

THE CORPORATION OF THE TOWNSHIP OF DOURO-DUMMER

# SUPPLEMENTAL GEOTECHNICAL SURVEY AND TESTING REPORT EDWARDS PROPERTY

MARCH 23, 2020

FINAL





# SUPPLEMENTAL GEOTECHNICAL SURVEY AND TESTING REPORT EDWARDS PROPERTY

THE CORPORATION OF THE TOWNSHIP  
OF DOURO-DUMMER

FINAL

PROJECT NO.: 161-16604-00

DATE: MARCH 23, 2020

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March 23, 2020

FINAL

THE CORPORATION OF THE TOWNSHIP OF DOURO-DUMMER  
894 South Street  
Warsaw, Ontario  
K0L 3A0

**Attention: Martina Chait-Hartwig, Temporary C.A.O.**

Dear Ms. Chait-Hartwig:

**Subject: Supplemental Geotechnical Survey and Testing Report - Edwards Property**

WSP is pleased to provide you with our Supplemental Geotechnical Survey and Testing report for the above noted aggregate resources Site.

The Report has been prepared in accordance with our proposal, and includes results of a supplemental test pit and drilling program and laboratory testing program.

We trust that this report meets your present requirements. Please contact us if you have any questions.

Yours truly,

Bernie Fuhrmann, B.E.S.  
Aggregate Development Specialist

Victoria Gledhill, P. Eng.  
Project Engineer

Garnet Brenchley, P.Eng.  
Senior Geotechnical Engineer

WSP ref.: 161-16604-00

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# SIGNATURES

PREPARED BY

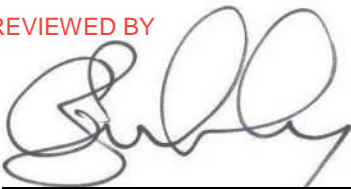


Victoria Gledhill, P. Eng.  
Project Engineer

March 23, 2020

Date

REVIEWED BY



Garnet Brenchley, P.Eng.  
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March 23, 2020

Date

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Bernie Fuhrmann, B.E.S.  
Aggregate Development Specialist

March 23, 2020

Date

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# 1 BACKGROUND

WSP was retained by the Township of Douro-Dummer to conduct a supplemental geotechnical survey of land, known locally as the Edwards Property (the Site), located on part of Lots 14 and 15, Concession 1 in the geographic Township of Dummer. The Site is approximately 1.5 km north of the community of Warsaw, fronting on County Road #4 along the east, Oke Road to the north, and Payne Line Road to the west. A location map is included as **Figure 1**.

A portion of the subject site is currently approved for extraction under the Aggregate Resources Act (A.R.A.) as a licenced gravel pit (Licence # 3303 – licenced to Ralph Edwards). Operations within the pit are guided by an approved A.R.A. Site Plan which permits the extraction of sand and gravel above the groundwater table.

In late 2016, WSP was advised that the Municipality was considering the purchase of the existing Edwards pit and some adjacent land holdings owned by the Edwards family, with the goal of investigating the possible development of a pit and quarry over the total holdings. The proposed development would utilize the sand and gravel resources available at the existing pit, and also access limestone bedrock. Extraction of the bedrock is not currently permitted by the existing pit licence or A.R.A. Site Plan.

As part of an initial investigation, the Municipality released RFP T-05-2016. The goal of the RFP was to provide the Township with an improved understanding of aggregate resources and groundwater depths within the Site.

WSP was selected to conduct the initial investigation and prepared a “Geotechnical Survey and Testing Report – Edwards Property”, dated January 2017, under WSP Project No. 161-16604-00 (hereafter referred to as the 2017 Report). Since preparation of the 2017 Report, WSP has been assisting the Municipality by conducting various investigations (i.e. Natural Environment and Hydrogeology) to determine the viability of filing a licence application with the Ministry of Natural Resources and Forestry, ahead of a potential purchase of the entire Edwards holdings by the Township.

In 2019, WSP understands that concerns were raised respecting the quality of aggregate found at the site. A subsequent peer review of WSP’s 2017 Report was completed by Cambium Inc. (C.I.). While C.I. found that the 2016 investigation completed by WSP was satisfactory, it recommended that additional test pitting of unconsolidated sand and gravel and coring to investigate bedrock resources be completed. Specifically, C.I. suggested that additional sampling and testing of the esker overburden deposit and the underlying Bobcaygeon limestone bedrock formation be conducted. Further, CI also suggested that, to assist in supporting any future license application, additional groundwater monitoring wells be installed.

The Township has subsequently requested WSP complete additional test pits on the esker, along with additional boreholes in the limestone (targeting the Bobcaygeon formation) with associated lab testing. This report summarizes WSP’s 2020 work program in this regard.

## 2 2020 INVESTIGATION

The purpose of the 2020 investigation was to further assess the aggregate resources at this Site, including the unconsolidated aggregates located on the Esker and consolidated bedrock, reaching down to and including, the Bobcaygeon bedrock formation. Additional monitoring wells were also installed, as a means to facilitate further evaluation of the groundwater table data.

### 2.1 ESKER TEST PITTING

A total of ten (10) test pits were located and excavated within the esker deposit. See **Figure 2** for such locations. Using a track-mounted excavator provided by the Property owner, the test pits were advanced to depths of 5.0 to 10.5 m. During test pitting, a WSP field technician collected representative samples of each stratigraphic layer for inspection and subsequent laboratory analysis. All test pits were logged in the field and photographed. The depth to groundwater seepage, if any, was documented. The test pits were backfilled and levelled on completion, and the approximate coordinates were determined using a hand-held GPS (NAD 83 datum). Elevations were inferred from the topographic plan (based on GPS coordinates). A summary of test pit details is provided in **Table 2-1**.

**Table 2-1: Test Pit Surface Elevation and Termination Depths Summary**

TEST PIT ID	APPROXIMATE COORDINATES (NAD 83)		APPROXIMATE SURFACE ELEVATION (mASL)	TERMINATION DEPTH (mBGL)	APPROXIMATE TERMINATION ELEVATION (mASL)
	EASTING	NORTHING			
TP19-01*	727792	4925118	237.6	10.5	227.1
TP19-02	727813	4924996	239.9	6.0	233.9
TP19-03	727810	4924983	239.3	5.0	234.3
TP19-04	727810	4924968	240.0	5.0	235.0
TP19-05	727768	4924884	237.5	5.0	232.5
TP19-06	727788	4924841	242.5	5.0	237.5
TP19-07	727717	4924632	246.6	5.0	241.6
TP19-08	727717	4924589	246.6	5.0	241.6
TP19-09	727713	4924564	246.2	5.0	241.2
TP19-10	727703	4924505	246.7	5.0	241.7

\* Soil stratigraphy of TP19-01 was observed from face of existing excavation

### 2.2 BEDROCK INVESTIGATIONS

A borehole drilling program for the Site was carried out by WSP in February 2020. The geotechnical investigation included three (3) boreholes advanced at locations shown on **Figure 2**. Additional details are provided in **Table 2-2** below.

Drilling and soil sampling was completed using a track-mounted commercial drill rig operating under the supervision of an experienced WSP technician. Within the overburden, the boreholes were advanced by means of 210 mm outside diameter (OD) continuous flight hollow stem augers. No soil sampling of the overburden was completed. Diamond drilling of the bedrock was conducted, and NQ size (55 mm diameter) core samples were taken continuously for the full depth of bedrock penetration. The rock cores were inspected, logged, photographed and sampled by a WSP technician, and subsequently stored at our laboratory facility. Core recovery ratios and Rock

Quality Designations (RQD's) were calculated at the time of coring. Details of laboratory rock testing are discussed in **Section 3** below.

**Table 2-2: Borehole Surface Elevation and Termination Depths Summary**

BOREHOLE ID	APPROXIMATE COORDINATES (NAD 83)		APPROXIMATE SURFACE ELEVATION (mASL)	TERMINATION DEPTH (mBGL)	APPROXIMATE TERMINATION ELEVATION (mASL)
EASTING	NORTHING				
BH20-01	727080	4925382	262.0	31.8	230.3
BH20-02	727196	4925081	258.0	28.3	229.7
BH20-03	727676	4924887	244.0	16.8	227.2

To assist in the continued hydrogeological investigation of the Site, all three boreholes were completed as piezometers to facilitate future measurements of groundwater levels. Piezometers were constructed with 50 mm OD Schedule 40 PVC machine-slotted screen and riser pipe, monitor tip, couplings, and a protective plastic cap or lockable J-Plug. Screened intervals 1.5 m long were backfilled with manufactured filter sand. Installations were completed in general accordance with Ontario Provincial Regulation (O. Reg.) 903, as amended.

## 2.3 LABORATORY TESTING

Aggregate material obtained from both the esker test pitting and bedrock coring programs were tested at WSP's (MTO and CCIL approved) laboratories. A sample of the Bobcaygeon bedrock formation obtained as part of the scope of work for the 2017 Report was also tested (BH16-1), and is included in the summary provided in **Section 3**.

Both the esker deposit sand and gravel and the cored Bobcaygeon formation bedrock were evaluated, with the goal of assessing suitability to meet the requirements of road gravel, winter sand, surface treatment, asphalt pavement, and concrete, as well as meet Ontario Provincial Standard Specification (OPSS) 1001 physical requirements.

The laboratory testing program is outlined in **Table 2-3** below.

**Table 2-3: Geotechnical Laboratory Testing Summary**

ANALYSIS	PROCEDURE/METHODOLOGY	NUMBER OF TESTS
Esker Deposit (Test Pit samples)		
Micro-Deval Abrasion – Coarse	Coarse, LS - 618	Ten (10)
Micro-Deval Abrasion – Fine	Fine, LS - 619	Ten (10)
Relative Density/Absorption	LS - 604,605	Ten (10)
Plasticity of Fines	LS - 631	Ten (10)
Sieve Analysis of Aggregates	LS - 602	Ten (10)
Bobcaygeon Formation (bedrock core samples)		
Absorption	LS- 605	Four (4)
Relative Density/Absorption	LS - 604,605	Four (4)
Freeze-Thaw Loss	LS - 614	Four (4)

Micro-Deval Abrasion – Coarse	LS - 618	Four (4)
Micro-Deval Abrasion – Fine	LS - 619	Four (4)
Sieve Analysis of Aggregates	LS - 602	Ten (10)



# 3 SUMMARY OF FINDINGS

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## 3.1 ESKER TEST PITTING

Test pitting was conducted on the esker at the locations noted on **Figure 2**. Oversized boulders were encountered at all ten (10) test pits. Complete test pit logs are presented in **Appendix D**.

No groundwater was encountered during the test pit investigation, and the excavations were generally dry and stable on completion. See **Appendix B** for Test Pit Photographs of the exposed conditions.

---

## 3.2 BEDROCK CORING

Bedrock investigations were conducted at three borehole locations. General results are provided in **Table 3-1** below, and borehole logs and photos of the bedrock core are provided in **Appendix H and G**, respectively.

**Table 3-1: Bedrock Observation Summary**

BOREHOLE ID	APPROXIMATE GROUND ELEVATION (mASL)	APPROXIMATE BEDROCK ELEVATION (mASL)	OBSERVATIONS
BH20-01	262.0	259.7	Verulam to Bobcaygeon Formation transition at elevation 236.8 mASL.
BH20-02	258.0	256.3	Verulam to Bobcaygeon Formation transition at elevation 232.8 mASL.
BH20-03	244.0	242.9	Verulam to Bobcaygeon Formation transition at elevation 230.1 mASL.
BH16-1*	230.5	230.5	Verulam to Bobcaygeon Formation transition at elevation 226.8 mASL.

\* Sample was obtained for the 2017 Report. The portion of core identified as the Bobcaygeon Formation was tested in laboratory during this current (2020) testing program.

Examinations of bedrock core samples confirmed that the majority of the bedrock within the sampled intervals was Verulam Formation. The purpose of this supplemental borehole investigation was to determine the elevation of transition to the underlying Bobcaygeon Formation, which was encountered between 226.8 and 236.8 mASL. Based on the drilling information from the current 2020 investigation, as well as findings from the 2017 Report, WSP has prepared a cross-section indicating an interpolated bedrock profile of the Site. Refer to **Figure 3**.

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## 3.3 LABORATORY ANALYSIS OF AGGREGATE MATERIALS

WSP completed aggregate quality tests on selected samples of the unconsolidated (Esker) and consolidated (bedrock) materials from the Site, as described previously.

Results are provided in **Appendix E and I**, and summarized as follows:

**Table 3-2: Summary of Laboratory Analysis (Physical Quality Requirements)**

SAMPLE ID	REL. DENS. & ABSORB. COARSE	REL. DENS. & ABSORB. FINES	MICRO-DEVAL COARSE (LOSS %) RESULT	MICRO- DEVAL FINE (LOSS %) RESULT	PLASTIC FINES (Y/N)	FREEZE THAW
Unconsolidated Material (Esker)						
TP19-01*	2.658/0.71	2.623/1.26	21.4	10.1	N	--
TP19-02	2.609/1.35	2.554/2.36	24.1	15.5	N	--
TP19-03	2.620/1.13	2.573/1.70	24.5	14.9	N	--
TP19-04	2.622/1.04	2.545/2.26	20.2	11.0	N	--
TP19-05	2.601/1.50	2.554/2.16	23.7	18.6	N	--
TP19-06	2.605/1.63	2.570/2.25	25.1*	15.5	N	--
TP19-07	2.616/1.22	2.554/2.52	22.6	13.9	N	--
TP19-08	2.613/1.19	2.563/1.83	20.3	11.6	N	--
TP19-09	2.601/1.48	2.607/1.25	-	9.0	N	--
TP19-10	2.595/1.65	2.583/1.66	24.2	15.4	N	--
<b>RANGE</b>	<b>0.71 to 1.65 (Absorption)</b>	<b>1.25 to 2.52 (Absorption)</b>	<b>20.2 to 25.1</b>	<b>9.0 to 18.6</b>	<b>N</b>	<b>--</b>
Consolidated Material (Bedrock)						
BH20-01	2.651/0.77	2.532/2.54	16.0	22.5	--	2.7
BH20-02	2.658/0.69	2.519/2.61	15.4	22.3	--	1.8
BH20-03	2.674/0.50	2.521/2.64	13.8	20.6	--	2.5
BH16-1	2.689/0.37	2.634/1.06	13.0	--		1.7
<b>Range</b>	<b>0.37 – 0.77 (Absorption)</b>	<b>1.06 – 2.64 (Absorption)</b>	<b>13.0 – 16.0</b>	<b>20.6 – 22.5</b>	<b>--</b>	<b>1.7 – 2.7</b>
PHYSICAL QUALITY REQUIREMENTS (OPSS 1010 and 1004)						
<b>Granular A</b>	<b>N/A</b>	<b>N/A</b>	<b>25</b>	<b>30</b>	<b>N</b>	N/A
<b>Granular B</b>	<b>N/A</b>	<b>N/A</b>	<b>30</b>	<b>35</b>	<b>N</b>	N/A
<b>Winter Sand</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	N/A

\* Sample does not meet physical quality requirements specifications for Granular A

**Table 3-3** summarizes gradation results of test pit and crushed bedrock material, and compares results to OPSS specification.

**Table 3-3: Comparison of Gradation Results to OPSS Specifications**

SIEVE SIZE (mm)	TP19-01	TP19-02	TP19-03	TP19-04	TP19-05	TP19-06	TP19-07	TP19-08	TP19-09	TP19-10	BH20-01	BH20-02	BH20-03	GRANULAR A*	GRANULAR B TYPE I*	WINTER SAND**
26.5	62.2	70.0	56.2	72.4	73.9	77.2	77.0	89.9	86.3	84.7	100	100	100	100	50 – 100	--
19.0	59.8	60.3	51.0	66.2	64.8	70.8	70.6	86.8	83.5	77.4	99.8	99.3	99.2	85 – 100	N/A	--
13.2	57.9	54.4	46.5	60.7	57.4	66.2	66.2	84.2	81.2	73.4	66.8	69.2	70.7	65 – 90	N/A	--
9.5	55.2	46.6	41.2	54.9	50.4	60.1	60.6	81.1	78.2	67.4	43.9	46.2	49.9	50 – 73	N/A	100
4.75	49.9	34.2	31.1	43.9	38.8	48.6	48.9	74.3	71.6	57.2	28.9	26.1	28.8	35 – 55	20 – 55	90 – 100
1.18	38.9	19.9	19.2	21.3	25.3	30.8	28.4	60.9	54.8	36.4	12.1	11.6	12.7	15 – 40	10 – 100	20 – 90
300	12.9	12.3	9.4	5.9	12.6	17.3	10.0	14.3	11.4	12.9	6.4	6.6	6.6	5 – 22	2 – 65	0 – 35
75	2.6	7.2	4.0	2.6	5.8	6.8	4.3	4.7	1.9	4.6	4.0	4.2	3.9	2.0 – 8.0	0 – 8.0	0 – 5.0
SPECIFICATION SUMMARY – DOES SAMPLE MEET OPSS SPECIFICATION (Y/N)																
Granular A	N	N	N	N	N	N	N	N	N	N	N	N	N	--	--	--
Granular B Type I	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--
Winter Sand**	N	N	N	N	N	N	N	N	N	N	N	N	N	--	--	--

\* OPSS 1010

\*\* OPSS 1004

# 4 CONCLUSIONS

WSP was retained to conduct a supplementary geotechnical survey of the Edwards property at the request of the Township of Douro-Dummer. The goal of the investigation was to obtain additional information on the unconsolidated Esker material, and to further investigate the bedrock resources at the Site.

The following conclusions are provided:

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## 4.1 UNCONSOLIDATED MATERIAL (ESKER)

- In general, the reported geotechnical test results comply with OPSS 1010 physical quality requirements for both Granular A and B (Type I) products, with the exception of TP19-06 for Granular A (see **Table 3-2**). The micro-deval course test results of 25.1% loss exceeds the maximum limits of 25% for Granular A.
  - Granular A: A portion of the reserve granular material can be produced into Granular A through screening, crushing and blending. The hardness of the stone fraction is marginally below the acceptable maximum limit and is not recommended for use in concrete or hot laid products. Micro-deval percent loss test values range between 20.2 to 25.1%. The maximum acceptable limit for micro-deval coarse for Granular A is 25%. A review of each gradation report suggests there is a general lack of percent crushable stone through key stone fractions. The total material percent stone content retained on the 4.75 mm screen ranges between 25.7% and 68.9%. Between 35% and 55% sand control would be required through screening to increase stone content.
  - Granular B Type I: The material is acceptable for Granular B Type I based on review of gradation reports and available physical quality test results, with the exception of samples obtained from TP19-01 and TP19-03. Oversize stones are present, and therefore screening would only be required if adherence to a Type I envelope was required, otherwise no processing is required. The fine fraction remains below 8% based on tested samples. Granular B Type I would be the easiest and most cost-effective product to produce.
  - Winter Sand: The percent fines (<75 um) of the total gradation range between 1.9% and 7.2%, while the sand fraction ranges between 2.6% and 21%. The maximum percent for sand fraction is 5% for Winter Sand. Eight of the ten test pits samples were unacceptable due to excess fines.
  - Test results for absorption for the fine fraction exceed 2% in TP19-2, TP19-4, TP19-5, TP19-6 and TP19-7. For Superpave 12.5 coarse products, the maximum percent for absorption is 2%. Materials with a lower absorption rate are better suited for hot-laid products to prevent surface pop-outs.
- 

## 4.2 CONSOLIDATED MATERIAL (BOBCAYGEON FORMATION)

- Freeze thaw testing was conducted on four (4) crushed core samples. No specifications for freeze thaw compliance are required for products such as Granular A, B and Select Subgrade Material (OPSS 1010). Freeze thaw samples from all four boreholes passed for pavement, structures, sidewalks and concrete base (OPSS 1002), Superpave (OPSS 1003), and all Classes of Surface Treatment Aggregate (OPSS 1006).
- Bedrock samples were crushed to 19 mm size for testing. In general, the reported geotechnical test results comply with OPSS 1010 physical quality requirements for both Granular A and B Type I products. Absorption was below 1% for all samples, which is acceptable for most uses.
- For concrete and asphalt, Micro-Deval results typically must be below 15%. The samples from BH20-03 and BH16-1 meets these requirements. However, the coarse fraction result for BH20-01 and BH20-02 samples do not meet the standards.

