SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

ASTM C 136 / C 117

Golder Associates

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
Suite 310 - 1500 Woolridge St
Coquitlam, BC, V3K 0B8

April 7, 2016
Project Number: 14-1417-0009-3130

ATTENTION: Mr. Terence Lai, M.Sc

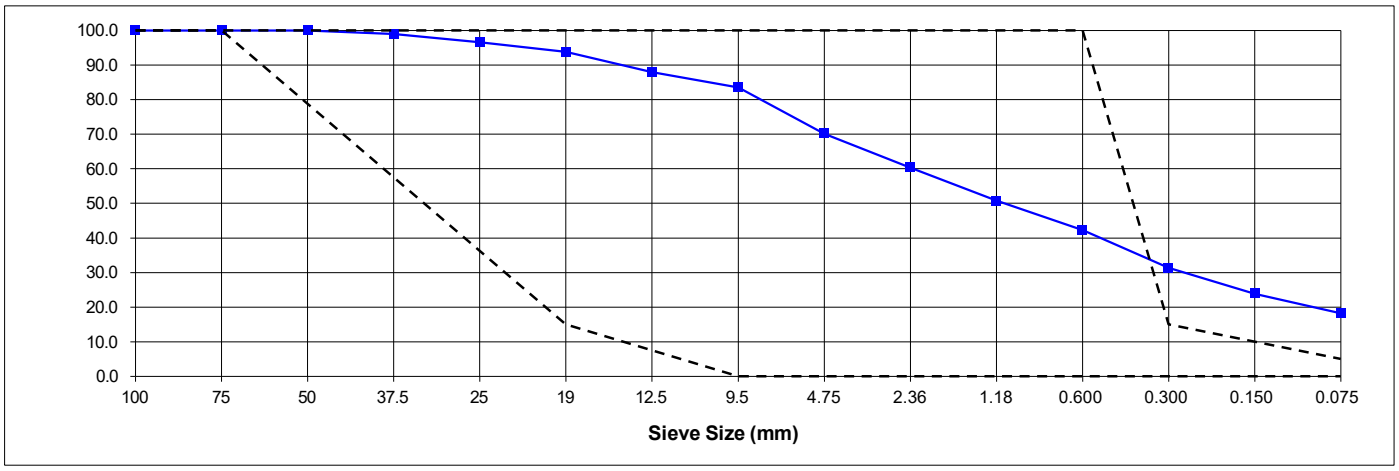
PROJECT: Raven Pit, Vancouver Island District

Sample:	**TH 16-10, Bag 905, SA1**
Source:	**Raven Pit**

DATE RECEIVED: March 30, 2016
DATE TESTED: April 5, 2016

SAMPLED BY: Client
TESTED BY: JP/VN

SIEVE ANALYSIS						MATERIAL SPECIFICATION: BC MOTI, SELECT GRANULAR SUB-BASE	
Sieve Size (mm)	Mass Ret. (g)	% Retained	% Passing	Individual % Retained (Split values)			
				+ 4.75	- 4.75		
100	0	0.0	100.0	0.0		100	100
75	0	0.0	100.0	0.0		100	100
50	0	0.0	100.0	0.0			
37.5	127	1.0	99.0	3.5			
25	295	2.4	96.6	8.0			
19	339	2.8	93.8	9.2		15	100
12.5	720	5.9	87.9	19.6			
9.5	536	4.4	83.6	14.6		0	100
4.75	1651	13.5	70.1	45.0			
2.36	46.5	9.7	60.4		13.9		
1.18	45.9	9.6	50.7		13.7		
0.600	40.3	8.4	42.3		12.0	0	100
0.300	52.2	10.9	31.4		15.6	0	15
0.150	35.8	7.5	23.9		10.7		
0.075	27.1	5.7	18.2		8.1	0	5
PAN	86.9	18.2	0		26.0		
Total		100.0		100.0	100.0		



SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

ASTM C 136 / C 117

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
Suite 310 - 1500 Woolridge St
Coquitlam, BC, V3K 0B8

