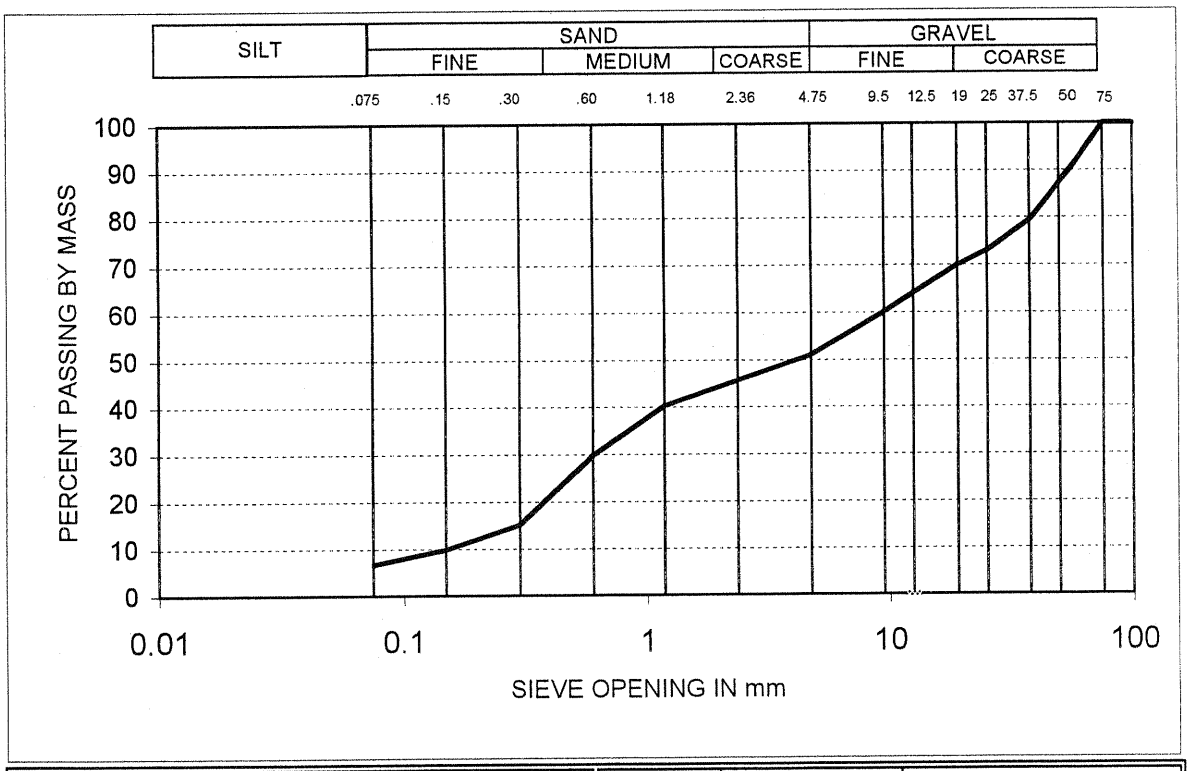
CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

IDENTIFICATION: **TP AP 03-05**
DESCRIPTION: **SI Silty SAND and GRAVEL**
SAMPLE SOURCE:

	DATE	BY
SAMPLED:		
RECEIVED:	**23-Dec-03**	**BRE**
TESTED:	**12-Jan-04**	**AGW**

TEST METHOD: **ASTM C 136, C 117**
REMARKS:



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**51**		
50.0	**87**			2.36	**46**		
37.5	**79**			1.18	**40**		
25.0	**73**			0.6	**30**		
19.0	**70**			0.3	**15**		
12.5	**64**			0.15	**10**		
9.5	**60**			0.075	**6.7**		

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PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