## 5 CLOSING

The primary goal of this investigation was to follow-up on the original work conducted by WSP in 2016, and summarized in the 2017 Report. The Municipality directed that additional sampling and testing of the surficial deposit (esker) be conducted, and that bedrock investigations specifically target an underlying layer of bedrock, known as the Bobcaygeon Formation.

This investigation re-confirmed that the sand and gravel within the site, and generally confined to the remaining Esker deposit, have the potential to achieve appropriate material specifications for the intended uses by the Municipality. The bedrock investigation revealed that the Bobcaygeon Formation exhibited slightly improved quality testing results when compared with bedrock material tested in 2017. However, conclusions related to suitability and feasibility of bedrock extraction have not changed. Refer to WSP's 2017 Report for a summary of Conclusions.

WSP is of the opinion that the Edwards Site contains aggregate resources which are suitable for appropriately-targeted uses by the Township. It is important for the Municipality to understand that there is variability within both the unconsolidated (i.e. sand and gravel) and unconsolidated (i.e. bedrock) formations within the site. While the site has the potential to achieve appropriate material specifications for the intended uses by the Municipality, when processing site materials, WSP understands that material quality issues may arise. Therefore, strict and ongoing quality control measures should be put in place throughout such processing.

Thank you for retaining WSP to complete this investigation. Should you have any questions please feel free to contact our office.

Submitted by,

**WSP Canada Inc.**



Vikki Gledhill, P.Eng.  
Geotechnical Project Engineer

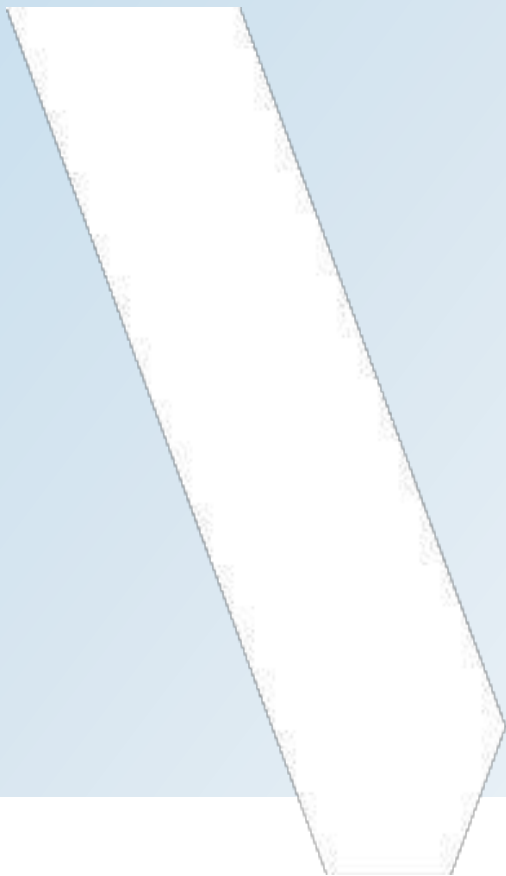


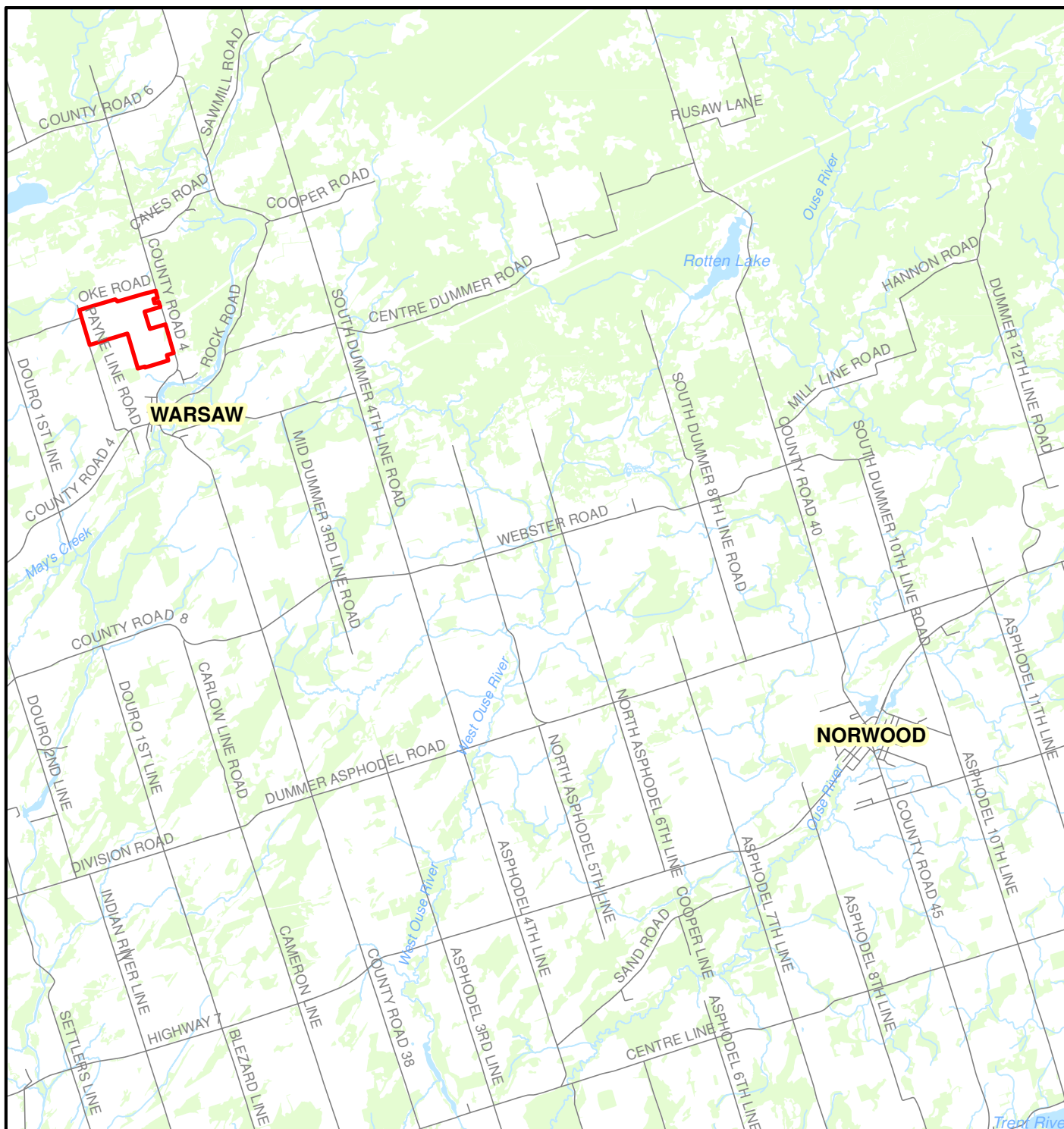
Garnet Brenchley, P.Eng.  
Senior Geotechnical Engineer



Bernie Fuhrmann, B.E.S  
Aggregate Development Specialist

# FIGURES





## LEGEND



APPROXIMATE SITE LOCATION



Data Source: Ministry of Natural Resources,  
Ontario Base Mapping, March 2014.

1,000 500 0 1,000 Metres

## SITE LOCATION MAP

### SUPPLEMENTAL GEOTECHNICAL SURVEY AND TESTING

Part of Lot 14/15, Concession 1

Douro-Dummer Township

For the Corporation of the Township of Douro-Dummer

DATE: MARCH 2020

SCALE: 1:100000

PROJECT: 161-16604-00

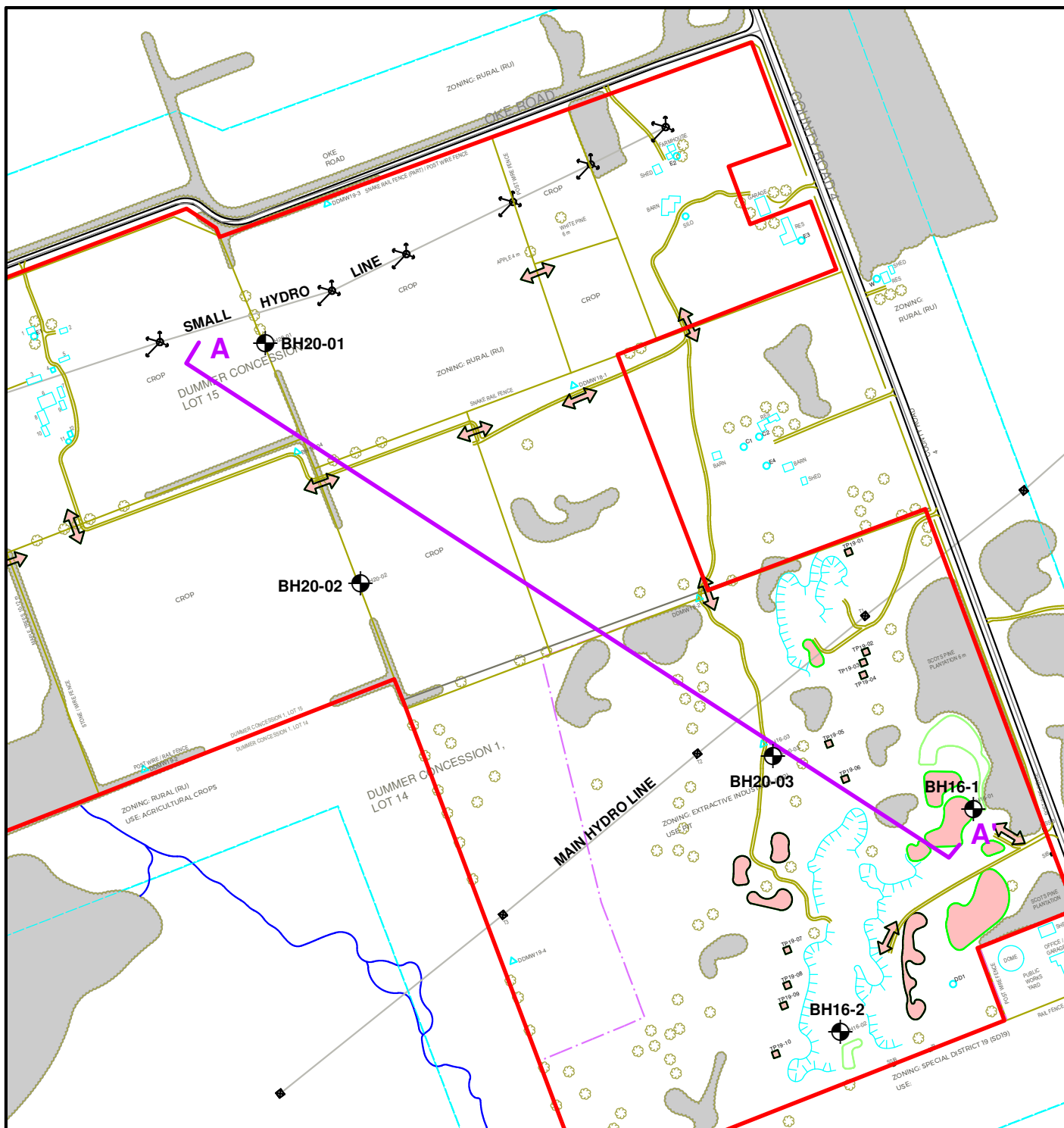
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FIGURE

1





## LEGEND

- APPROXIMATE SITE BOUNDARY
- EXISTING LICENSED PIT
- BOREHOLE LOCATION
- CROSS SECTION LOCATION



Data Source: Ministry of Natural Resources,  
Ontario Base Mapping, March 2014.

70 35 0 70 Metres

## CROSS SECTION LOCATION

### SUPPLEMENTAL GEOTECHNICAL SURVEY AND TESTING

Part of Lot 14/15, Concession 1

Douro-Dummer Township

For the Corporation of the Township of Douro-Dummer

DATE: MARCH 2020

SCALE: 1:7000

PROJECT: 161-16604-00

FILE. NO.: 161-16604-00 F2

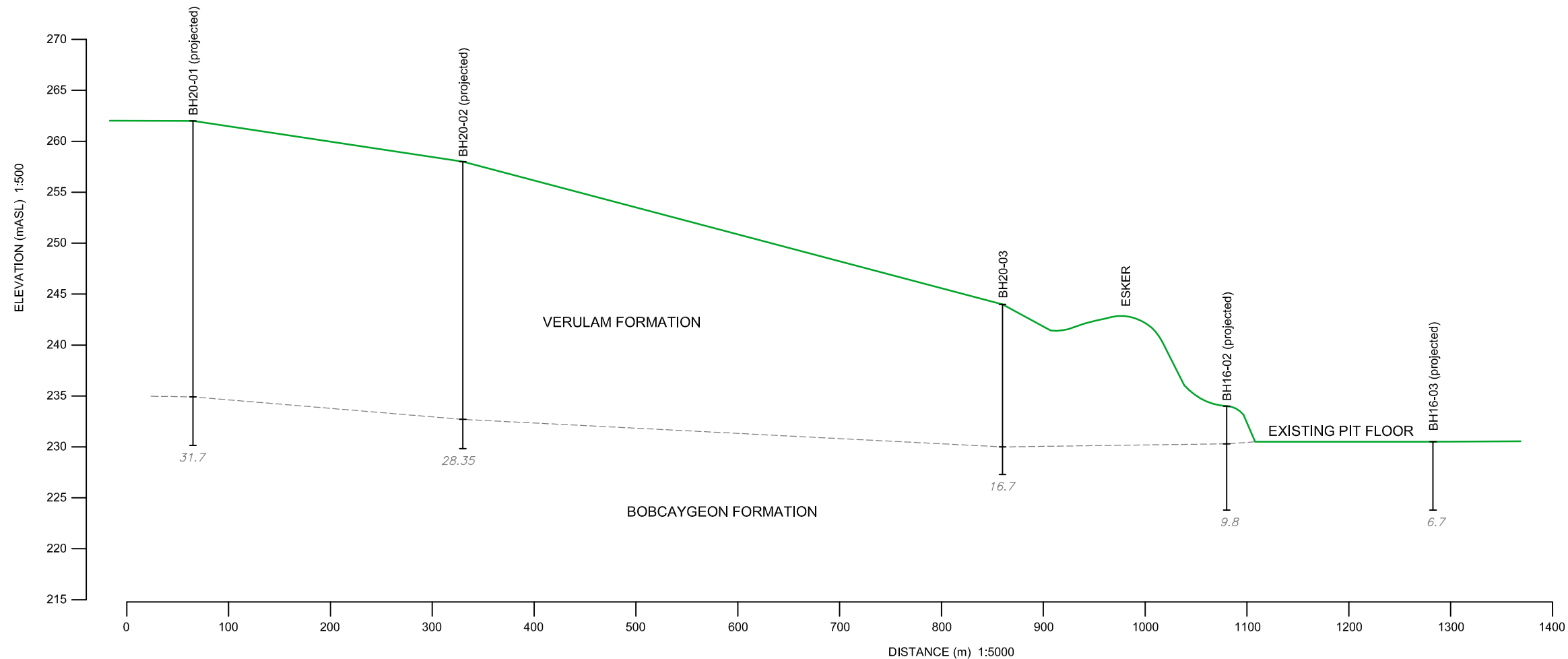


FIGURE

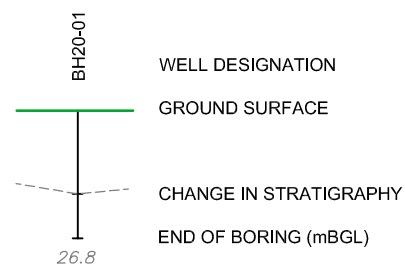
2

**A**  
North West

**A'**  
South East



LEGEND



NOTE:  
THE ACTUAL SOIL STRATIFICATION HAS BEEN VERIFIED FROM DATA OBTAINED AT THE WATER WELL LOCATIONS ONLY. THE INFERRED CONTACTS SHOWN ARE BASED ON GEOLOGICAL EVIDENCE AND THESE MAY VARY FROM THOSE SHOWN BETWEEN BORINGS. WELL DATA IS PROJECTED ONTO THE SECTION WHICH ALSO MAY CREATE SOME IRREGULARITIES IN CONTACT DEPTHS.

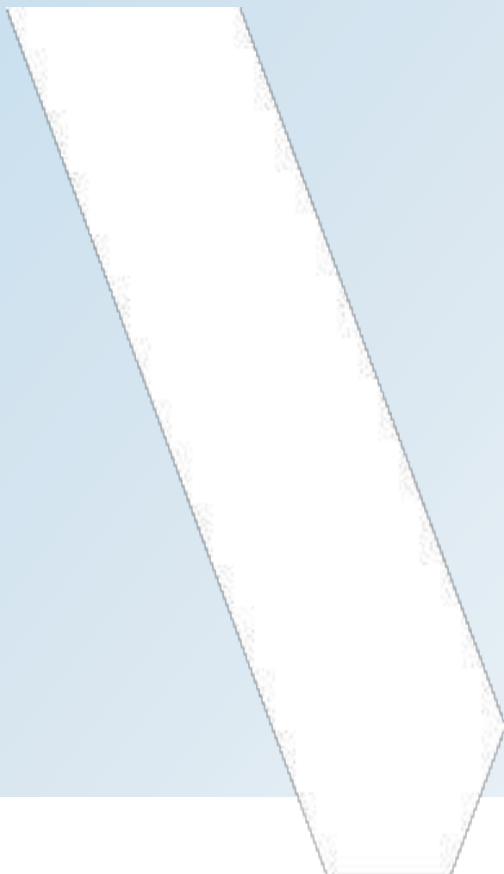
**CROSS SECTION A-A'**

SUPPLEMENTAL GEOTECHNICAL  
SURVEY AND TESTING  
Pt of Lot 14/15, Conc. 1, Douro-Dummer Township  
For the Corporation of the Township of  
Douro-Dummer