April 7, 2016
Project Number: 14-1417-0009-3130

ATTENTION: Mr. Terence Lai, M.Sc

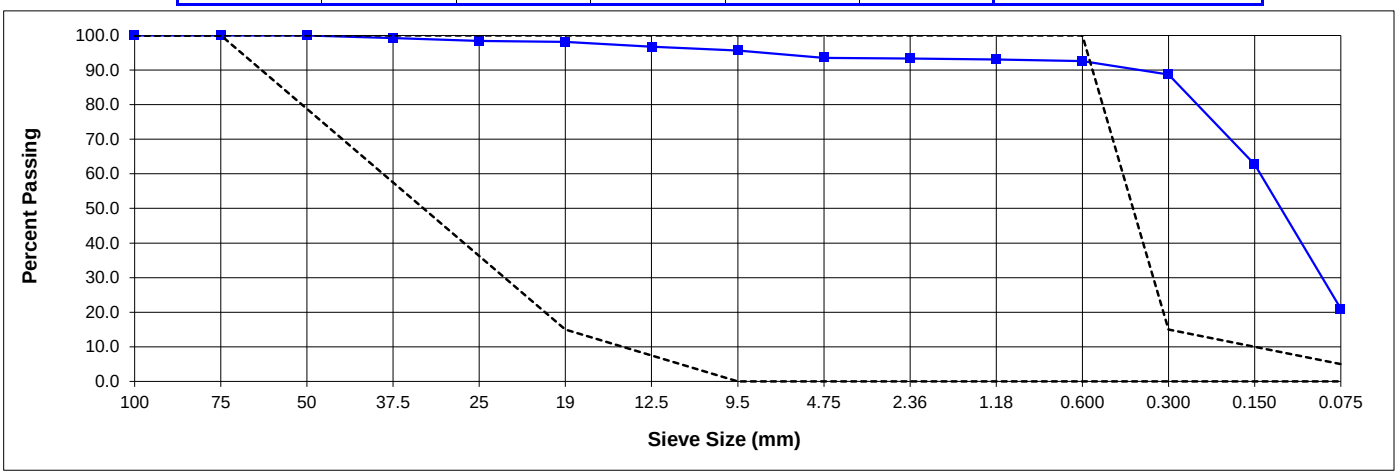
PROJECT: Raven Pit, Vancouver Island District

Sample:	**TH 16-10, Bag 906, SA2**
Source:	**Raven Pit**

DATE RECEIVED: March 30, 2016
DATE TESTED: April 1, 2016

SAMPLED BY: Client
TESTED BY: JP/DC

SIEVE ANALYSIS						MATERIAL SPECIFICATION: BC MOTI, SELECT GRANULAR SUB-BASE	
Sieve Size (mm)	Mass Ret. (g)	% Retained	% Passing	Individual % Retained (Split values)			
				+ 4.75	- 4.75		
100	0	0.0	100.0	0.0		100	100
75	0	0.0	100.0	0.0		100	100
50	0	0.0	100.0	0.0			
37.5	70	0.7	99.3	11.4			
25	83	0.9	98.4	13.5			
19	24	0.3	98.1	3.9		15	100
12.5	136	1.4	96.7	22.1			
9.5	104	1.1	95.6	16.9		0	100
4.75	197	2.1	93.6	32.1			
2.36	0.5	0.2	93.3		0.2		
1.18	0.5	0.2	93.1		0.2		
0.600	1.1	0.5	92.6		0.5	0	100
0.300	8.4	3.9	88.7		4.1	0	15
0.150	56.7	26.0	62.8		27.8		
0.075	91.1	41.8	21.0		44.6	0	5
PAN	45.8	21.0	0		22.4		
Total		100.0		100.0	100.0		



Note: Tested sample represents entirety of sample provided by client.

Total mass + 4.75mm:	614 g	Mass before wash:	204.1 g
Total mass - 4.75mm:	8909 g	Mass after wash:	165.8 g
Total mass of sample:	9523 g	Wash loss fines:	38.3 g
		Fines from pan:	7.5 g

Reported by: S. John, AScT

Reviewed by: L. Hu, M. Sc. E., P.Eng.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other zones/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Percent Passing

Note: Tested sample represents entirety of sample provided by client.

Total mass + 4.75mm:	3668 g	Mass before wash:	334.7
g Total mass - 4.75mm:	8595 g	Mass after wash:	252.0
g Total mass of sample:	12263 g	Wash loss fines:	82.7
g			
		Fines from pan:	4.2 g

Reported by: _____ Reviewed by: _____

S. John, AScT

L. Hu, M. Sc. E., P.Eng.

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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816

RESISTANCE OF COARSE AGGREGATE TO DEGRADATION BY ABRASION IN THE MICRO-DEVAL APPARATUS

ASTM D 6928

April 7, 2016
Project Number: 14-1417-0009-3130

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
Suite 310 - 1500 Woolridge St.
Coquitlam, BC
V3K 0B8

ATTENTION: Mr. Terence Lai, M.Sc.