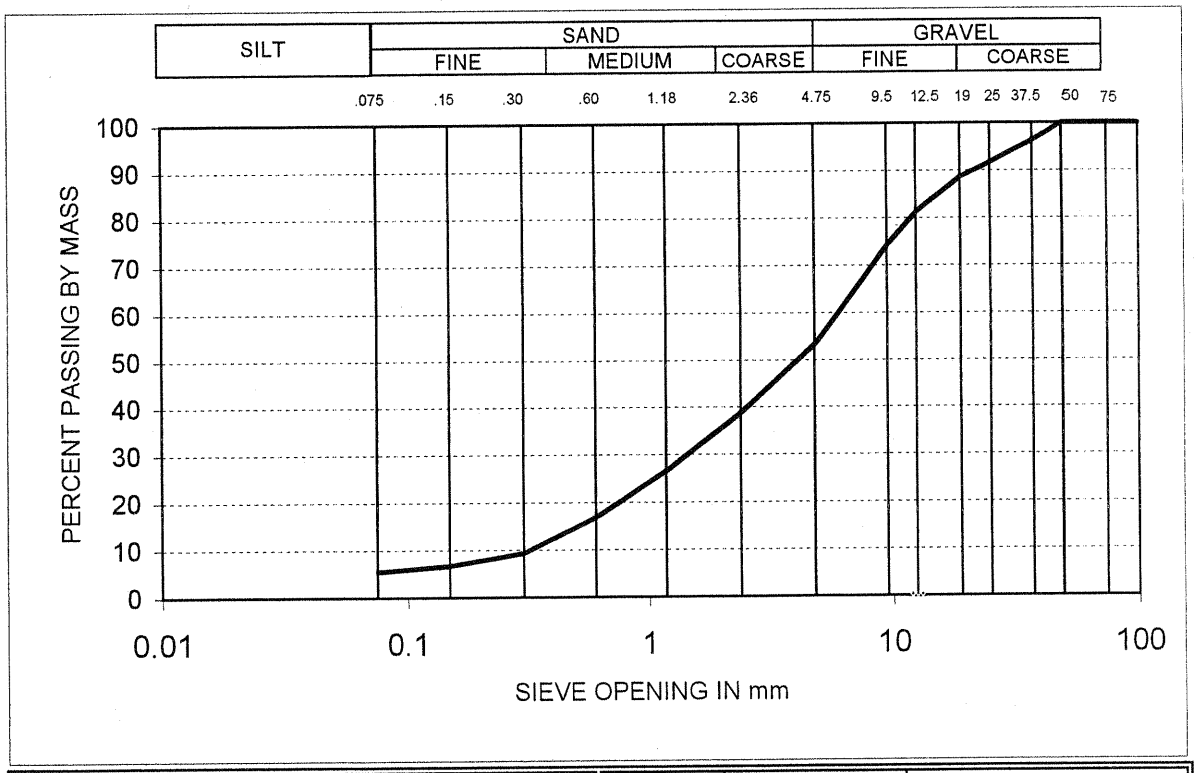
CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

IDENTIFICATION: **TP AP 03-09**
DESCRIPTION: **SI Silty GRAVEL and SAND**
SAMPLE SOURCE:

	DATE	BY
SAMPLED:		
RECEIVED:	**23-Dec-03**	**BRE**
TESTED:	**12-Jan-04**	**AGW**

TEST METHOD: **ASTM C 136, C 117**
REMARKS:



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**53**		
50.0	**100**			2.36	**39**		
37.5	**96**			1.18	**27**		
25.0	**92**			0.6	**17**		
19.0	**89**			0.3	**9**		
12.5	**81**			0.15	**7**		
9.5	**74**			0.075	**5.5**		

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PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

