Asphalt Aggregate Resource Assessment
Technical Summary
Jasper National Park, Alberta

Parks Canada Agency
Highway Service Centre
Banff National Park Compound
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McElhanney

Executive Summary

McElhanney Consulting Services Ltd. (MCSL) was commissioned by Parks Canada Agency (PCA) to conduct a test pit program in existing borrow pits and in areas of potential interest to assess aggregate resource volume and suitability for asphalt aggregate for future paving projects on Hwy 93N and Hwy 16 within the Jasper and Banff National Parks. The objectives of this technical summary was to:

1. Present the results of the test pitting assessments completed for five previous borrow pits as summarized in Table I below:

Table I: Summary of Gravel Pits Assessed

Pit Name	Location	National Park	Number of Test Pits	Number of Samples
Ranger	Hwy 93N, 48.0 km from Hwy 16 intersection	Jasper	10	3
Kerkeslin	Highway 93N, 33.2 km from Hwy 16 intersection	Jasper	6	2
8 Mile	Hwy 93N, 12.4 km from Hwy 16 intersection	Jasper	7	3
Roche Miette	Highway 16, 41.4 km SW of Hwy 93N intersection	Jasper	3	0
Pit 11 (David Thompson)	Hwy 11, 3.2 km from Hwy 93N intersection	Banff	6	4

2. Complete laboratory testing on samples collected during the field program, consisting of gradation analysis, relative density of coarse and fine aggregate, and micro-deval testing;

3. Identify which borrow pits appear to be suitable to produce asphalt aggregate (16 and 19 mm) and well graded base (25 and 50 mm) as per BC Ministry of Transportation and Infrastructure (BC MoTI) 2012 Specifications.

Material Durability

Table II shows the results of the laboratory durability testing completed on the samples collected during the field program as well as the specifications as required per Section 202 (Granular Surfacing, Base and Sub-Bases) and Section 502 (Asphalt Pavement Construction) of the BC MoTI's 2012 Standard Specification of Highway Construction.

Table II. Durability Test Results

Pit Name	Test Pit No.	Sample Number	Micro-Deval, % (Coarse)	Absorption, %		Bulk Relative Density	
				Coarse	Fine	Coarse	Fine
Ranger	TP14-03	1	7.2	0.56	1.48	2.66	2.60
	TP14-06	3	7.3	0.64	1.60	2.66	2.60
Kerkeslin	TP14-05	4	5.5	0.57	2.65	2.65	2.52
	TP14-06	5	5.6	0.45	1.54	2.66	2.58
8 Mile	TH14-05	7	4.3	0.40	1.07	2.67	2.62
	TH14-07	8	4.8	0.50	1.61	2.70	2.59
Pit 11	TP14-03	10	7.0	0.54	2.44	2.74	2.59
	TP14-05	12	5.6	0.75	2.50	2.58	2.71

Test	**BC MoT Specifications[1]**
Micro Deval	≤30 for select granular sub-base (coarse) and bridge end fill aggregates ≤25 for surfacing and base course aggregates ≤20 for Class 2 pavement asphalt mix aggregates ≤18 for Class 1 pavement asphalt mix aggregates
Absorption	≤ 2% for coarse paving aggregates ≤ 1% for coarse graded aggregate seals ≤ 1.5% for fine graded aggregate seals
Relative Density	~2.65 for all aggregate products

Note: Testing was completed on pit run minus 75 mm (unprocessed) samples not crushed product.

Material Gradation Suitability

Based on the 2014 assessment results, the suitability of materials based on gradation analysis for the five pits are provide in Table III:

Table III. Material Suitability for Asphalt Aggregate

Pit	Medium Mix Asphalt (MMA)		Well Graded Base (WGB)	
	19 mm	16 mm	50 mm	25 mm
Ranger	Yes	Yes	Yes however crushing with oversize fraction (>75 mm) would be required to produce.	Yes
Kerkeslin	Yes however screening of fine to medium sand may be required.	Yes however screening of fine to medium sand may be required.	Does not appear to be enough oversize to produce 50 mm WGB without adding additional material over 50 mm.	Crushing and screening of medium to fine sands would be required to produce.

[1] Ministry of Transportation, 2012 Standard Specifications for Highway Construction, Adopted November 1, 2011

Pit	Medium Mix Asphalt (MMA)		Well Graded Base (WGB)	
	19 mm	16 mm	50 mm	25 mm
8 Mile	Yes	Yes	Yes however crushing with oversize fraction (>75 mm) would be required to produce.	Yes
Roche Miette	No too high in fines.	No too high in fines.	No too high in fines.	No too high in fines.
Pit 11 (David Thompson Pit)	Yes however would have to avoid area of pit with clay coating on rocks.	Yes however would have to avoid area of pit with clay coating on rocks.	Does not appear to be enough oversize to produce 50 mm WGB without adding additional material over 50 mm.	Yes

Conclusions

The volume estimates (pit run) and pit suitability are summarized in Table IV.

Table IV. Summary of Gravel Volumes and Suitability

Pit	Area	Estimated Gravel Volume (m^3)	Estimated Crushed Volume after Waste[3] (m^3)	Suitability
Ranger	Existing Pit Floor	24,000[1]	17,000	Met MoTI specifications for WGB and asphalt paving aggregates. Appears suitable to produce 25 and 50 mm WGB (with inclusion of oversize) and 16 and 19 mm MMA.
	North Slope Area	120,000	86,000	
Kerkeslin Pit	South Area	70,000[2]	50,000	Met the specifications for mirco-deval and course absorption; however, one sample was marginal for fine absorption with a result exceeding the specification by 0.65% for paving aggregate. Appears suitable to produce 25 mm WGB and 16 and 19 mm MMA; however limited in the percentage of oversize material to produce 50 mm WGB.
	North Area	30,000[2]	21,000	

Pit	Area	Estimated Gravel Volume (m^3)	Estimated Crushed Volume after Waste[3] (m^3)	Suitability
8 Mile Pit	Existing Pit Floor	60,000	43,000	Met MoTI specifications for WGB and asphalt paving aggregates. Appears suitable to produce 25 and 50 mm WGB (with inclusion of oversize) and 16 and 19 mm medium mix aggregate.
	West Area	210,000[2]	150,000	
Roche Miette	Existing Pit Floor	NE	NE	No suitable granular material was encountered in the test pits.
Pit 11 (David Thompson Pit)	North Slope Area	15,000	11,000	Met the specifications for mirco-deval and course absorption; however, both samples were marginal for fine absorption with results exceeding the specification by 0.4 to 0.5% for paving aggregate. Appears suitable to produce 25 mm WGB and 16 and 19 mm MMA; however limited in the percentage of oversize material to produce 50 mm WGB.
	West Area	65,000[2]	46,000	

Notes:
[1] Volume based on average granular thickness encountered above water table.
[2] Additional investigation required to confirm volume.
[3] Crushed volumes include a waste factor is 40% based on historical trends.
NE=Not Encountered

Recommendations

Based on the test pitting assessments and laboratory testing completed the following recommendations for borrow pit development are provided:

1. Re-establish Ranger Pit and 8 Mile Pit as there appears to be some volume of materials in the existing pit floors. Pit 11 (David Thompson Pit) would also be recommended for development as some material appears to be available to intermediate processing in the North Slope Area.

2. Additional assessment of North Slope Area of Ranger Pit, East Area of 8 Mile Pit and North Slope Area of Pit 11 (David Thompson Pit). Additional investigation would require disturbance of existing vegetation and treed areas and permits would be required for assessment.

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1 INTRODUCTION

McElhanney Consulting Services Ltd. (MCSL) is pleased to submit this technical summary report detailing the preliminary asphalt aggregate resource assessment conducted in various borrow pits for the Parks Canada Agency (PCA). The purpose of the assessment was to conduct a test pit program in the existing borrow pits and in areas of potential interest to assess aggregate resource volume and suitability for asphalt aggregate for future paving projects on Hwy 93N and Hwy 16 within the Jasper and Banff National Parks.

2 SCOPE OF WORK

The scope of work was to access the pits for potential to produce paving aggregate and well graded base for future paving projects. The scope of work was as follows:

- Complete a test pit assessment in the pit identified by PCA;
- Survey of the existing pit areas;
- Complete laboratory testing on samples collected during the field program, consisting of gradation analysis, relative density of coarse and fine aggregate, and micro-deval testing;
- Preparation of this technical summary detailing the results of the test pit assessment and laboratory testing and recommendations for the suitability of the material encountered for production of well graded base (WGB) and medium mix asphalt (MMA) aggregates.

3 FIELD ASSESSMENT

The field test pitting program was conducted by MCSL on November 13 to 14, 2014. Five existing pits where assessed for asphalt aggregate potential. Test pits where excavated in existing pit floors and in pit slopes within previously cleared areas in order to not disturb natural vegetation.

The pits assessed are summarized in Table 2.1. Four of the pits where located within the Jasper National Park and one in Banff National Park.

Table 2.1. Summary of Gravel Pits Assessed

Pit Name	Location	National Park	Number of Test Pits	Number of Samples
Ranger	Hwy 93N, 48.0 km from Hwy 16 intersection	Jasper	10	3
Kerkeslin	Highway 93N, 33.2 km from Hwy 16 intersection	Jasper	6	2
8 Mile	Hwy 93N, 12.4 km from Hwy 16 intersection	Jasper	7	3
Roche Miette	Highway 16, 41.4 km SW of Hwy 93N intersection	Jasper	3	0
Pit 11 (David Thompson)	Hwy 11, 3.2 km from Hwy 93N intersection	Banff	6	4

The test pits were logged and sampled by MCSL's geotechnical engineer, Shiloh Carlson, PEng. Test Pit Summary Logs and laboratory test results for the five sites are appended in the appendices, Table 2.2 shows which pit is associated with each Appendix.

Table 2.2. Appendix Listing

Pit Name	Appendix
Ranger Pit	A
Kerkeslin Pit	B
8 Mile Pit	C
Roche Miette Pit	D
Pit 11 (David Thompson Pit)	E

Soils were described according to the MoT Unified Soil Classification (USC) Legend attached in Appendix F.

Test pit locations and prominent features such as natural embankments, slope breaks, depressions and/or draws, roads and other manmade features were survey by MCSL and are shown on the appended site plans.

Photographs were taken at each test pit location. Select photographs are shown in the attached Photo Sheets.

4 LABORATORY TESTING

Samples obtained during the assessment where submitted for laboratory testing to assess if the materials in the pits are suitable for asphalt aggregate production. The following laboratory tests were performed:

- Wash Sieve Analysis (ASTM C136 and C117) on 12 samples;
- Micro Deval on Coarse Aggregates (ASTM D6928-03) on 8 samples;

- Relative Density and Absorption of Coarse and Fine Aggregate (ASTM C127 and C128) on 8 samples.

Laboratory reports for the individual samples are appended and summarized in the Test Pit Summary Logs. Note that sieve analyses were conducted on material passing the 75 mm screen only. The percentage and size of oversize material was visually estimated in the field and are listed in the test pit summary log.

5 MATERIAL GRADATIONS

Table 5.1 shows the gradation test results as a percentage by weight of the fines (silts and clays), sand and gravel components. The USC classification for each of the laboratory tested samples are also listed.

Table 5.3. Laboratory Gradations

Test Pit	Depth (m)		Fines (%)	Sand (%)	Gravel (%)		USC
	From	To			Fine (4.75-25mm)	Coarse (25-75mm)	
Ranger Pit							
TP14-03	1.0	5.0	2	33	42	23	GW
TP14-04	0.4	5.0	2	30	38	30	GW
TP14-06	0	4.2	2	19	49	30	GW
Average – Ranger Pit			***2***	***27***	***43***	***28***	-
Kerkeslin Pit							
TP14-05	1.5	4.0	5	48	31	16	SP-SM
TP14-06	0	3.0	2	49	22	27	GP
Average – Kerkeslin Pit			***3***	***49***	***26***	***22***	-
8 Mile Pit							
TP14-01	2.5	3.6	1	33	35	31	GP
TP14-05	0.1	3.5	1	36	21	42	GP
TP14-07	2.6	4.0	1	29	26	44	GW
Average – 8 Mile Pit			***1***	***33***	***27***	***39***	-
Pit 11 (David Thompson Pit)							
TP14-02	0.2	4.0	7	27	48	18	GW-GM
TP14-03	0	4.0	3	26	53	18	GP
TP14-04	0.6	3.0	4	30	14	52	GW
TP14-05	0	4.5	6	27	45	22	GW-GM
Average – Pit 11			***5***	***28***	***40***	***27***	-

A summary of the gradations corrected to include the field estimated oversize are provided in Table 5.2.

Table 5.4. Summary of Gradations Including Oversize Material

Test Pit	Fines (%)	Sand (%)	Gravel (%)		Estimated Oversize (%)		Max Diameter (mm)
			Fine (4.75-25mm)	Coarse (25-75mm)	Cobbles (75-300mm)	Boulders (>300 mm)	
Ranger Pit							
TP14-03	1	26	33	17	20	3	400
TP14-04	1	24	30	24	20	2	400
TP14-06	2	14	38	24	20	2	350
Average	***1***	***21***	***34***	***22***	***20***	***2***	-
Kerkeslin Pit							
TP14-05	5	46	30	16	3	-	100
TP14-06	2	48	22	26	2	-	100
Average	***4***	***47***	***26***	***21***	***2***	**-**	**-**
8 Mile Pit							
TP14-01	1	23	24	22	30	-	300
TP14-05	1	25	14	28	30	2	350
TP14-07	1	22	20	33	25	-	350
Average	***1***	***23***	***19***	***28***	***28***	**1**	**-**
Pit 11 (David Thompson Pit)							
TP14-02	7	25	45	16	7	-	300
TP14-03	3	25	51	17	4	-	200
TP14-04	4	28	49	13	6	-	200
TP14-05	6	24	41	20	9	-	200
Average	***5***	***26***	***47***	***16***	***6***	**-**	**-**

6 MATERIAL DURABILITY

Table 6.1 shows the results of the durability tests as well as the specifications as required per Section 202 (Granular Surfacing, Base and Sub-Bases) and Section 502 (Asphalt Pavement Construction) of the British Columbia Ministry of Transportation and Infrastructure (BC MoTI) 2012 Standard Specification of Highway Construction.

Table 6.5. Durability Test Results

Pit Name	Test Pit No.	Sample Number	Micro-Deval, % (Coarse)	Absorption, %		Bulk Relative Density	
				Coarse	Fine	Coarse	Fine
Ranger	TP14-03	1	7.2	0.56	1.48	2.66	2.60
	TP14-06	3	7.3	0.64	1.60	2.66	2.60
Kerkeslin	TP14-05	4	5.5	0.57	2.65	2.65	2.52
	TP14-06	5	5.6	0.45	1.54	2.66	2.58
8 Mile	TH14-05	7	4.3	0.40	1.07	2.67	2.62
	TH14-07	8	4.8	0.50	1.61	2.70	2.59
Pit 11	TP14-03	10	7.0	0.54	2.44	2.74	2.59
	TP14-05	12	5.6	0.75	2.50	2.58	2.71

Test	**BC MoT Specifications[2]**
Micro Deval	≤30 for select granular sub-base (coarse) and bridge end fill aggregates ≤25 for surfacing and base course aggregates ≤20 for Class 2 pavement asphalt mix aggregates ≤18 for Class 1 pavement asphalt mix aggregates
Absorption	≤ 2% for coarse paving aggregates ≤ 1% for coarse graded aggregate seals ≤ 1.5% for fine graded aggregate seals
Relative Density	~2.65 for all aggregate products

Note: Testing was completed on pit run (unprocessed) samples not crushed product.

7 MATERIAL SUITABILITY

It is understood that PCA required medium mix asphalt (MMA) aggregate (16 and 19 mm) and well graded base (25 mm and 50 mm) for future paving projects. Material will be produced as per the BC MoTI 2012 Specifications. Based on the 2014 assessment results, the suitability of materials based on gradation analysis for the five pits are provide in Table 7.1.

[2] Ministry of Transportation, 2012 Standard Specifications for Highway Construction, Adopted November 1, 2011

Table 7.6. Material Suitability for MMA and WGB Aggregate

Pit	Medium Mix Asphalt		WGB	
	19 mm	16 mm	50 mm	25 mm
Ranger	Yes	Yes	Yes however crushing with oversize fraction (>75 mm) would be required to produce.	Yes
Kerkeslin	Yes however screening of fine to medium sand may be required.	Yes however screening of fine to medium sand may be required.	Does not appear to be enough oversize to produce 50 mm WGB without adding additional material over 50 mm.	Crushing and screening of medium to fine sands would be required to produce.
8 Mile	Yes	Yes	Yes however crushing with oversize fraction (>75 mm) would be required to produce.	Yes
Roche Miette	No too high in fines.	No too high in fines.	No too high in fines.	No too high in fines.
Pit 11 (David Thompson Pit)	Yes however would have to avoid area of pit with clay coating on rocks.	Yes however would have to avoid area of pit with clay coating on rocks.	Does not appear to be enough oversize to produce 50 mm WGB without adding additional material over 50 mm.	Yes

The results of the samples from Ranger Pit meet the durability specifications for WGB and paving aggregate. Ranger Pit contained a significant proportion of oversize material and including this material in the crushing process may improve the gradations for WGB and paving aggregate and also the durability of the crushed products.

The results of the samples from Kerkeslin Pit meet the specifications for mirco-deval and course absorption; however, was marginal for the sample tested from TP14-05 for fine absorption with a result of 2.65% exceeding the specification of 2% for paving aggregate. The gradations including the oversize material appears to be suitable to produce 16 and 19 mm MMA and 25 mm WGB; however, limited in the percentage of oversize material to produce 50 mm WGB.

The results of the samples from 8 Mile Pit meet the durability specifications for WGB and paving aggregate. Similar to Ranger Pit, 8 Mile Pit contained a significant proportion of oversize material and including this material in the crushing process may improve the gradations for WGB and paving aggregate and also the durability of the crushed products.

The results of the samples from Pit 11 (David Thompson Pit) tested meet the specifications for mirco-deval and course absorption; however, both samples were marginal for fine absorption with results of 2.44 and 2.50% exceeding the specification of 2% for paving aggregate. The gradations including the oversize material appears to be suitable to produce 16 and 19 mm MMA and 25 mm WGB; however limited in the percentage of oversize material to produce 50 mm WGB. Some areas tested partially in the existing pit floor the gravel and cobbles appeared to have a clay coating. Material with the clay coating will likely by unsuitable to produce paving aggregates; however the granular soils in the north and west slopes of the pit appear to have less clay and are likely more suitable.

Given that the testing was completed on pit run (unprocessed) samples percent fracture was not completed. It would be expected that aggregate processing such as crushing, blending and screening would be completed. During processing the percent fracture should be monitoring as well as the gradation to ensure it is being processed per the required specifications. BC MoT specifies a minimum fracture count (two or more faces) of 85% for class 1 asphalt aggregate and a minimum fracture count (at least one face) of 50% for base course.

8 VOLUME ESTIMATES

The volume estimates are provided in the following tables. Volumes are for unprocessed pit run and are based on the measured depths encountered during the subsurface test pit assessment and observations made of the existing granular slopes. The potential volumes of granular material were calculated by averaging the total thickness of granular materials encountered in the test pits and multiplying by an estimated surface area. The volumes provided are estimated based on limited test pit data available and assumptions that granular material extend beyond the tree line in some areas; therefore, the actual volumes of granular material may be highly variable. Additional investigation into vegetation and treed areas are recommended and have been further detail in Section 9.

Where groundwater or seepage was identified in the test pits, only the approximate granular material above the groundwater elevation has been included in the estimate. Note that the higher groundwater conditions may occur during other times of the year (for example during freshet) and therefore considerably less volume of aggregate may be available if the water table levels rise above the depths assessed. Also a working surface above the ground water table has not been included and may affect the volumes available.

Table 8.7. Volume Estimates

Area	Test Pit Number	Elevation (m)	Material			Depth of Groundwater (m)
			Topsoil	Overburden	Gravel	
Ranger Pit						
Existing Pit Floor (~24,000m^2)	TP14-01	1300.8	-	-	1.0[1]	1.0
	TP14-02	1301.2	-	-	1.2[1]	1.2
	TP14-07	1301.2	-	-	0.3[1]	0.3
	TP14-08	1304.3	-	-	4.0	NE
	TP14-09	1300.9	-	-	0.6	NE
	Approximate Layer Thickness (m)		-	-	~1.0	
	Volume (m3)				24,000	
North Slope (~24,000m^2)	TP14-03	1308.9	-	-	5.0	NE
	TP14-04	1308.9	-	-	5.0	NE
	TP14-06	1304.5	-	-	4.2	4.2
	Approximate Layer Thickness (m)		-	-	~5.0	
	Volume (m3)				120,000[2]	
Kerkeslin Pit						
South Area (~35,000m^2)	TP14-04	1209.3	-	-	1.5	NE
	TP14-05	1213.7	-	1.5	2.5	NE
	Approximate Layer Thickness (m)		-	0.75	2.0	
	Volume (m3)			26,250	70,000[2]	
North Area (~10,000m^2)	TP14-06	1204.2	-	-	3.0	NE
	Approximate Layer Thickness (m)		-	-	3.0	
	Volume (m3)		-	-	30,000[2]	
8 Mile Pit						
Existing Pit Floor (~24,000m^2)	TP14-01	1085.2	-	-	3.6	3.5
	TP14-02	1091.1	-	-	4.0	NE
	TP14-03	1084.9	-	1.0	3.0	NE
	TP14-06	1089.4	-	-	1.5	NE
	Approximate Layer Thickness (m)		-	0.3	2.5	
	Volume (m3)		-	7,200	60,000	
West Area (~60,000m^2)	TP14-04	1085.6	0.1	-	3.4	NE
	TP14-05	1090.3	0.1	-	3.4	NE
	TP14-07	1090.0	0.1	-	3.9	NE
	Approximate Layer Thickness (m)		0.1	-	3.5	
	Volume (m3)		6,000	-	210,000[2]	

Area	Test Pit Number	Elevation (m)	Material			Depth of Groundwater (m)
			Topsoil	Overburden	Gravel	
Roche Miette Pit						
Existing Pit Floor	TP14-01	993.3	-	3.0	NE	NE
	TP14-02	994.6	-	2.7	NE	NE
	TP14-07	993.2	-	2.3	NE	NE
	Approximate Layer Thickness (m)		-	-	-	
	Volume (m3)		-	-	-	
Pit 11 (David Thompson Pit)						
North Slope Area (~5,000m^2)	TP14-03	1437.1	-	-	4.0	
	TP14-04	1442.5	-	0.6	2.4	
	Approximate Layer Thickness (m)		-	0.3	~3.0	
	Volume (m3)			1,500	15,000	
West Area (~13,000m^2)	TP14-05	1449.9	-	-	> 3.5	NE
	TP14-05B	1448.9	-	-	> 2.5	NE
	Approximate Layer Thickness (m)		-	-	~5.0	
	Volume (m3)		-	-	65,000[2]	

Notes:
[1] Granular thickness shown is depth encountered above water table.
[2] Additional investigation required to confirm volume.
NE=Not Encountered

9 CONCLUSIONS AND RECOMMENDATIONS

Table 9.1 provides a summary of the pit run gravel material volumes encountered or estimated and the pit suitability for producing WGB and MMA aggregate.