PROJECT: Raven Pit, Vancouver Island District

Sample:	**TH 16-11, Bag 907, SA1 (Laboratory Crushed to Passing 25 mm)**
Source:	**Raven Pit**

Date received: March 30, 2016
Date tested: April 1, 2016

Sampled by: Client
Tested by: DC

Grading	**Section 8.2** 19 x 16 mm, 16 x 12.5 mm & 12.5 x 9.5 mm sieve fractions
Loss at Conclusion of Test (%)	**8.2**

Validation test: Drain Brothers control aggregate loss was 13.3 %, tested on April 1, 2016. Valid range is between 11.4 % and 14.8 %

Reported by: _____
S. John, AScT

Reviewed by: _____
L. Hu, M. Sc. E., P.Eng.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

RESISTANCE OF FINE AGGREGATE TO DEGRADATION BY ABRASION IN THE MICRO-DEVAL APPARATUS

ASTM D 7428

April 7, 2016
Project Number: 14-1417-0009-3130

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
Suite 310 - 1500 Woolridge St.
Coquitlam, BC
V3K 0B8

ATTENTION: Mr. Terence Lai, M.Sc.

PROJECT: Raven Pit, Vancouver Island District

Sample:	**TH 16-11, Bag 907, SA1**
Source:	**Raven Pit**

Date received: March 30, 2016
Date tested: April 5, 2016

Sampled by: Client
Tested by: DC/VN

Grading	**Fines** 4.75 x 0.075 mm sieve fraction
Loss at Conclusion of Test (%)	**10.7**

Validation test: Sutherland sand control aggregate loss was 16.7 %, tested on April 5, 2016. Valid range is between 15.2 % & 18.4 %

Reported by: _____
S. John, AScT

Reviewed by: _____
L. Hu, M. Sc. E., P.Eng.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

RESISTANCE OF COARSE AGGREGATE TO DEGRADATION BY ABRASION IN THE MICRO-DEVAL APPARATUS

ASTM D 6928

April 7, 2016
Project Number: 14-1417-0009-3130

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
Suite 310 - 1500 Woolridge St.
Coquitlam, BC
V3K 0B8

ATTENTION: Mr. Terence Lai, M.Sc.

PROJECT: Raven Pit, Vancouver Island District

Sample:	**TH 16-12, Bag 908, SA1 (Laboratory Crushed to Passing 25 mm)**
Source:	**Raven Pit**

Date received: March 30, 2016
Date tested: April 1, 2016

Sampled by: Client
Tested by: DC

Grading	**Section 8.2** 19 x 16 mm, 16 x 12.5 mm & 12.5 x 9.5 mm sieve fractions
Loss at Conclusion of Test (%)	**9.6**

Validation test: Drain Brothers control aggregate loss was 13.3 %, tested on April 1, 2016. Valid range is between 11.4 % and 14.8 %

Reported by: _____
S. John, AScT

Reviewed by: _____
L. Hu, M. Sc. E., P.Eng.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

RESISTANCE OF FINE AGGREGATE TO DEGRADATION BY ABRASION IN THE MICRO-DEVAL APPARATUS

ASTM D 7428

April 7, 2016
Project Number: 14-1417-0009-3130

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
Suite 310 - 1500 Woolridge St.
Coquitlam, BC
V3K 0B8

ATTENTION: Mr. Terence Lai, M.Sc.

PROJECT: Raven Pit, Vancouver Island District

Sample:	**TH 16-12, Bag 908, SA1**
Source:	**Raven Pit**

Date received: March 30, 2016
Date tested: April 5, 2016

Sampled by: Client
Tested by: DC/VN

Grading	**Fines** 4.75 x 0.075 mm sieve fraction
Loss at Conclusion of Test (%)	**10.3**

Validation test: Sutherland sand control aggregate loss was 16.7 %, tested on April 5, 2016. Valid range is between 15.2 % & 18.4 %

Reported by: _____
S. John, AScT

Reviewed by: _____
L. Hu, M. Sc. E., P.Eng.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