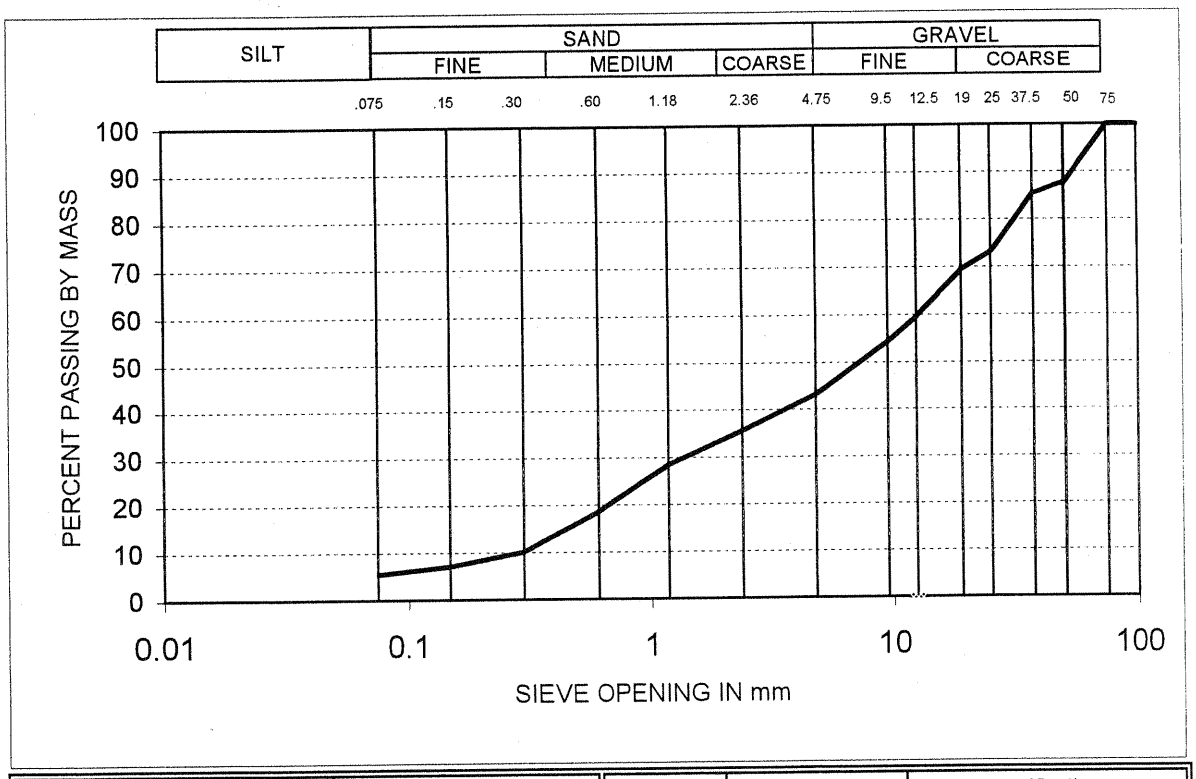
CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

IDENTIFICATION: **TP AP 03-11**
DESCRIPTION: **SI Silty Sandy GRAVEL**
SAMPLE SOURCE:

	DATE	BY
SAMPLED:		
RECEIVED:	**23-Dec-03**	**BRE**
TESTED:	**12-Jan-04**	**AGW**

TEST METHOD: **ASTM C 136, C 117**
REMARKS: **ASTM D 2419 Sand Equivalent value = 42**
BC MoT Degradation Factor = 58



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**43**		
50.0	**88**			2.36	**36**		
37.5	**85**			1.18	**29**		
25.0	**73**			0.6	**19**		
19.0	**69**			0.3	**10**		
12.5	**59**			0.15	**7**		
9.5	**54**			0.075	**5.5**		