DATE: MARCH 2020	SCALES: AS SHOWN
PROJECT: 161-16604-00	FILE NO.: 161-16604-00 F3

# APPENDIX

## A SITE PLAN









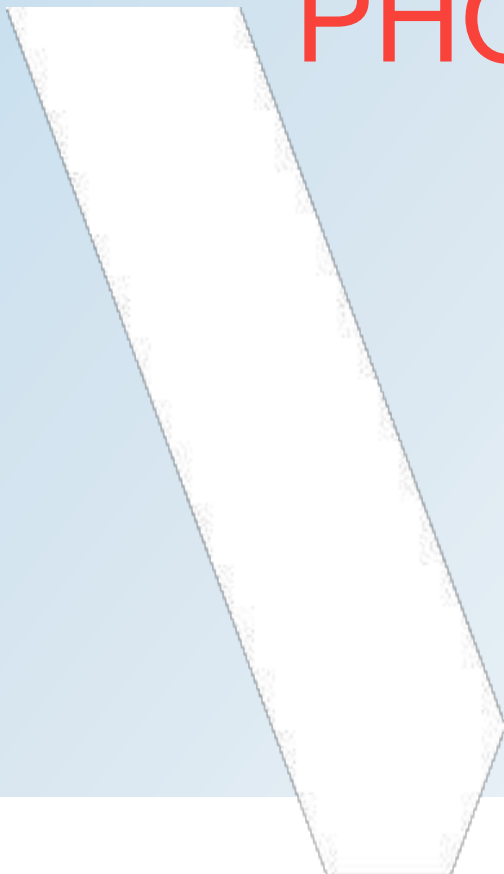


# APPENDIX

# B

## TEST PIT

## PHOTOGRAPHS







Photograph 1: TP1



Photograph 2: TP1





Photograph 3: TP1



Photograph 4: TP1



Photograph 5: TP2



Photograph 6: TP2





Photograph 7: TP3



Photograph 8: TP3



Photograph 9: TP4



Photograph 10: TP4





Photograph 11: TP4



Photograph 12: TP4



Photograph 13: TP4



Photograph 14: TP5





Photograph 15: TP5



Photograph 16: TP6





Photograph 17: TP6



Photograph 18: TP6



Photograph 19: TP6



Photograph 20: TP7





Photograph 21: TP7



Photograph 22: TP7



Photograph 23: TP8



Photograph 24: TP8





Photograph 25: TP8



Photograph 26: TP9

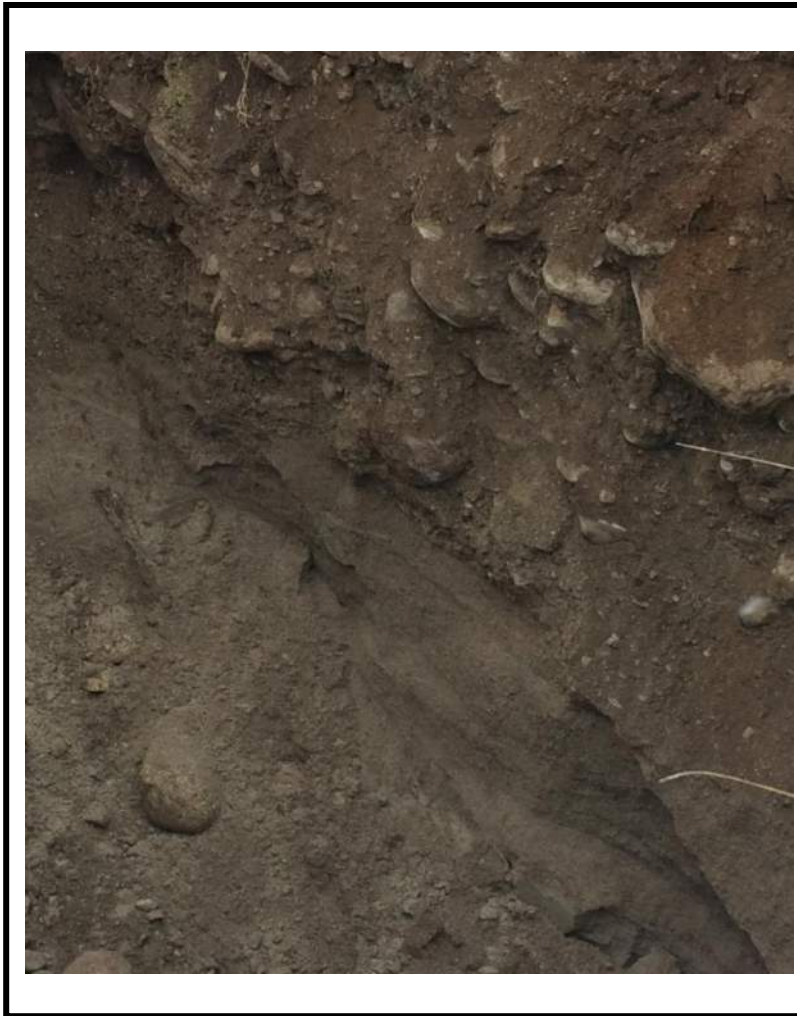


Photograph 27: TP9



Photograph 28: TP9





Photograph 29: TP9



Photograph 30: TP9



Photograph 31: TP10



Photograph 32: TP10





Photograph 33: TP10



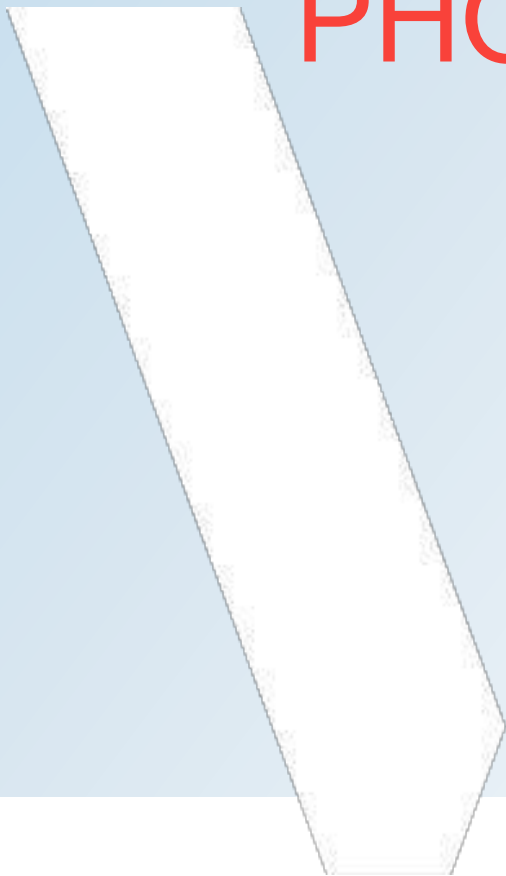
Photograph 34: TP10



Photograph 35: TP10

# APPENDIX

## C TEST PIT SAMPLE PHOTOS







Photograph 1: TP19-01



Photograph 2: TP19-02





Photograph 3: TP19-03



Photograph 4: TP19-04





Photograph 5: TP19-05



Photograph 6: TP19-06





Photograph 7: TP19-07



Photograph 8: TP19-08



Photograph 9: TP19-09

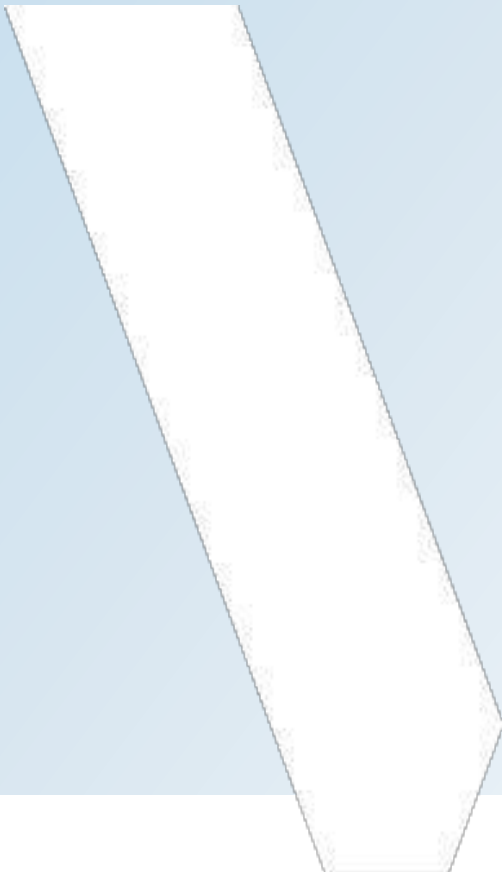


Photograph 10: TP19-10



# APPENDIX

## D TEST PIT LOGS



# TEST PIT NO. 19-01

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Nov 28, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 237.6 m**

**REVIEWER: GB**

[illegible]

# TEST PIT NO. 19-02

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**





**DATE COMPLETED:** Nov 28, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 239.9 m**

**REVIEWER: GB**

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION		WATER CONTENT %			REMARKS	
				TYPE	DPT VALUE	% WATER	% RECOVERY	EAGLE 2 (PPM)	"DPT" VALUE			10 20 30			
									5	10	15	SHEAR STRENGTH			
												W <sub>p</sub>	W <sub>L</sub>		
0.0															
0.3	TOPSOIL														
1.0	SAND AND GRAVEL: Brown SAND AND GRAVEL, trace rootlets, trace organics, moist			GS1											
2.0	COBBLES AND BOULDERS: COBBLES AND BOULDERS, some sand and gravel, some silt, moist														
3.0				GS2											
4.0	SAND AND GRAVEL: Light brown SAND AND GRAVEL, some cobbles, some silt, moist														
5.0				GS3											
6.0	Test pit terminated at 6 m below ground surface in SAND AND GRAVEL.												Test pit open and dry upon completion.		
7.0															
8.0															
9.0															
10.0															
11.0															
12.0															

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Nov 28, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 239.3 m**

**REVIEWER: GB**

[illegible]



**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Nov 28, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 240.0 m**

**REVIEWER: GB**

[illegible]

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Nov 28, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 237.5 m**

**REVIEWER: GB**

[illegible]

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Nov 28, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 242.5 m**

**REVIEWER: GB**

[illegible]

# TEST PIT NO. 19-07

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Dec 05, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 246.6 m**

**REVIEWER: GB**

[illegible]



**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Dec 05, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 246.6 m**

**REVIEWER: GB**

[illegible]

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Dec 05, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 246.2 m**

**REVIEWER: GB**

[illegible]

# TEST PIT NO. 19-10

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Dec 05, 2019

**TEST PIT TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 246.7 m**

**REVIEWER: GB**

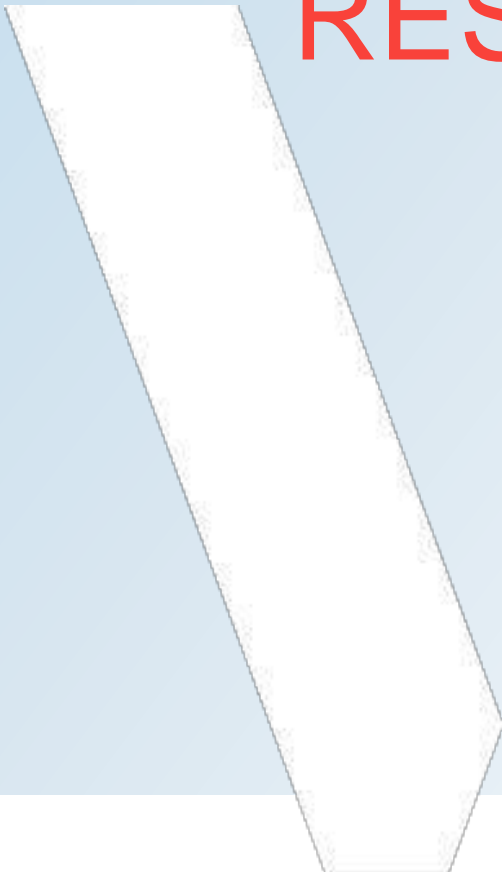
[illegible]



# APPENDIX

**E**

## TEST PIT LAB RESULTS



## APPENDIX

# ***E-1*** *MICRO DEVAL ABRASION TEST (COARSE AND FINE)*



## Micro Deval Abrasion Test Method LS-618 - Coarse

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Client:</b>	Township of Douro-Dummer
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	January 8, 2020
<b>Sampled By:</b>	MSN	<b>Material Type:</b>	Sand and Gravel
<b>Date Sampled:</b>	December 5, 2019	<b>Source:</b>	Quarry

Sample No.	Test Pit No.	Original Mass (g)	Final Mass (g)	Mass Loss (g)	Percent Loss
TP19-01	TP19-01	1248.9	982.1	266.8	21.4
TP19-02	TP19-02	1499.26	1138.24	361.0	24.1
TP19-03	TP19-03	1500.6	1133.34	367.3	24.5
TP19-04	TP19-04	1493.2	1192.27	300.9	20.2
TP19-05	TP19-05	1501.9	1145.88	356.0	23.7
TP19-06	TP19-06	1500.7	1124.77	375.9	25.1
TP19-07	TP19-07	1499.1	1159.61	339.5	22.6
TP19-08	TP19-08	1438.6	1142.71	295.9	20.6
TP19-09	TP19-09	0	0	N/A	N/A
TP19-10	TP19-10	1497	1134.3	362.7	24.2

**Notes:** Sample soaked in 2000 ml of tap water for 1 hour

Aver. Charge Weight (g): 5000.5

Reference Sample Control Range:	11.4% - 14.8%
Reference Sample Percent Loss:	14.3
Reference Sample Average Percent Loss:	13.8

TP19-01, TP19-08 & TP19-10 not completed to LS-618. Insufficient amount of sample provided for test. Results may not be accurate

TP19-09 did not contain a representative amount of coarse material to complete.

Tested by: WGH/NLO

Date: January 8, 2020

Verified by: KLC

Date: January 8, 2020





## Micro Deval Abrasion Test Method LS-619 - Fine

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Client:</b>	Township of Douro-Dummer
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	January 8, 2020
<b>Sampled By:</b>	MSN	<b>Material Type:</b>	Sand and Gravel
<b>Date Sampled:</b>	December 5, 2019	<b>Source:</b>	Quarry

Sample No.	Test Pit No.	Original Mass (g)	Final Mass (g)	Mass Loss (g)	Percent Loss
TP19-01	TP19-01	501.4	450.8	50.7	10.1
TP19-02	TP19-02	501.0	423.3	77.7	15.5
TP19-03	TP19-03	504.0	428.8	75.2	14.9
TP19-04	TP19-04	500.3	445.3	55.0	11.0
TP19-05	TP19-05	499.6	406.6	93.0	18.6
TP19-06	TP19-06	503.0	425.2	77.8	15.5
TP19-07	TP19-07	500.9	431.5	69.4	13.9
TP19-08	TP19-08	503.3	444.8	58.6	11.6
TP19-09	TP19-09	503.2	457.7	45.5	9.0
TP19-10	TP19-10	501.1	423.9	77.2	15.4

**Notes:** Sample soaked in 750 ml of tap water for 24 hours

**Aver. Charge Weight (g):** 1250.41

**Reference Sample Control Range:** 15.2 - 18.4%

**Reference Sample Percent Loss:** 17.2

**Reference Sample Average Percent Loss:** 17.55

**Tested by:** WGH/NLO

**Date:** January 8, 2020

**Verified by:** KLC

**Date:** January 8, 2020

## APPENDIX

# ***E-2*** *RELATIVE DENSITY AND ABSORPTION (COARSE AND FINE)*



## Relative Density and Absorption - Fine Aggregate LS605 / ASTM C128

<b>Project Name:</b>	Douro Dummer Aggregate Investigation	<b>Client:</b>	Douro Dummer Township
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	1/8/2020
<b>Sampled By:</b>	MSN	<b>Material Type:</b>	Sand and Gravel
<b>Date Sampled:</b>	December 5, 2020	<b>Source:</b>	Quarry

Sample No.	Temp. (°C) T	Pycnometer No.	Pycnometer Mass (g)	Mass of SSD Sand in Air (g) S	Mass of Sand/Pycnometer/Water (g) C	Mass of Pycnometer to Cal Point (g) (@ T) B	Mass of Dry Sand in Air A	Relative Density (Oven Dry)	Relative Density (SSD)	Apparent Relative Density	Absorption (%)
TP19-01	21.60	O	166.03	502.49	977.20	664.08	496.3	2.621	2.653	2.709	1.25
TP19-01	21.60	Z	167.37	501.12	978.07	665.49	494.8	2.624	2.658	2.715	1.28
Average								2.623	2.656	2.712	1.26
TP19-02	22.60	P	174.13	502.30	982.25	672.06	490.5	2.553	2.615	2.720	2.40
TP19-02	22.90	O	166.03	502.57	974.18	663.91	491.2	2.554	2.613	2.715	2.31
Average								2.554	2.614	2.717	2.36
TP19-03	21.30	P	174.10	501.18	981.96	672.17	492.7	2.574	2.619	2.693	1.71
TP19-03	21.50	Z	167.17	502.87	975.99	665.49	494.6	2.571	2.614	2.687	1.68
Average								2.573	2.616	2.690	1.70
TP19-04	23.20	O	166.03	501.60	972.55	663.91	490.2	2.541	2.599	2.700	2.32
TP19-04	23.40	P	174.14	501.40	980.90	671.94	490.6	2.549	2.605	2.701	2.21
Average								2.545	2.602	2.700	2.26
TP19-05	22.50	Y	169.53	501.12	976.27	667.51	490.3	2.549	2.605	2.701	2.21
TP19-05	22.70	O	166.01	502.42	974.08	663.91	492.0	2.559	2.613	2.706	2.12
Average								2.554	2.609	2.703	2.16

Reference Sample Control Mean	
Reference Sample Average Percent Absorption:	1.92
Reference Sample Average Relative Density:	2.597

Operator: NLO Date: January 8, 2020

Verified by:  Date: January 8, 2020

Control Range
Absorption
Range 1.58 - 2.12%
Mean Relative Density (Oven Dry)
Range 2.593 - 2.629



## Relative Density and Absorption - Fine Aggregate LS605 / ASTM C128

<b>Project Name:</b>	Douro Dummer Aggregate Investigation	<b>Client:</b>	Douro Dummer Township
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	1/8/2020
<b>Sampled By:</b>	MSN	<b>Material Type:</b>	Sand and Gravel
<b>Date Sampled:</b>	December 5, 2020	<b>Source:</b>	Quarry

Sample No.	Temp. (°C) T	Pycnometer No.	Pycnometer Mass (g)	Mass of SSD Sand in Air (g) S	Mass of Sand/Pycnometer/Water (g) C	Mass of Pycnometer to Cal Point (g) (@ T) B	Mass of Dry Sand in Air A	Relative Density (Oven Dry)	Relative Density (SSD)	Apparent Relative Density	Absorption (%)
TP19-06	23.20	Z	167.18	503.00	976.80	665.33	491.6	2.567	2.626	2.729	2.32
TP19-06	22.60	Y	169.49	502.70	979.08	667.51	492.0	2.574	2.630	2.727	2.17
Average								2.570	2.628	2.728	2.25
TP19-07	23.10	Z	167.18	500.15	974.63	665.33	487.9	2.557	2.621	2.731	2.50
TP19-07	23.10	Y	169.49	502.39	977.78	667.46	490.0	2.551	2.616	2.727	2.53
Average								2.554	2.618	2.729	2.52
TP19-08	23.80	Y	169.49	500.57	975.82	667.33	491.6	2.559	2.606	2.685	1.82
TP19-08	23.00	Z	167.18	502.83	975.70	665.33	493.8	2.566	2.613	2.692	1.83
Average								2.563	2.609	2.688	1.83
TP19-09	22.70	Z	167.18	502.72	977.53	665.33	496.3	2.605	2.639	2.696	1.29
TP19-09	22.80	O	166.02	501.54	975.55	663.91	495.5	2.609	2.641	2.695	1.21
Average								2.607	2.640	2.695	1.25
TP19-10	23.50	P	174.10	501.63	982.51	671.94	493.3	2.582	2.625	2.700	1.70
TP19-10	23.30	Y	169.51	502.43	978.53	667.40	494.4	2.584	2.626	2.698	1.63
Average								2.583	2.626	2.699	1.66

Reference Sample Control Mean	
Reference Sample Average Percent Absorption:	1.92
Reference Sample Average Relative Density:	2.597

Operator: NLO Date: January 8, 2020

Verified by:  Date: January 8, 2020

Control Range
Absorption
Range 1.58 - 2.12%
Mean Relative Density (Oven Dry)
Range 2.593 - 2.629