AMEC Environment & Infrastructure
#110 - 18568 - 96th Avenue
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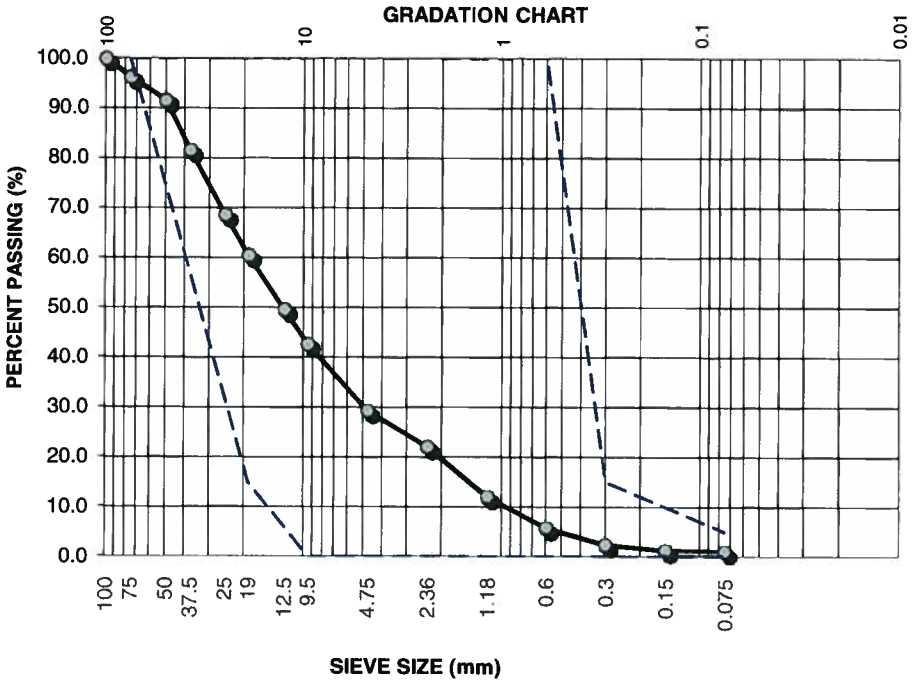
Tel: 604-295-8657
Fax: 604-295-8658

SIEVE ANALYSIS REPORT

CLIENT: Ministry of Transportation & Infrastructure
310 - 1500 Woolridge St.
Coquitlam, BC V3K 0B8
ATTN: Terence Lai

Project Number: VA06707-105
Date: January 2, 2014
Client P.O.: 156CS0670

PROJECT: Raven Pit - Vancouver Island District



Lab Number: L4860

Date Sampled: Sampled by MOTI
Date Received: 2-Dec-13
Date Tested: 27-Dec-13
Sampled By: MOTI
Tested By: William Mendez

TP/TH No.: TP13-14
Bag No.: 734
Material Type: Pit Run
Sample No.: 1

Gravel Sizes (mm)	Percent Passing	Gradation Limits Lower		Upper
100	100		-	
75	96	100	-	100
50	92		-	
37.5	82		-	
25	69		-	
19	60	15	-	100
12.5	50		-	
9.5	43	0	-	100

Sand Sizes And Fines (mm)	Percent Passing	Gradation Limits Lower		Upper
4.75	29		-	
2.36	22		-	
1.18	12		-	
0.6	5.7	0	-	100
0.3	2.3	0	-	15
0.15	1.2		-	
0.075	1.0	0	-	5

Comments: Sieve analysis test was conducted in accordance with ASTM C136 and C117
Plotted to Table 202-C SGSB gradation specification