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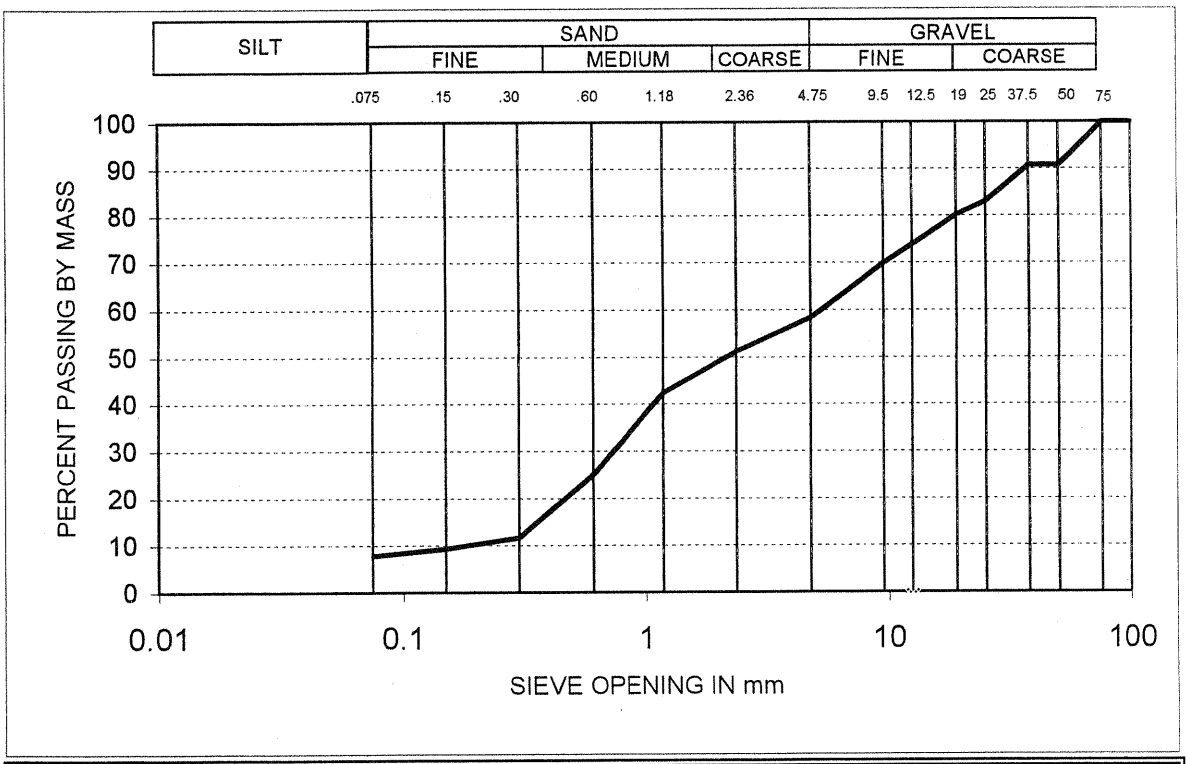
PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

			DATE	BY
IDENTIFICATION:	**TP AP 03-12**	SAMPLED:		
DESCRIPTION:	**SI Silty Gravelly SAND**	RECEIVED:	**23-Dec-03**	**BRE**
SAMPLE SOURCE:		TESTED:	**12-Jan-04**	**AGW**

TEST METHOD: **ASTM C 136, C 117**
REMARKS: **Clay lumps and wood debris in sample**



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**58**		
50.0	**91**			2.36	**51**		
37.5	**91**			1.18	**42**		
25.0	**83**			0.6	**25**		
19.0	**80**			0.3	**12**		
12.5	**74**			0.15	**9**		
9.5	**70**			0.075	**7.8**		

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PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

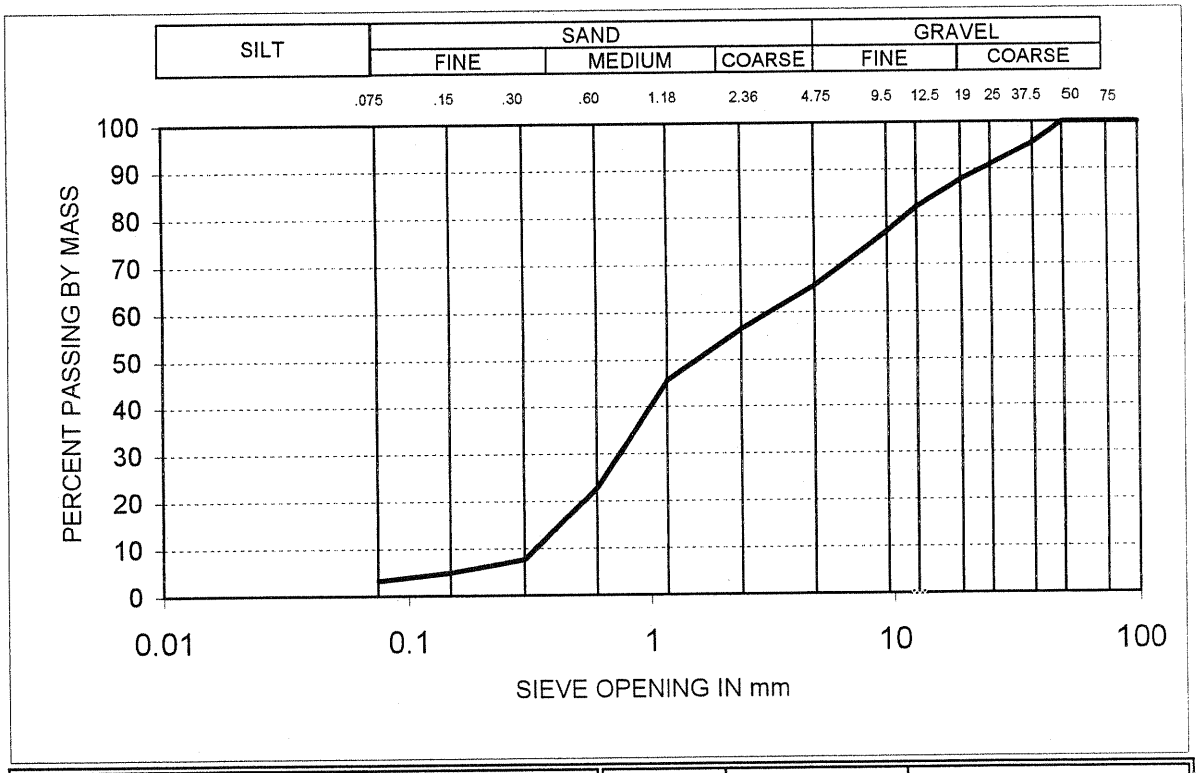
CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