Table 9.8. Summary of Gravel Volume and Suitability

Pit	Area	Estimated Gravel Volume (m^3)	Estimated Crushed Volume After Waste[3] (m^3)	Suitability
Ranger	Existing Pit Floor	24,000[1]	17,000	Met MoTI specifications for WGB and asphalt paving aggregates. Appears suitable to produce 25 and 50 mm WGB (with inclusion of oversize) and 16 and 19 mm medium mix aggregate.
	North Slope Area	120,000	86,000	
Kerkeslin Pit	South Area	70,000[2]	50,000	Met the specifications for mirco-deval and course absorption; however, one sample was marginal for fine absorption with a result exceeding the specification by 0.65% for paving aggregate. Appears suitable to produce 25 mm WGB and 16 and 19 mm medium mix aggregate; however limited in the percentage of oversize material to produce 50 mm WGB.
	North Area	30,000[2]	21,000	
8 Mile Pit	Existing Pit Floor	60,000	43,000	Met MoTI specifications for WGB and asphalt paving aggregates. Appears suitable to produce 25 and 50 mm WGB (with inclusion of oversize) and 16 and 19 mm medium mix aggregate.
	West Area	210,000[2]	150,000	
Roche Miette	Existing Pit Floor	NE	NE	No suitable granular material was encountered in the test pits.
Pit 11 (David Thompson Pit)	North Slope Area	15,000	11,000	Met the specifications for mirco-deval and course absorption; however, both samples were marginal for fine absorption with results exceeding the specification by 0.4 to 0.5% for paving aggregate. Appears suitable to produce 25 mm WGB and 16 and 19 mm medium mix aggregate; however limited in the percentage of oversize material to produce 50 mm WGB.
	West Area	65,000[2]	46,000	

Notes:
[1] Volume based on average granular thickness encountered above water table.
[2] Additional investigation required to confirm volume.
[3] Crushed volumes include a waste factor is 40% based on historical trends.
NE=Not Encountered

Based on the test pitting assessments and laboratory testing completed the following recommendations for borrow pit development are provided:

3. Re-establish Ranger Pit and 8 Mile Pit as there appears to be some volume of materials in the existing pit floors. Pit 11 (David Thompson Pit) would also be recommended for development as some material appears to be available to intermediate processing in the North Slope Area.

4. Additional assessment of North Slope Area of Ranger Pit, West Area of 8 Mile Pit and North Slope Area of Pit 11 (David Thompson Pit). Additional investigation would require disturbance of existing vegetation and treed areas and permits would be required for assessment.

10 CLOSURE

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Please do not hesitate to contact the undersigned should you have any questions or comments.

Respectfully submitted,

DRAFT

Shiloh Carlson, PEng (BC/AB)
Geotechnical Engineer

DRAWINGS

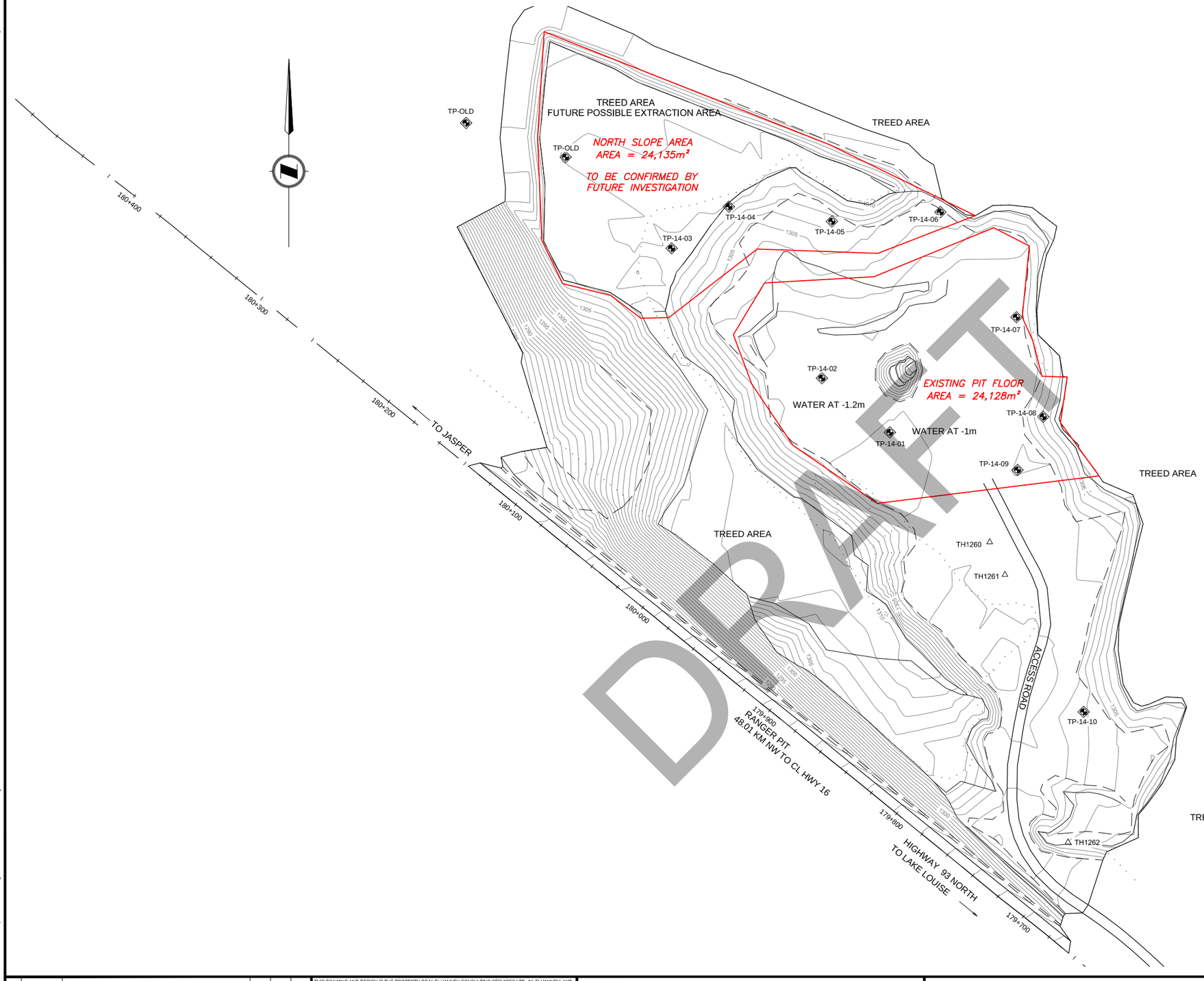
537-01 Ranger Pit Plan

537-02 Kerkeslin Pit Plan

537-03 8 Mile Pit Plan

537-04 Roche Miette Pit Plan

537-05 Pit 11 (David Thompson) Pit Plan



Rev	Date	Description	Drawn	Design	App'd

0 1:2500 100

ORIGINAL DWG SIZE: ANSI B (11" x 17")

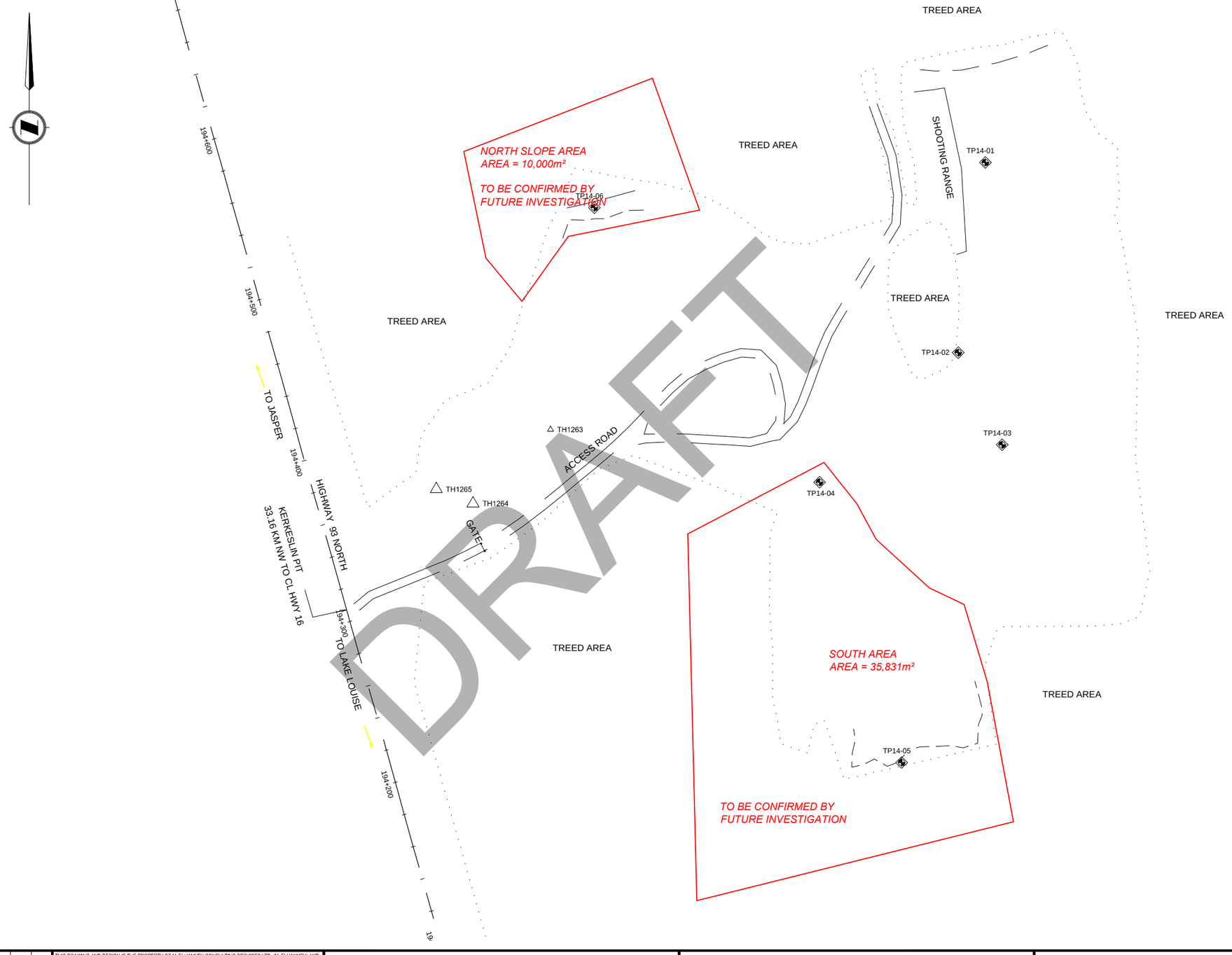
McElhanney
McElhanney Consulting Services Ltd.
555 North Nechako Road
Suite 12
Prince George BC
Canada V2K 1A1
Tel 250 561 2229

PARKS CANADA AGENCY

RANGER PIT
JASPER NATIONAL PARK
PIT PLAN

Drawing No.
537-01

Project Number	Rev.
2511-00537-0	#



Rev	Date	Description	Drawn	Design	App'd

0 1:2500 100

ORIGINAL DWG SIZE: ANSI B (11" x 17")

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McElhanney Consulting Services Ltd.
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Prince George BC
Canada V2K 1A1
Tel 250 561 2229

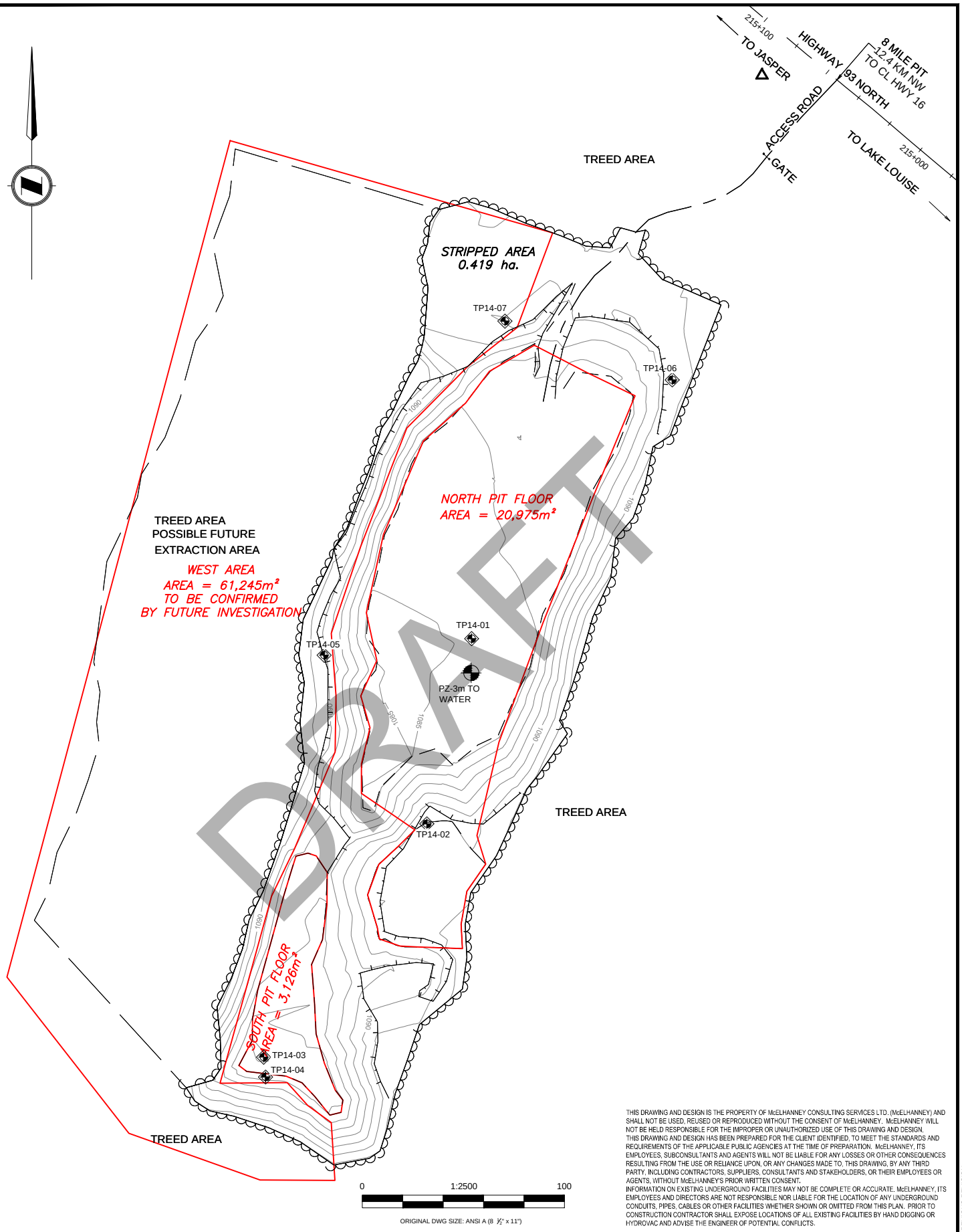
PARKS CANADA AGENCY

KERKESLIN PIT
JASPER NATIONAL PARK
PIT PLAN

Drawing No. 537-02

Project Number 2511-00537-0

Rev. #



ORIGINAL DWG SIZE: ANSI A (8 ½" x 11")

McElhanney
McElhanney Consulting Services Ltd.
555 North Nechako Road
Suite 12
Prince George BC
Canada V2K 1A1
Tel 250-561 3939

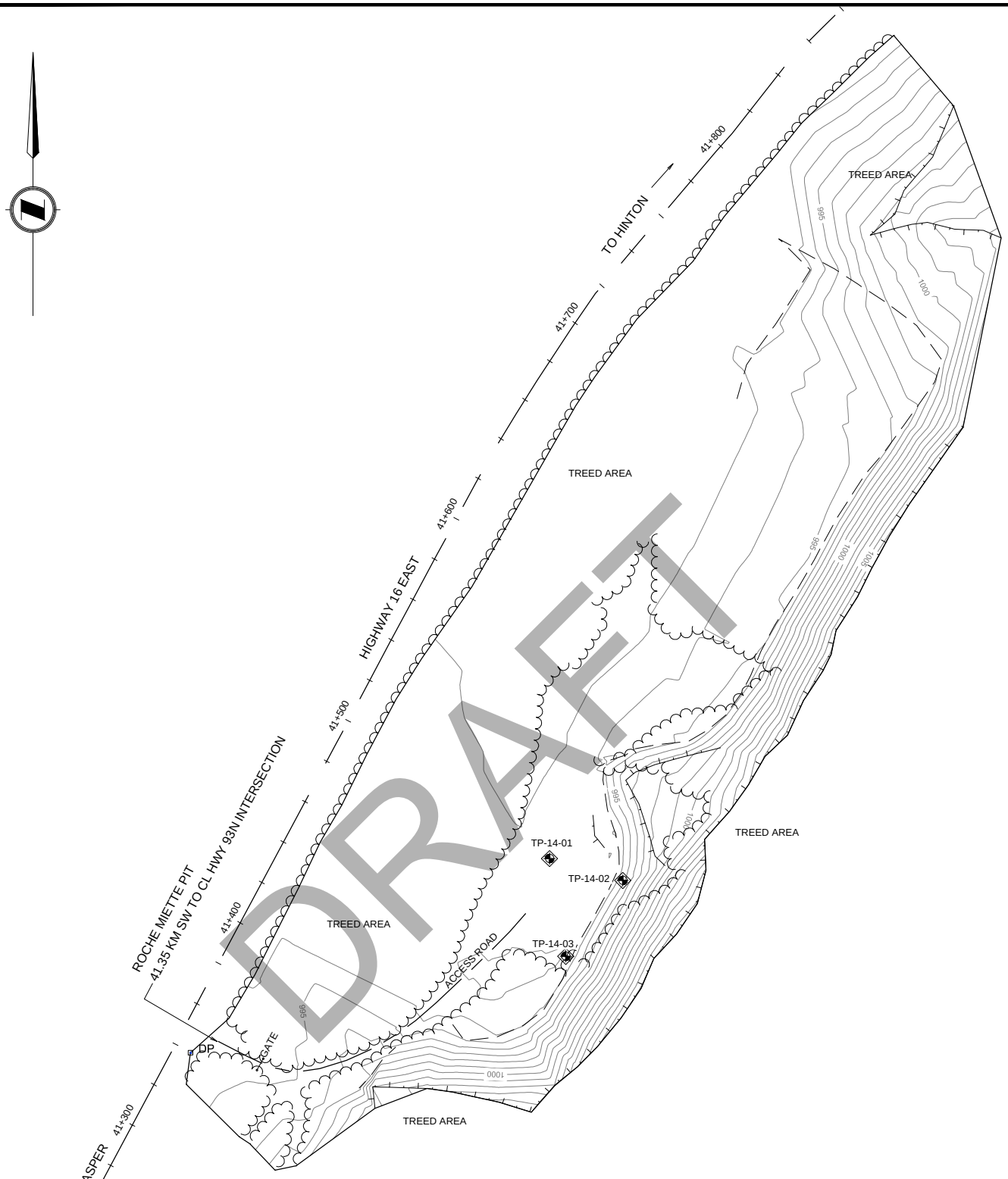
PARKS CANADA AGENCY

8 MILE PIT
JASPER NATIONAL PARK
PIT PLAN

Drawing No.
537-03

Project Number	Rev.
2511-00537-0	-

DESTROY ALL PRINTS BEARING PREVIOUS REVISION



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ORIGINAL DWG SIZE: ANSI A (8 ½" x 11")

McElhanney
McElhanney Consulting Services Ltd.
596 North Nechako Road
Suite 12
Prince George BC
Canada V2K 1A1
Tel 250-561 3339