Prepared By: Giti Ghorbanian
Senior Materials Technologist

Reviewed By:
Riyad Islam, M.A.Sc, P.Eng
Materials Engineer

AMEC Environment & Infrastructure
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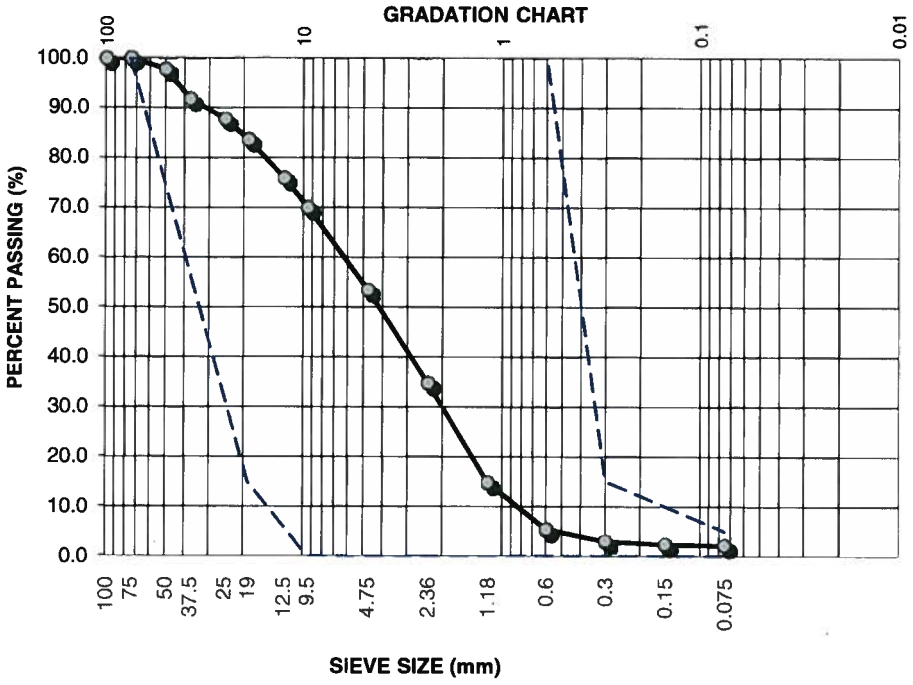
SIEVE ANALYSIS REPORT

CLIENT: Ministry of Transportation & Infrastructure
310 - 1500 Woolridge St.
Coquitlam, BC V3K 0B8
ATTN: Terence Lai

Project Number: VA06707-105
Date: January 2, 2014
Client P.O.: 156CS0670

PROJECT: Raven Pit - Vancouver Island District



Lab Number: L4861

Date Sampled: Sampled by MOTI
Date Received: 2-Dec-13
Date Tested: 23-Dec-13
Sampled By: MOTI
Tested By: Rodrigo Lauricio/ WM

TP/TH No.: TP13-14
Bag No.: 735
Material Type: Pit Run
Sample No.: 2

Gravel Sizes (mm)	Percent Passing	Gradation Limits Lower	Upper
100	100	-	
75	100	100 -	100
50	98	-	
37.5	92	-	
25	88	-	
19	84	15 -	100
12.5	76	-	
9.5	70	0 -	100

Sand Sizes And Fines (mm)	Percent Passing	Gradation Limits Lower	Upper
4.75	53	-	
2.36	35	-	
1.18	15	-	
0.6	5.4	0 -	100
0.3	3.0	0 -	15
0.15	2.4	-	
0.075	2.2	0 -	5

Comments: Sieve analysis test was conducted in accordance with ASTM C136 and C117
Plotted to Table 202-C SGSB gradation specification

Prepared By: Giti Ghorbanian
Senior Materials Technologist

Reviewed By:
Riyad Islam, M.A.Sc, P.Eng
Materials Engineer

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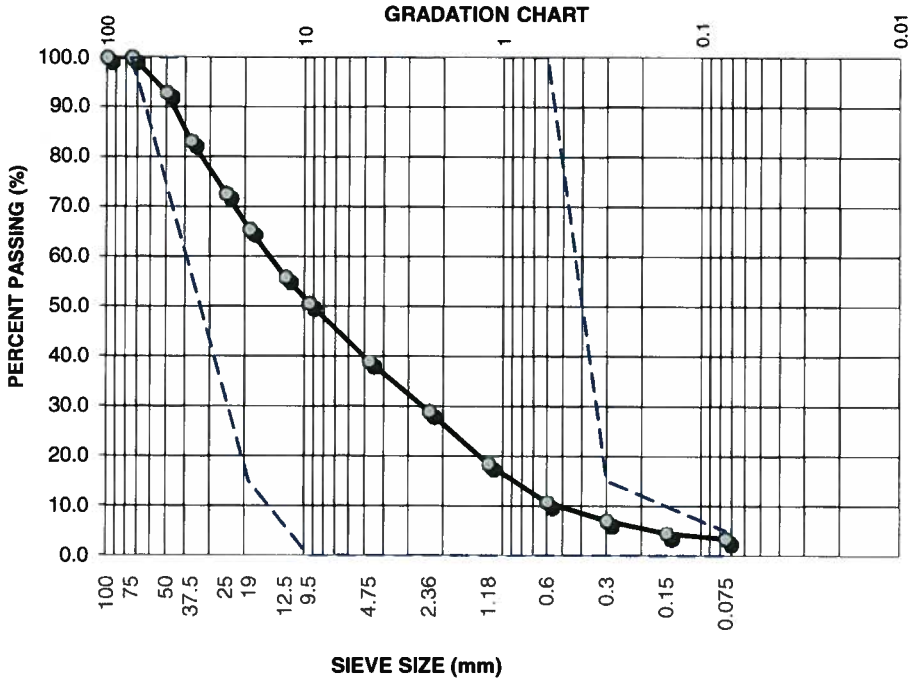
SIEVE ANALYSIS REPORT

