• Government of Nunavut

Geotechnical Investigation

Type of Document
Draft

Project Name
Geotechnical Investigation, Airside Surface Rehabilitation Aggregate Search and Airside Surfaces Assessment, Whale Cove Airport, Whale Cove, Nunavut

Project Number
OTT-00249103-A0

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Date Submitted
January 16, 2019

Government of Nunavut

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Executive Summary

A geotechnical investigation was undertaken at the site of the Whale Cove Airport and vicinity located in the Hamlet of Whale Cove, Nunavut. This work was authorized by the Government of Nunavut via Standing Offer Agreement Reference Number: 2014-48, Contract Number: 15NA18006-01.

The purpose of the geotechnical investigation was to locate a granular source that can be processed to produce base levelling material to be used for overlay and future maintenance of the airside surfaces. A general visual review of the condition of the air side was also completed as part of this project.

The aggregate source investigation comprised of excavating test pits at five locations within the airport general area and collection of aggregate samples for laboratory testing comprising of grain-size analyses, Atterberg Limits and percentage of crushed content.

The investigation revealed that the most suitable source of granular material for use as base levelling material is at Quarry No. 4 located approximately 1.0 km east of the runway. The geological map indicates that this quarry is located in the geological deposit identified as RT_v (i.e. 1 m to 3 m thick till consisting of boulders and gravel on bedrock). It is noted that fines have been washed out of this deposit by melt water flow. Therefore, this material lacks fines. This deposit is expected to contain sufficient material, which can be processed to produce enough material for overlay and maintenance for the next 12 years. A potential source of fines has been identified as Test Pit 3 (at Quarry No. 3). This test pit is located in the geological deposit identified as T_p, i.e. till plain generally sandy, silty diamicton with less than 25 percent clay. Import of fines may be also required to supplement the fines identified in the Hamlet.

Visual review of the runway revealed that there is little to no cross fall. The condition of the runway is poor with large aggregates and rocks from the underlying base penetrating the wear surface. The runway is ravelling at some locations. It is recommended that the following steps should be implemented to reduce frequency of runway maintenance.

Adequate drainage ditches should be provided on both sides of the runway to facilitate drainage of the runway. The runway shoulder should be reinstated, and the cross fall of the runway should be improved to between 1.0 percent and 1.5 percent. Loose gravel stripped from the runway should not be mounded on the sides of the runway. The base levelling material used should meet the specifications especially the amount of fines, which is crucial to the surface binding. The fines content of the material should be increased to 10 percent. After removal of the loose gravel, the runway surface should be thoroughly compacted. The required thickness of base levelling material should then be placed and compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D-698-12e2. In addition, consideration may be given for the use of base stabilizing materials, such as Envirokleen or EK35 by Midwest or equivalent, which bind the surface layer resulting in reduced maintenance requirements.

An additional investigation should be completed during the summer months to accurately establish the volume of the available aggregate from Quarry No. 4 and to evaluate the quality of fines that can be

borrowed from the location of Quarry No. 3 or other potential till plain areas. The additional work should be completed using a backhoe instead of a loader.

The above and other related considerations are discussed in greater detail in this report.

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1 Introduction

A geotechnical investigation was undertaken at the Whale Cove Airport and vicinity (Figure 1) in Nunavut, Canada. This work was authorized by the Government of Nunavut via Standing Offer Agreement Reference Number: 2014-48, Contract Number: 15NA18006-01.

The purpose of the geotechnical investigation was to:

1.) Identify potential aggregate source, collect samples and analyze them to determine their suitability for rehabilitation of airside surfaces of the Whale Cove Airport. The aggregate source is to be sufficient to complete the airside surfaces overlay and to produce a 12-year maintenance stock pile.

2.) Brief condition assessment report of the airside surfaces and the aggregate stockpile, which is currently used for maintenance purposes.

3.) Provide recommendations to improve the runway maintenance program and requirements.

2 Background Information

Transport Canada has cited this runway for the following items:

1.) Runway surface crown improvements.

2.) Lack of availability of maintenance of gravel stockpile.

3.) Very poor runway condition with rocks from the underlying base penetrating the wearing surface.