PARKS CANADA AGENCY

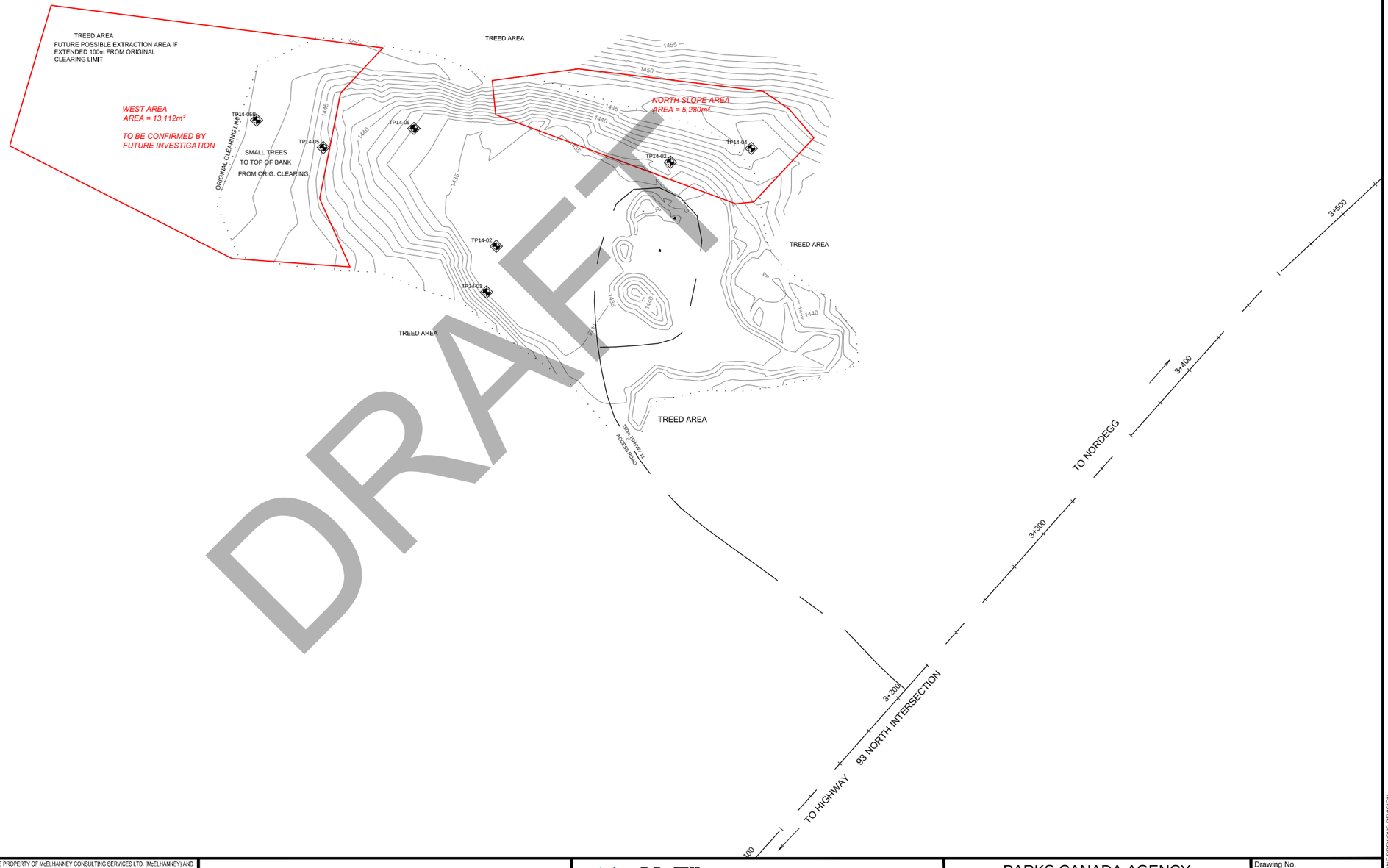
ROCHE MIETTE PIT
JASPER NATIONAL PARK
PIT PLAN

Drawing No.
537-04

Project Number	Rev.
2511-00537-0	-

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

McElhanney AP - 14-11-25
DATE: 2015-01-06, 11:46 FILE: H:\PROJ\2511\00537-00-JasperGravel\Drawings\00537 150106 JASPER PITS.dwg



Rev	Date	Description	Drawn	Design	App'd
-	-	---	-	-	-

0 1:2000 100

ORIGINAL DWG SIZE: ANSI B (11" x 17")

McElhanney
McElhanney Consulting Services Ltd.
5B8 North Nechako Road
Suite 12
Prince George BC
Canada V2K 1A1
Tel 250 561 2229

PARKS CANADA AGENCY

PIT 11 (DAVID THOMPSON PIT)
BANFF NATIONAL PARK
PIT PLAN

Drawing No.
537-05

Project Number
2511-00537-0

Rev.
-

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

DATE: 2015-01-06, 15:16 FILE: H:\PROJ\2511\00537-00-JasperGravel\Drawings\00537 150105 SASK RIVER PIT.dwg

McElhanney B - 14-11-25

PHOTOGRAPHS

Photo Sheet 1 – Ranger Pit

Photo Sheet 2 – Kerkeslin Pit

Photo Sheet 3 – 8 Mile Pit

Photo Sheet 4 – Roche Miette

Photo Sheet 5 – Pit 11 (David Thompson Pit)

Looking at south at existing pit area.

Gravel excavated from TP14-01.

Groundwater in TP14-01.

Gravel excavated from TP14-04.

Looking at North Slope Area.

Gravel excavated from TP14-06.

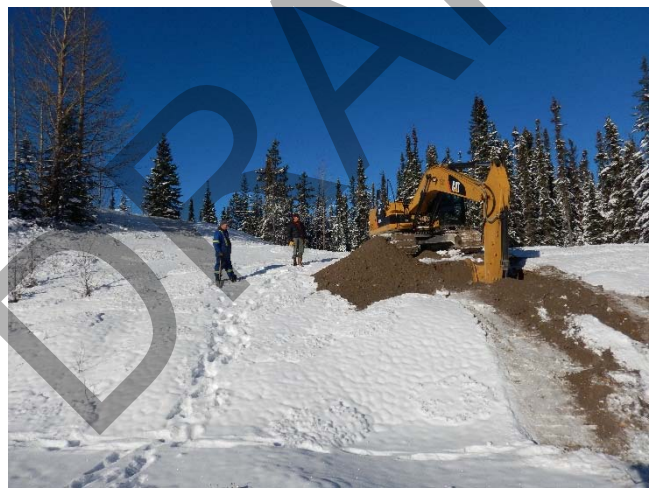
McElhanney McElhanney Consulting Services Ltd.	Prepared by: SMC	PARKS CANADA AGENCY	Client Proiect No: -
	Date: December 2014	RANGER PIT AGGREGATE RESOURCE ASSESSMENT JASPER NATIONAL PARK	MCSL Proiect No: 2511-00537-00
	Scale: NTS		**Photo Sheet 1**

Sand in TP14-01.

Looking south towards south end of pit.

Gravel in South Slope (TP14-05).

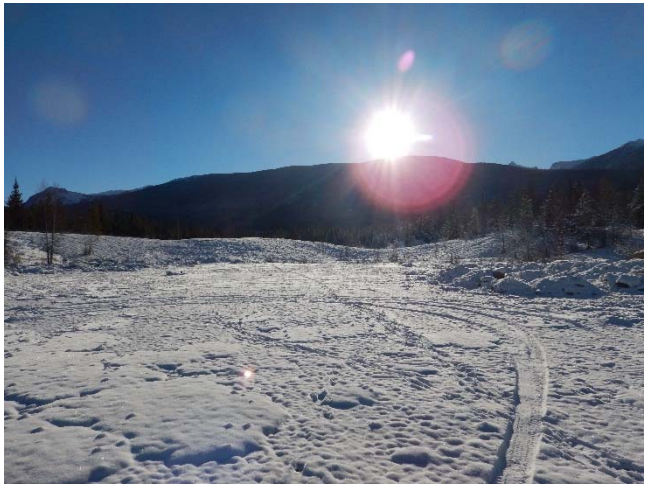
Looking northwest at North Slope area.



Excavating TP14-06 in North Slope Area.

Gravel excavated from TP14-06.

McElhanney McElhanney Consulting Services Ltd.	Prepared by: SMC	PARKS CANADA AGENCY	Client Project No: -
	Date: December 2014	KERKESLIN PIT AGGREGATE RESOURCE ASSESSMENT JASPER NATIONAL PARK	MCSL Project No: 2511-00537-00
	Scale: NTS		**Photo Sheet 2**



Looking at north end of the pit.

Gravel from TP14-01 excavated in existing floor.

Excavation of TP14-02.

Looking toward south end of the pit.

Excavation of TP14-05 on the west slope.

Gravel excavated from TP14-06

McElhanney McElhanney Consulting Services Ltd.	Prepared by: SMC	PARKS CANADA AGENCY	Client Proiect No: -
	Date: December 2014	8 MILE PIT AGGREGATE RESOURCE ASSESSMENT JASPER NATIONAL PARK	MCSL Proiect No: 2511-00537-00
	Scale: NTS		**Photo Sheet 3**

Looking southwest.

Existing waste piles and east slope.

Looking northeast.

McElhanney McElhanney Consulting Services Ltd.	Prepared by: SMC	PARKS CANADA AGENCY	Client Proiect No: -
	Date: December 2014	ROCHE MIETTE PIT AGGREGATE RESOURCE ASSESSMENT JASPER NATIONAL PARK	MCSL Proiect No: 2511-00537-00
	Scale: NTS		**Photo Sheet 4**

Excavated gravel from TP14-01. Gravel had clay coating.

Looking north at TP14-03 in North Slope Area.

Gravel excavated from TP14-03.

Gravel excavated from TP14-04.

Looking toward west end of the pit.

Gravel excavated from TP14-05.

McElhanney McElhanney Consulting Services Ltd.	Prepared by: SMC	PARKS CANADA AGENCY	Client Proiect No: -
	Date: December 2014	PIT 11 (DAVID THOMPSON PIT) AGGREGATE RESOURCE ASSESSMENT BANFF NATIONAL PARK	MCSL Proiect No: 2511-00537-00
	Scale: NTS		**Photo Sheet 5**

APPENDIX A: RANGER PIT

Test Pit Summary Logs

Charts A1 to A4

Laboratory Test Results

AGGREGATE LOG

Project No: 2511-00537-00
Project: Jasper National Park Gravel Assessment
Location: Ranger Pit

Contractor: Okanagan Aggregates Ltd.
Excavator: CAT 320DL
Weather: Sunny, ~ -25C, snow cover

Date: November 13, 2014
Logged By: S.Carlson, PEng

Test Pit Number	Sample Number	Depth (m)		Layer Thickness (m)	Field Classification	Field Estimate Gradation (%)			Field Estimate Oversize (%)			Max Size (mm)	Water Table (m)	Sand Size (F,M,C)	Lab Clasfication	Laboratory Test Gradation (%)			Comments
		From	To			Fines	Sand	Gravel	75-150	150-300	>300 mm					Fines	Sand	Gravel	
TH14-01	-	0	1.5	1.5	GP-GM	4	36	60	8	5	1	300	1	M,C					Heavy groundwater seepage.
TP14-02	-	0	1.2	1.2	SP-SM	5	55	40	5	3	-	250	1.2	M,C					Rootlets to 1.0 m. Sloughing of test pit walls.
		1.2	2.2	1.0	SP-SM	6	79	15	-	-	-	-							
TP14-03	-	0	0.5	0.5	GP	4	36	60	5	2	-	200	-	M,C					
	-	0.5	1	0.5	SP	4	66	30	-	-	-	-	-	M,C					
	1	1.0	5.0	4.0	GP	4	32	64	10	10	3	400	-	M,C	GP	2	33	65	Some sloughing.
TP14-04	-	0	0.4	0.4	GP	4	36	60	6	3	-	200		M,C					
	-	0.4	0.9	0.5	SP	4	71	25	-	-	-	-		M,C					
	2	0.9	5.0	4.1	GP	4	36	60	10	10	2	400	-	M,C	GP	2	30	68	
TP14-05	-	0	2.0	2.0	GM	12	30	58	5	5	5	500		M,C					Reclaimed slope, appears to be oversize dump. Woody debris.
TP14-06	3	0	4.2	4.2	GP	4	31	65	10	10	2	350	4.2	M,C	GP	2	19	79	Sloughing. Gravel saturated in bottom.
	-	4.2	4.5	0.3	CH	-	-	-	-	-	-	-							
TP14-07	-	0	0.3	0.3	GP	-	-	-	-	-	-	-	0.3	-					High watertable near surface.

Notes:

AGGREGATE LOG

Project No: 2511-00537-00
Project: Jasper National Park Gravel Assessment
Location: Ranger Pit

Contractor: Okanagan Aggregates Ltd.
Excavator: CAT 320DL
Weather: Sunny, ~ -25C, snow cover

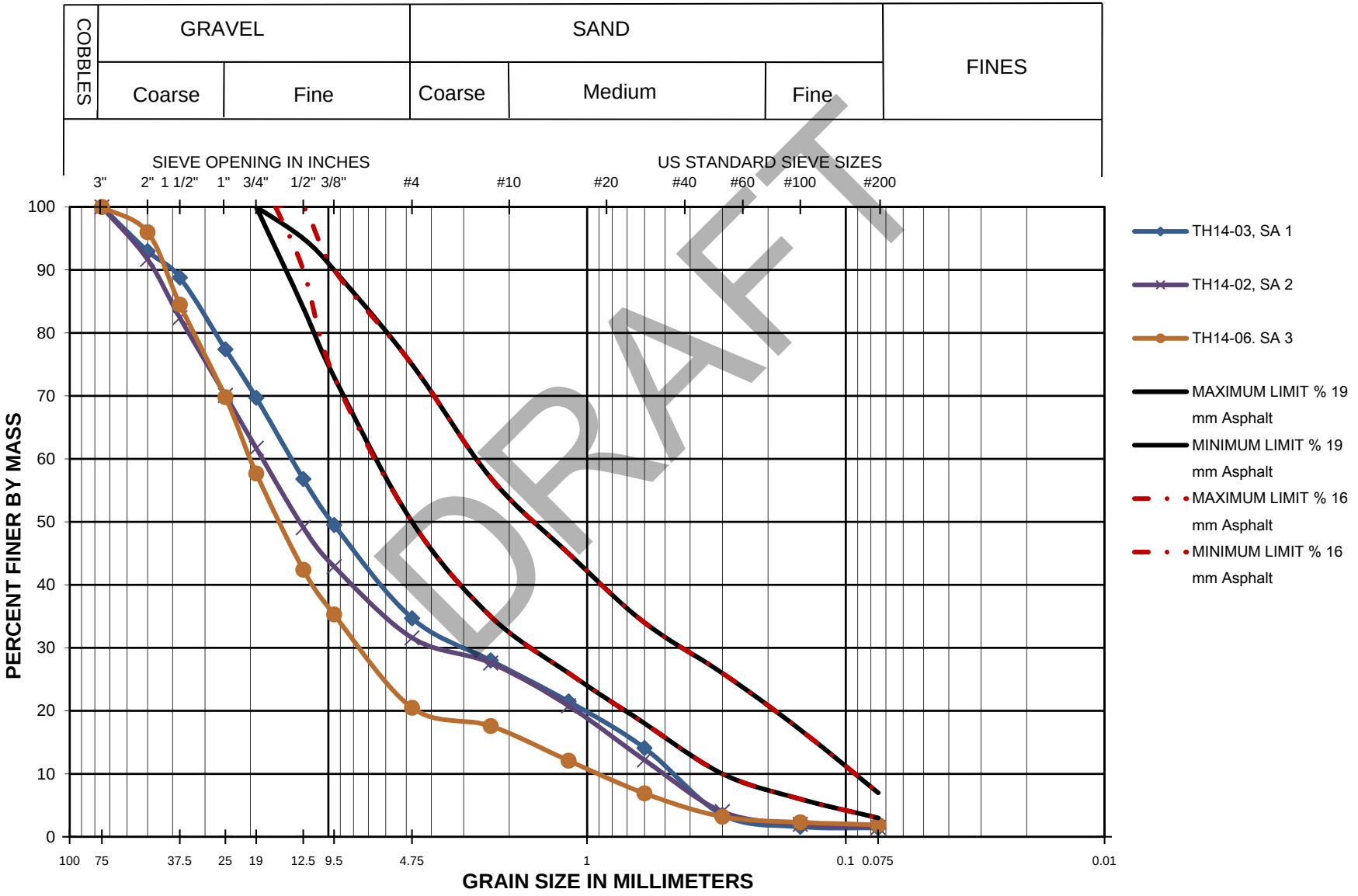
Date: November 13, 2014
Logged By: S.Carlson, PEng

Test Pit Number	Sample Number	Depth (m)		Layer Thickness (m)	Field Classification	Field Estimate Gradation (%)			Field Estimate Oversize (%)			Max Size (mm)	Water Table (m)	Sand Size (F,M,C)	Lab Clasfication	Laboratory Test Gradation (%)			Comments
		From	To			Fines	Sand	Gravel	75-150	150-300	>300 mm					Fines	Sand	Gravel	
TP14-08	-	0	0.2	0.2	OL	-	-	-	-	-	-	-	-	-					Roots
	-	0.2	1.8	1.6	GP	4	30	66	10	5	-	200	-	M,C					
	-	1.8	2.1	0.3	SP	4	86	10	-	-	-	-	-	M					
	-	2.1	4.0	1.9	GP	4	30	66	10	5	-	200	-	M,C					
TP14-09	-	0	0.6	0.6	GP	4	30	66	10	5	-	200	-	M,C					
	-	0.6	0.8	0.2	CH	-	-	-	-	-	-	-	-	-					
TP14-10	-	0	0.2	0.2	OL	-	-	-	-	-	-	-	-	-					Rootlets.
	-	0.2	1.5	1.3	SP	4	71	25	-	-	-	-	-	M					
	-	1.5	4.0	2.5	SP	3	87	10	-	-	-	-	-	F,M					Silty seams.

Notes:

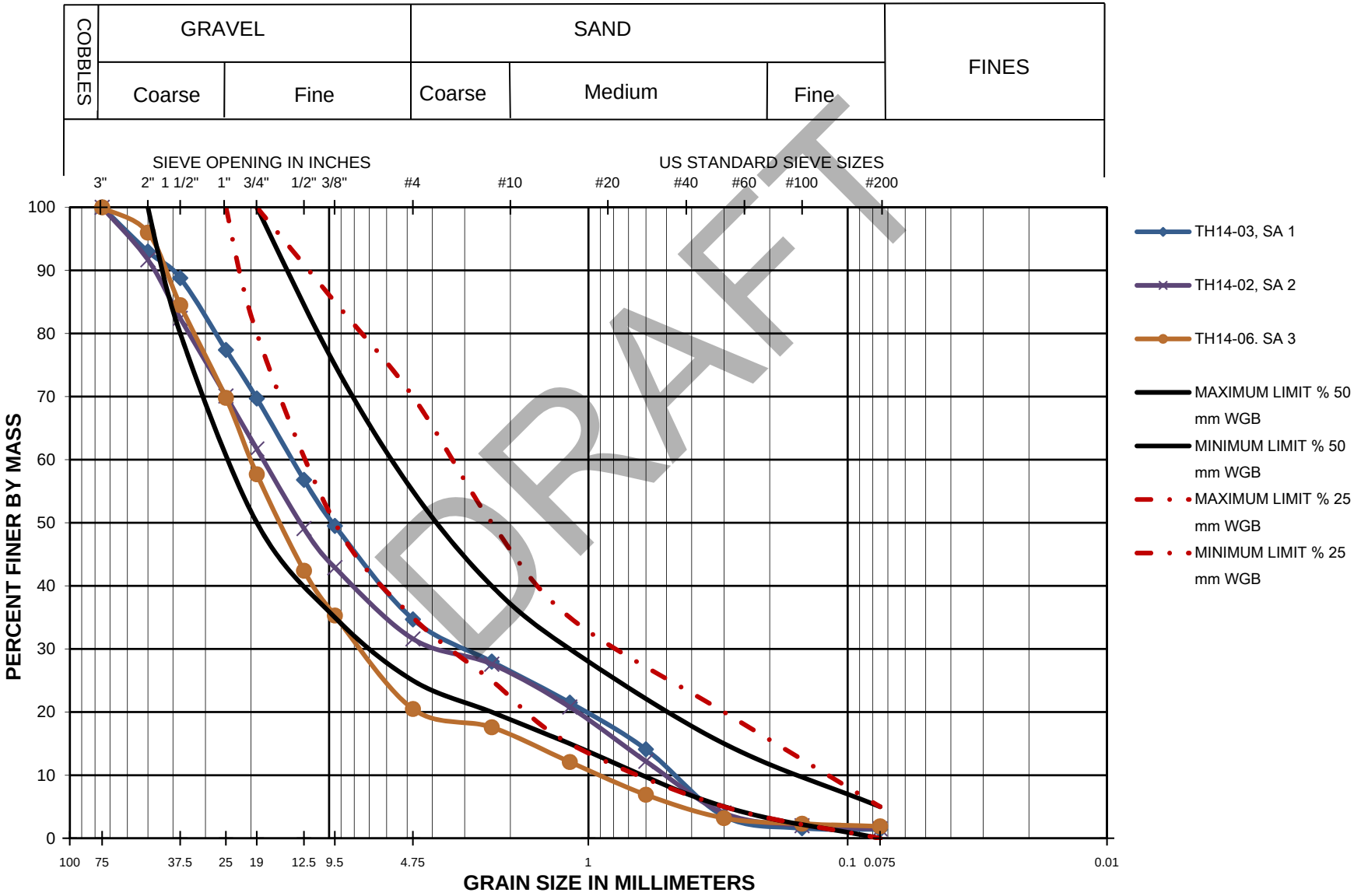
McElhanney

PARKS CANADA AGENCY
CHART A1 - LABORATORY GRADATION CURVES
RANGER PIT - PIT RUN (MINUS 75 MM)
MOTI ASPHALT SPECIFICATIONS