CLIENT: Ministry of Transportation & Infrastructure
310 - 1500 Woolridge St.
Coquitlam, BC V3K 0B8
ATTN: Terence Lai

Project Number: VA06707-105
Date: January 2, 2014
Client P.O.: 156CS0670

PROJECT: Raven Pit - Vancouver Island District



Lab Number: L4862

Date Sampled: Sampled by MOTI
Date Received: 2-Dec-13
Date Tested: 8-Dec-13
Sampled By: MOTI
Tested By: Rodrigo Lauricio/ WM

TP/TH No.: TP13-15
Bag No.: 736
Material Type: Pit Run
Sample No.: 1

Gravel Sizes (mm)	Percent Passing	Gradation Limits Lower		Upper
100	100		-	
75	100	100	-	100
50	93		-	
37.5	83		-	
25	73		-	
19	65	15	-	100
12.5	56		-	
9.5	51	0	-	100

Sand Sizes And Fines (mm)	Percent Passing	Gradation Limits Lower		Upper
4.75	39		-	
2.36	29		-	
1.18	18		-	
0.6	11	0	-	100
0.3	7.0	0	-	15
0.15	4.5		-	
0.075	3.4	0	-	5

Comments: Sieve analysis test was conducted in accordance with ASTM C136 and C117
Plotted to Table 202-C SGSB gradation specification

Prepared By: Giti Ghorbanian
Senior Materials Technologist

Reviewed By:
Riyad Islam, M.A.Sc, P.Eng
Materials Engineer

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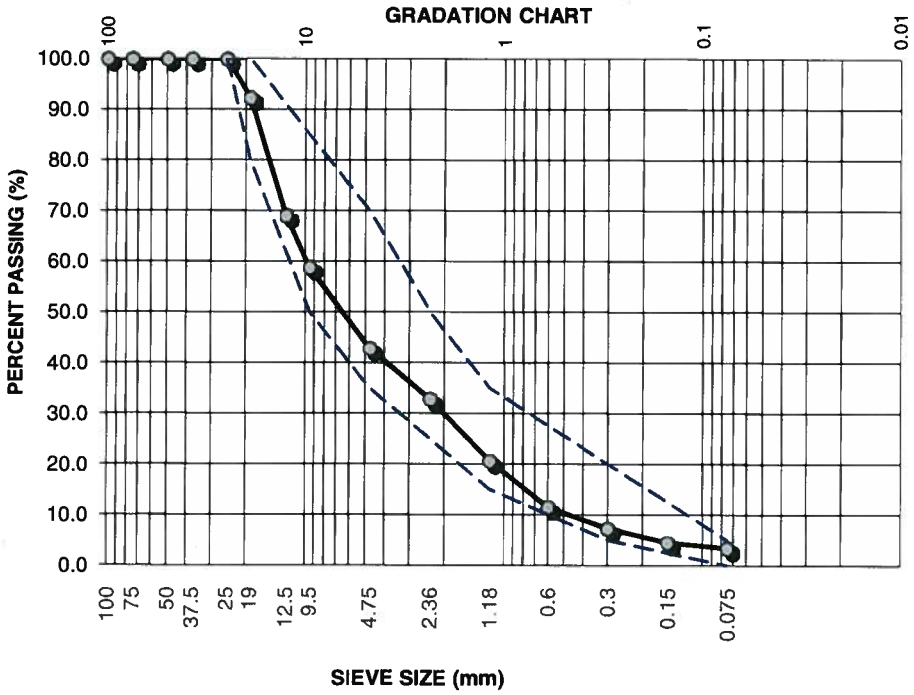
SIEVE ANALYSIS REPORT