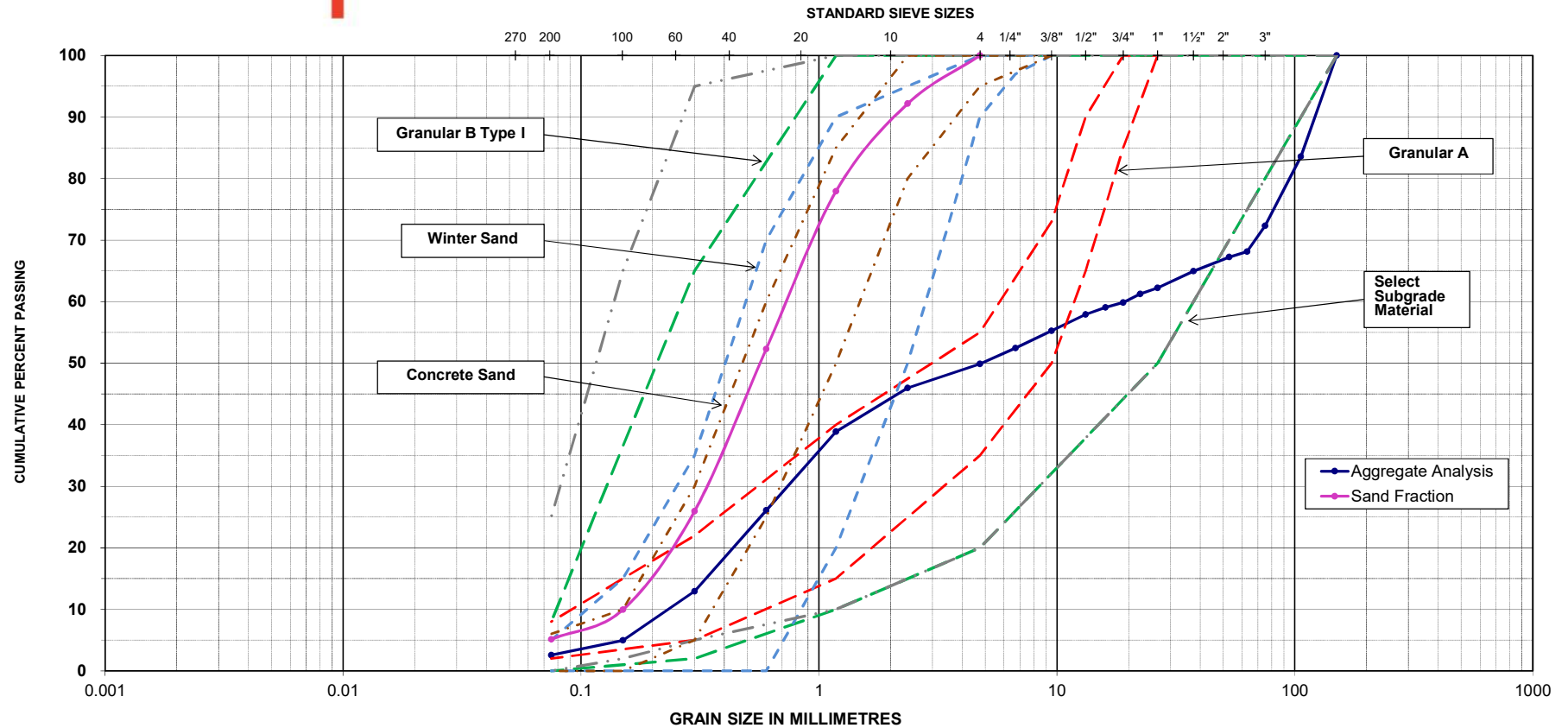


## APPENDIX

# ***E-3*** *PARTICLE SIZE DISTRIBUTION PLOTS*



## PARTICLE SIZE DISTRIBUTION



MIT Scale

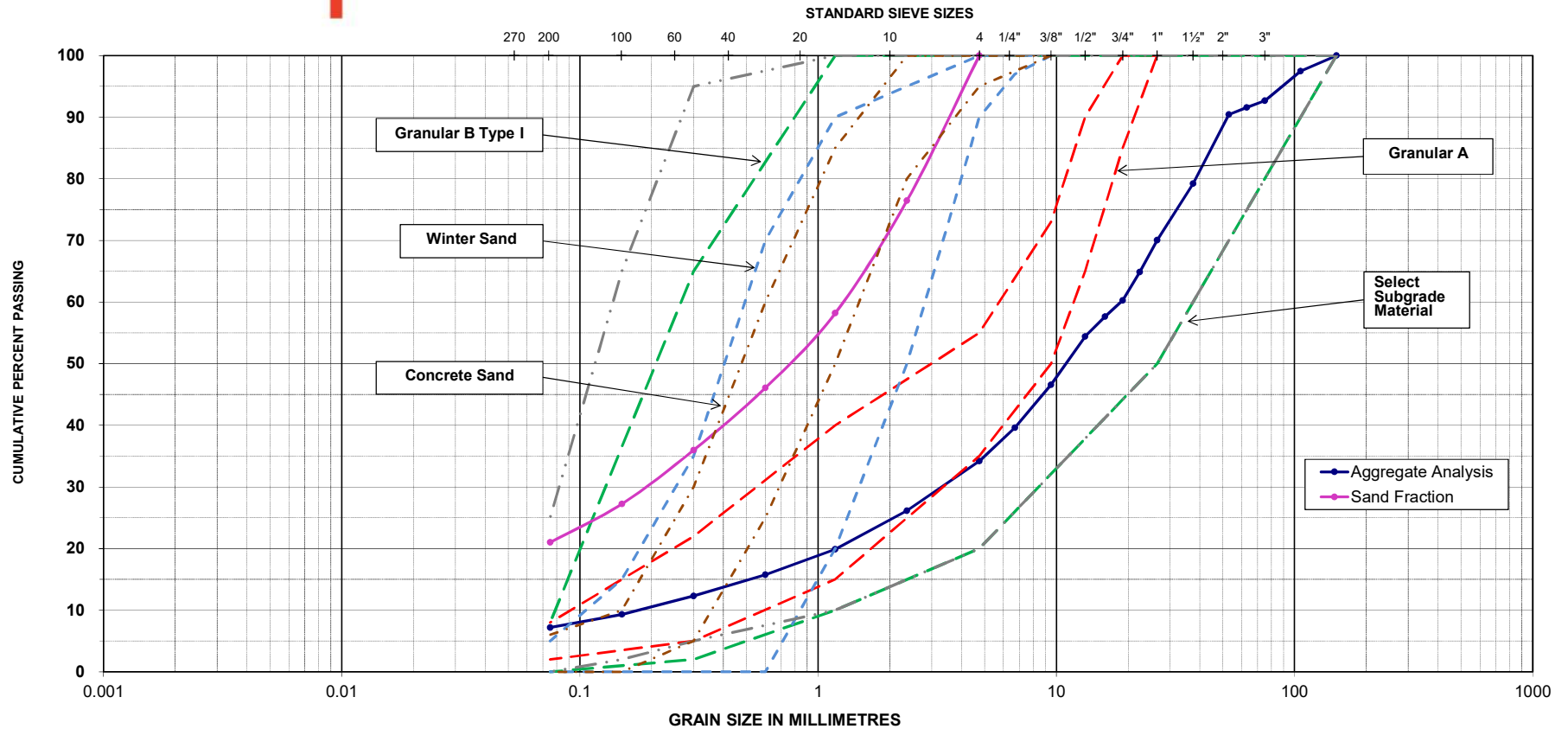
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

Project Name:	Douro-Dummer Aggregate Investigation	Project No.:	161-16604-00	Date Sampled:	12/05/2019
Material Source.:	Quarry	Location:	TP19-01	Sample No./Depth:	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	59.8	From Gradation Graph (mm):			
106 mm	83.6	16.0 mm	59.1	D75	81.0	D8	0.2
75 mm	72.3	13.2 mm	57.9	D60	19.0	D10	0.2
63 mm	68.1	9.5 mm	55.2	Cu	79.17		
53 mm	67.3	4.75 mm	49.9	% Wash	4.3		
37.5 mm	64.9	1.18 mm	38.9				
26.5 mm	62.2	0.30 mm	12.9				
22.4 mm	61.2	0.075 mm	2.6				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

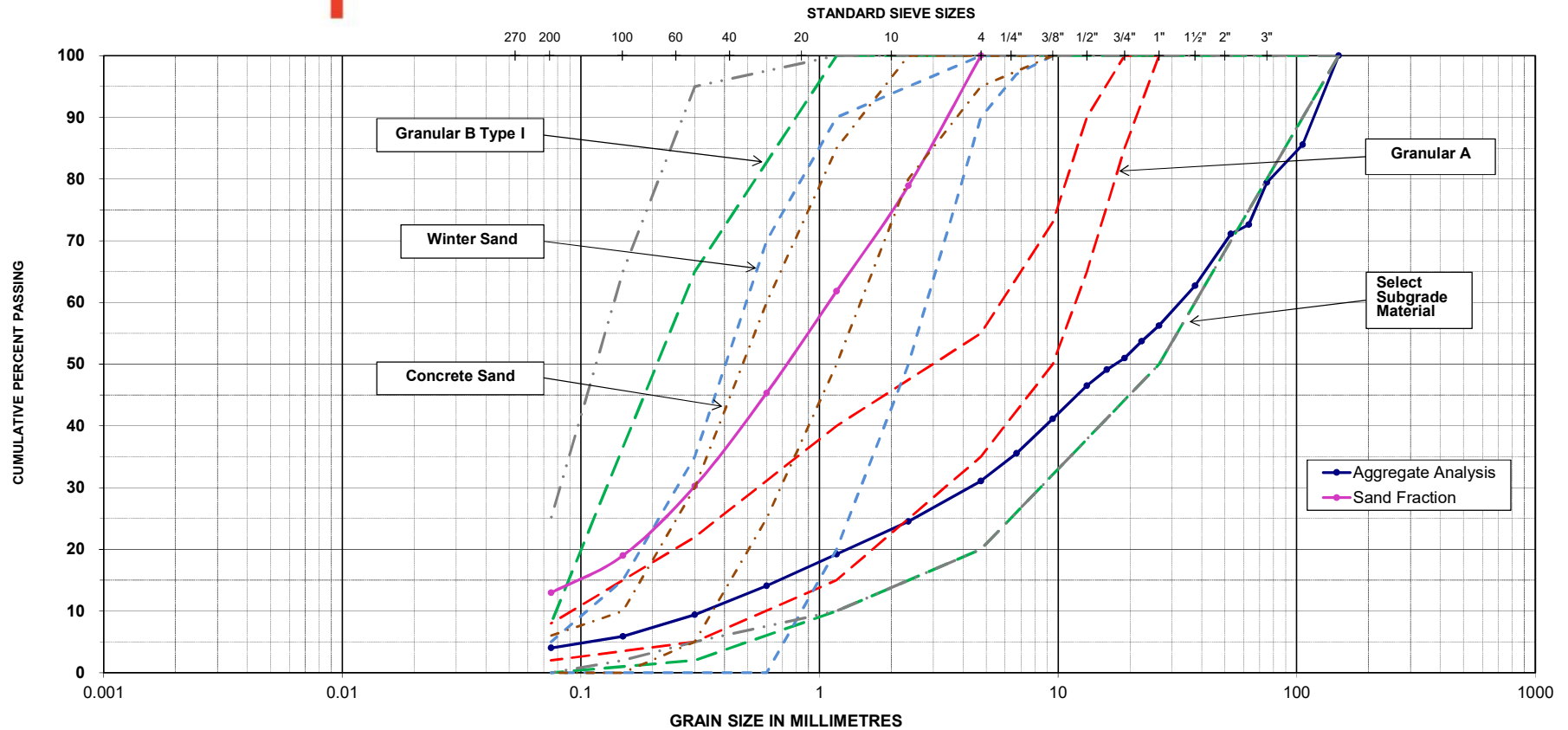
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

Project Name:	Douro-Dummer Aggregates Investigation	Project No.:	161-16604-00	Date Sampled:	12/05/2019
Material Source.:	Quarry	Location:	TP19-02	Sample No./Depth:	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	60.3	From Gradation Graph (mm):			
106 mm	97.5	16.0 mm	57.6	D75	32.0	D8	0.2
75 mm	92.7	13.2 mm	54.4	D60	19.0	D10	0.2
63 mm	91.6	9.5 mm	46.6	Cu	105.56		
53 mm	90.4	4.75 mm	34.2	% Wash	17.5		
37.5 mm	79.2	1.18 mm	19.9				
26.5 mm	70.0	0.30 mm	12.3				
22.4 mm	64.9	0.075 mm	7.2				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

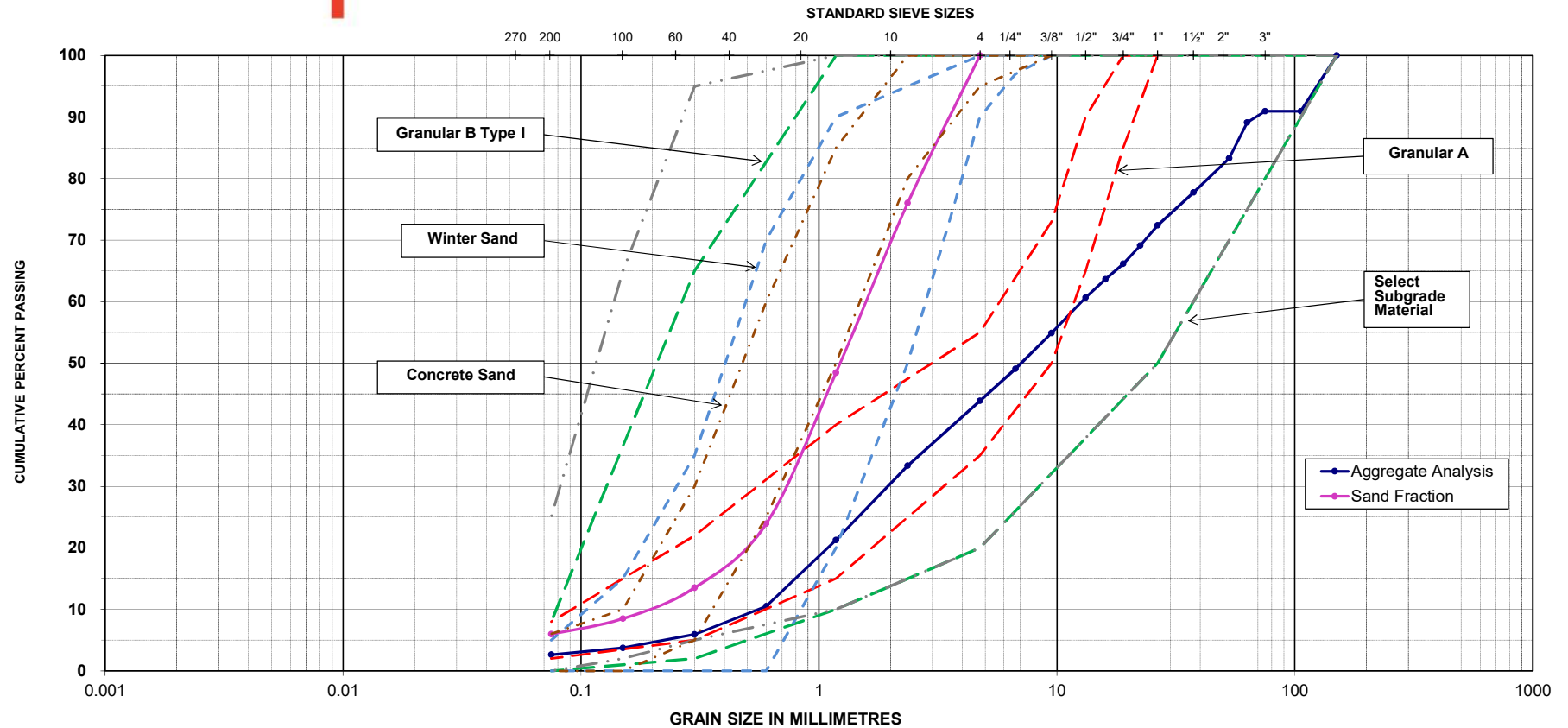
Project Name:	Douro-Dummer Aggregate Investigation	Project No.:	161-16604-00	Date Sampled:	12/05/2019
Material Source.:	Quarry	Location:	TP19-03	Sample No./Depth:	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	51.0	From Gradation Graph (mm):			
106 mm	85.6	16.0 mm	49.1	D75	66.0	D8	0.2
75 mm	79.5	13.2 mm	46.5	D60	33.0	D10	0.2
63 mm	72.6	9.5 mm	41.2	Cu	137.50		
53 mm	71.1	4.75 mm	31.1	% Wash	10.4		
37.5 mm	62.7	1.18 mm	19.2				
26.5 mm	56.2	0.30 mm	9.4				
22.4 mm	53.7	0.075 mm	4.0				





## PARTICLE SIZE DISTRIBUTION



MIT Scale

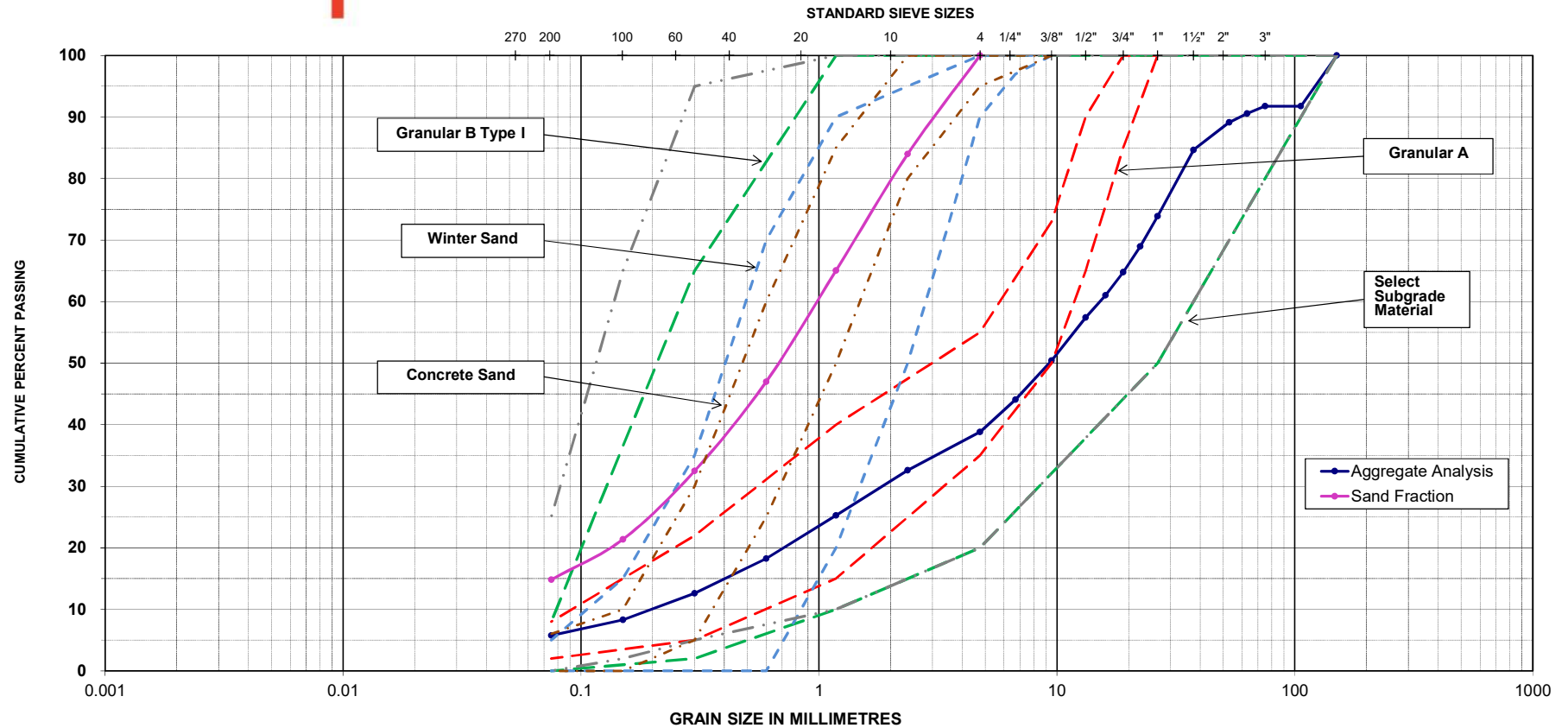
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