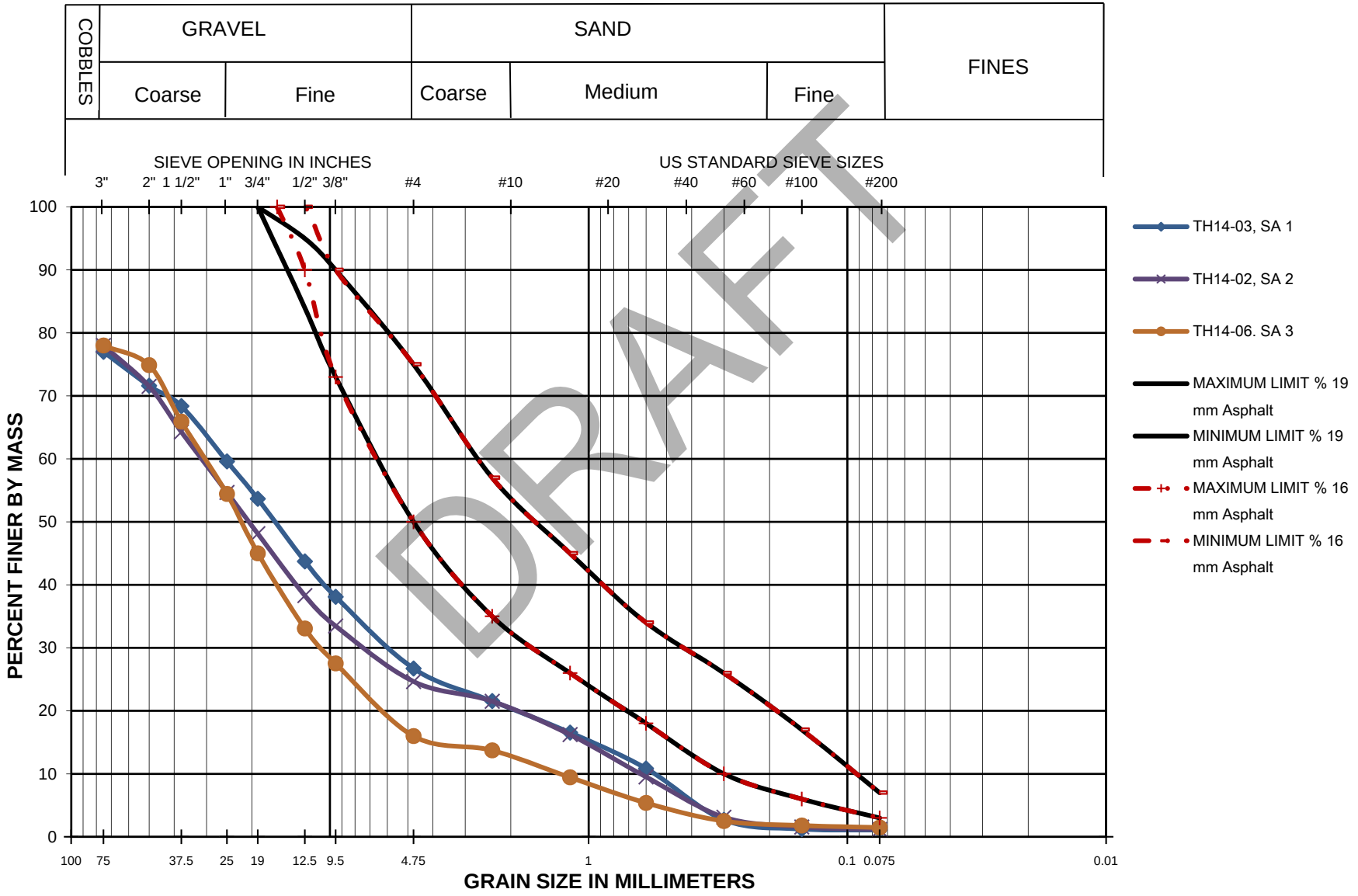
McElhanney

PARKS CANADA AGENCY
CHART A2 - LABORATORY GRADATION CURVES
RANGER PIT - PIT RUN (MINUS 75 MM)
MOTI WELL GREADED BASE SPECIFICATIONS



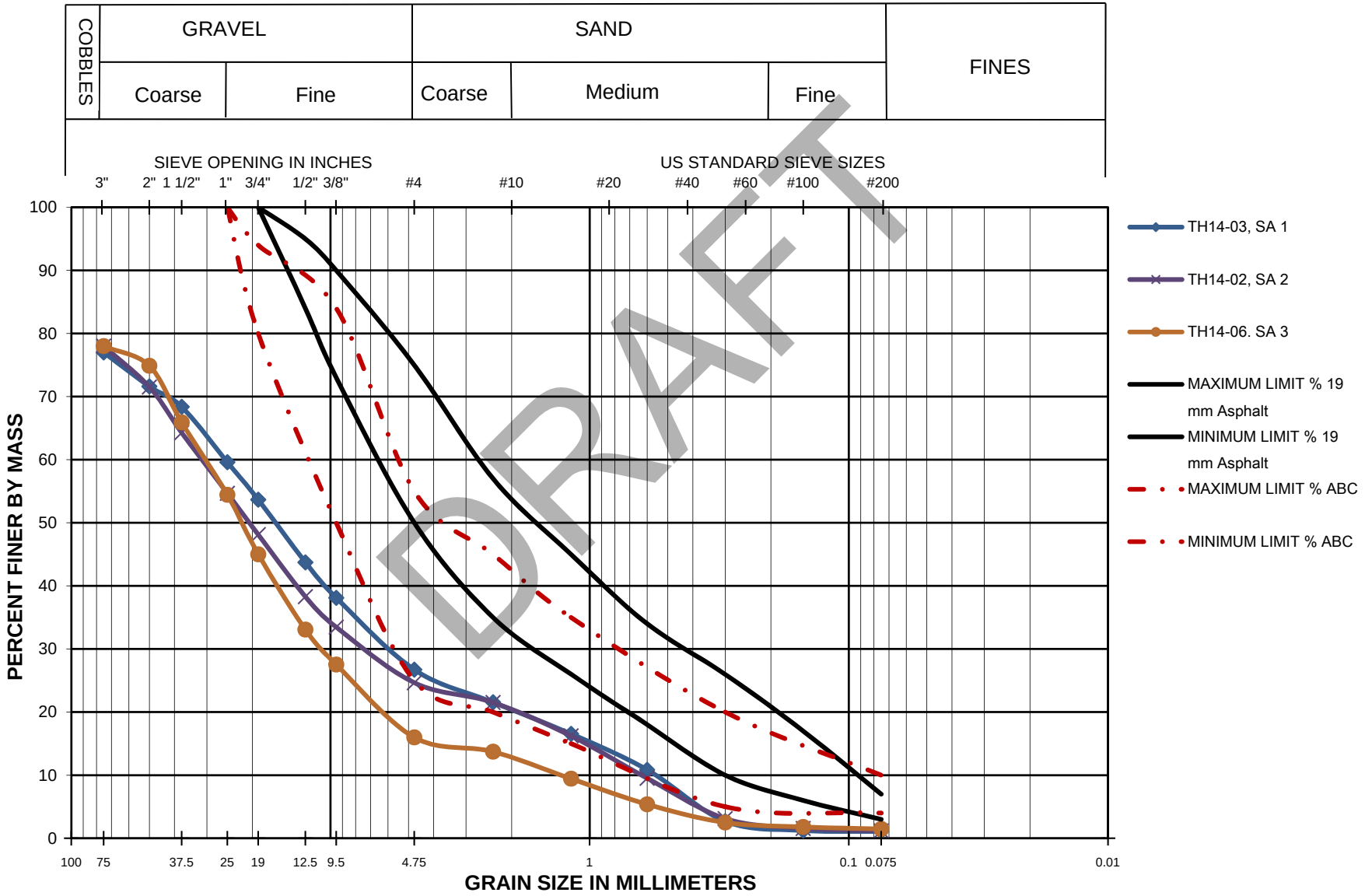
McElhanney

PARKS CANADA AGENCY
CHART A34 - LABORATORY GRADATION CURVES
RANGER PIT - PIT RUN (WITH OVERSIZE)
MOTI ASPHALT SPECIFICATIONS



McElhanney

PARKS CANADA AGENCY
CHART A5 - LABORATORY GRADATION CURVES
RANGER PIT - PIT RUN (WITH OVERSIZE)
MOTI WELL GRADED BASE COURSE SPECIFICATIONS



McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

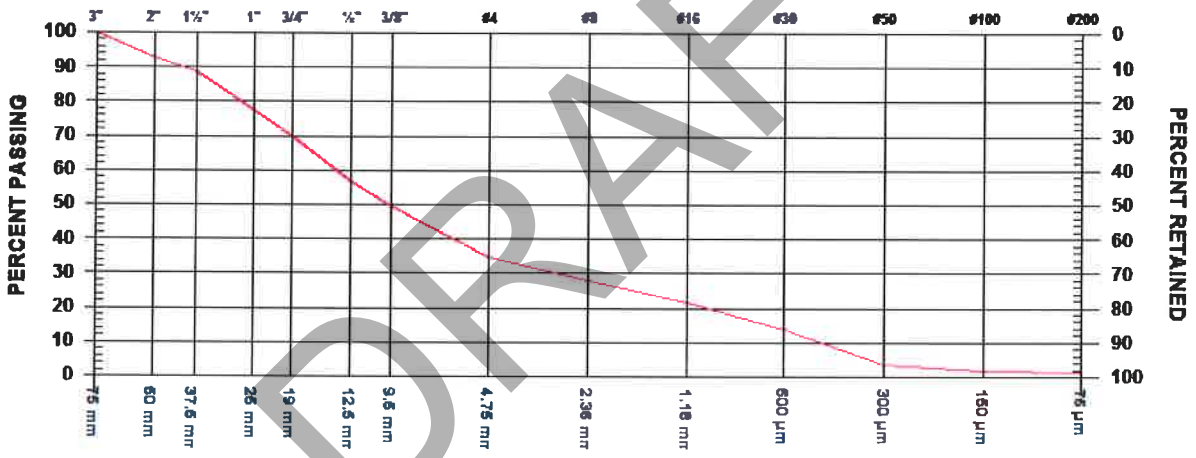
PROJECT Asphalt Aggregate Resource Assessment
Test Pitting Assessment
Jasper National Park
Jasper

CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 1 DATE RECEIVED 20/Nov/2014 DATE TESTED 22/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Ranger Pit TP14-03
SOURCE SA1: 1 to 5 m depth
SPECIFICATION
MATERIAL TYPE Sandy Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	93.0	
1 1/2"	37.5 mm	88.8	
1"	25 mm	77.4	
3/4"	19 mm	69.7	
1/2"	12.5 mm	56.8	
3/8"	9.5 mm	49.5	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	34.7	
No. 8	2.36 mm	28.0	
No. 16	1.18 mm	21.5	
No. 30	600 µm	14.1	
No. 50	300 µm	3.5	
No. 100	150 µm	1.6	
No. 200	75 µm	1.4	

MOISTURE CONTENT 3.9%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER.

McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

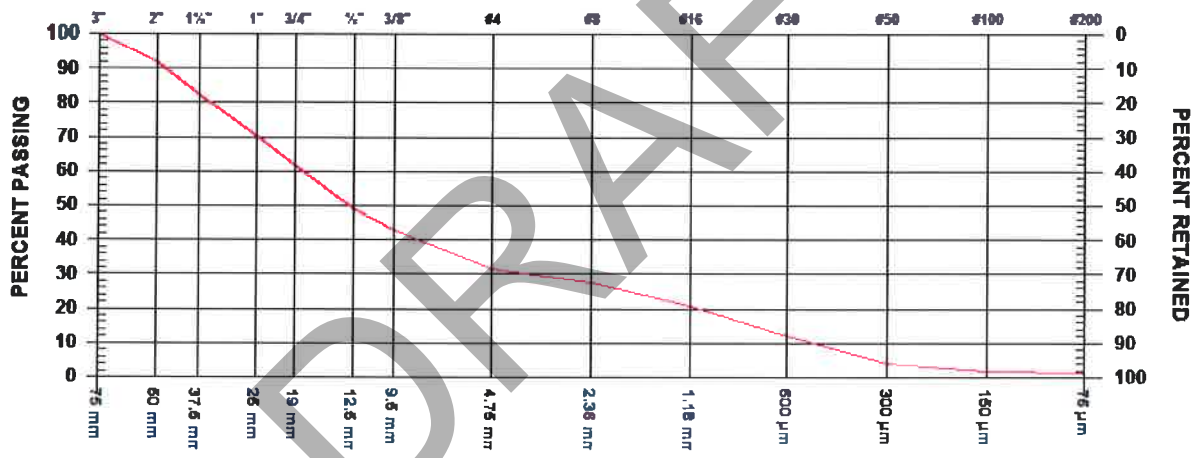
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Jasper National Park
Test Pitting Assessment — Jasper
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 2 DATE RECEIVED 20/Nov/2014 DATE TESTED 22/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Ranger Pit TP14-04
SOURCE SA2: 0.4 m to 5.0 m depth
SPECIFICATION
MATERIAL TYPE Sandy Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	91.7	
1 1/2"	37.5 mm	82.4	
1"	25 mm	70.1	
3/4"	19 mm	61.7	
1/2"	12.5 mm	49.1	
3/8"	9.5 mm	42.9	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	31.6	
No. 8	2.36 mm	27.6	
No. 16	1.18 mm	20.8	
No. 30	600 µm	12.2	
No. 50	300 µm	4.0	
No. 100	150 µm	2.0	
No. 200	75 µm	1.5	

MOISTURE CONTENT 4.3%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER. _____

McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

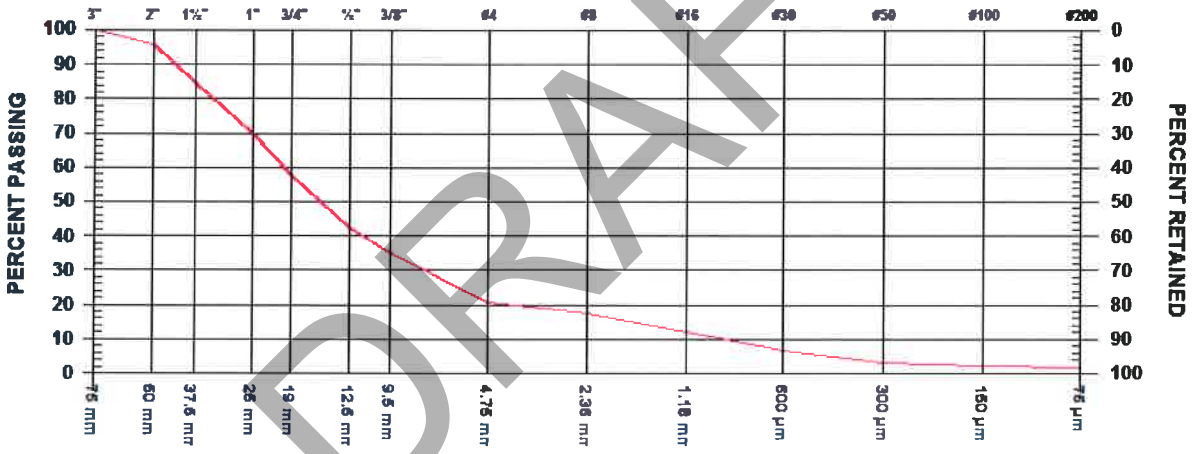
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Jasper National Park
Test Pitting Assessment — Jasper
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 3 DATE RECEIVED 20/Nov/2014 DATE TESTED 22/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Ranger Pit TP14-06
SOURCE SA3: 0 to 4.2 m depth
SPECIFICATION
MATERIAL TYPE Gravel with Some Sand and Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	96.0	
1 1/2"	37.5 mm	84.5	
1"	25 mm	69.8	
3/4"	19 mm	57.7	
1/2"	12.5 mm	42.4	
3/8"	9.5 mm	35.3	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	20.5	
No. 8	2.36 mm	17.6	
No. 16	1.18 mm	12.1	
No. 30	600 µm	6.9	
No. 50	300 µm	3.2	
No. 100	150 µm	2.3	
No. 200	75 µm	1.9	

MOISTURE CONTENT 11.6%

COMMENTS
Materials 75 mm and larger not included in the laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER.

McElhanney

Project No.	2511-00537-00	Client:	Parks Canada
Pit:	Ranger Pit	Date Sampled:	October 13-14, 2014
Product:	Pit Run	Date Rec'd:	December 12, 2014
T.P.	14-03 Sample #: 1	Date Tested:	December 8, 2014

BULK RELATIVE DENSITY OF AGGREGATE

COARSE AGGREGATE

BULK RELATIVE DENSITY	2.659
PERCENT WATER ABSORPTION	0.56

FINE AGGREGATE

BULK RELATIVE DENSITY	2.600
PERCENT WATER ABSORPTION	1.48

McElhanney

MICRO-DEVAL ASTM D6928

Project No. 2511-00537-00
Pit: Ranger Pit
Product: Pit Run
T.P. 14-03 Sample #: 1
Technician: R.Fenske

Client: Parks Canada
Date Sampled: October 13-14, 2014
Date Rec'd:
Date Tested: December 11, 2014

Passing		Retained		"A" Grading (3/4"-)		"B" Grading (1/2"-)		"C" Grading (3/8"-)	
mm	Inches	mm	Inches	Required	Actual	Required	Actual	Required	Actual
19.0	3/4	16.0	5/8	375 g	374.8				
16.0	5/8	12.5	1.2	375 g	374.9				
12.5	1/2	9.5	3/8	750 g	750.0	750 g			
9.5	3/8	6.7	0.265			375 g	0.0	750 g	0.0
6.7	0.265	4.75	# 4			375 g	0.0	750 g	0.0
				Total	1499.7		0.0		0.0

Max Size Aggregate Used

Intital Sample Weight (A) 1499.7
Final Sample Weight (C) 1391.5
Pan Weight (B) 402.7

Percent Loss **7.2%**

McElhanney

Project No.	2511-00537-00	Client:	Parks Canada
Pit:	Ranger Pit	Date Sampled:	October 13-14, 2014
Product:	Pit Run	Date Rec'd:	
T.P.	14-06 Sample #: 3	Date Tested:	December 10, 2014

BULK RELATIVE DENSITY OF AGGREGATE

COARSE AGGREGATE

BULK RELATIVE DENSITY	2.663
PERCENT WATER ABSORPTION	0.64

FINE AGGREGATE

BULK RELATIVE DENSITY	2.598
PERCENT WATER ABSORPTION	1.60

McElhanney

MICRO-DEVAL ASTM D6928

Project No.	2511-00537-00	**Client:**	Parks Canada
Pit:	Ranger Pit	**Date Sampled:**	October 13-14, 2014
Product:	Pit Run	**Date Rec'd:**	
T.P.	14-06 Sample #: 3	**Date Tested:**	December 11, 2014
Technician:	R.Fenske		

Passing		Retained		"A" Grading (3/4"-)		"B" Grading (1/2"-)		"C" Grading (3/8"-)	
mm	Inches	mm	Inches	Required	Actual	Required	Actual	Required	Actual
19.0	3/4	16.0	5/8	375 g	374.8				
16.0	5/8	12.5	1.2	375 g	375.0				
12.5	1/2	9.5	3/8	750 g	744.7	750 g			
9.5	3/8	6.7	0.265			375 g	0.0	750 g	0.0
6.7	0.265	4.75	# 4			375 g	0.0	750 g	0.0
				Total	1494.5		0.0		0.0

Max Size Aggregate Used

Intital Sample Weight (A)	1494.5
Final Sample Weight (C)	1384.7
Pan Weight (B)	443.8
Percent Loss	**7.3%**

APPENDIX B: KERKESLIN PIT

Test Pit Summary Logs

Charts B1 to B4

Laboratory Test Results

AGGREGATE LOG

Project No: 2511-00537-00
Project: Jasper National Park Gravel Assessment
Location: Kerkeslin Pit

Contractor: Okanagan Aggregates Ltd.
Excavator: CAT 320DL
Weather: Sunny, ~ -25C, snow cover

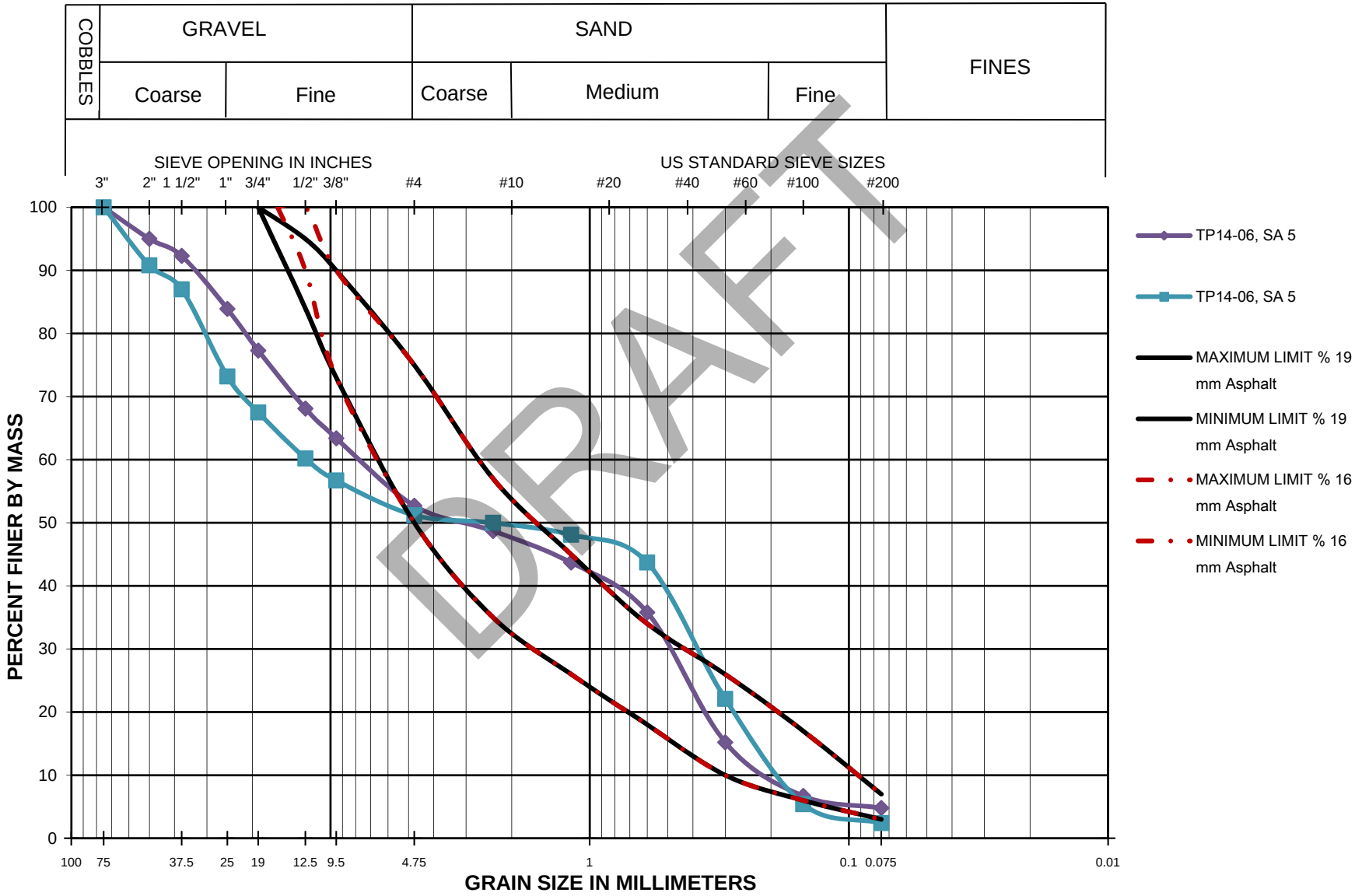
Date: November 13, 2014
Logged By: S.Carlson, PEng