IDENTIFICATION: **TP AP 03-20**
DESCRIPTION: **Gravelly SAND**
SAMPLE SOURCE:

	DATE	BY
SAMPLED:		
RECEIVED:	**23-Dec-03**	**BRE**
TESTED:	**12-Jan-04**	**SMG**

TEST METHOD: **ASTM C 136, C 117**
REMARKS: **ASTM D 2419 Sand Equivalent Value = 70**
BC MoT Degradation Factor = 59



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**66**		
50.0	**100**			2.36	**57**		
37.5	**96**			1.18	**45**		
25.0	**91**			0.6	**23**		
19.0	**88**			0.3	**8**		
12.5	**82**			0.15	**5**		
9.5	**77**			0.075	**3.3**		

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PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

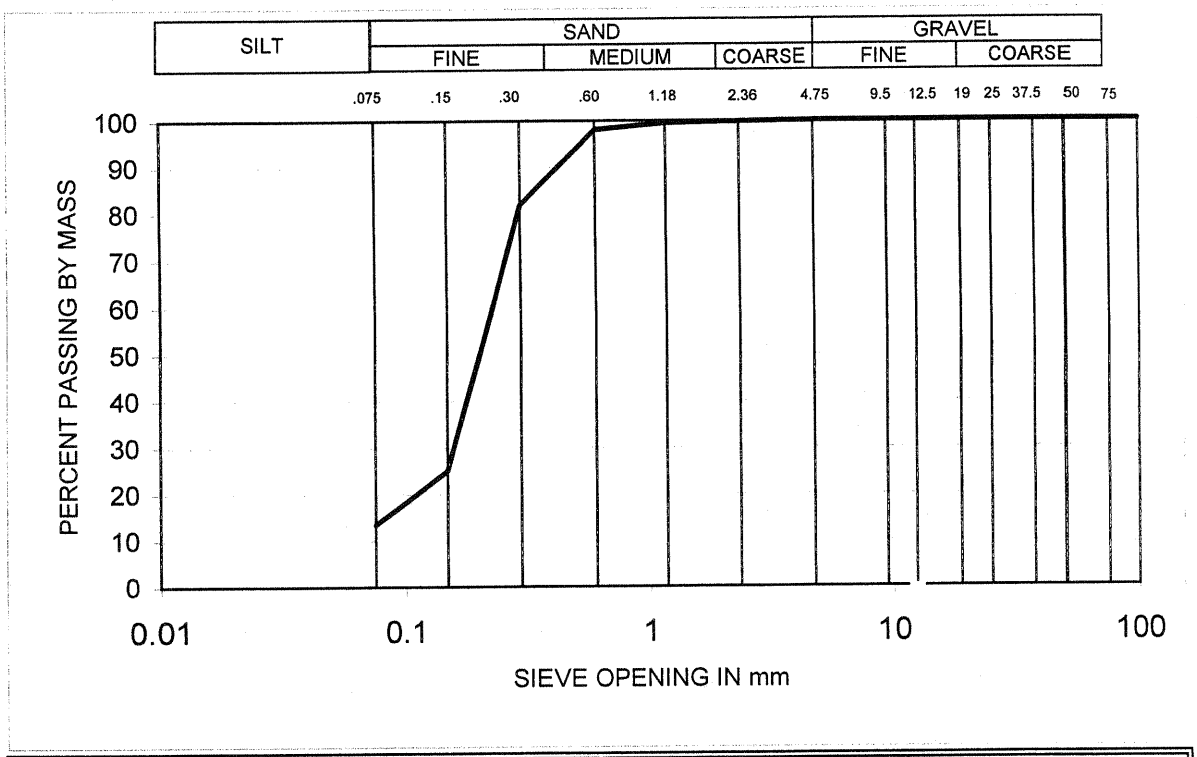
CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