Project Name:	Douro-Dummer Aggregates Investigation	Project No.:	161-16604-00	Date Sampled:	12/05/2019
Material Source.:	Quarry	Location:	TP19-04	Sample No./Depth:	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	66.2	From Gradation Graph (mm):			
106 mm	90.9	16.0 mm	63.6	D75	30.0	D8	0.5
75 mm	90.9	13.2 mm	60.7	D60	14.0	D10	0.6
63 mm	89.1	9.5 mm	54.9	Cu	23.33		
53 mm	83.3	4.75 mm	43.9	% Wash	5.1		
37.5 mm	77.7	1.18 mm	21.3				
26.5 mm	72.4	0.30 mm	5.9				
22.4 mm	69.1	0.075 mm	2.6				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

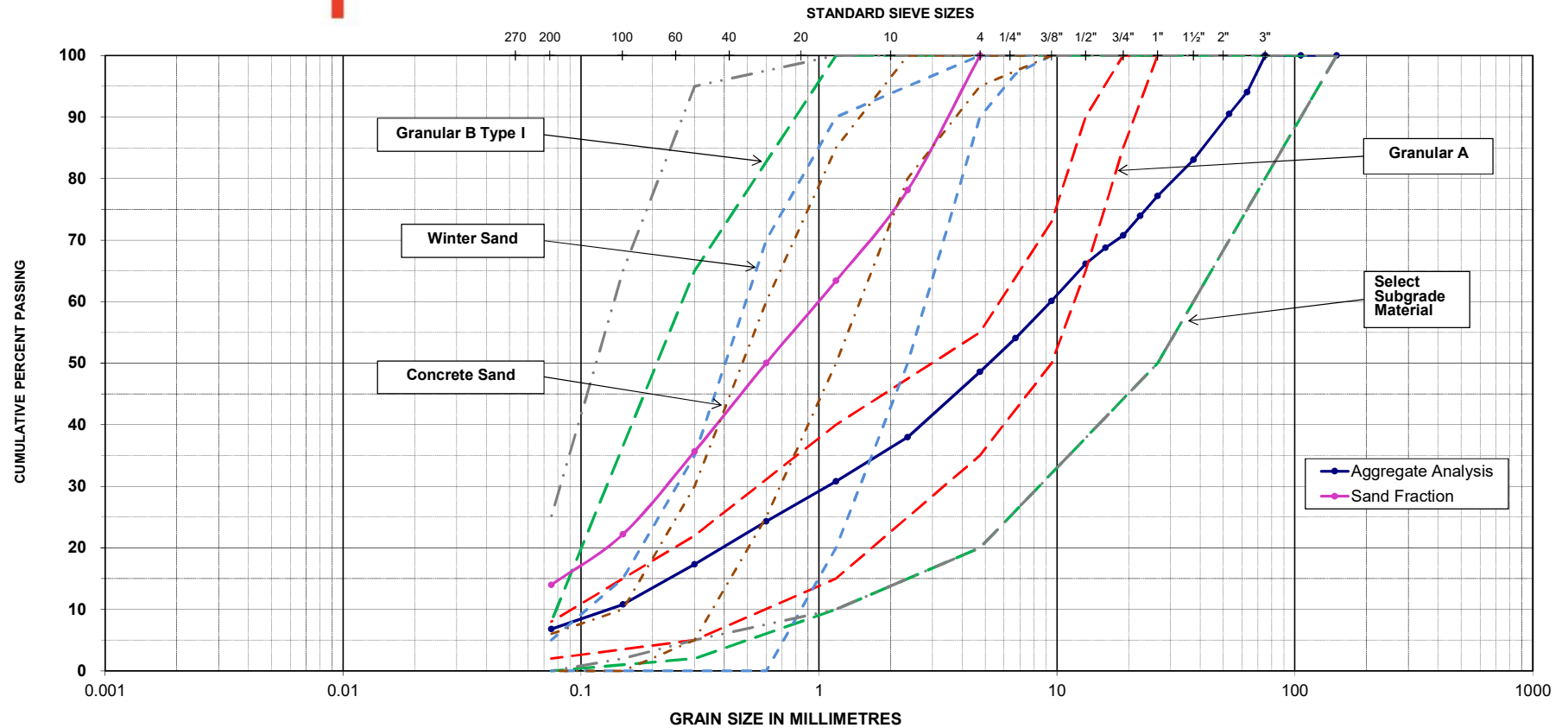
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Project No.:</b>	161-16604-00	<b>Date Sampled:</b>	12/05/2019
<b>Material Source.:</b>	Quarry	<b>Location:</b>	TP19-05	<b>Sample No./Depth:</b>	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	64.8	From Gradation Graph (mm):			
106 mm	91.8	16.0 mm	61.0	D75	27.0	D8	0.2
75 mm	91.8	13.2 mm	57.4	D60	16.0	D10	0.2
63 mm	90.5	9.5 mm	50.4	Cu	80.00		
53 mm	89.1	4.75 mm	38.8	% Wash	11.7		
37.5 mm	84.6	1.18 mm	25.3				
26.5 mm	73.9	0.30 mm	12.6				
22.4 mm	69.0	0.075 mm	5.8				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

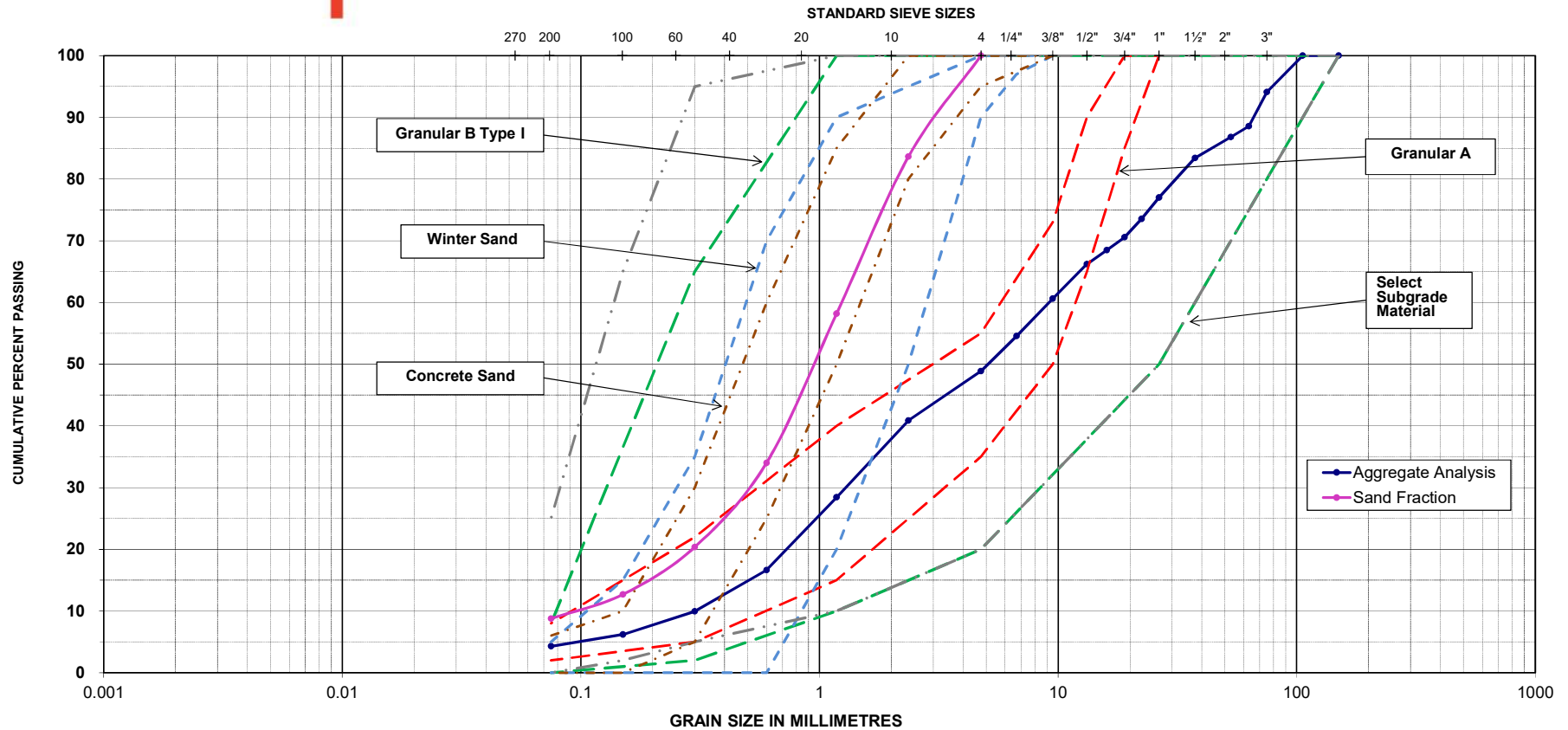
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Project No.:</b>	161-16604-00	<b>Date Sampled:</b>	12/05/2019
<b>Material Source.:</b>	Quarry	<b>Location:</b>	TP19-06	<b>Sample No./Depth:</b>	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	70.8	From Gradation Graph (mm):			
106 mm	100.0	16.0 mm	68.8	D75	24.0	D8	0.1
75 mm	100.0	13.2 mm	66.2	D60	9.5	D10	0.1
63 mm	94.0	9.5 mm	60.1	Cu	67.86		
53 mm	90.5	4.75 mm	48.6	% Wash	10.7		
37.5 mm	83.1	1.18 mm	30.8				
26.5 mm	77.2	0.30 mm	17.3				
22.4 mm	73.9	0.075 mm	6.8				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

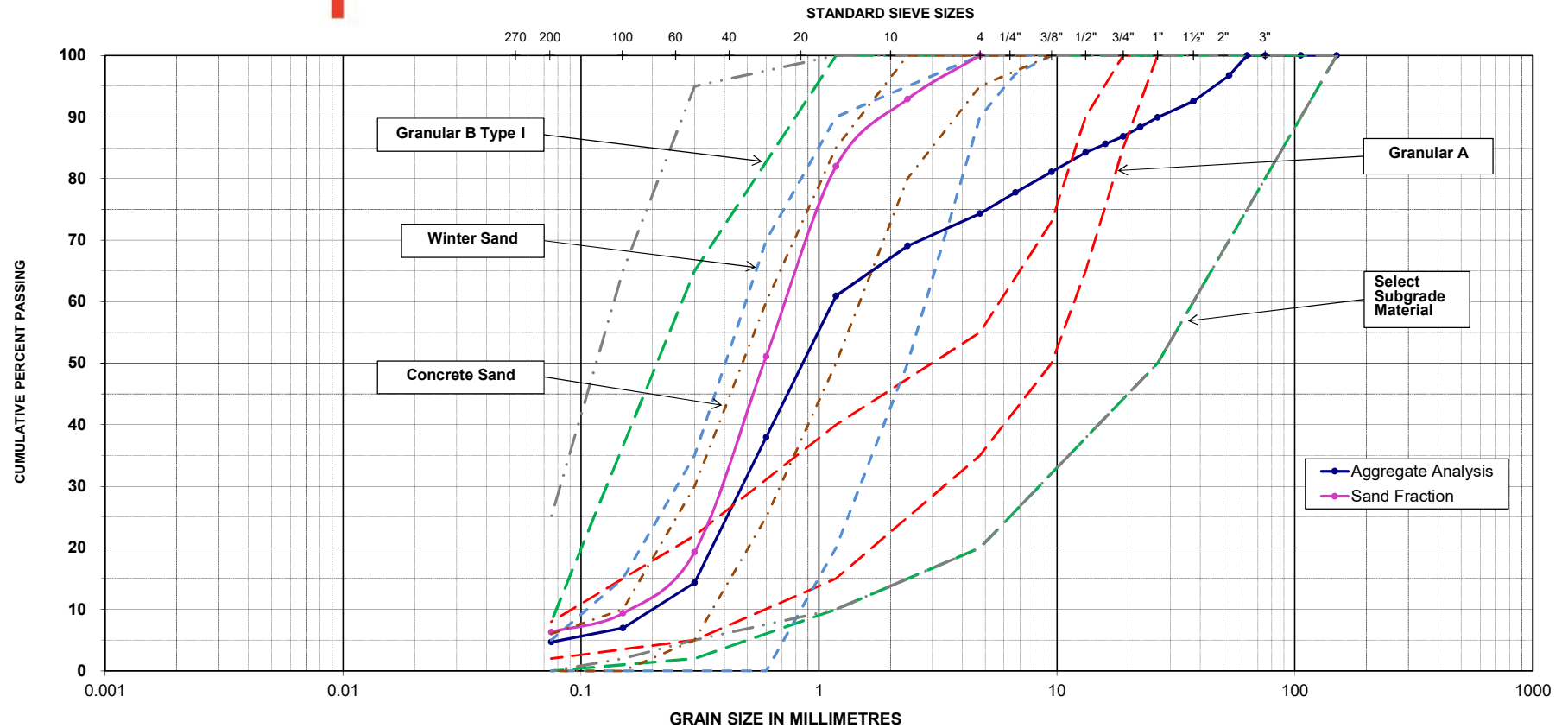
Project Name:	Douro-Dummer Aggregate Investigation	Project No.:	161-16604-00	Date Sampled:	12/05/2019
Material Source.:	Quarry	Location:	TP19-07	Sample No./Depth:	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	70.6	From Gradation Graph (mm):			
106 mm	100.0	16.0 mm	68.5	D75	25.0	D8	0.3
75 mm	94.1	13.2 mm	66.2	D60	9.2	D10	0.3
63 mm	88.6	9.5 mm	60.6	Cu	30.67		
53 mm	86.8	4.75 mm	48.9	% Wash	7.0		
37.5 mm	83.4	1.18 mm	28.4				
26.5 mm	77.0	0.30 mm	10.0				
22.4 mm	73.5	0.075 mm	4.3				





## PARTICLE SIZE DISTRIBUTION



MIT Scale

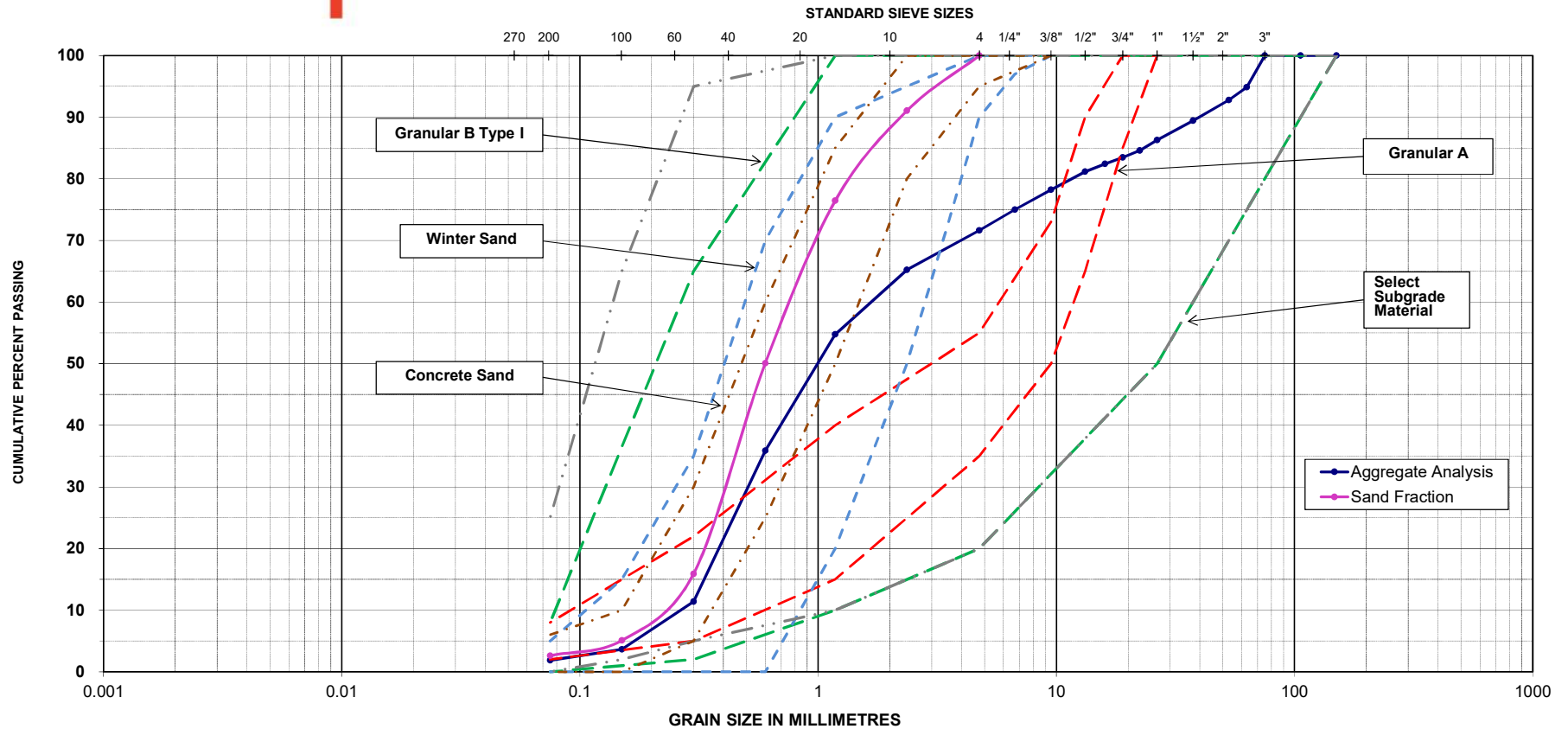
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Project No.:</b>	161-16604-00	<b>Date Sampled:</b>	12/05/2019
<b>Material Source.:</b>	Quarry	<b>Location:</b>	TP19-08	<b>Sample No./Depth:</b>	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	86.8	From Gradation Graph (mm):			
106 mm	100.0	16.0 mm	85.6	D75	4.0	D8	0.2
75 mm	100.0	13.2 mm	84.2	D60	1.3	D10	0.2
63 mm	100.0	9.5 mm	81.1	Cu	6.50		
53 mm	96.7	4.75 mm	74.3	% Wash	4.8		
37.5 mm	92.6	1.18 mm	60.9				
26.5 mm	89.9	0.30 mm	14.3				
22.4 mm	88.4	0.075 mm	4.7				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