Test Pit Number	Sample Number	Depth (m)		Layer Thickness (m)	Field Classification	Field Estimate Gradation (%)			Field Estimate Oversize (%)			Max Size (mm)	Water Table (m)	Sand Size (F,M,C)	Lab Clasfication	Laboratory Test Gradation (%)			Comments
		From	To			Fines	Sand	Gravel	75-150	150-300	>300 mm					Fines	Sand	Gravel	
TP14-01	-	0	2.5	2.5	SP-SM	5	90	5	2	-	-	100	-	F,M					Existing pit floor.
TP14-02	-	0	1.0	1.0	SP	5	80	15	-	-	-	-	-	F,M					Existing pit floor.
TP14-03	-	0	1.0	1.0	SP-SM	5	85	10	-	-	-	-	-	F,M					Existing pit floor.
		1.0	1.5	0.5	CL	-	-	-	-	-	-	-	-	-					Till-like.
TP14-04	-	0	1.5	1.5	SP-SM	6	50	44	3	-	-	100	-	M					Existing pit floor.
		1.5	2	0.5	CL	-	-	-	-	-	-	-	-	-					Till-like.
TP14-05	-	0	1.5	1.5	GM														
	4	1.5	4.0	2.5	GP	4	46	50	3	-	-	100	-	M	SP-SM	5	48	47	Excavated in bank.
	-	4.0	5.0	1.0	SP	4	71	25	-	-	-	-	-	M					
TP14-06	5	0	3.0	3.0	SP	4	50	46	2	-	-	100	-	M	GP-GM	2	49	49	

Notes:

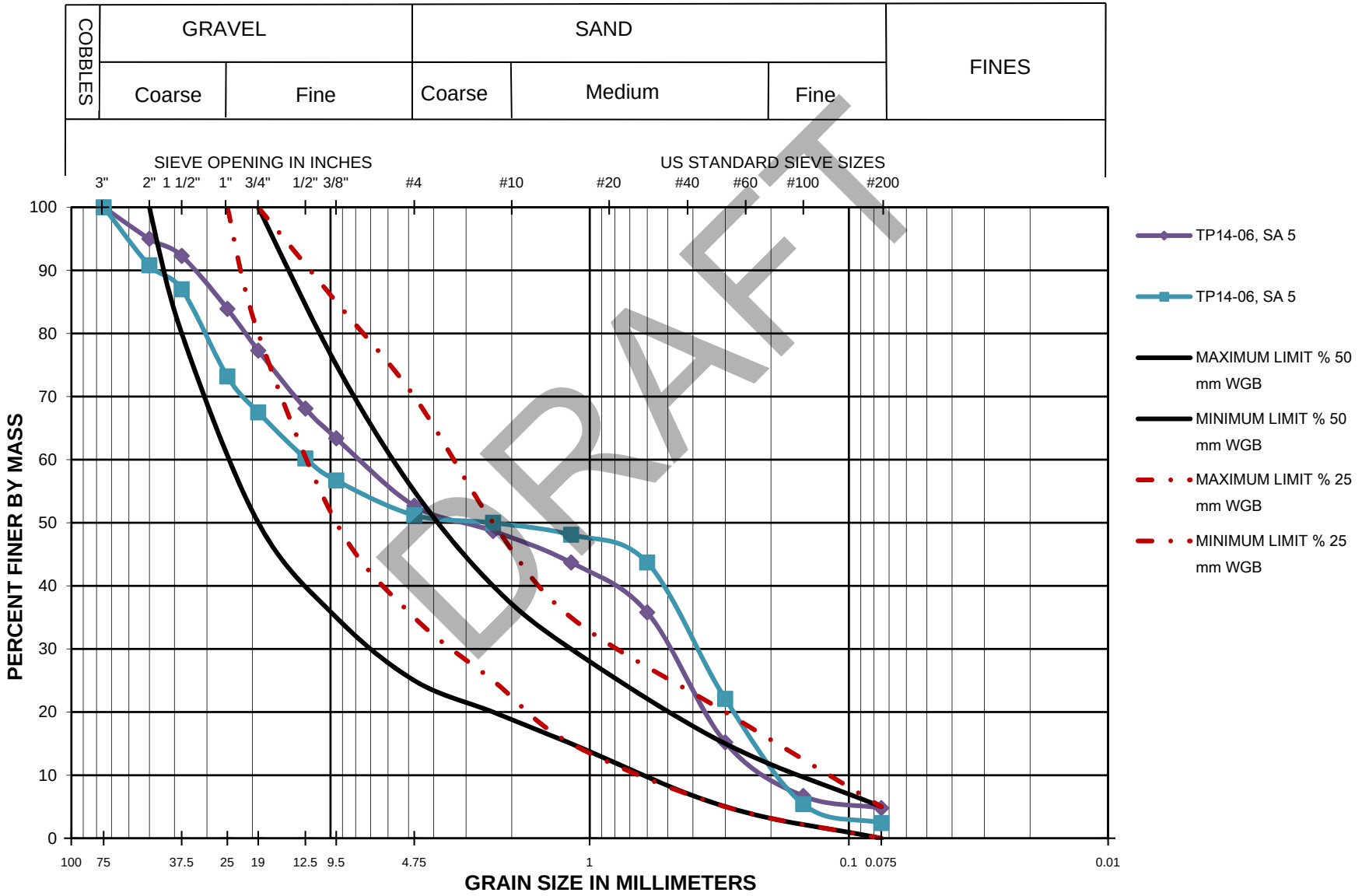
McElhanney

PARKS CANADA AGENCY
CHART B1 - LABORATORY GRADATION CURVES
KERKESLIN PIT - PIT RUN (MINUS 75 MM)
MOTI ASPHALT SPECIFICATIONS



McElhanney

PARKS CANADA AGENCY
CHART B2 - LABORATORY GRADATION CURVES
KERKESLIN PIT - PIT RUN (MINUS 75 MM)
MOTI WELL GRADED BASE SPECIFICATIONS



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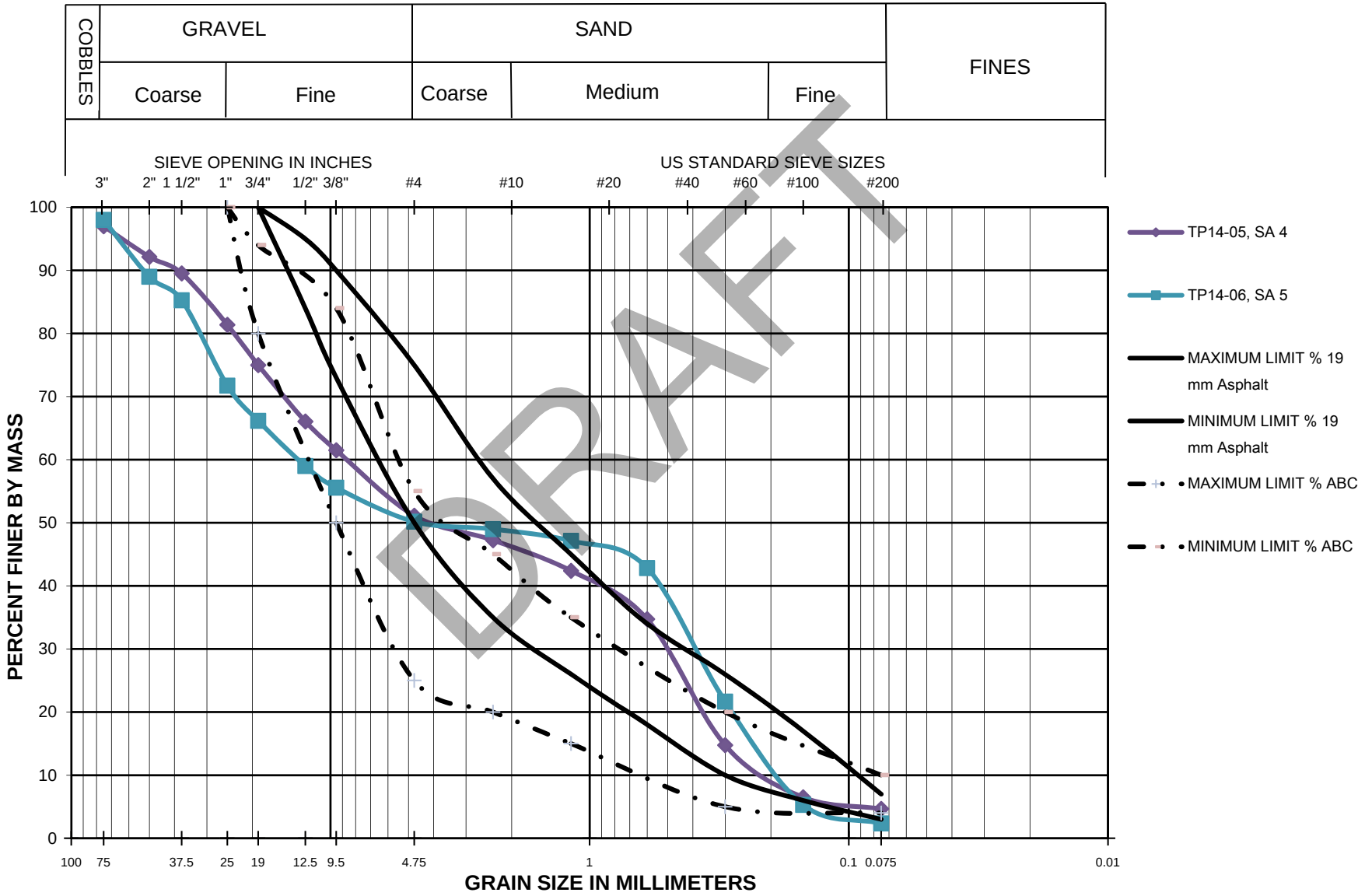
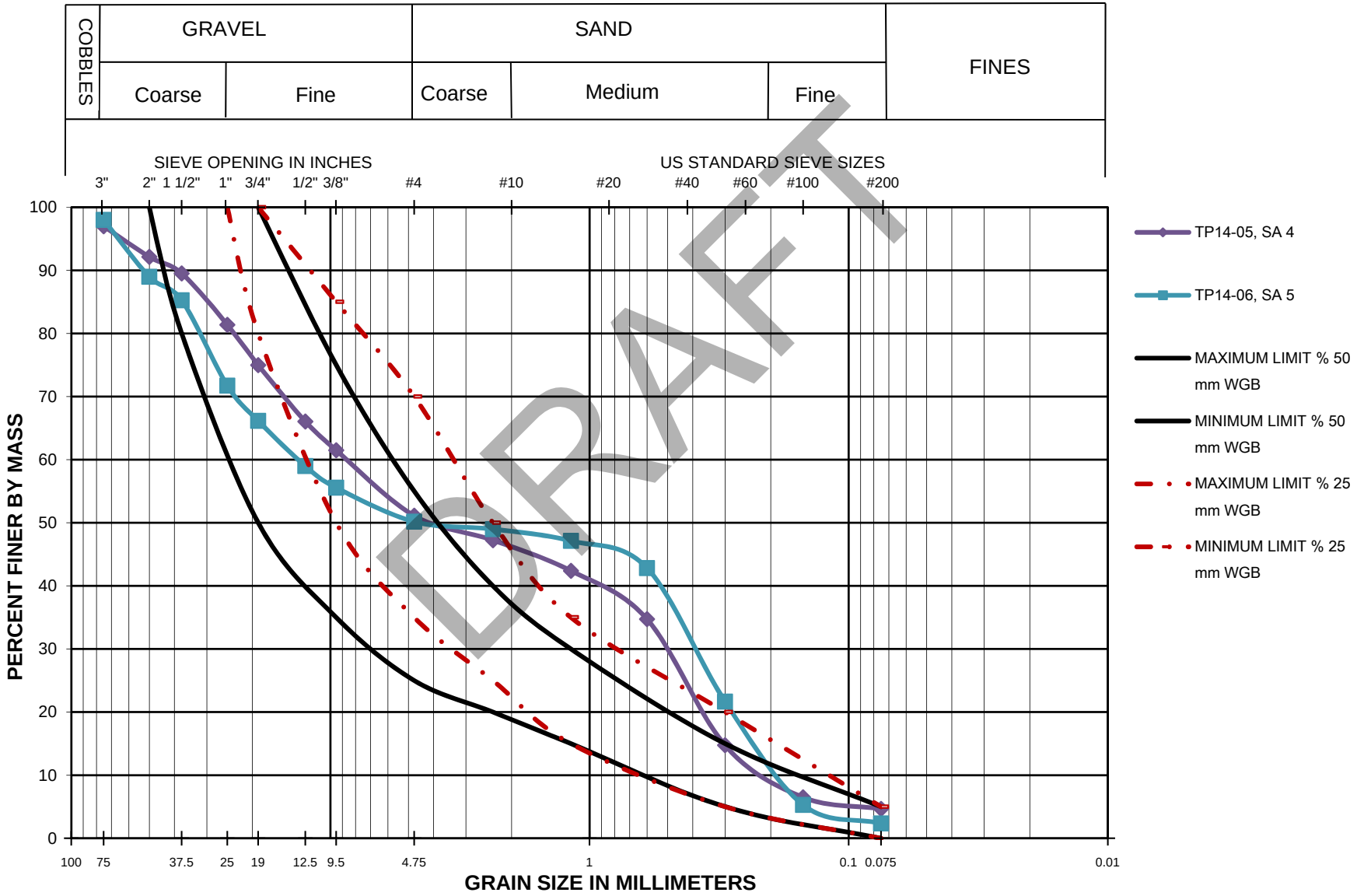
PARKS CANADA AGENCY
CHART B3 - LABORATORY GRADATION CURVES
KERKESLIN PIT - PIT RUN (WITH OVERSIZE)
MOTI ASPHALT SPECIFICATIONS



McElhanney

PARKS CANADA AGENCY
CHART B4 - LABORATORY GRADATION CURVES
KERKESLIN PIT - PIT RUN (WITH OVERSIZE)
MOTI WELL GRADED BASE SPECIFICATIONS



McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

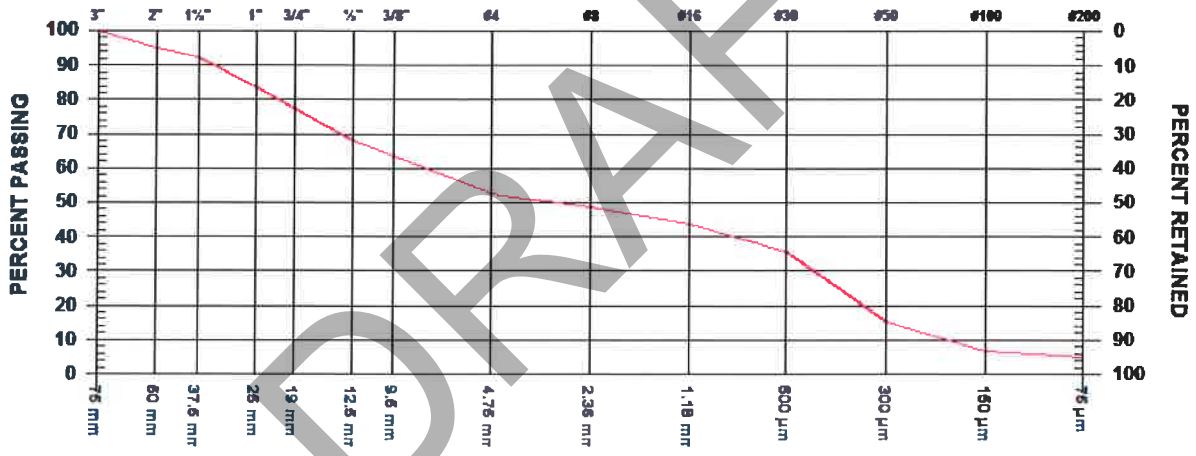
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Jasper National Park
Test Pitting Assessment — Jasper
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 4 DATE RECEIVED 20/Nov/2014 DATE TESTED 24/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Kerkesin Pit TP14-05
SOURCE SA4: 1.5 to 4.0 m depth
SPECIFICATION
MATERIAL TYPE Sand and Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	95.0	
1 1/2"	37.5 mm	92.3	
1"	25 mm	83.9	
3/4"	19 mm	77.3	
1/2"	12.5 mm	68.1	
3/8"	9.5 mm	63.4	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	52.7	
No. 8	2.36 mm	48.7	
No. 16	1.18 mm	43.7	
No. 30	600 µm	35.8	
No. 50	300 µm	15.2	
No. 100	150 µm	6.7	
No. 200	75 µm	4.8	

MOISTURE CONTENT 4.4%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER.

McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

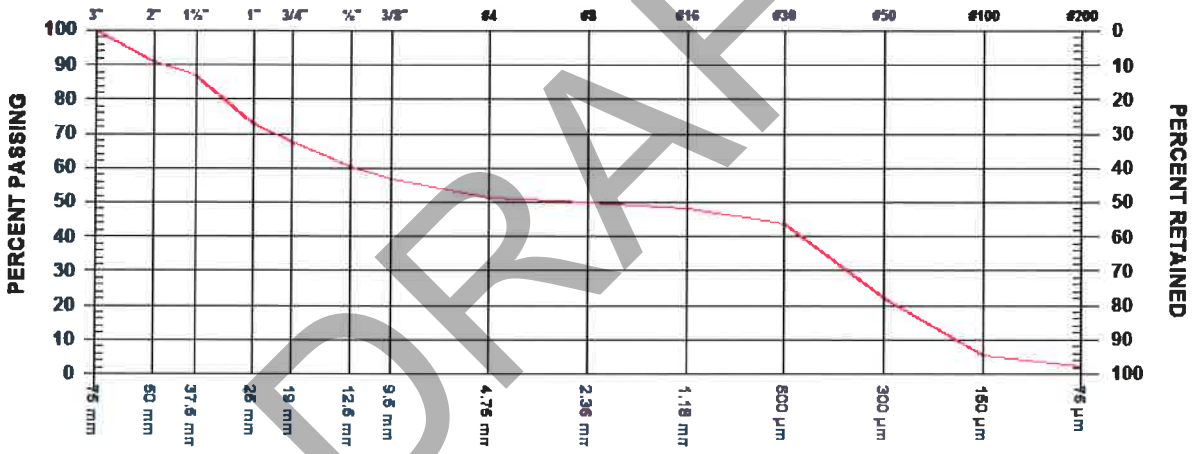
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Jasper National Park
Test Pitting Assessment — Jasper
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 5 DATE RECEIVED 20/Nov/2014 DATE TESTED 24/Nov/2014 DATE SAMPLED 13/Nov/2014

SUPPLIER Kerkesin Pit TP14-06
SOURCE SA5: 0 to 3.0 m
SPECIFICATION
MATERIAL TYPE Gravel and Sand with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	90.8	
1 1/2"	37.5 mm	87.0	
1"	25 mm	73.2	
3/4"	19 mm	67.5	
1/2"	12.5 mm	60.2	
3/8"	9.5 mm	56.7	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	51.2	
No. 8	2.36 mm	50.0	
No. 16	1.18 mm	48.1	
No. 30	600 µm	43.7	
No. 50	300 µm	22.1	
No. 100	150 µm	5.4	
No. 200	75 µm	2.4	

MOISTURE CONTENT 4.1%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER.

McElhanney

Project No.	2511-00537-00	Client:	Parks Canada
Pit:	Kerkeslin Pit	Date Sampled:	October 13-14, 2014
Product:	Pit Run	Date Rec'd:	
T.P.	14-05 Sample #: 4	Date Tested:	December 8, 2014

BULK RELATIVE DENSITY OF AGGREGATE

COARSE AGGREGATE

BULK RELATIVE DENSITY	2.654
PERCENT WATER ABSORPTION	0.57

FINE AGGREGATE

BULK RELATIVE DENSITY	2.524
PERCENT WATER ABSORPTION	2.65

McElhanney

MICRO-DEVAL ASTM D6928

Project No. 2511-00537-00
Pit: Kerkeslin Pit
Product: Pit Run
T.P. 14-05 Sample #: 4
Technician: R.Fenske

Client: Parks Canada
Date Sampled: October 13-14, 2014
Date Rec'd:
Date Tested: December 10, 2014

Passing		Retained		"A" Grading (3/4"-)		"B" Grading (1/2"-)		"C" Grading (3/8"-)	
mm	Inches	mm	Inches	Required	Actual	Required	Actual	Required	Actual
19.0	3/4	16.0	5/8	375 g	375.2				
16.0	5/8	12.5	1.2	375 g	374.7				
12.5	1/2	9.5	3/8	750 g	750.6	750 g			
9.5	3/8	6.7	0.265			375 g	0.0	750 g	0.0
6.7	0.265	4.75	# 4			375 g	0.0	750 g	0.0
				Total	1500.5		0.0		0.0

Max Size Aggregate Used

Intital Sample Weight (A) 1500.5
Final Sample Weight (C) 1417.6
Pan Weight (B) 445.6

Percent Loss **5.5%**

McElhanney

Project No.	2511-00537-00	Client:	Parks Canada
Pit:	Kerkeslin Pit	Date Sampled:	October 13-14, 2014
Product:	Pit Run	Date Rec'd:	
T.P.	14-06 Sample #: 5	Date Tested:	December 6, 2014

BULK RELATIVE DENSITY OF AGGREGATE

COARSE AGGREGATE

BULK RELATIVE DENSITY	2.657
PERCENT WATER ABSORPTION	0.45

FINE AGGREGATE

BULK RELATIVE DENSITY	2.583
PERCENT WATER ABSORPTION	1.54

McElhanney

MICRO-DEVAL ASTM D6928

Project No.	2511-00537-00	**Client:**	Parks Canada
Pit:	Kerkeslin Pit	**Date Sampled:**	October 13-14, 2014
Product:	Pit Run	**Date Rec'd:**	
T.P.	14-06 Sample #: 5	**Date Tested:**	December 10, 2014
Technician:	R.Fenske		

Passing		Retained		"A" Grading (3/4"-)		"B" Grading (1/2"-)		"C" Grading (3/8"-)	
mm	Inches	mm	Inches	Required	Actual	Required	Actual	Required	Actual
19.0	3/4	16.0	5/8	375 g	374.9				
16.0	5/8	12.5	1.2	375 g	375.3				
12.5	1/2	9.5	3/8	750 g	750.6	750 g			
9.5	3/8	6.7	0.265			375 g	0.0	750 g	0.0
6.7	0.265	4.75	# 4			375 g	0.0	750 g	0.0
				Total	1500.8		0.0		0.0

Max Size Aggregate Used

Intital Sample Weight (A)	1500.8
Final Sample Weight (C)	1416.9
Pan Weight (B)	413.0
Percent Loss	**5.6%**