IDENTIFICATION: **TP AP 03-32**
DESCRIPTION: **Silty SAND**
SAMPLE SOURCE:

	DATE	BY
SAMPLED:		
RECEIVED:	**23-Dec-03**	**BRE**
TESTED:	**9-Jan-04**	**DAS**

TEST METHOD: **ASTM C 136, C 117**
REMARKS:



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**100**		
50.0	**100**			2.36	**100**		
37.5	**100**			1.18	**99**		
25.0	**100**			0.6	**98**		
19.0	**100**			0.3	**82**		
12.5	**100**			0.15	**25**		
9.5	**100**			0.075	**13.4**		

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V6G 2T3

PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

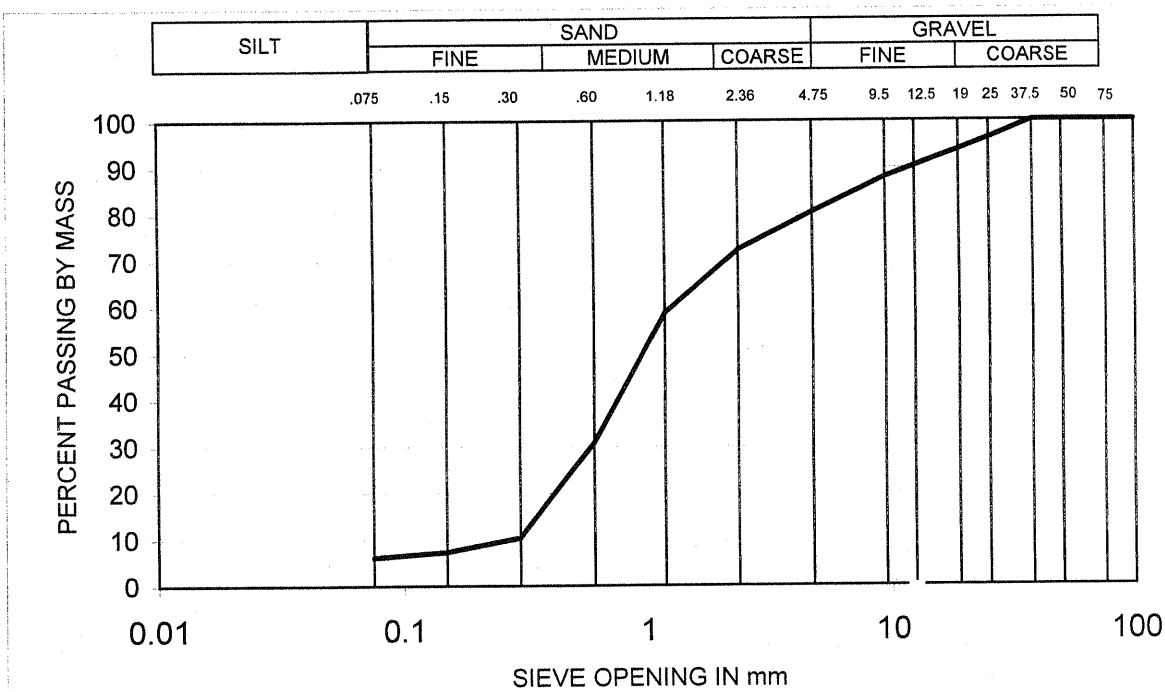
CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

IDENTIFICATION: **TP AP 03-53**
DESCRIPTION: **SI Silty Gravelly SAND**
SAMPLE SOURCE:

	DATE	BY
SAMPLED:		
RECEIVED:	**23-Dec-03**	**BRE**
TESTED:	**13-Jan-04**	**SMG**

TEST METHOD: **ASTM C 136, C 117**
REMARKS:



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**80**		
50.0	**100**			2.36	**72**		
37.5	**100**			1.18	**59**		
25.0	**96**			0.6	**31**		
19.0	**94**			0.3	**10**		
12.5	**90**			0.15	**7**		
9.5	**88**			0.075	**6.1**		

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PROJECT No. **17-604-143**
REPORT DATE: **16-Jan-04**

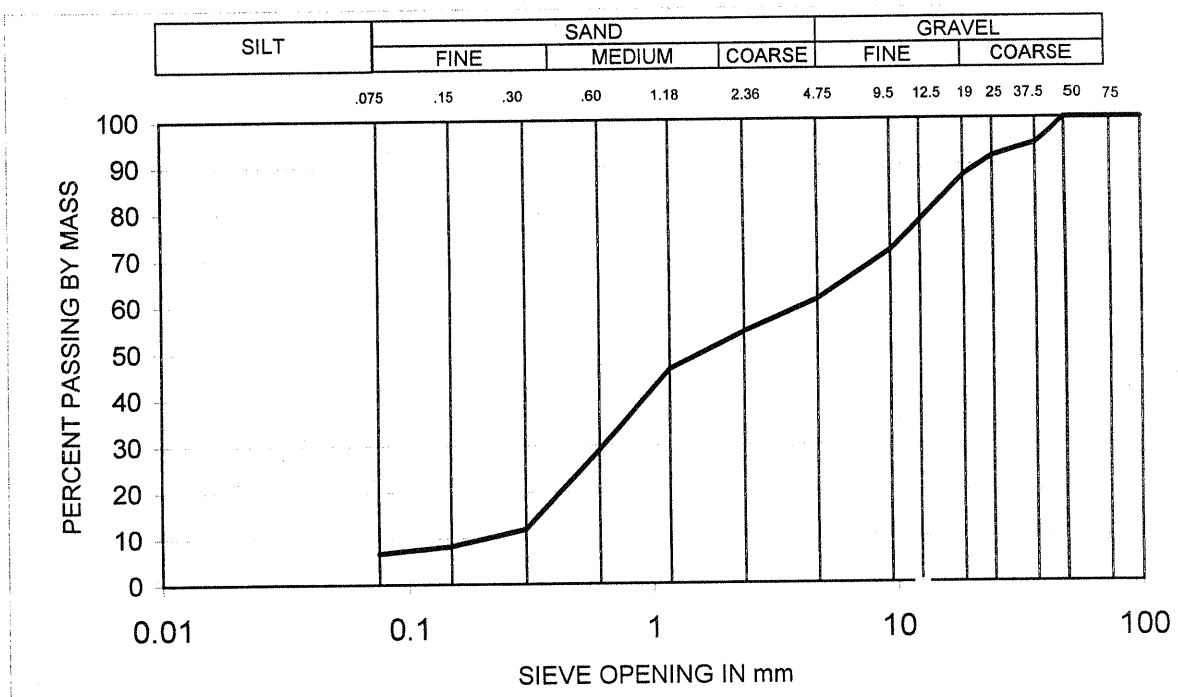
CC: **Mr. Travis Ferby**
Ministry of Energy & Mines

PROJECT: **SIERRA YOYO DESAN ROAD**

IDENTIFICATION: **TP AP 03-56**
DESCRIPTION: **SI Silty Gravelly SAND**
SAMPLE SOURCE:

	DATE	BY
SAMPLED:		
RECEIVED:	**23-Dec-03**	**BRE**
TESTED:	**13-Jan-04**	**SMG**

TEST METHOD: **ASTM C 136, C 117**
REMARKS:



Sieve Size mm	% Passing	Specifications Upper	Specifications Lower	Sieve Size mm	% Passing	Specifications Upper	Specifications Lower
75.0	**100**			4.75	**61**		
50.0	**100**			2.36	**54**		
37.5	**94**			1.18	**46**		
25.0	**92**			0.6	**29**		
19.0	**88**			0.3	**12**		
12.5	**78**			0.15	**8**		
9.5	**72**			0.075	**6.7**		