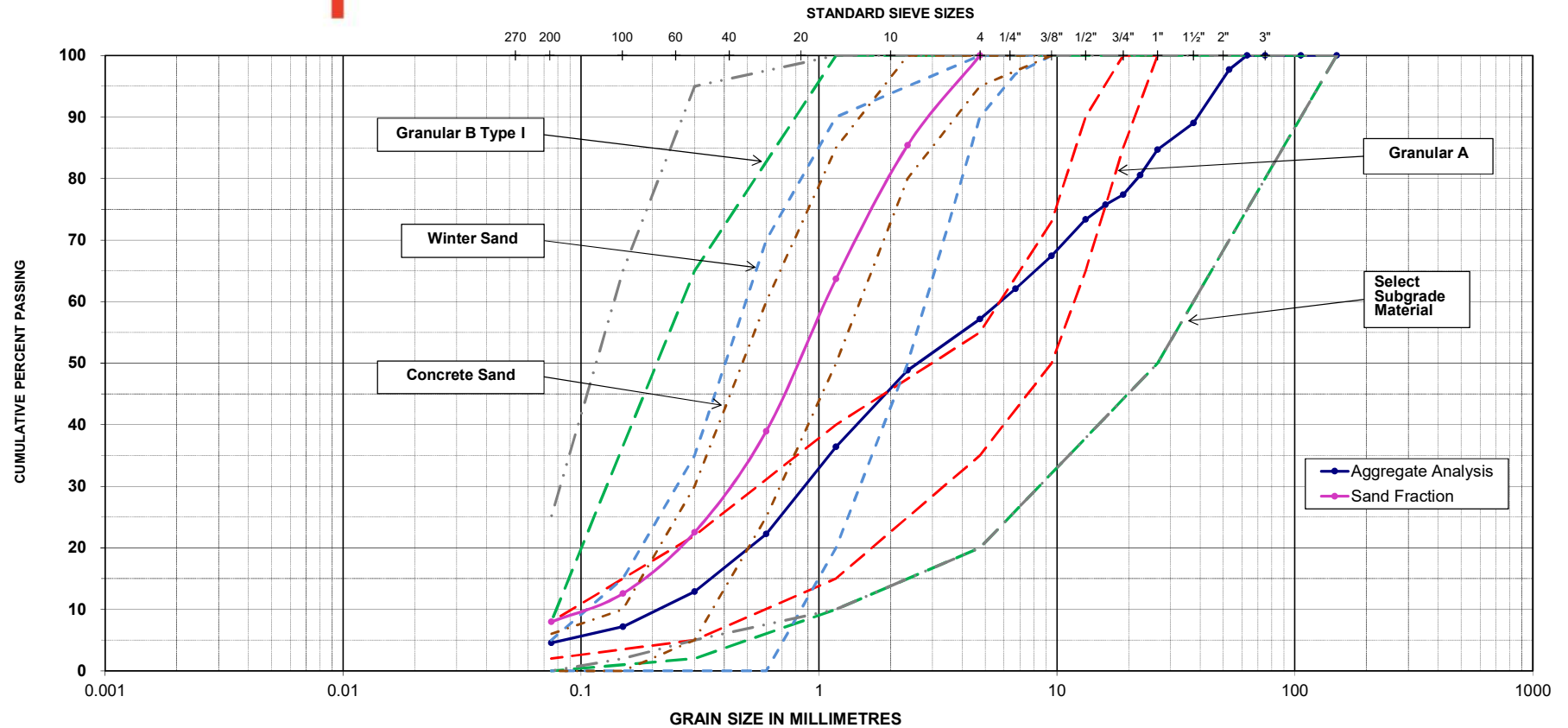
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Project No.:</b>	161-16604-00	<b>Date Sampled:</b>	12/05/2019
<b>Material Source.:</b>	Quarry	<b>Location:</b>	TP19-09	<b>Sample No./Depth:</b>	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	83.5	From Gradation Graph (mm):			
106 mm	100.0	16.0 mm	82.4	D75	7.0	D8	0.3
75 mm	100.0	13.2 mm	81.2	D60	1.7	D10	0.3
63 mm	94.9	9.5 mm	78.2	Cu	6.54		
53 mm	92.8	4.75 mm	71.6	% Wash	2.2		
37.5 mm	89.4	1.18 mm	54.8				
26.5 mm	86.3	0.30 mm	11.4				
22.4 mm	84.6	0.075 mm	1.9				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

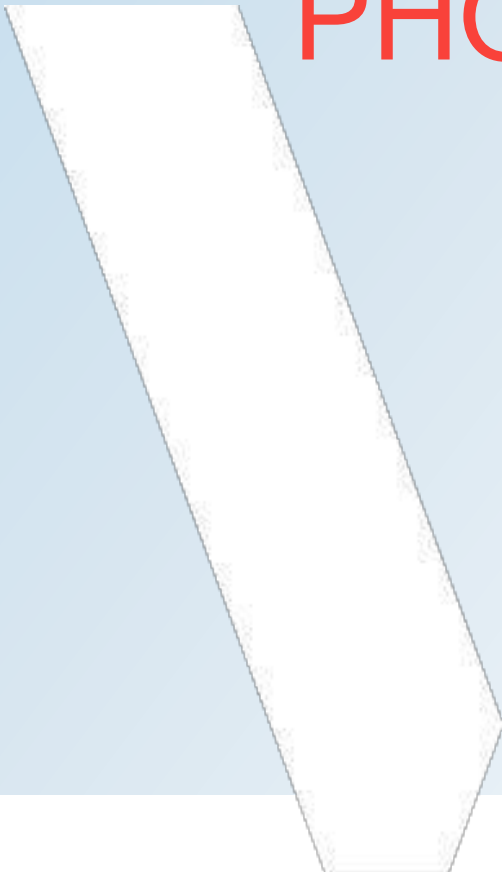
<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Project No.:</b>	161-16604-00	<b>Date Sampled:</b>	12/05/2019
<b>Material Source.:</b>	Quarry	<b>Location:</b>	TP19-10	<b>Sample No./Depth:</b>	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	77.4	From Gradation Graph (mm):			
106 mm	100.0	16.0 mm	75.7	D75	15.0	D8	0.2
75 mm	100.0	13.2 mm	73.4	D60	6.0	D10	2.2
63 mm	100.0	9.5 mm	67.4	Cu	2.73		
53 mm	97.7	4.75 mm	57.2	% Wash	6.4		
37.5 mm	89.0	1.18 mm	36.4				
26.5 mm	84.7	0.30 mm	12.9				
22.4 mm	80.6	0.075 mm	4.6				

# APPENDIX

# F

DRILLING  
PHOTOS



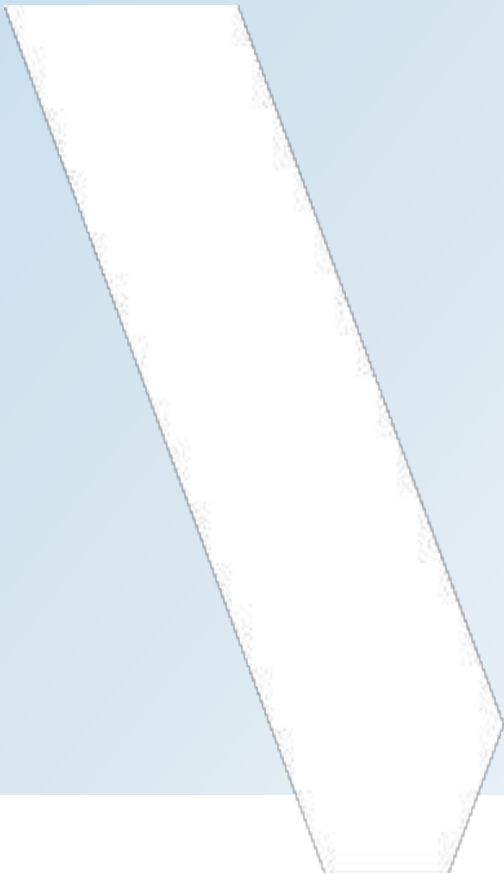




Photograph 1: BH20-1

# APPENDIX

## G CORE PHOTOS





Photograph 1: BH20-01



Photograph 2: BH20-01





Photograph 3: BH20-01

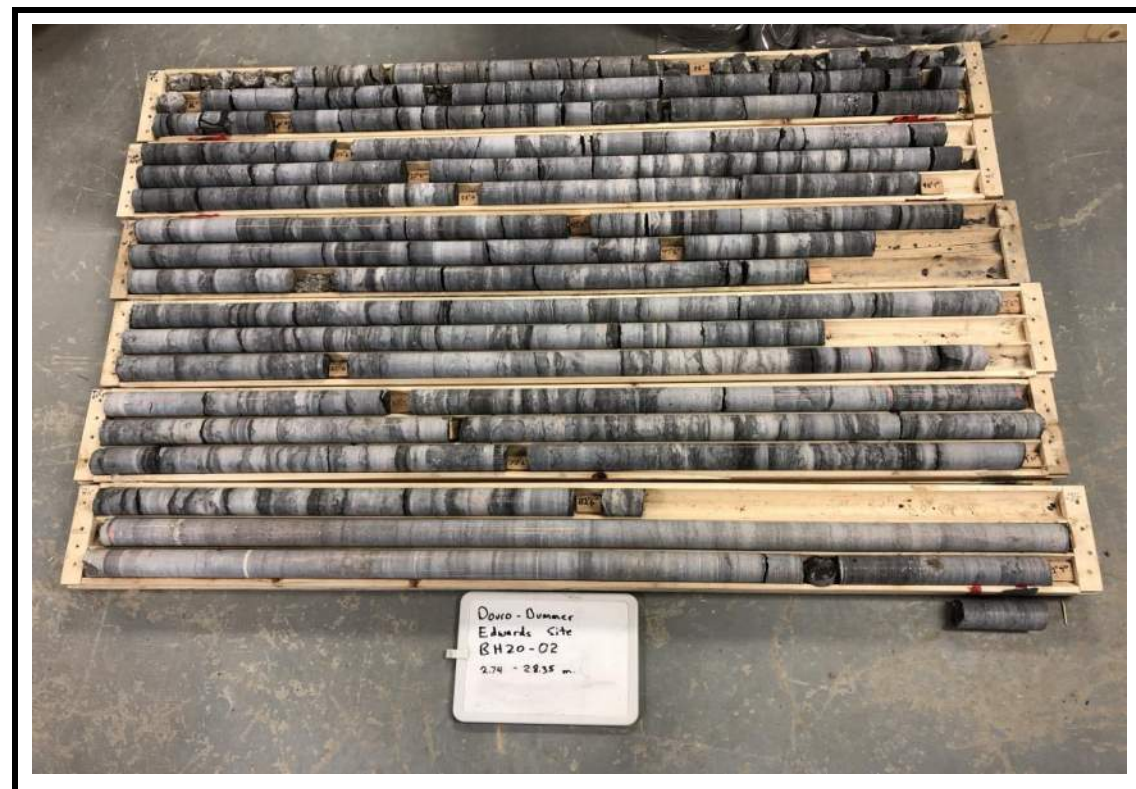


Photograph 4: BH20-01





Photograph 5: BH20-01



Photograph 6: BH20-02

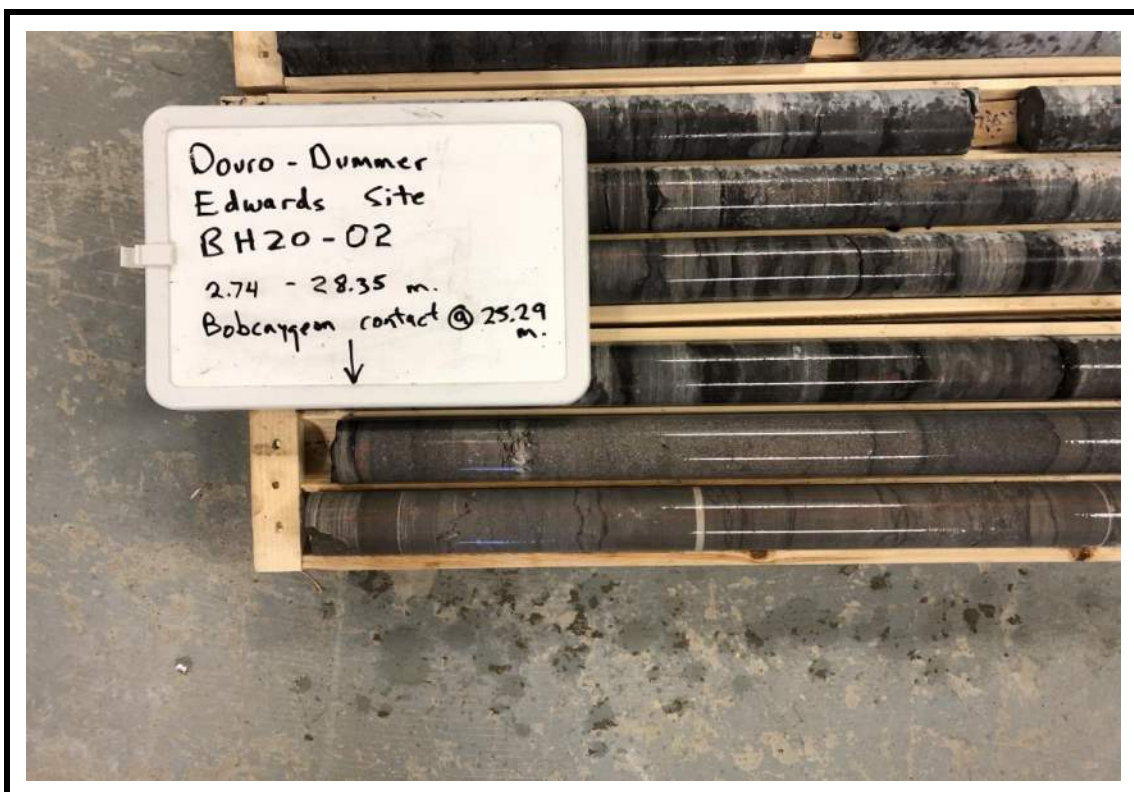


Photograph 7: BH20-02



Photograph 8: BH20-02

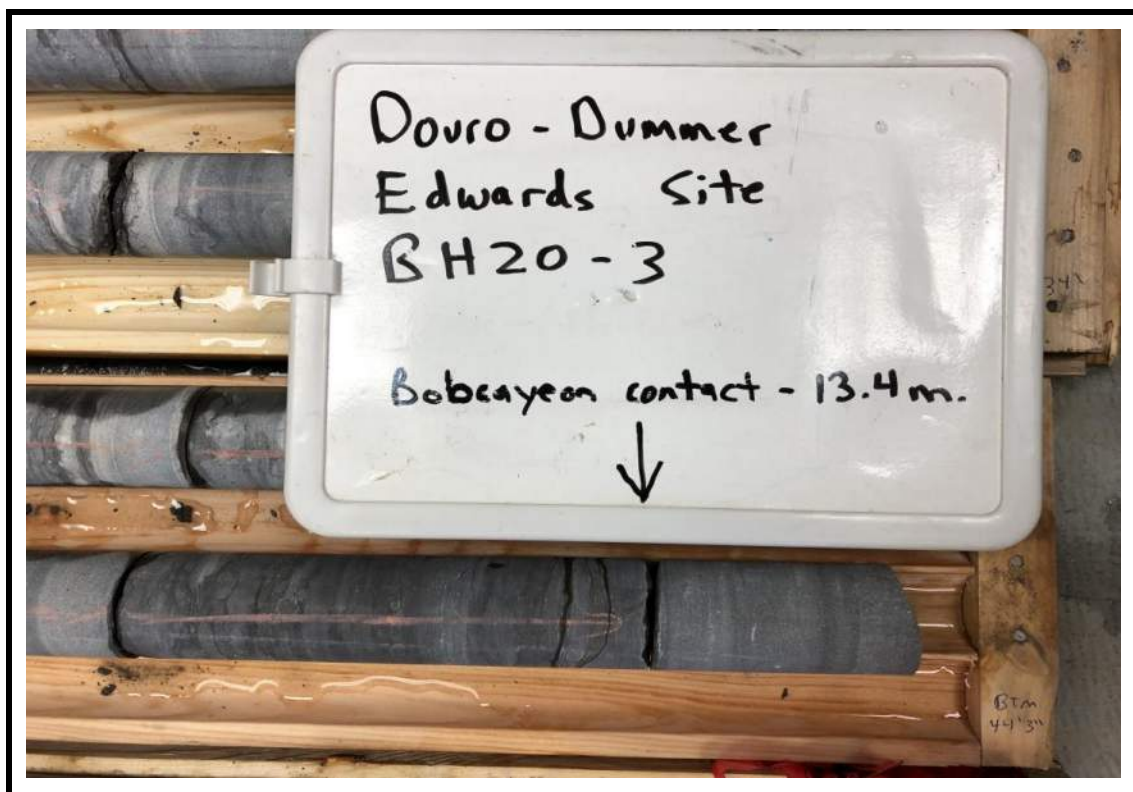




Photograph 9: BH20-02



Photograph 10: BH20-02



Photograph 11: BH20-03



Photograph 12: BH20-03

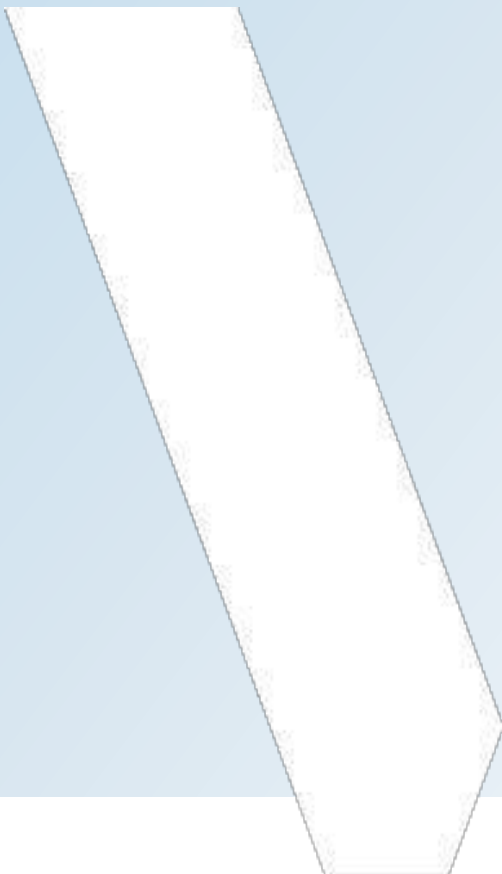




Photograph 13: BH20-03

# APPENDIX

## H BOREHOLE LOGS





# BOREHOLE NO. 20-01

PAGE 1 of 2

PROJECT NAME: EDWARDS PIT

PROJECT NO.: 161-16604-00

CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER

DATE COMPLETED: Feb 12, 2020

BOREHOLE TYPE: OPEN HOLE EXCAVATION

SUPERVISOR: MN

GROUND ELEVATION: 262.0 m

REVIEWER: GB

DEPTH (m)	ELEV (MASL)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH 20 40 60 80 Intact (Max) Cu Remoulded Cu	WATER CONTENT % 10 20 30 W <sub>p</sub> W <sub>L</sub>	REMARKS
					TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)			
0.0	262.0	OVERBURDEN										
1.0												
2.0												
2.3	259.7	WEATHERED LIMESTONE: Grey, intensely fractured, rough, planar joint shape (Verulam formation)										
3.0	259.1	LIMESTONE: Grey, medium to very fine grained, very broken to broken, moderately to slightly fractured, slightly weathered, fresh below 4.2 m, rough to smooth, planar joint shape, (Verulam formation)			RC1			97	37			
4.0												
5.0					RC2			100	40			
6.0												
7.0					RC3			100	75			
8.0												
9.0					RC4			100	87			
10.0												
11.0					RC5			100	93			
12.0												
13.0					RC6			100	70			
14.0												
15.0					RC7			100	93			
16.0												
17.0					RC8			100	95			
18.0												
19.0					RC9			100	91			Silty sand seam 130mm thick noted at 15.4 mbgs
20.0												
					RC10			100	97			
					RC11			100	95			Brachiopods present

WSP GEOLOGIC (METRIC) WITH MASL 161-16604-00 DRAFTBLOGS.GPJ WSP\_ENV\_V1.GDT 3/9/20



# BOREHOLE NO. 20-01

PAGE 2 of 2

PROJECT NAME: EDWARDS PIT

PROJECT NO.: 161-16604-00

CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER

DATE COMPLETED: Feb 12, 2020

BOREHOLE TYPE: OPEN HOLE EXCAVATION

SUPERVISOR: MN

GROUND ELEVATION: 262.0 m

REVIEWER: GB

DEPTH (m)	ELEV (masl)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE				CONE PENETRATION		WATER CONTENT %		REMARKS			
					TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)	"N" VALUE	SHEAR STRENGTH	W <sub>P</sub>		W <sub>L</sub>		
										10					20	30
										20					40	60
						Intact (MaX) Cu										
						Remoulded Cu										
20.0					RC12			100	95							
21.0																
22.0					RC13			100	93							
23.0																
24.0					RC14			100	100							
25.0																
25.2	236.8	LIMESTONE: Light grey, coarse to fine grained, fresh, planar joint shape, rough to smooth (Bobcaygeon formation) - Stepped			RC15			100	94							
26.0																
27.0					RC16			100	100							
28.0																
28.0					RC17			100	93							
29.0		- Darker seam														
30.0					RC18			100	92							
31.0																
31.0		- Darker seam			RC19			100	83							
31.8	230.3	Borehole terminated at 31.8 m below ground surface in LIMESTONE BEDROCK.														
32.0																
33.0																
34.0																
35.0																
36.0																
37.0																
38.0																
39.0																
40.0																