APPENDIX C: 8 MILE PIT

Test Pit Summary Logs

Charts C1 to C4

Laboratory Test Results

AGGREGATE LOG

Project No: 2511-00537-00
Project: Jasper National Park Gravel Assessment
Location: **8** Mile Pit

Contractor: Okanagan Aggregates Ltd.
Excavator: CAT 320DL
Weather: Sunny, - 15C, snow cover

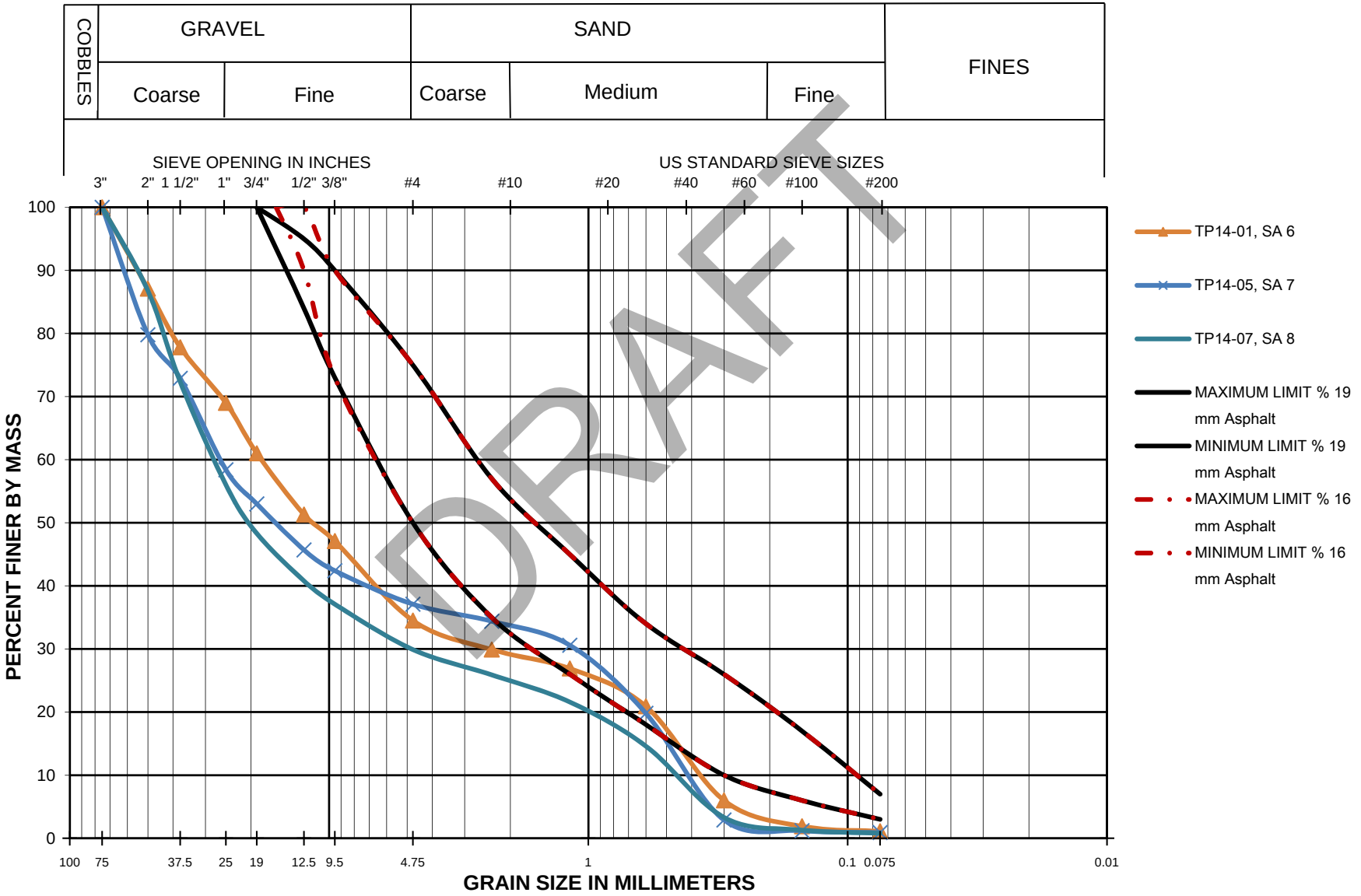
Date: November 13, 2014
Logged By: S.Carlson, PEng

Test Pit Number	Sample Number	Depth (m)		Layer Thickness (m)	Field Classification	Field Estimate Gradation (%)			Field Estimate Oversize (%)			Max Size (mm)	Water Table (m)	Sand Size (F,M,C)	Lab Clasfication	Laboratory Test Gradation (%)			Comments
		From	To			Fines	Sand	Gravel	75-150	150-300	>300 mm					Fines	Sand	Gravel	
TP14-01	6	0	2.5	2.5	GP	4	30	66	20	10	-	300		M,C	GP	1	33	66	Some sloughing.
		2.5	3.6	1.1	GP	4	35	61	15	5	-	300	3.5	M,C					Moderate seepage.
TP14-02	-	0	4.0	4.0	GP	4	30	66	20	10	2	350	-	M,C					
TP14-03	-	0	1.0	1.0	CB	-	-	100	80	30	2	350	-	-					
		1.0	2.0	1.0	GP	4	30	66	20	10	-	300	-	-					
TP14-04	-	0	0.1	0.1	OL	-	-	-	-	-	-	-	-	-					Forest litter, roots.
	-	0.1	3.5	3.4	GP	4	35	61	20	10	2	350	-	M,C					
TP14-05	-	0	0.1	0.1	OL	-	-	-	-	-	-	-	-	-					
	7	0.1	3.5	3.4	GP	4	35	61	20	10	2	350	-	M,C	GP	1	36	63	
TP14-06	-	0	1.5	1.5	GP	4	30	66	25	10	3	600	-	M,C					Placed fill, some organics.
TP14-07	-	0	0.1	0.1	OL	-	-	-	-	-	-	-	-	-					
	-	0.1	2.0	1.9	GP	4	30	66	30	10	-	300	-	M,C					Fill, trace asphalt.
	8	2.0	4.0	2.0	GP	4	35	61	25	-	-	150	-	M,C	GP	1	29	70	Sloughing.

Notes:

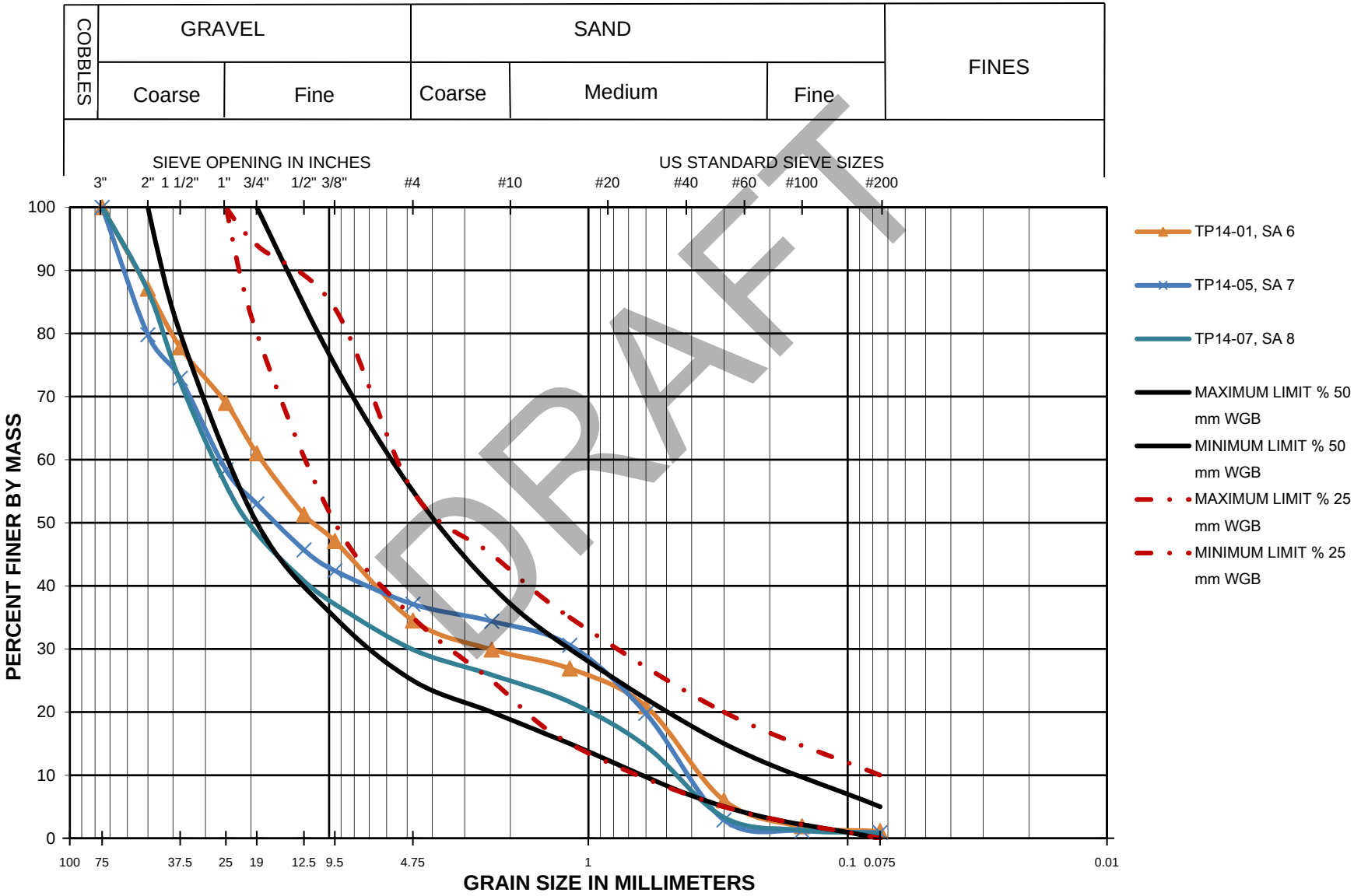
McElhanney

PARKS CANADA AGENCY
CHART C1 - LABORATORY GRADATION CURVES
8 MILE PIT - PIT RUN (MINUS 75 MM)
MOTI ASPHALT SPECIFICATIONS



McElhanney

PARKS CANADA AGENCY
CHART C2 - LABORATORY GRADATION CURVES
8 MILE PIT - PIT RUN (MINUS 75 MM)
MOTI WELL GRADED BASE SPECIFICATIONS



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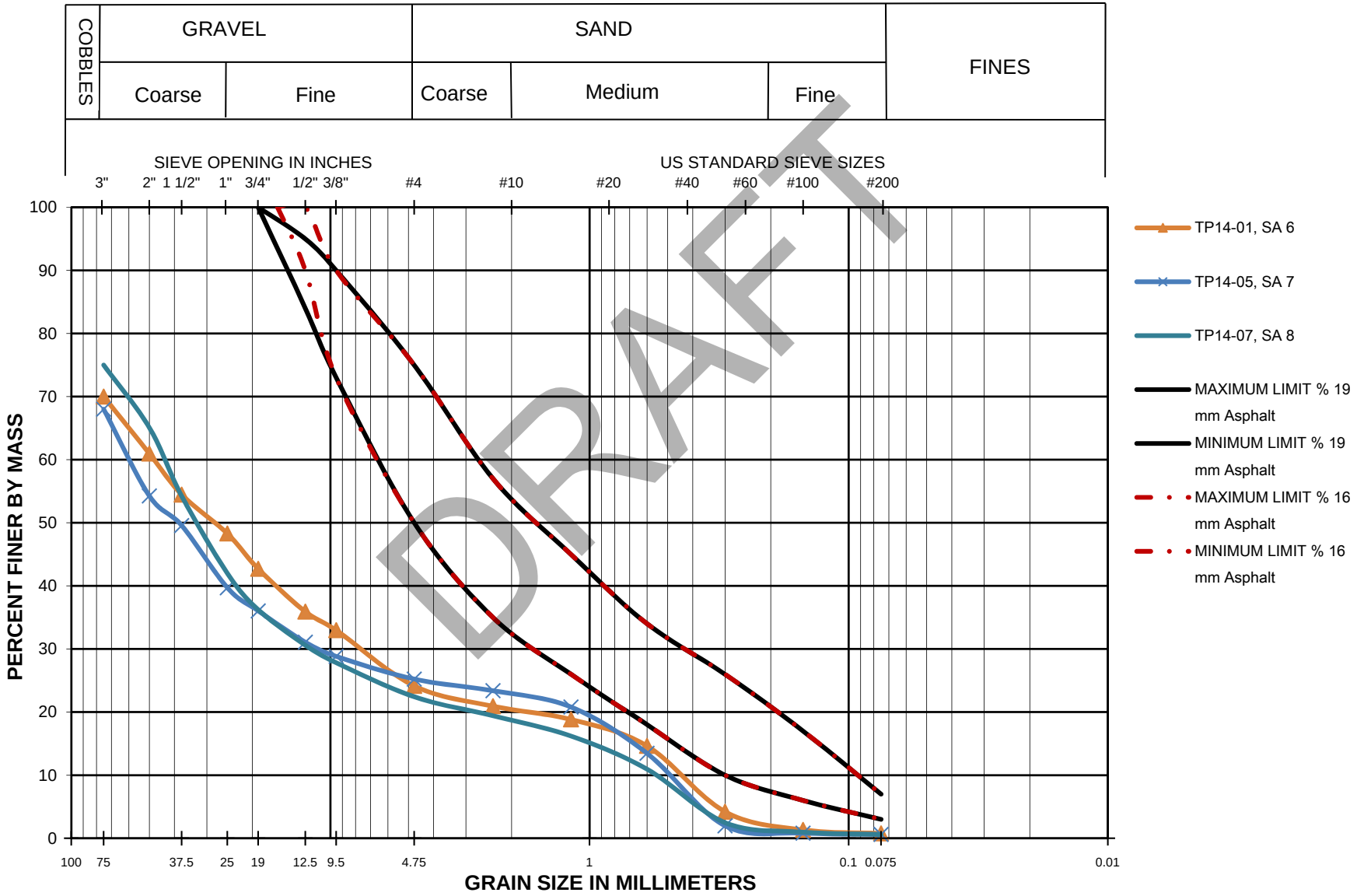
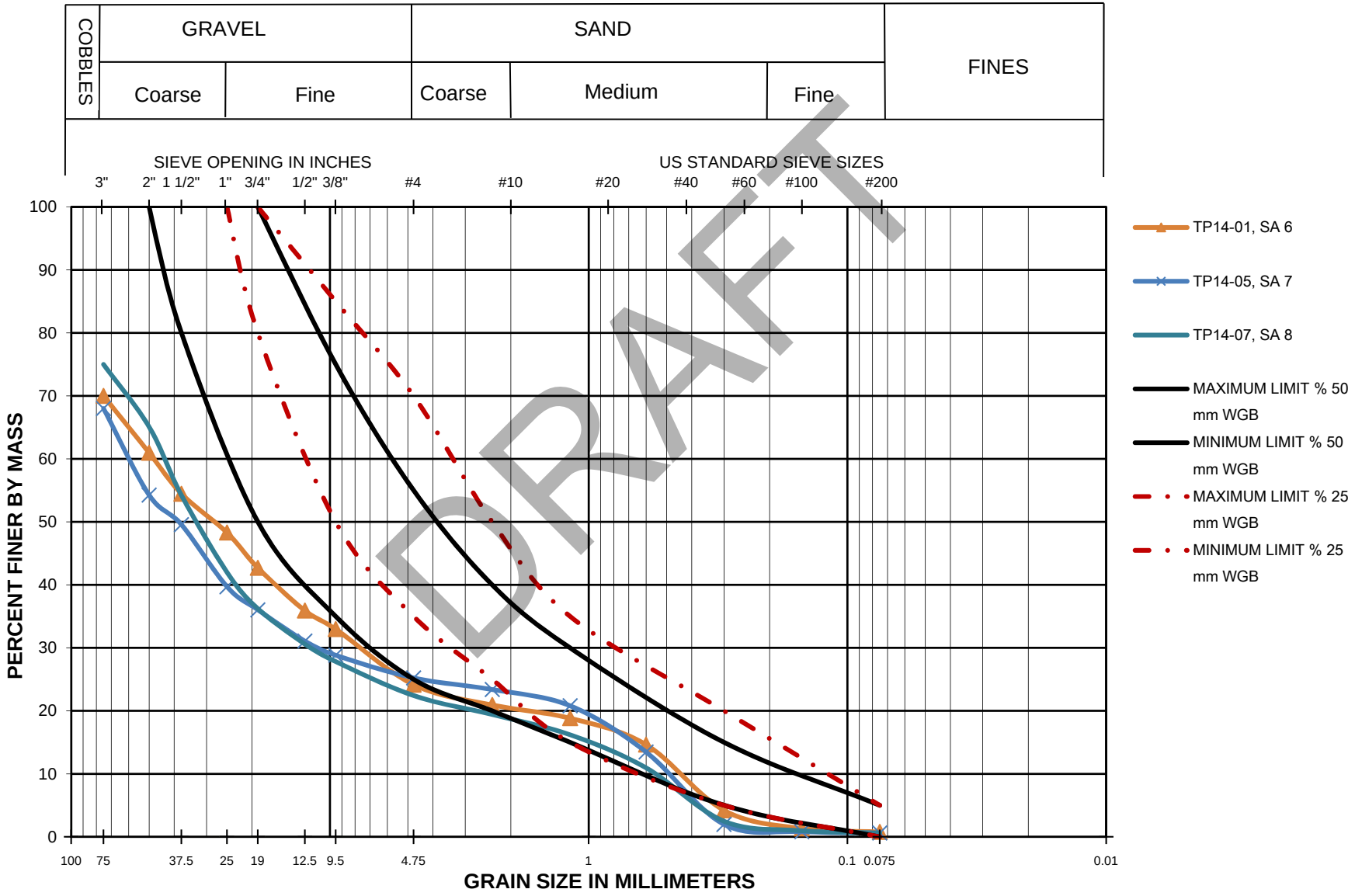
PARKS CANADA AGENCY
CHART C3 - LABORATORY GRADATION CURVES
8 MILE PIT - PIT RUN (WITH OVERSIZE)
MOTI ASPHALT SPECIFICATIONS



McElhanney

PARKS CANADA AGENCY
CHART C4 - LABORATORY GRADATION CURVES
8 MILE PIT - PIT RUN (WITH OVERSIZE)
MOTI WELL GRADED BASE SPECIFICATIONS



McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537
CLIENT Parks Canada Agency
C.C.

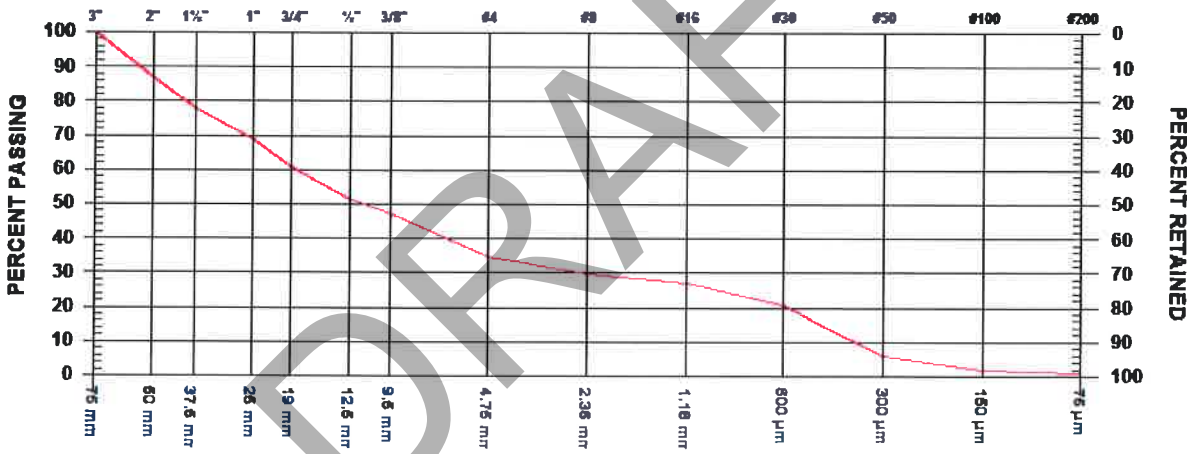
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment
Test Pitting Assessment
Jasper National Park
Jasper
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 6 DATE RECEIVED 20/Nov/2014 DATE TESTED 24/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Mile 8 Pit TP14-01
SOURCE SA6: 2.5 to 3.6 m depth
SPECIFICATION
MATERIAL TYPE Sandy Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	87.1	
1 1/2"	37.5 mm	77.8	
1"	25 mm	69.0	
3/4"	19 mm	61.0	
1/2"	12.5 mm	51.3	
3/8"	9.5 mm	47.1	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	34.5	
No. 8	2.36 mm	29.9	
No. 16	1.18 mm	26.9	
No. 30	600 µm	20.9	
No. 50	300 µm	6.0	
No. 100	150 µm	1.9	
No. 200	75 µm	1.1	

MOISTURE CONTENT 2.7%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER.

McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

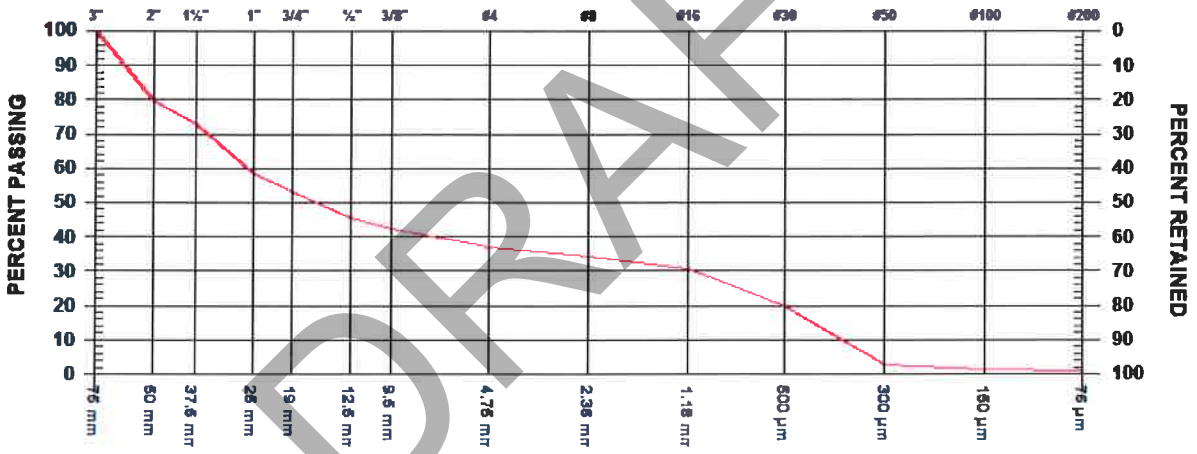
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Jasper National Park
Test Pitting Assessment — Jasper
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 7 DATE RECEIVED 20/Nov/2014 DATE TESTED 24/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Mile 8 Pit TP14-05
SOURCE SA7: 0.1 to 3.5 m depth
SPECIFICATION
MATERIAL TYPE Gravel and Sand with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	79.8	
1 1/2"	37.5 mm	72.9	
1"	25 mm	58.4	
3/4"	19 mm	53.0	
1/2"	12.5 mm	45.7	
3/8"	9.5 mm	42.4	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	37.1	
No. 8	2.36 mm	34.4	
No. 16	1.18 mm	30.6	
No. 30	600 µm	19.8	
No. 50	300 µm	2.9	
No. 100	150 µm	1.2	
No. 200	75 µm	0.9	

MOISTURE CONTENT 1.4%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER. _____

McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

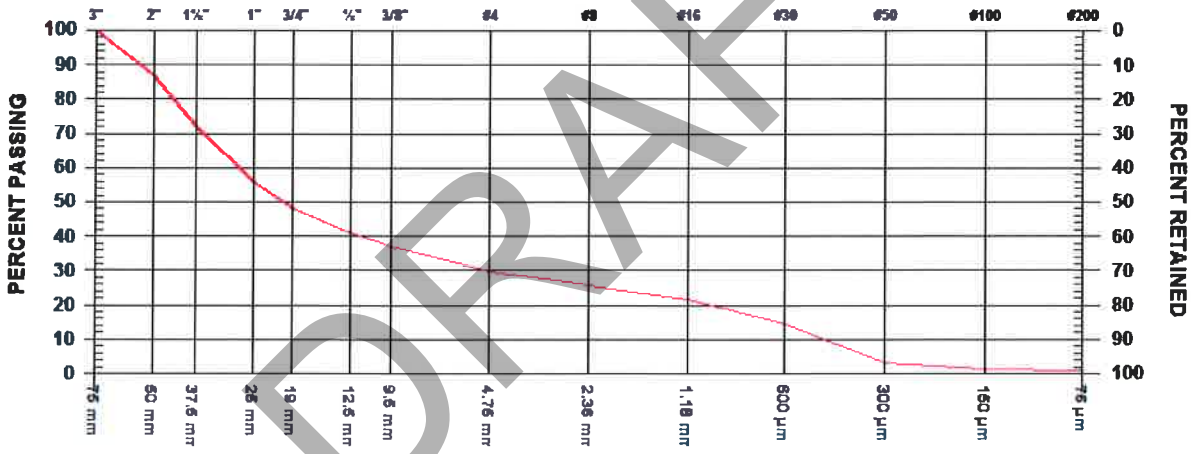
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Jasper National Park
Test Pitting Assessment — Jasper
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 8 DATE RECEIVED 20/Nov/2014 DATE TESTED 24/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Mile 8 Pit TP14-07
SOURCE SA8: 2.6 to 4.0 m depth
SPECIFICATION
MATERIAL TYPE Sandy Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	86.8	
1 1/2"	37.5 mm	72.3	
1"	25 mm	56.0	
3/4"	19 mm	48.3	
1/2"	12.5 mm	40.8	
3/8"	9.5 mm	37.1	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	29.9	
No. 8	2.36 mm	25.9	
No. 16	1.18 mm	21.6	
No. 30	600 µm	14.6	
No. 50	300 µm	3.3	
No. 100	150 µm	1.3	
No. 200	75 µm	0.8	

MOISTURE CONTENT 1.7%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER. _____

McElhanney

Project No.	2511-00537-00	Client:	Parks Canada
Pit:	8 Mile Pit	Date Sampled:	October 13-14, 2014
Product:	Pit Run	Date Rec'd:	
T.P.	14-05 Sample #: 7	Date Tested:	December 6, 2014

BULK RELATIVE DENSITY OF AGGREGATE

COARSE AGGREGATE

BULK RELATIVE DENSITY	2.666
PERCENT WATER ABSORPTION	0.40

FINE AGGREGATE

BULK RELATIVE DENSITY	2.617
PERCENT WATER ABSORPTION	1.07

McElhanney

MICRO-DEVAL ASTM D6928

Project No. 2511-00537-00
Pit: 8 Mile
Product: Pit Run
T.P. 14-05 Sample #: 7
Technician: R.Fenske

Client: Parks Canada
Date Sampled: October 13-14, 2014
Date Rec'd:
Date Tested: December 11, 2014

Passing		Retained		"A" Grading (3/4"-)		"B" Grading (1/2"-)		"C" Grading (3/8"-)	
mm	Inches	mm	Inches	Required	Actual	Required	Actual	Required	Actual
19.0	3/4	16.0	5/8	375 g	374.8				
16.0	5/8	12.5	1.2	375 g	374.8				
12.5	1/2	9.5	3/8	750 g	749.2	750 g			
9.5	3/8	6.7	0.265			375 g	0.0	750 g	0.0
6.7	0.265	4.75	# 4			375 g	0.0	750 g	0.0
				Total	1498.8		0.0		0.0

Max Size Aggregate Used

Intital Sample Weight (A) 1498.8
Final Sample Weight (C) 1433.7
Pan Weight (B) 445.6

Percent Loss **4.3%**

McElhanney

Project No.	2511-00537-00	Client:	Parks Canada
Pit:	8 Mile Pit	Date Sampled:	October 13-14, 2014
Product:	Pit Run	Date Rec'd:	
T.P.	14-07 Sample #: 8	Date Tested:	December 6, 2014

BULK RELATIVE DENSITY OF AGGREGATE

COARSE AGGREGATE

BULK RELATIVE DENSITY	2.702
PERCENT WATER ABSORPTION	0.50

FINE AGGREGATE

BULK RELATIVE DENSITY	2.586
PERCENT WATER ABSORPTION	1.61

McElhanney

MICRO-DEVAL ASTM D6928

Project No. 2511-00537-00
Pit: 8 Mile
Product: Pit Run
T.P. 14-07 Sample #: 8
Technician: R.Fenske

Client: Parks Canada
Date Sampled: October 13-14, 2014
Date Rec'd:
Date Tested: December 11, 2014

Passing		Retained		"A" Grading (3/4"-)		"B" Grading (1/2"-)		"C" Grading (3/8"-)	
mm	Inches	mm	Inches	Required	Actual	Required	Actual	Required	Actual
19.0	3/4	16.0	5/8	375 g	375.0				
16.0	5/8	12.5	1.2	375 g	374.9				
12.5	1/2	9.5	3/8	750 g	749.9	750 g			
9.5	3/8	6.7	0.265			375 g	0.0	750 g	0.0
6.7	0.265	4.75	# 4			375 g	0.0	750 g	0.0
				Total	1499.8		0.0		0.0

Max Size Aggregate Used

Intital Sample Weight (A) 1499.8
Final Sample Weight (C) 1427.7
Pan Weight (B) 445.6

Percent Loss **4.8%**

APPENDIX D: ROCHE MIETTE PIT

Test Pit Summary Logs

AGGREGATE LOG

Project No: 2511-00537-00
Project: Jasper National Park Gravel Assessment
Location: Roche Miette

Contractor: Okanagan Aggregates Ltd.
Excavator: CAT 320DL
Weather: ~ -20, snow cover

Date: November 13, 2014
Logged By: S.Carlson, PEng

Test Pit Number	Sample Number	Depth (m)		Layer Thickness (m)	Field Classification	Field Estimate Gradation (%)			Field Estimate Oversize (%)			Max Size (mm)	Water Table (m)	Sand Size (F,M,C)	Lab Clasfication	Laboratory Test Gradation (%)			Comments
		From	To			Fines	Sand	Gravel	75-150	150-300	>300 mm					Fines	Sand	Gravel	
TP14-01	-	0	1.0	1.0	GP-GM	5	45	50	-	-	-	75	-	M					Fill
	-	1.0	3.0	2.0	CL	-	-	-	-	-	-	-	-	-					
TP14-02	-	0	0.3	0.3	OL	-	-	-	-	-	-	-	-	-					
	-	0.3	3	2.7	GM	15	35	50	5	-	-	-	-	M					Organic odour.
TP14-03	-	0	0.2	0.2	OL	-	-	-	-	-	-	-	-	-					Grass.
	-	0.2	2.5	2.3	GM	15	35	50	5	-	-	-	-	M					Organic odour.

Notes:

APPENDIX E: PIT 11 (DAVID THOMPSON PIT)

Test Pit Summary Logs

Charts E1 to E4

Laboratory Test Results

AGGREGATE LOG

Project No: 2511-00537-00
Project: Jasper National Park Gravel Assessment
Location: Pit 11 (David Thompson Pit)

Contractor: Okanagan Aggregates Ltd.
Excavator: CAT 320DL
Weather: ~ -20, snow cover

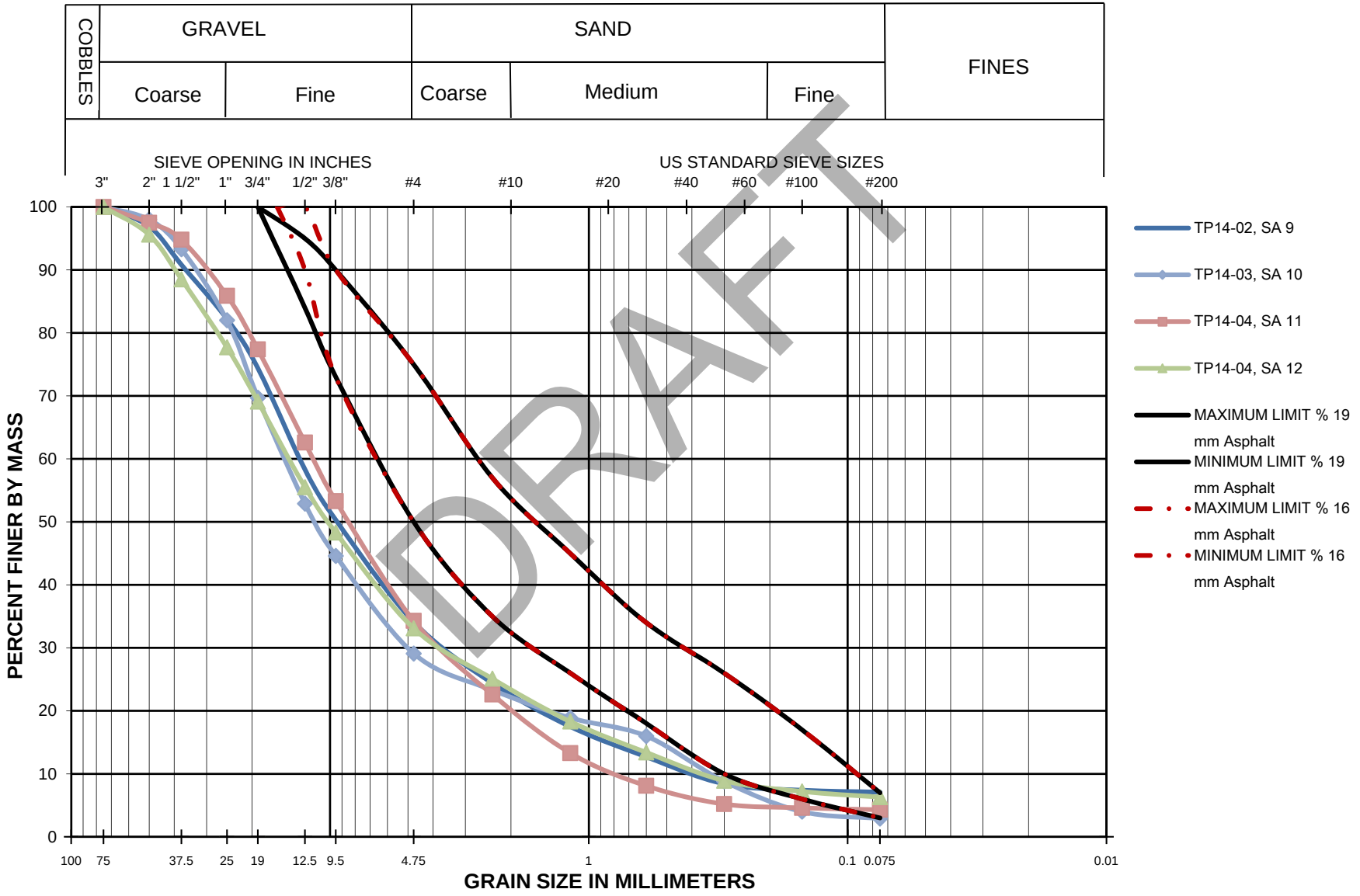
Date: November 13, 2014
Logged By: S.Carlson, PEng

Test Pit Number	Sample Number	Depth (m)		Layer Thickness (m)	Field Classification	Field Estimate Gradation (%)			Field Estimate Oversize (%)			Max Size (mm)	Water Table (m)	Sand Size (F,M,C)	Lab Clasfication	Laboratory Test Gradation (%)			Comments
		From	To			Fines	Sand	Gravel	75-150	150-300	>300 mm					Fines	Sand	Gravel	
TP14-01	-	0	4.0	4.0	GP-GC	10	38	52	5	2	1	400	-	M,C					Rocks are clay coated.
TP14-02	-	0	0.2	0.2	OL	-	-	-	-	-	-	-	-	-					
	9	0.2	4.2	4.0	GP-GC	10	36	54	5	2	-	300	4.2	M,C	GP-GM	7	27	66	Thin clay lenses, rocks clay coated.
TP14-03	10	0	4.0	4.0	GP-GC	5	40	55	3	1	-	200	-	M,C	GP	3	26	71	Rounded rocks. Occasional clay lenses.
TP14-04	-	0	0.6	0.6	ML	-	-	-	-	-	-	-	-	-					Overburden, rootlets.
	11	0.6	3.0	2.4	GP-GM	7	38	55	5	1	-	200	-	M,C	GP	4	30	66	Rounded rock.
TP14-05	12	0	3.5	3.5	GP	5	40	55	7	2	-	200	-	M,C	GP-GM	6	27	67	Rounded rock. Gravel becomes finer with depth.
TP14-05B	-	0	0.3	0.3	OL	-	-	-	-	-	-	-	-	-					Organics, roots.
	-	0.3	2.5	2.2	GP	5	38	57	10	2	-	300	-	C					
TP14-06	-	0	0.3	0.3	ML	-	-	-	-	-	-	-	-	-					Overburden, roots, wood debris.
		0.3	1.3	1.0	GM	-	-	-	-	-	-	-	-	-					Fill, wood debris.
		1.3	2.3	1.0	GP-GM	5	38	57	-	-	-	-	-	-					Rocks are clay coated.
		2.3	3.0	0.7	GP-GC	12	37	51	-	-	-	-	-	-					

Notes:

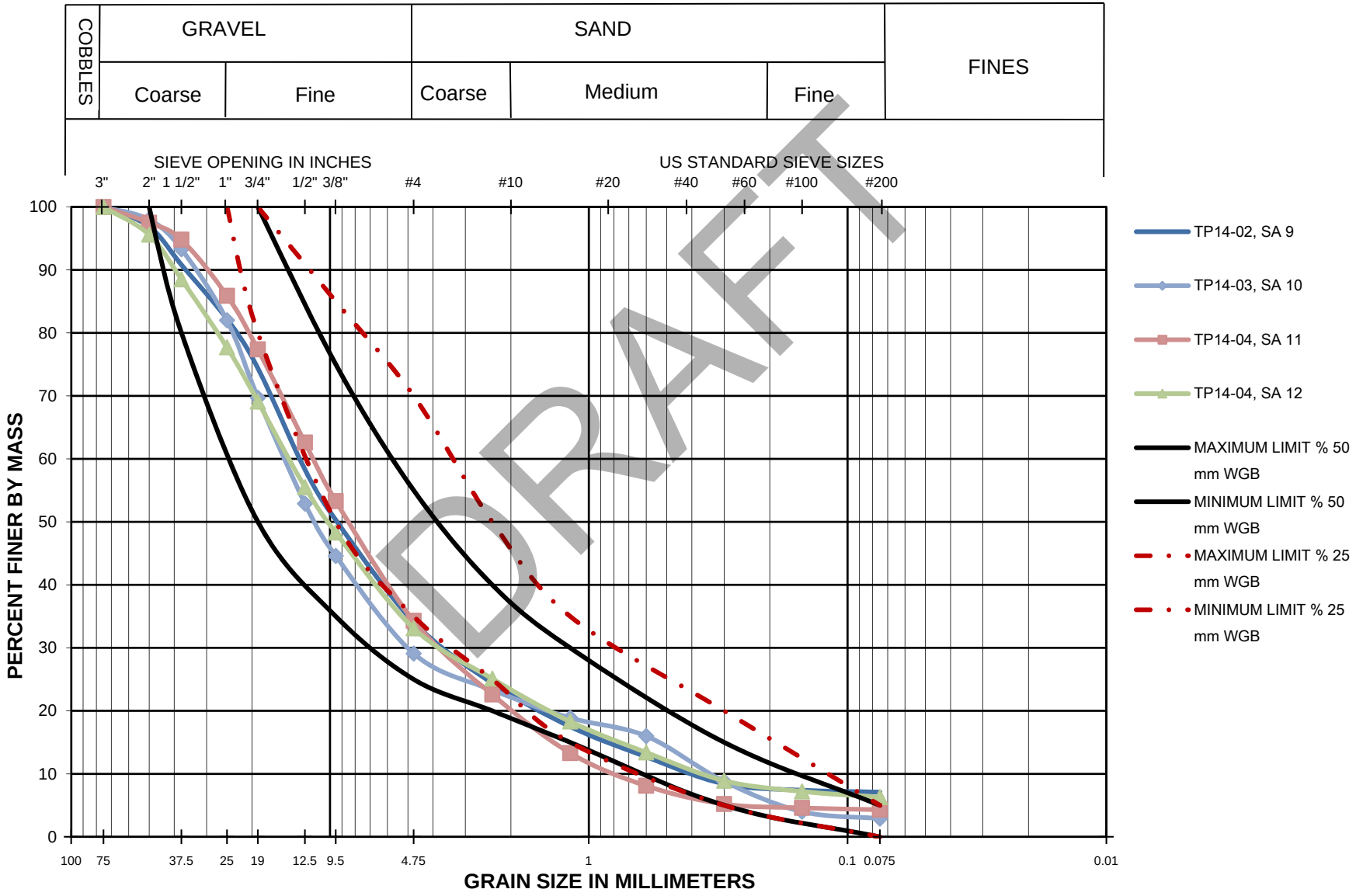
McElhanney

PARKS CANADA AGENCY
CHART E1 - LABORATORY GRADATION CURVES
PIT 11 - PIT RUN (MINUS 75 MM)
MOTI ASPHALT SPECIFICATIONS



McElhanney

PARKS CANADA AGENCY
CHART E2 - LABORATORY GRADATION CURVES
PIT 11 (DAVID THOMPSON) - PIT RUN (MINUS 75 MM)
MOTI WELL GRADED BASE SPECIFICATIONS