CLIENT: Ministry of Transportation & Infrastructure
310 - 1500 Woolridge St.
Coquitlam, BC V3K 0B8
ATTN: Terence Lai

Project Number: VA06707-105
Date: 2-Jan-2014
Client P.O.: 156CS0670

PROJECT: Raven Pit - Vancouver Island District



Lab Number: L4862

Date Sampled: Sampled by MOTI
Date Received: 2-Dec-13
Date Tested: 13-Dec-13
Sampled By: MOTI
Tested By: Alexie Mirochnikov

TP/TH No.: TP13-15
Bag No.: 736
Material Type: Crushed
Sample No.: 1

Gravel Sizes (mm)	Percent Passing	Gradation Limits Lower		Upper
100	100		-	
75	100		-	
50	100		-	
37.5	100		-	
25	100	100	-	100
19	92	80	-	100
12.5	69		-	
9.5	59	50	-	85

Sand Sizes And Fines (mm)	Percent Passing	Gradation Limits Lower		Upper
4.75	43	35	-	70
2.36	33	25	-	50
1.18	21	15	-	35
0.6	11		-	
0.3	7.3	5	-	20
0.15	4.5		-	
0.075	3.4	0	-	5

Comments: Sieve analysis test was conducted in accordance with ASTM C136 and C117
Plotted to Table 202-C WGB gradation specification

Prepared By: Giti Ghorbanian
Senior Materials Technologist

Reviewed By:
Riyad Islam, M.A.Sc, P.Eng
Materials Engineer

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FRACTURE COUNT FOR COARSE AGGREGATE (BCH 1-13)

CLIENT: Ministry of Transportation & Infrastructure
310 - 1500 Woolridge St.
Coquitlam, BC V3K 0B8
ATTN: Terence Lai

Project Number: VA06707-105
Date: January 7, 2014
Client P.O.: 156CS0670

PROJECT: Raven Pit - Vancouver Island District

Sample Source & ID: TP13-15 Bag #736- SA #1 - Crushed

Lab No.: L4862

Sieve Size (mm)	Original Weight (g)	Fractured Particles (g)	Non-Fractured Particles (g)	% Fracture
50 to 37.5				
37.5 to 25.0				
25.0 to 19.0	1023.5	799.6	223.9	
19.0 to 13.2	1283.6	989.9	293.7	
13.2 to 9.5	1267.3	1012.3	255.0	
Totals	3574.4	2801.8	772.6	**78**

Comments: Fracture Particles in Coarse Aggregate tests were conducted in accordance with BCH 1-13 Method B

Prepared By:
Giti Ghorbanian
Senior Materials Technologist

Reviewed By:
Riyad Islam, M.A.Sc, P.Eng
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Test Results for Resistance of Aggregate to Degradation by Abrasion in the Micro-Deval

CLIENT: Ministry of Transportation & Infrastructure
310 - 1500 Woolridge St.
Coquitlam, BC V3K 0B8
ATTN: Terence Lai

Project Number: VA06707-105
Date: January 7, 2014
Client P.O.: 156CS0670

PROJECT: Raven Pit - Vancouver Island District

Sample Source & ID: TP13-15 Bag # 736 SA #1 - Pit Run
Lab No.: L4862

Coarse and Fine Aggregate

Grading	Initial Mass (g)	Final Mass (g)	Loss of Mass (g)	% Loss
	A	B	A - B	(A-B)*100/A
Coarse	1497.8	1322.5	175.3	11.7
Fine	500.3	435.2	65.1	13.0

Comments:

Maximum size of aggregate is 50.0 mm.

Resistance of materials to Degradation by Abrasion in the Micro-Deval Apparatus was conducted in accordance with ASTM D6928 for Coarse aggregate and ASTM D7428 for Fine aggregate

Grading for coarse aggregate used for test is: 19-16 mm, 16-12.5 mm, 12.5-9.5 mm

Drain Brothers- Stony Lake Quarry was used as calibration coarse materials and percent loss is 15.0%. Southerland Sand was used as calibration fine materials and percent loss is 17.7%.

MOTI Standard:

Maximum acceptable value of any base material is 25 or less
Maximum acceptable value of any Sub-base material is 30 or less

Prepared By:
Giti Ghorbanian
Senior Materials Technologist

Reviewed By:
Riyad Islam, M.A.Sc, P.Eng
Materials Engineer