WSP GEOLOGIC (METRIC) WITH MASL 161-16604-00 DRAFTBLOGS.GPJ WSP\_ENV\_V1.GDT 3/9/20



**BOREHOLE NO. 20-02**

**PROJECT NAME: EDWARDS PIT**

**PROJECT NO.: 161-16604-00**

**CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER**

**DATE COMPLETED:** Feb 14, 2020

**BOREHOLE TYPE: OPEN HOLE EXCAVATION**

**SUPERVISOR: MN**

**GROUND ELEVATION: 258.0 m**

**REVIEWER: GB**

[illegible]



# BOREHOLE NO. 20-02

PAGE 2 of 2

PROJECT NAME: EDWARDS PIT

PROJECT NO.: 161-16604-00

CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER

DATE COMPLETED: Feb 14, 2020

BOREHOLE TYPE: OPEN HOLE EXCAVATION

SUPERVISOR: MN

GROUND ELEVATION: 258.0 m

REVIEWER: GB

DEPTH (m)	ELEV (masl)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION		WATER CONTENT %		REMARKS		
					TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)	"N" VALUE		SHEAR STRENGTH	WATER CONTENT %			
										10	20		10		20	30
										20	40		60		80	W <sub>P</sub>
20.0																
21.0																
22.0																
23.0																
24.0																
25.0																
25.2	232.8	LIMESTONE: Light grey, fine grained, plannar joint shape, smooth (Bobcaygeon formation)														
26.0																
27.0																
28.0																
28.3	229.7	Borehole terminated at 28.3 m below ground surface in LIMESTONE BEDROCK.														
29.0																
30.0																
31.0																
32.0																
33.0																
34.0																
35.0																
36.0																
37.0																
38.0																
39.0																
40.0																



# BOREHOLE NO. 20-03

PAGE 1 of 1

PROJECT NAME: EDWARDS PIT

PROJECT NO.: 161-16604-00

CLIENT: CORPORATION OF THE TOWNSHIP OF DOURO DUMMER

DATE COMPLETED: Feb 19, 2020

BOREHOLE TYPE: OPEN HOLE EXCAVATION

SUPERVISOR: MN

GROUND ELEVATION: 244.0 m

REVIEWER: GB

DEPTH (m)	ELEV (MASL)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION "N" VALUE SHEAR STRENGTH 20 40 60 80 Intact (Max) Cu Remoulded Cu	WATER CONTENT % 10 20 30 W <sub>p</sub> W <sub>L</sub>		REMARKS
					TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)				
0.0	244.0	OVERBURDEN											
1.0													
1.1	242.9	WEATHERED LIMESTONE:			RC1			100	0				
1.3	242.7	Grey, very broken, weathered, medium grained, rough			RC2			100	0				
2.0		LIMESTONE: Grey, medium to very fine grained, broken, weathered, smooth, planar joint shape (Verulam formation)			RC3			100	12				
3.0		- Thinly bedded											
4.0					RC4			100	23				
5.0													
6.0					RC5			100	20				
7.0													
8.0					RC6			100	92				
9.0													
10.0					RC7			100	92				
11.0													
12.0					RC8			100	95				
13.0													
14.0		- Very broken			RC9			100	100				
14.6	230.1	LIMESTONE: Light grey, medium to fine grained, fresh, some vertical fractures, stepped, very thinly bedded, rough (Bobcaygeon formation)			RC10			100	95				
15.0		- Some dark laminations			RC11			100	0				
16.0													
16.8	227.2	Borehole terminated at 16.8 m below ground surface in LIMESTONE BEDROCK.			RC12			100	82				
17.0													
18.0					RC13			100	100				
19.0													
20.0													

Sandy silt seam 25mm thick noted at 4.3 mbgs



# BOREHOLE NO. BH16-1

PAGE 1 of 1

PROJECT NAME: EDWARDS PIT GEOTECHNICAL STUDY

PROJECT NO.: 161-16604-00

CLIENT: DOURO-DUMMER TOWNSHIP

DATE COMPLETED: Dec 02, 2016

BOREHOLE TYPE: NQ CORE

SUPERVISOR: IAA

GROUND ELEVATION: 230.5 m (Inferred from plan)

REVIEWER: JSA

DEPTH (m)	ELEV (MASL)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE					CONE PENETRATION		WATER CONTENT %		REMARKS
					TYPE	N VALUE	% WATER	% RECOVERY	ROD (%)	"N" VALUE	SHEAR STRENGTH	10	20	
0.0	230.5									10 20 30	20 40 60 80	10	20	
1.0		<b>LIMESTONE:</b> Light grey to buff, fine grained to micritic, thin to medium bedded, medium hard, broken, slightly weathered, stylolitic, horizontal fracturing along beds / stylolitic margins (Bobcaygeon formation)			RC1			90	47					
2.0		- Micritic, thickly bedded			RC2			89	34					
3.0														
3.7	226.8	<b>LIMESTONE:</b> Light grey, fine to medium grained, thickly bedded to massive, medium hard, broken to blocky, fresh, stylolitic, sparry calcite crystals, horizontal fracturing along stylolitic margins (Bobcaygeon formation)			RC3			100	36					
4.0					RC4			98	80					
5.0														
6.0														
6.7	223.8	Borehole terminated at 6.7 m below ground surface in LIMESTONE BEDROCK.												Groundwater level at 4.12 m below ground surface on December 21 <sup>st</sup> , 2016
7.0														Strong methane odour, driller terminated borehole due to safety protocols
8.0														
9.0														
10.0														
11.0														
12.0														
13.0														
14.0														
15.0														



# APPENDIX



## CORE TEST LAB RESULTS

## APPENDIX

# ***I-1*** *MICRO DEVAL ABRASION TESTS (COARSE AND FINE)*



## Micro Deval Abrasion Test Method LS-619 - Fine

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Client:</b>	Township of Douro-Dummer
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	February 27, 2020
<b>Sampled By:</b>	MSN	<b>Material Type:</b>	Crushed Rock Core
<b>Date Sampled:</b>	February 18, 2020	<b>Source:</b>	Quarry

Sample No.	Test Pit No.	Original Mass (g)	Final Mass (g)	Mass Loss (g)	Percent Loss
BH20-01	BH20-01	500.2	387.5	112.7	22.5
BH20-02	BH20-02	500.0	388.7	111.3	22.3
BH20-03	BH20-03	500.0	396.9	103.1	20.6

**Notes:** Sample soaked in 750 ml of tap water for 24 hours

**Aver. Charge Weight (g):** 1250.0

**Reference Sample Control Range:** 15.2 - 18.4%

**Reference Sample Percent Loss:** 17.2

**Reference Sample Average Percent Loss:** 17.55

**Tested by:** WGH/NLO

**Date:** February 27, 2020

**Verified by:** KLC

**Date:** February 27, 2020



## Micro Deval Abrasion Test Method LS-619 - Fine

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Client:</b>	Township of Douro-Dummer
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	December 10, 2019
<b>Sampled By:</b>	IAA	<b>Material Type:</b>	Crushed Core
<b>Date Sampled:</b>	December 2, 2016	<b>Source:</b>	N/A

Sample No.	Test Pit No.	Original Mass (g)	Final Mass (g)	Mass Loss (g)	Percent Loss
BH16-1	0	502.1	420.8	81.3	16.2

**Notes:** Sample soaked in 750 ml of tap water for 24 hours

**Charge Weight (g):** 1250.3

**Reference Sample Control Range:** 15.2 - 18.4%

**Reference Sample Percent Loss:** 17.2

**Reference Sample Average Percent Loss:** 17.55

**Tested by:** NLO

**Date:** December 10, 2019

**Verified by:** RJ

**Date:** December 10, 2019





## Micro Deval Abrasion Test Method LS-618 - Coarse

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Client:</b>	Township of Douro-Dummer
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	February 27, 2020
<b>Sampled By:</b>	MSN	<b>Material Type:</b>	Crushed Rock Core
<b>Date Sampled:</b>	February 18, 2020	<b>Source:</b>	Quarry

Sample No.	Test Pit No.	Original Mass (g)	Final Mass (g)	Mass Loss (g)	Percent Loss
BH20-01	BH20-01	1500.9	1261.4	239.5	16.0
BH20-02	BH20-02	1499.9	1268.35	231.6	15.4
BH20-03	BH20-03	1502.35	1295.68	206.7	13.8

**Notes:** Sample soaked in 2000 ml of tap water for 1 hour

Aver. Charge Weight (g): 5001.7

Reference Sample Control Range:	11.4% - 14.8%
Reference Sample Percent Loss:	14.3
Reference Sample Average Percent Loss:	13.8

Tested by: WGH/NLO

Date: February 27, 2020

Verified by: KLC

Date: February 27, 2020



## Micro Deval Abrasion Test Method LS-618 - Coarse

<b>Project Name:</b>	Douro-Dummer Aggregate Investigation	<b>Client:</b>	Township of Douro-Dummer
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	December 10, 2019
<b>Sampled By:</b>	IAA	<b>Material Type:</b>	Crushed Core
<b>Date Sampled:</b>	December 2, 2016	<b>Source:</b>	N/A

Sample No.	Test Pit No.	Original Mass (g)	Final Mass (g)	Mass Loss (g)	Percent Loss
BH16-1	0	1501.6	1306.6	195.0	13.0

<b>Notes:</b>	Sample soaked in 2000 ml of tap water for 1 hour		
<b>Charge Weight (g):</b>	4999.9		
<b>Reference Sample Control Range:</b>	11.4% - 14.8%		
<b>Reference Sample Percent Loss:</b>	14.3		
<b>Reference Sample Average Percent Loss:</b>	13.8		
<b>Tested by:</b>	NLO	<b>Date:</b>	December 10, 2019
<b>Verified by:</b>	RJ	<b>Date:</b>	December 10, 2019

## APPENDIX

# ***I-2*** *RELATIVE DENSITY AND ABSORPTION (COARSE AND FINE)*



## Relative Density and Absorption - Coarse Aggregate LS604

<b>Project Name:</b>	Douro-Dummer Aggregate Investigations	<b>Material Type:</b>	Sand and Gravel
<b>Project No:</b>	161-16604-00	<b>Date Sampled:</b>	February 18, 2020
<b>Client:</b>	Douro-Dummer Township	<b>Sampled By:</b>	MSN
<b>Sample Location:</b>	Boreholes	<b>Date Tested:</b>	February 27, 2020

Sample No.	Surface-Dry Sand Mass In Air (B)	Oven-Dry Sand Mass In Air (A)	Aggregate Mass in Water (C)	Bulk Relative Density (A/(B-C))	Bulk Relative Density SSD (B/(B-C))	Apparent Relative Density (A/(A-C))	Absorption ((B-A)/A)*100
BH20-01	3061.90	3038.60	1916.00	2.652	2.672	2.707	0.77
BH20-01	3056.90	3033.40	1912.00	2.649	2.670	2.705	0.77
Average				2.651	2.671	2.706	0.77
BH20-02	3043.10	3022.90	1906.10	2.659	2.676	2.707	0.67
BH20-02	3048.00	3026.70	1908.84	2.657	2.676	2.708	0.70
Average				2.658	2.676	2.707	0.69
BH20-03	3085.90	3069.00	1936.30	2.670	2.684	2.709	0.55
BH20-03	3085.90	3072.20	1938.90	2.678	2.690	2.711	0.45
Average				2.674	2.687	2.710	0.50

Sample Size Reference ASTM C-127/LS-602	
Nominal Sieve Size	Min. Mass (kgs)
63.0 mm	12.0
50.0 mm	8.0
37.5 mm	5.0
25.0 mm	4.0
19.0 mm	3.0
12.5 mm	2.0

Control Range
Absorption Range 0.55 - 0.81 %
Mean Relative Density (Oven Dry) Range 2.658 - 2.682

Tested by: WGH

Verified by: 

Date: 18-Feb-20

Date: 18-Feb-20





## Relative Density and Absorption - Fine Aggregate LS605 / ASTM C128

<b>Project Name:</b>	Douro Dummer Aggregate Investigation	<b>Client:</b>	Douro Dummer Township
<b>Project No:</b>	161-16604-00	<b>Date Tested:</b>	February 27, 2020
<b>Sampled By:</b>	MSN	<b>Material Type:</b>	Crushed Rock Core
<b>Date Sampled:</b>	February 18, 2020	<b>Source:</b>	Quarry

Sample No.	Temp. (°C) T	Pycnometer No.	Pycnometer Mass (g)	Mass of SSD Sand in Air (g) S	Mass of Sand/Pycnometer/Water (g) C	Mass of Pycnometer to Cal Point (g) (@ T) B	Mass of Dry Sand in Air A	Relative Density (Oven Dry)	Relative Density (SSD)	Apparent Relative Density	Absorption (%)
BH20-01	22.30	Z	167.19	500.18	972.60	665.38	487.9	2.529	2.592	2.700	2.51
BH20-01	22.50	O	166.02	500.16	971.76	663.97	487.7	2.535	2.600	2.711	2.56
Average								2.532	2.596	2.706	2.54
BH20-02	21.90	O	166.02	500.08	970.71	664.03	487.3	2.520	2.586	2.698	2.62
BH20-02	22.30	Z	167.19	500.03	971.91	665.44	487.4	2.518	2.583	2.694	2.59
Average								2.519	2.585	2.696	2.61
BH20-03	21.50	O	166.02	501.23	971.45	664.08	488.0	2.517	2.585	2.701	2.70
BH20-03	21.90	Z	167.19	500.40	972.60	665.44	487.9	2.525	2.590	2.700	2.57
Average								2.521	2.587	2.701	2.64

Reference Sample Control Mean	
Reference Sample Average Percent Absorption:	1.92
Reference Sample Average Relative Density:	2.597

Operator: NLO Date: 27-Feb-20  
Verified by:  Date: 27-Feb-20

Control Range
Absorption Range 1.58 - 2.12%
Mean Relative Density (Oven Dry) Range 2.593 - 2.629



### Relative Density and Absorption of Coarse Aggregate (LS-604)

Sample No.: MM-8564 Date Sampled: Dec.02, 2019  
Job No.: 161-16604-00 Date Tested: Dec.11, 2019  
Job Name: Douro-Dummer Aggregate Investigation Tested By: John  
Source: Product Code:  
Material Type: Crushed Aggregate

		Trial Number		Average	
		1	2		
	Tare Name	P5	P10		
A	Weight Sample Oven Dry & Tare	3762.2	3690.5		
B	Weight Tare	704.3	687.5		
C	Weight Sample Oven Dry (A-B)	3057.9	3003		
D	Water Temperature (23 C +/- 1.7 C)	23	23		
E	Weight Sample SSD	3069.1	3014.4		
F	Weight of Sample in Water	1932.4	1897.5		
	Bulk Relative Density (C/(E-F))	2.690	2.689	2.689	Control 2.689
	Bulk Relative Density SSD (E/(E-F))	2.700	2.699	2.699	
	Apparent Relative Density (C/(C-F))	2.717	2.716	2.717	
	Absorption (E-C)/C*100	0.366	0.380	0.373	0.39

☐ - Conforming ☐ - Non-Conforming(Attach Report)

☐ - Meets Spec ☐ - Out of Spec

Percent Max Absorption as Per Spec  
SP110F12

Comments: \_\_\_\_\_  
\_\_\_\_\_

Technician: \_\_\_\_\_

Supervisor: \_\_\_\_\_



## Relative Density and Absorption of Fine Aggregate (LS-605)

Sample No.: MM-8564 Date Sampled: Dec.02, 2019  
Job No.: 161-16604-00 Date Tested: Dec.12, 2019  
Job Name: Douro-Dummer Aggregate Investigation Tested By: John  
Source: \_\_\_\_\_ Product Code: \_\_\_\_\_  
Material Type: Crushed Aggregate

		Trial Number		Average	
		1	2		
	Tare Name	P4	P10		
A	Weight Sample Oven Dry & Tare	1194.2	1194.2		
B	Weight Tare	685.4	687.4		
C	Weight Sample Oven Dry (A-B)	508.8	506.8		
D	Water Temperature (23 C +/- 1.7 C)	23	23		
E	Weight Flask & Water	670.5	664.4		
F	Weight Sample & Flask & Water	991.6	984.1		
G	Weight Sample SSD (if other than 500g)	514.2	512.2		
	Flask Number				
	Bulk Relative Density $(C/(G-(F-E)))$	2.635	2.633	2.634	Control 2.608
	Bulk Relative Density SSD $(G/(G-(F-E)))$	2.663	2.661	2.662	
	Apparent Relative Density $(C/(C-(F-E)))$	2.711	2.709	2.710	
	Absorption $(G-C)/C*100$	1.061	1.066	1.063	1.75

☐ - Conforming ☐ - Non-Conforming(Attach Report)  
☐ - Meets Spec ☐ - Out of Spec

Percent Max Absorption as Per Spec  
SP110F12

Comments: \_\_\_\_\_  
\_\_\_\_\_

Technician: \_\_\_\_\_

Supervisor: \_\_\_\_\_

# ***I-3*** *FREEZE-THAW RESULTS*





## Freezing and Thawing of Coarse Aggregate (LS-614)

Sample No. 20MM-177 Source: BH20-01 Date Sampled: Feb.18, 2020  
 Job No. 161-16604-00 Material Type: Crushed Rock Core Date Tested: Mar.02, 2020  
 Job Name: Douro-Dummer Aggregate Investigation Township/District: N/A Tested By: JL

Jar #	13.2mm (1250g)		9.5mm (1000g)		4.75mm (500g)		Percent Loss
	Initial Mass	Final Mass	Initial Mass	Final Mass	Initial Mass	Final Mass	
2	1253.7	1235.8					1.4
5			1000.8	951.2			5.0
10					500.4	489.1	2.3

Date/Time Soaked: Mar.02, 2020 @ 15:30

	Ratio	Target	Actual
16.0mm			
13.2mm			

	Ratio	Target	Actual
6.7mm			
4.75mm			

### Weighted Average

Sieve Size	% Loss on Individual Sieve (A)	% Retained on Sieve (B)	% Loss * % Retained (A)*(B)=(C)
19.0mm	1.4	0.2	0.3
16.0mm & 13.2mm	1.4	46.4	66.2
9.5mm	5.0	32.2	159.6
6.7mm & 4.75mm	2.3	21.2	47.9
-4.75mm (if >10%)*			

\* for calculation purposes only

Sum of C=D	274.0
Weighted Loss D/100	2.7

	Time/Date In FRZ.	Time/Date Out FRZ.	Temp. High/Low
Cycle 1	Mar.03 15:00	Mar.04 8:30	22 -18.9
Cycle 2	Mar.04 15:30	Mar.05 8:00	22 -19
Cycle 3	Mar.05 16:00	Mar.06 8:00	22 -19
Cycle 4	Mar.06 16:00	Mar.09 8:00	22 -18.5
Cycle 5	Mar.09 16:00	Mar.10 8:00	22 18

☐ - Conforming

☐ - Non-Conforming(Attach Report)

☐ - Meets Spec

☐ - Out of Spec

Percent Loss Max as Per Spec

SP110F11 or F12

Control Test Result

13.3%

Range: 8.5% - 15.3%

Comments: \_\_\_\_\_

Technician: JL

Supervisor: MD



## Freezing and Thawing of Coarse Aggregate (LS-614)

Sample No. 20MM-178 Source: BH20-02 Date Sampled: Feb.18, 2020  
 Job No. 161-16604-00 Material Type: Crushed Rock Core Date Tested: Mar.02, 2020  
 Job Name: Douro-Dummer Aggregate Investigation Township/District: N/A Tested By: JL

Jar #	13.2mm (1250g)		9.5mm (1000g)		4.75mm (500g)		Percent Loss
	Initial Mass	Final Mass	Initial Mass	Final Mass	Initial Mass	Final Mass	
19	1251	1237.2					1.1
16			1000.7	967.7			3.3
11					500.5	494.8	1.1