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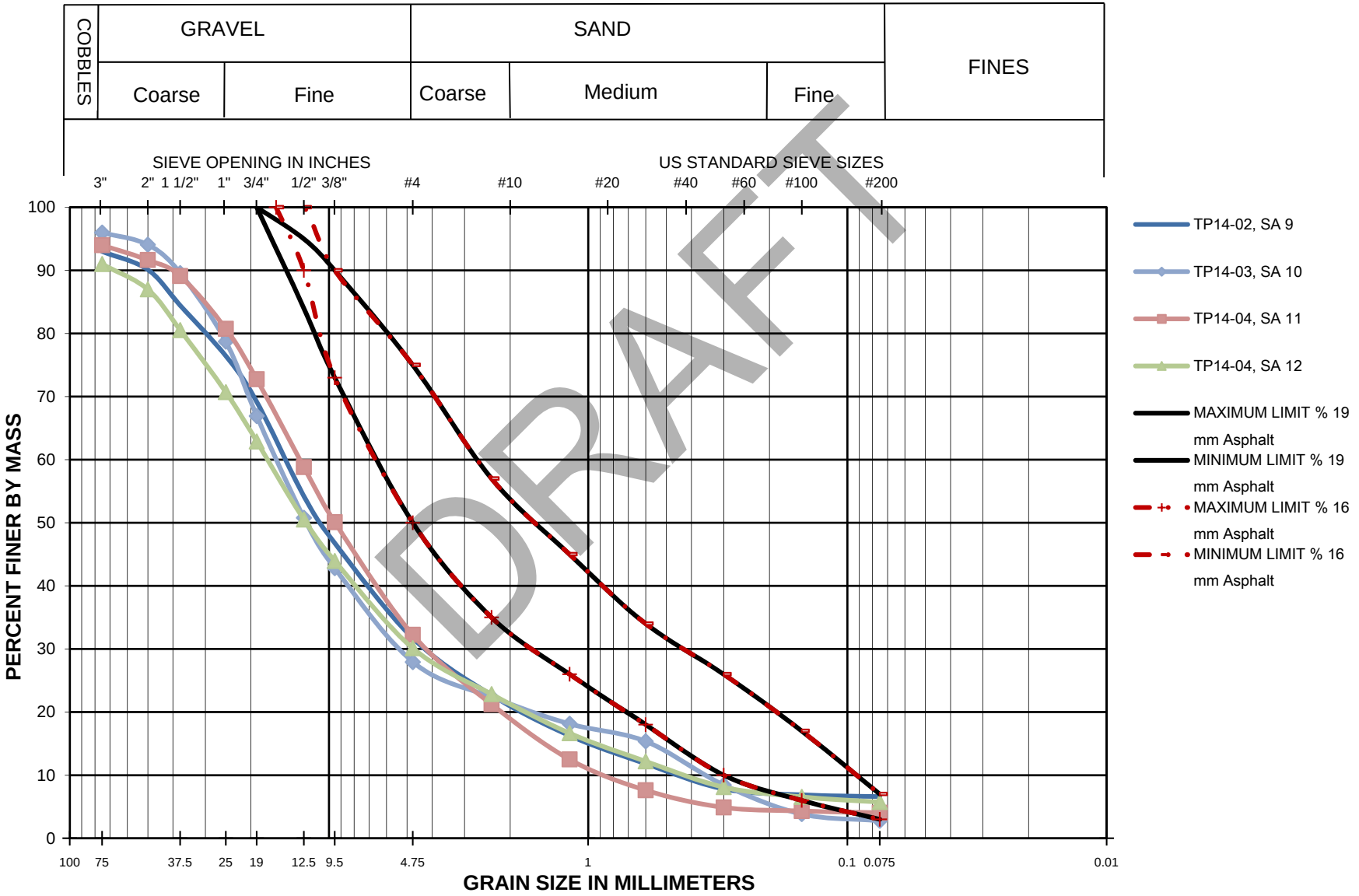
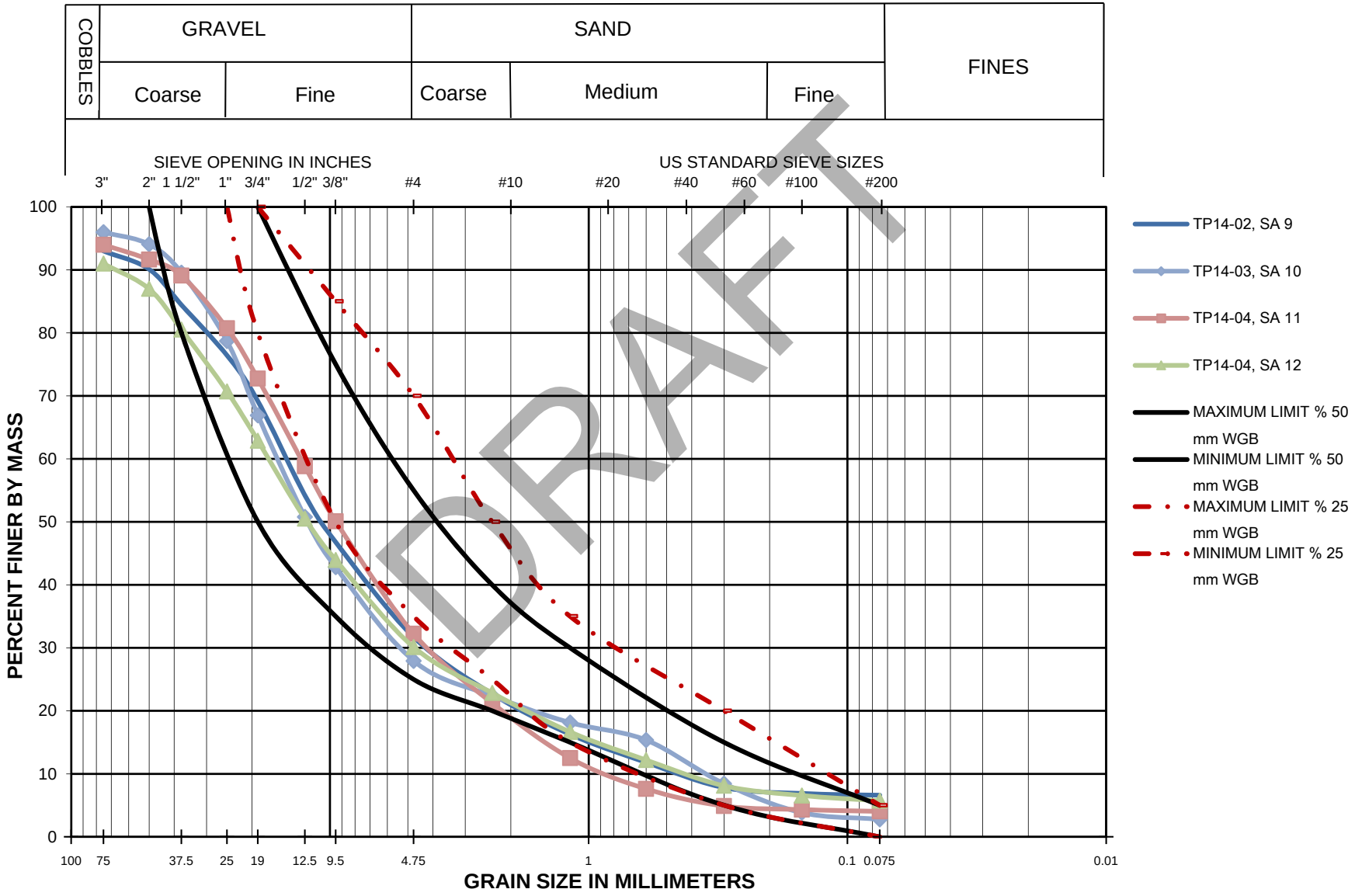
PARKS CANADA AGENCY
CHART E3 - LABORATORY GRADATION CURVES
PIT 11 (DAVID THOMPSON) - PIT RUN (WITH OVERSIZE)
MOTI ASPHALT SPECIFICATIONS



McElhanney

PARKS CANADA AGENCY
CHART E4 - LABORATORY GRADATION CURVES
PIT 11 (DAVID THOMPSON) - PIT RUN (WITH OVERSIZE)
MOTI WELL GRADED BASE SPECIFICATIONS



McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

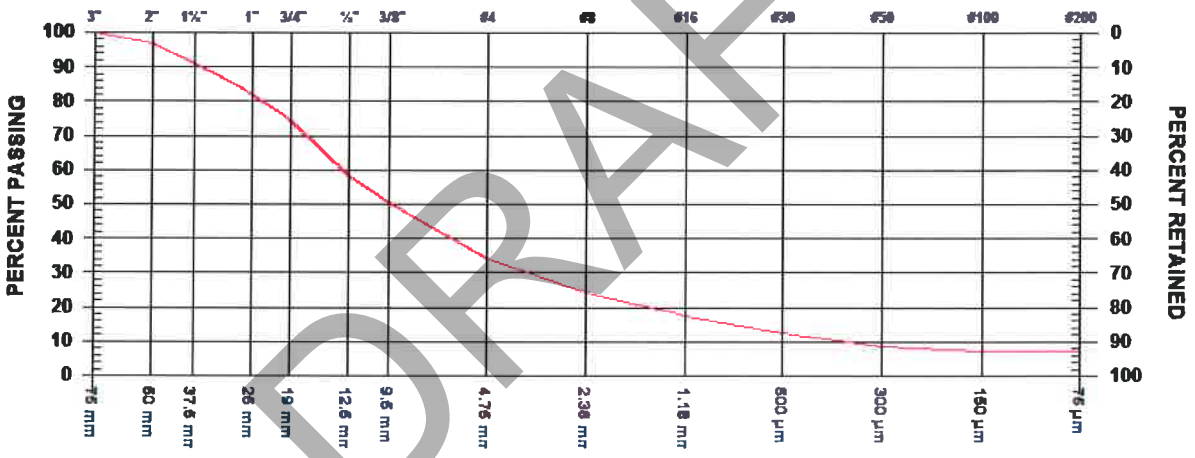
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Banff National Park
Test Pitting Assessment — Highway 11
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 9 DATE RECEIVED 20/Nov/2014 DATE TESTED 25/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Pit 11 TP14-02
SOURCE SA 9: 0.2 m depth
SPECIFICATION
MATERIAL TYPE Sandy Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	96.9	
1 1/2"	37.5 mm	90.8	
1"	25 mm	82.2	
3/4"	19 mm	74.4	
1/2"	12.5 mm	58.3	
3/8"	9.5 mm	50.3	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	34.1	
No. 8	2.36 mm	24.4	
No. 16	1.18 mm	17.5	
No. 30	600 µm	12.7	
No. 50	300 µm	8.4	
No. 100	150 µm	7.4	
No. 200	75 µm	7.1	

MOISTURE CONTENT 2.6%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER.

McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

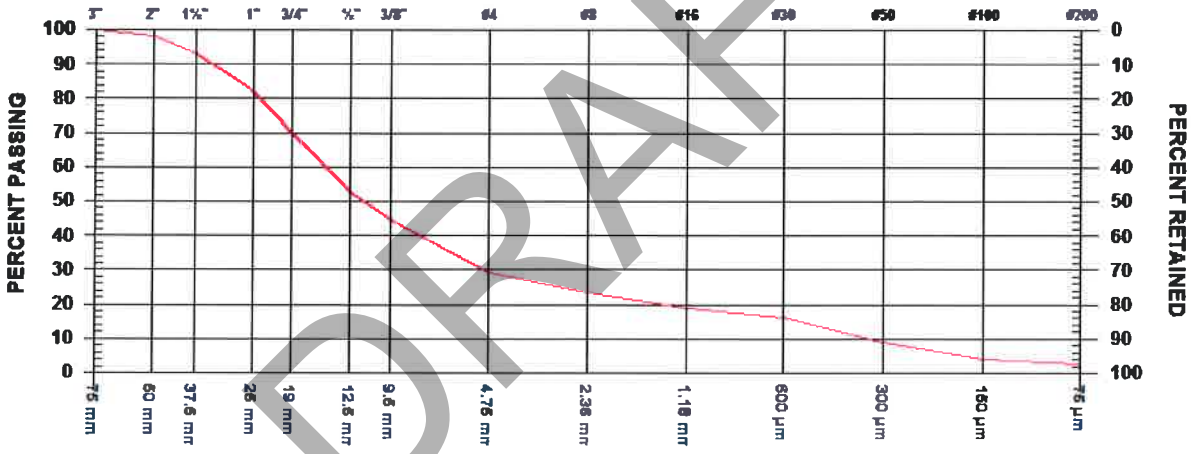
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Banff National Park
Test Pitting Assessment — Highway 11
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 10 DATE RECEIVED 20/Nov/2014 DATE TESTED 25/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Pit 11 TP14-03
SOURCE SA10: 0 to 4.0 m depth
SPECIFICATION
MATERIAL TYPE Sandy Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	98.0	
1 1/2"	37.5 mm	93.3	
1"	25 mm	82.0	
3/4"	19 mm	69.7	
1/2"	12.5 mm	52.9	
3/8"	9.5 mm	44.6	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	29.1	
No. 8	2.36 mm	23.3	
No. 16	1.18 mm	18.9	
No. 30	600 µm	16.0	
No. 50	300 µm	8.8	
No. 100	150 µm	4.0	
No. 200	75 µm	2.9	

MOISTURE CONTENT 1.9%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER. _____

McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

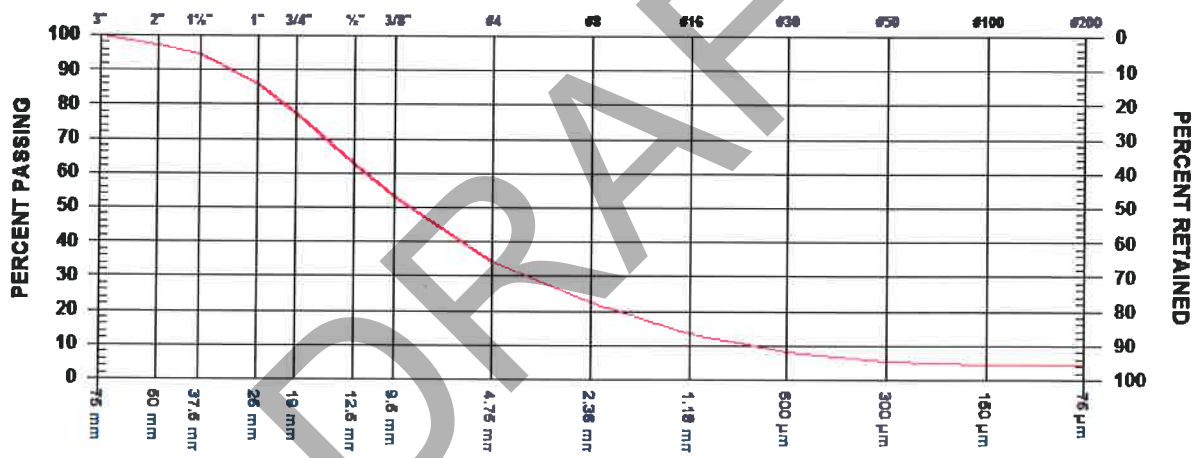
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Banff National Park
Test Pitting Assessment — Highway 11
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 11 DATE RECEIVED 20/Nov/2014 DATE TESTED 25/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Pit 11 TP14-04
SOURCE SA11: 0.6 to 3.0 m depth
SPECIFICATION
MATERIAL TYPE Sandy Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	97.5	
1 1/2"	37.5 mm	94.8	
1"	25 mm	85.9	
3/4"	19 mm	77.4	
1/2"	12.5 mm	62.6	
3/8"	9.5 mm	53.3	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	34.3	
No. 8	2.36 mm	22.6	
No. 16	1.18 mm	13.3	
No. 30	600 µm	8.1	
No. 50	300 µm	5.2	
No. 100	150 µm	4.6	
No. 200	75 µm	4.3	

MOISTURE CONTENT 3.4%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER.

McElhanney Consulting Services Ltd.
3907 4th Avenue
Smithers, BC V0J 2N0

SIEVE ANALYSIS REPORT
8 16 30 50 SERIES

PROJECT NO. 2511-00537-00
CLIENT Parks Canada Agency
C.C.

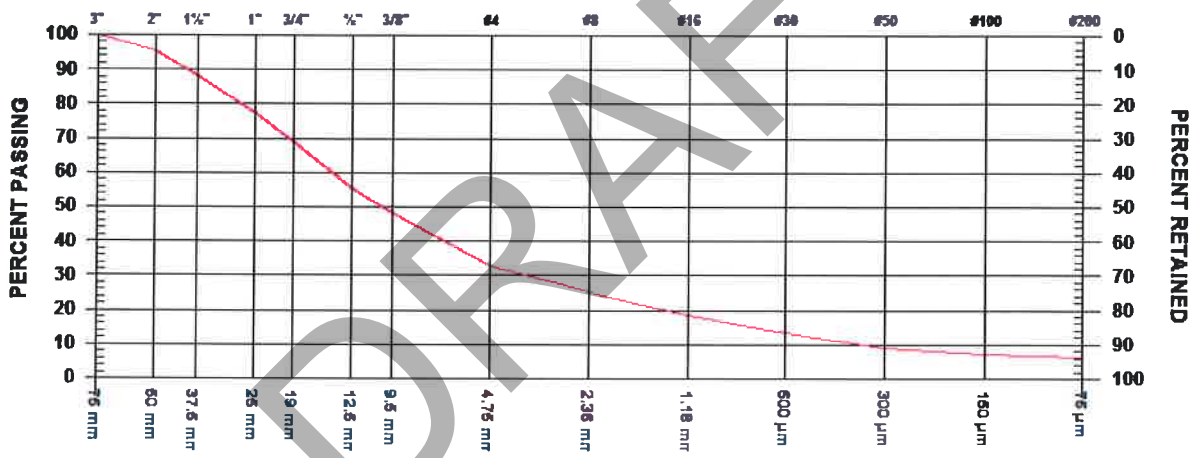
TO
Parks Canada Agency
Highway Services Centre
Banff National Park Compound
240 Hawk Avenue, Banff, AB
T1L 1K2

PROJECT Asphalt Aggregate Resource Assessment — Banff National Park
Test Pitting Assessment — Highway 11
CONTRACTOR Okanagan Aggregates Ltd.

SIEVE TEST NO. 12 DATE RECEIVED 20/Nov/2014 DATE TESTED 25/Nov/2014 DATE SAMPLED 13/Oct/2014

SUPPLIER Pit 11 TP14-05
SOURCE SA12: 0 to 4.5 m depth
SPECIFICATION
MATERIAL TYPE Sandy Gravel with Trace Fines

SAMPLED BY SC
TESTED BY LB
TEST METHOD WASHED



GRAVEL SIZES		PERCENT PASSING	GRADATION LIMITS
3"	75 mm	100.0	
2"	50 mm	95.6	
1 1/2"	37.5 mm	88.5	
1"	25 mm	77.7	
3/4"	19 mm	69.1	
1/2"	12.5 mm	55.5	
3/8"	9.5 mm	48.3	

SAND SIZES AND FINES		PERCENT PASSING	GRADATION LIMITS
No. 4	4.75 mm	33.1	
No. 8	2.36 mm	25.1	
No. 16	1.18 mm	18.3	
No. 30	600 µm	13.4	
No. 50	300 µm	8.9	
No. 100	150 µm	7.2	
No. 200	75 µm	6.3	

MOISTURE CONTENT 2.6%

COMMENTS
Materials 75 mm and larger not included in laboratory analysis. Tested as per ASTM C117 and C136 standards.

 06/Jan/2015 McElhanney Consulting Services Ltd. PER.

McElhanney

Project No.	2511-00537-00	Client:	Parks Canada
Pit:	Pit 11 (David Thompson)	Date Sampled:	October 13-14, 2014
Product:	Pit Run	Date Rec'd:	
T.P.	14-03 Sample #: 10	Date Tested:	December 7, 2014

BULK RELATIVE DENSITY OF AGGREGATE

COARSE AGGREGATE

BULK RELATIVE DENSITY	2.742
PERCENT WATER ABSORPTION	0.54

FINE AGGREGATE

BULK RELATIVE DENSITY	2.588
PERCENT WATER ABSORPTION	2.44

McElhanney

MICRO-DEVAL ASTM D6928

Project No. 2511-00537-00
Pit: Pit 11 (David Thompson Pit)
Product: Pit Run
T.P. 14-03 Sample #: 10
Technician: R.Fenske

Client: Parks Canada
Date Sampled: October 13-14, 2014
Date Rec'd:
Date Tested: December 7, 2014

Passing		Retained		"A" Grading (3/4"-)		"B" Grading (1/2"-)		"C" Grading (3/8"-)	
mm	Inches	mm	Inches	Required	Actual	Required	Actual	Required	Actual
19.0	3/4	16.0	5/8	375 g	374.7				
16.0	5/8	12.5	1.2	375 g	374.5				
12.5	1/2	9.5	3/8	750 g	750.3	750 g			
9.5	3/8	6.7	0.265			375 g	0.0	750 g	0.0
6.7	0.265	4.75	# 4			375 g	0.0	750 g	0.0
				Total	1499.5		0.0		0.0

Max Size Aggregate Used

Intital Sample Weight (A) 1499.5
Final Sample Weight (C) 1394.5
Pan Weight (B) 445.6

Percent Loss **7.0%**

McElhanney

Project No.	2511-00537-00	Client:	Parks Canada
Pit:	Pit 11 (David Thompson)	Date Sampled:	October 13-14, 2014
Product:	Pit Run	Date Rec'd:	
T.P.	14-05 Sample #: 12	Date Tested:	December 10, 2014

BULK RELATIVE DENSITY OF AGGREGATE

COARSE AGGREGATE

BULK RELATIVE DENSITY	2.712
PERCENT WATER ABSORPTION	0.75

FINE AGGREGATE

BULK RELATIVE DENSITY	2.578
PERCENT WATER ABSORPTION	2.50

McElhanney

MICRO-DEVAL ASTM D6928

Project No.	2511-00537-00	**Client:**	Parks Canada
Pit:	Pit 11 (David Thompson Pit)	**Date Sampled:**	October 13-14, 2014
Product:	Pit Run	**Date Rec'd:**	
T.P.	14-05 Sample #: 12	**Date Tested:**	December 7, 2014
Technician:	R.Fenske		

Passing		Retained		"A" Grading (3/4"-)		"B" Grading (1/2"-)		"C" Grading (3/8"-)	
mm	Inches	mm	Inches	Required	Actual	Required	Actual	Required	Actual
19.0	3/4	16.0	5/8	375 g	374.9				
16.0	5/8	12.5	1.2	375 g	375.1				
12.5	1/2	9.5	3/8	750 g	750.1	750 g			
9.5	3/8	6.7	0.265			375 g	0.0	750 g	0.0
6.7	0.265	4.75	# 4			375 g	0.0	750 g	0.0
				Total	1500.1		0.0		0.0

Max Size Aggregate Used

Intital Sample Weight (A)	1500.1
Final Sample Weight (C)	1365.4
Pan Weight (B)	442.9
Percent Loss	**9.0%**

APPENDIX F: MOTI UNIFIED SOILS CLASSIFICATION LEGEND

MATERIALS CLASSIFICATION LEGEND

MAJOR DIVISIONS		SYMBOL	SOIL TYPE
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	WELL GRADED GRAVELS OR GRAVEL–SAND MIXTURES, < 5% FINES
		GP	POORLY–GRADED GRAVELS OR GRAVEL–SAND MIXTURES, < 5% FINES
		GM*	SILTY GRAVELS, GRAVEL–SAND–SILT MIXTURES
		GC*	CLAYEY GRAVELS, GRAVEL–SAND–CLAY MIXTURES
	SAND AND SANDY SOILS	SW	WELL–GRADED SANDS OR GRAVELLY SANDS, < 5% FINES
		SP	POORLY–GRADED SANDS OR GRAVELLY SANDS, < 5% FINES
		SM*	SILTY SANDS SAND–SILT MIXTURES
		SC*	CLAYEY SANDS SAND–CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS w_L <50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS AND ORGANIC SILT–CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS w_L >50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, PLASTIC SILTS
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
ORGANIC SOILS		Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS
TOPSOIL		TS	TOPSOIL WITH ROOTS, ETC.
COBBLES		SB	ROCK FRAGMENTS AND COBBLES, PARTICLE SIZE 75mm TO 300mm
LARGE BOULDERS		LB	BOULDERS, PARTICLE SIZE OVER 300mm
BEDROCK		BR	BEDROCK

FOR SOILS HAVING 5 – 12% PASSING .075 SIEVE, USE DUAL SYMBOL

*GM1; GC1; SM1; SC1; 12 – 20%
GM2; GC2; SM2; SC2; 20 – 30%
GM3; GC3; SM3; SC3; 30 – 40%
GM4; GC4; SM4; SC4; 40 – 50%

} PASSING .075mm SIEVE

REV. 90–04–26