Date/Time Soaked: Mar.02, 2020 @ 15:30

	Ratio	Target	Actual
16.0mm			
13.2mm			

	Ratio	Target	Actual
6.7mm			
4.75mm			

### Weighted Average

Sieve Size	% Loss on Individual Sieve (A)	% Retained on Sieve (B)	% Loss * % Retained (A)*(B)=(C)
19.0mm	1.1	0.9	1.0
16.0mm & 13.2mm	1.1	40.7	44.9
9.5mm	3.3	31.2	102.9
6.7mm & 4.75mm	1.1	27.2	31.0
-4.75mm (if >10%)*			

\* for calculation purposes only

Sum of C=D	179.8
Weighted Loss D/100	1.8

	Time/Date In FRZ.	Time/Date Out FRZ.	Temp. High/Low
Cycle 1	Mar.03 15:00	Mar.04 8:30	22 -18.9
Cycle 2	Mar.04 15:30	Mar.05 8:00	22 -19
Cycle 3	Mar.05 16:00	Mar.06 8:00	22 -19
Cycle 4	Mar.06 16:00	Mar.09 8:00	22 -18.5
Cycle 5	Mar.09 16:00	Mar.10 8:00	22 18

☐ - Conforming

☐ - Non-Conforming(Attach Report)

☐ - Meets Spec

☐ - Out of Spec

Percent Loss Max as Per Spec

SP110F11 or F12

Control Test Result

13.3%

Range: 8.5% - 15.3%

Comments: \_\_\_\_\_

Technician: JL

Supervisor: MD



## Freezing and Thawing of Coarse Aggregate (LS-614)

Sample No. 20MM-179 Source: BH20-03 Date Sampled: Feb.18, 2020  
 Job No. 161-16604-00 Material Type: Crushed Rock Core Date Tested: Mar.02, 2020  
 Job Name: Douro-Dummer Aggregate Investigation Township/District: N/A Tested By: JL

Jar #	13.2mm (1250g)		9.5mm (1000g)		4.75mm (500g)		Percent Loss
	Initial Mass	Final Mass	Initial Mass	Final Mass	Initial Mass	Final Mass	
19	1250.9	1238.1					1.0
16			1000.2	958			4.2
11					500.3	486.1	2.8

Date/Time Soaked: Mar.02, 2020 @ 15:30

	Ratio	Target	Actual
16.0mm			
13.2mm			

	Ratio	Target	Actual
6.7mm			
4.75mm			

### Weighted Average

Sieve Size	% Loss on Individual Sieve (A)	% Retained on Sieve (B)	% Loss * % Retained (A)*(B)=(C)
19.0mm	1.0	1.1	1.1
16.0mm & 13.2mm	1.0	40	40.9
9.5mm	4.2	29.2	123.2
6.7mm & 4.75mm	2.8	29.7	84.3
-4.75mm (if >10%)*			

\* for calculation purposes only

Sum of C=D	249.6
Weighted Loss D/100	2.5

	Time/Date In FRZ.	Time/Date Out FRZ.	Temp. High/Low
Cycle 1	Mar.03 15:00	Mar.04 8:30	22 -18.9
Cycle 2	Mar.04 15:30	Mar.05 8:00	22 -19
Cycle 3	Mar.05 16:00	Mar.06 8:00	22 -19
Cycle 4	Mar.06 16:00	Mar.09 8:00	22 -18.5
Cycle 5	Mar.09 16:00	Mar.10 8:00	22 18

☐ - Conforming

☐ - Non-Conforming(Attach Report)

☐ - Meets Spec

☐ - Out of Spec

Percent Loss Max as Per Spec

SP110F11 or F12

Control Test Result

13.3%

Range: 8.5% - 15.3%

Comments: \_\_\_\_\_

Technician: JL

Supervisor: MD



## Freezing and Thawing of Coarse Aggregate (LS-614)

Sample No. <u>MM-8564</u>	Source: <u>BH16-1</u>	Date Sampled: <u>Dec.02, 2019</u>
Job No. <u>161-16604-00</u>	Material Type: <u>Rock Cores</u>	Date Tested: <u>Dec.11, 2019</u>
Job Name: <u>Douro-Dummer Aggregate Investigation</u>	Township/District: _____	Tested By: <u>JL</u>

Jar #	13.2mm (1250g)		9.5mm (1000g)		4.75mm (500g)		Percent Loss
	Initial Mass	Final Mass	Initial Mass	Final Mass	Initial Mass	Final Mass	
5	1250.3	1225.9					2.0
7			1001.2	992.3			0.9
11					500	491.1	1.8

Date/Time Soaked: Dec.12, 2019 @ 3:30

	Ratio	Target	Actual
16.0mm			
13.2mm			

	Ratio	Target	Actual
6.7mm			
4.75mm			

### Weighted Average

Sieve Size	% Loss on Individual Sieve (A)	% Retained on Sieve (B)	% Loss * % Retained (A)*(B)=(C)
19.0mm			
16.0mm & 13.2mm	2.0	44.3	86.5
9.5mm	0.9	17.2	15.3
6.7mm & 4.75mm	1.8	38.5	68.5
-4.75mm (if >10%)*			

\* for calculation purposes only

Sum of C=D	170.3
Weighted Loss D/100	1.7

Cycle 1

Cycle 2

Cycle 3

Cycle 4

Cycle 5

Time/Date In FRZ.	Time/Date Out FRZ.	Temp. High/Low
Dec.13 16:00	Dec.14 8:00	21 -19
Dec.14 16:00	Dec.15 8:00	21 -18.5
Dec.15 16:00	Dec.16 8:00	21 -18.5
Dec.16 16:00	Dec.17 8:00	21 -18.5
Dec.17 16:00	Dec.18 8:00	21 -18.5

☐ - Conforming

☐ - Non-Conforming(Attach Report)

☐ - Meets Spec

☐ - Out of Spec

Percent Loss Max as Per Spec

SP110F11 or F12

Control Test Result

10.5%

Range: 8.5% - 15.3%

Comments: \_\_\_\_\_

Technician: JL

Supervisor: MD

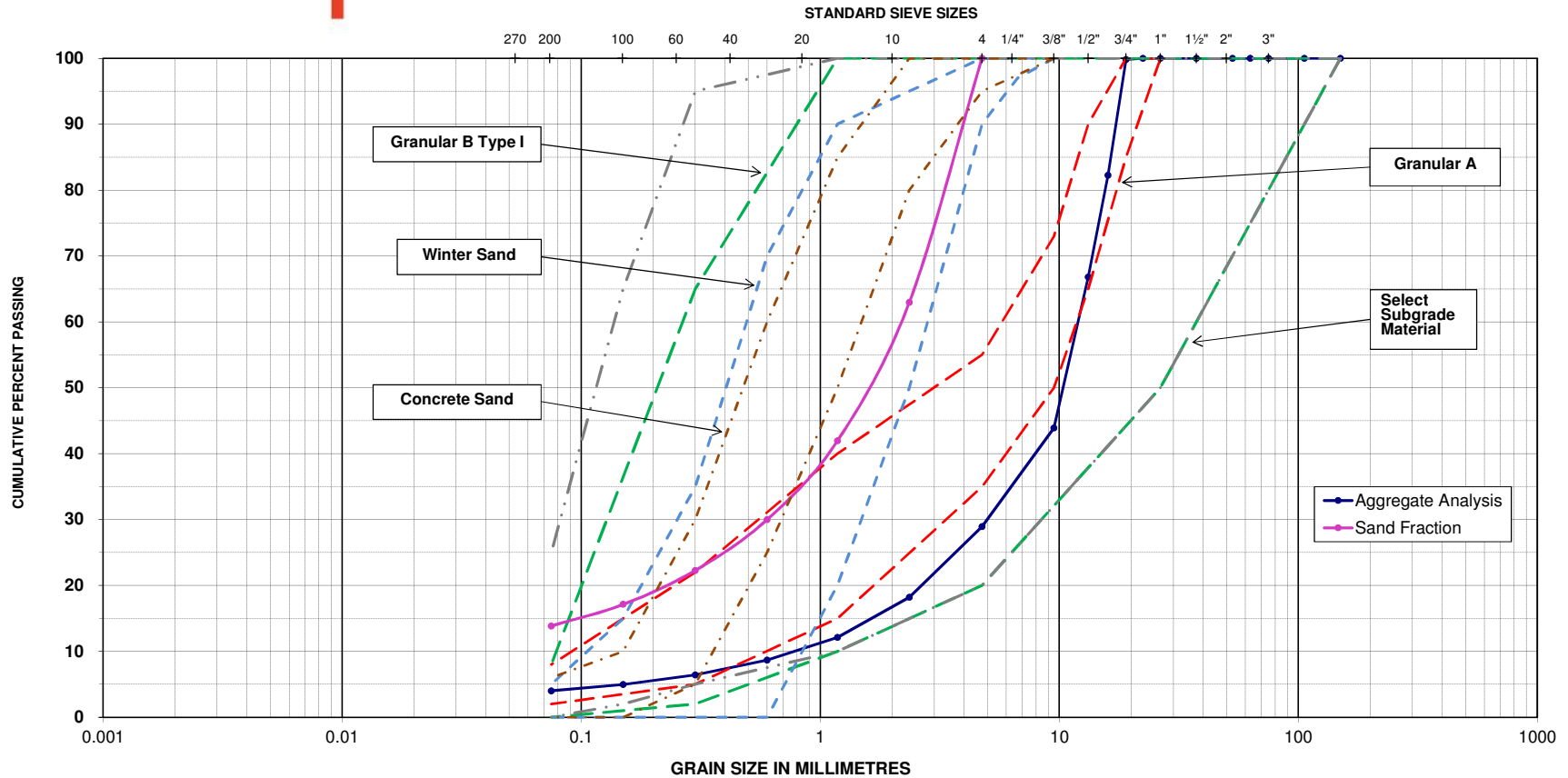


## APPENDIX

# ***I-4*** *PARTICLE SIZE DISTRIBUTION PLOTS*



## PARTICLE SIZE DISTRIBUTION



MIT Scale

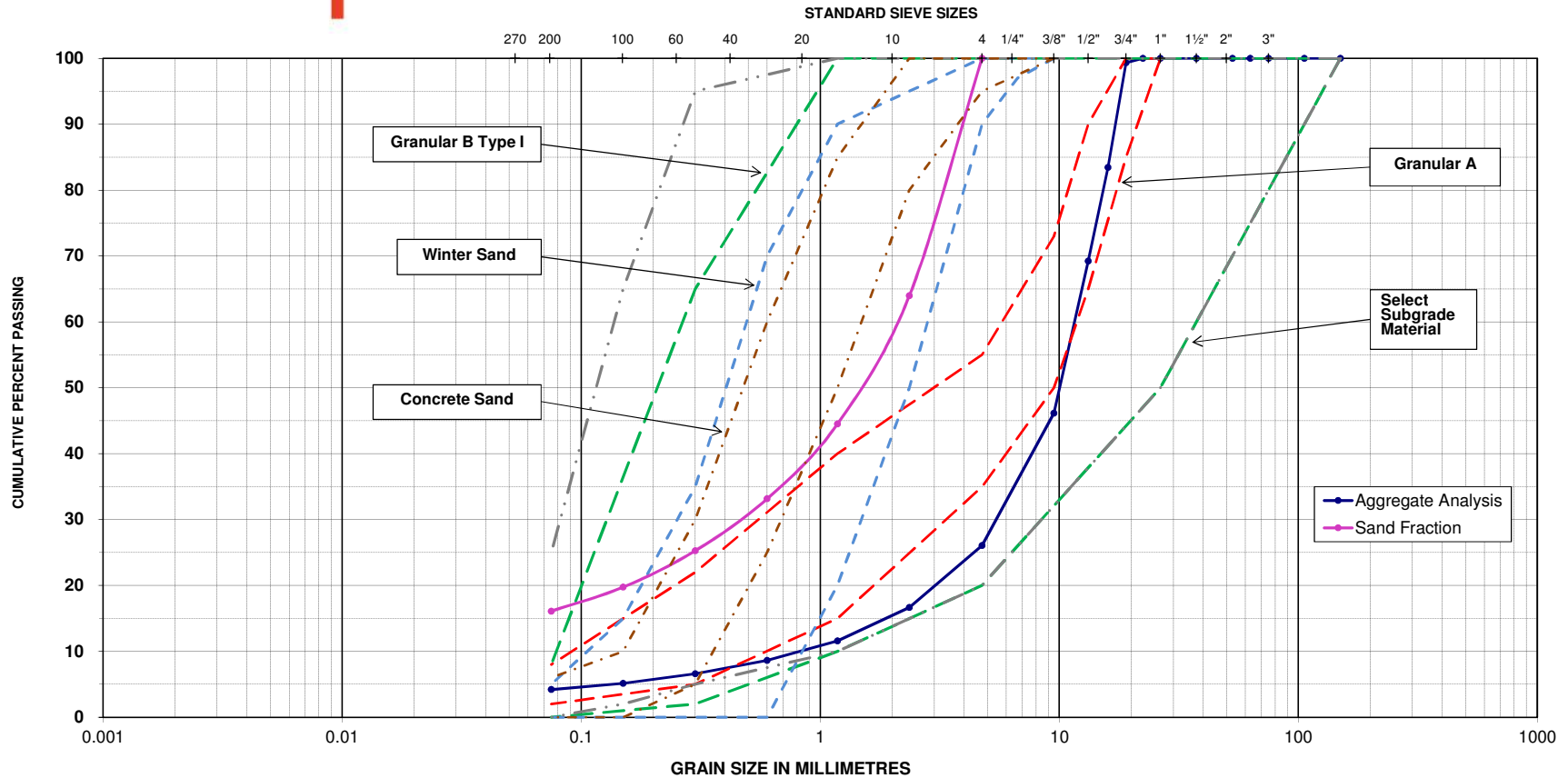
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

Project Name:	Douro-Dummer Aggregate Investigation	Project No.:	161-16604-00	Date Sampled:	02/18/20
Material Source.:	Crushed Rock Core	Location:	BH20-01	Sample No./Depth:	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	99.8	From Gradation Graph (mm):			
106 mm	100.0	16.0 mm	82.2	D75	15.0	D8	0.1
75 mm	100.0	13.2 mm	66.8	D60	13.0	D10	0.2
63 mm	100.0	9.5 mm	43.9	Cu	86.67		
53 mm	100.0	4.75 mm	28.9	% Wash	13.2		
37.5 mm	100.0	1.18 mm	12.1				
26.5 mm	100.0	0.30 mm	6.4				
22.4 mm	100.0	0.075 mm	4.0				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

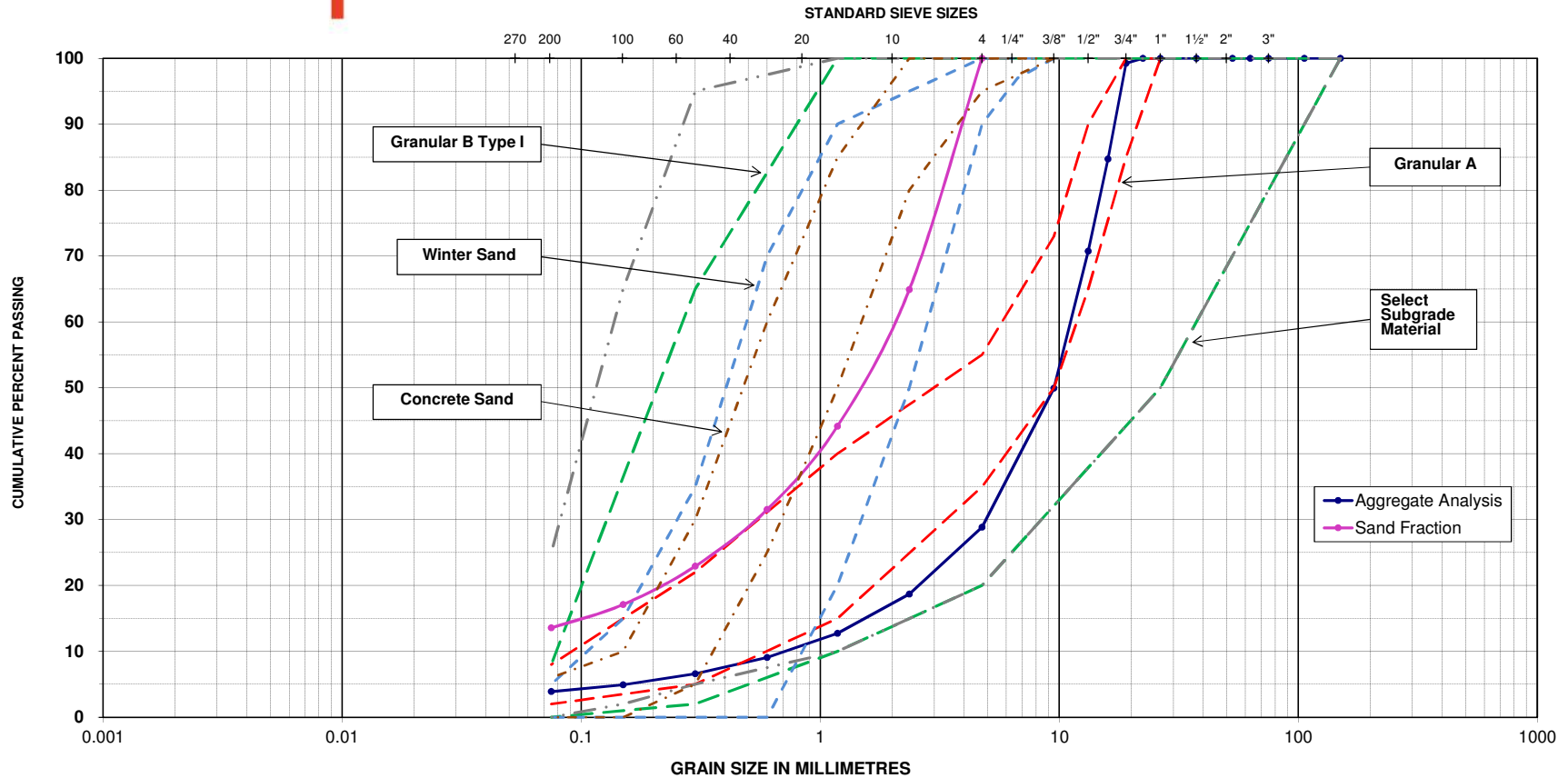
CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

Project Name:	Douro-Dummer Aggregate Investigation	Project No.:	161-16604-00	Date Sampled:	02/18/20
Material Source.:	Crushed Rock Core	Location:	BH20-02	Sample No./Depth:	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	99.3	From Gradation Graph (mm):			
106 mm	100.0	16.0 mm	83.5	D75	15.0	D8	0.1
75 mm	100.0	13.2 mm	69.2	D60	13.0	D10	0.1
63 mm	100.0	9.5 mm	46.2	Cu	100.00		
53 mm	100.0	4.75 mm	26.1	% Wash	15.3		
37.5 mm	100.0	1.18 mm	11.6				
26.5 mm	100.0	0.30 mm	6.6				
22.4 mm	100.0	0.075 mm	4.2				



## PARTICLE SIZE DISTRIBUTION



MIT Scale

CLAY	SILT			SAND			GRAVEL			COBBLES
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

Project Name:	Douro-Dummer Aggregate Investigation	Project No.:	161-16604-00	Date Sampled:	02/18/20
Material Source.:	Crushed Rock Core	Location:	BH20-03	Sample No./Depth:	N/A

Sieve Size	% Passing	Sieve Size	% Passing	Aggregate Properties			
150 mm	100.0	19.0 mm	99.2	From Gradation Graph (mm):			
106 mm	100.0	16.0 mm	84.7	D75	15.0	D8	0.1
75 mm	100.0	13.2 mm	70.7	D60	12.0	D10	0.2
63 mm	100.0	9.5 mm	49.9	Cu	80.00		
53 mm	100.0	4.75 mm	28.8	% Wash	13.4		
37.5 mm	100.0	1.18 mm	12.7				
26.5 mm	100.0	0.30 mm	6.6				
22.4 mm	100.0	0.075 mm	3.9				