4.) Runway has no transverse slope and has poor drainage characteristics. The runway shoulders are poorly graded and non-existent in some places. The poor transverse profile of the shoulders compromises snow cleaning.

3 Whale Cove Climate

Whale Cove is located on the western shore of Hudson Bay near the tip of a small peninsula at approximately 62º10'22"N and 92º34'46" West. Based on the permafrost mapping, it is located well within the zone of continuous permafrost. Whale Cove features a cold tundra climate with cold winters averaging around -23ºC and cool, very wet and rainy summers averaging around 6.8ºC. Michel Allard of Laval University conducted a broad assessment of Whale Cove ground conditions in July 2009. Allard suggested that the active layer thickness may have increased by about one metre in bedrock and 20 to 30 cm in soil such as till.

4 Procedure

The potential aggregate sources were investigated by excavating five test pits at five locations in the vicinity of the airport and within the Hamlet. The locations were selected by representatives of Government of Nunavut based on their experience and previous studies undertaken. It is understood that Test Pits 1 to 3 were excavated in the vicinity of abandoned quarries, which were used as granular material for construction of the road north of the Hamlet. Test Pit 4 was located in the quarry that is currently used by the airport to obtain base levelling material. Test Pit 5 was located in the abandoned quarry that was used to borrow material for construction of the sewage lagoon. The locations investigated are shown on Site Plan, Figure 2.

The investigation consisted of excavating five test pits with a front-end loader to a depth of 1.0 m to 2.0 m since a backhoe was not available in the Hamlet at the time of the investigation. The fieldwork was supervised by a geotechnician from EXP. All the test pits were logged and a select samples of the aggregate (i.e. material finer than 150 mm sieve) was placed in a plastic bag and identified. The larger pieces were not sampled to facilitate handling and to manage transportation costs and since the large material will be eventually screened prior to processing and crushing of the material.

All the test pits were backfilled on completion. The samples were transported to the EXP laboratory located in the City of Ottawa for examination by a geotechnical engineer and for laboratory testing purposes. Laboratory testing consisted of performing grain-size analysis, Atterberg Limit test and percent of crushed content tests on each sample collected.

Photographs of the general locations of each potential source/quarry investigated and samples collected are presented in Appendix A.

5 Site Geology

Figure 3 illustrates surficial geology of Whale Cove and vicinity. The geological deposits in which the test pits were excavated have been discussed below.

5.1 Beach Sediments (M_r)

This deposit comprises of sand and gravel and boulders of variable thickness. It was deposited in the Tyrrell Sea by glacial stream and during regression by non-glacial streams.

5.2 Ice-contact Sediments (GF_e)

This deposit comprises of stratified sand and gravel of variable thickness. It was deposited near ice margins in, over or around ice or in ice tunnels commonly known as askers but includes isolated hummocky deposits. Many eskers are beaded or interrupted at regular intervals by major bulges marking positions where deltaic on sub-aqueous fan deposition occurred during periods of slowed ice retreat.

5.3 Till Plain (T_p)

Sandy, silty sediment resulting from dry land erosion that is unsorted to poorly sorted and contains particles ranging in size from clay to boulders, suspended in a matrix of mud or sand. It contains less than 25 percent clay-sized particles and is of variable thickness.

5.4 Till Veneer and Bedrock (T_v and R)

It comprises of boulders and gravel and is 1m to 3m thick. The boulders and gravel are concentrated on the surface resulting from washing out of fines by melt water flow.

The bedrock is undifferentiated. It consists of Precambrian igneous and metamorphic rocks, red volcanic rocks and unmetamorphosed sediments.

6 Soil Description

The soils encountered in the five test pits have been described on Test Pit Logs, Table 1.

Table 1: Test Pit Logs

Test Pit No.	Coordinates	Depth (m)	Soil Description	Geological Deposit Description
1 Road accessible quarry located approximately 10 km north of runway.	15 V 0515585, UTM 6909139	0 – 2.0	Sandy, gravel, some cobbles, trace silt, frozen, no visible ice, brown to grey.	(M_r) Beach sediment. Sand and gravel and boulders.
2 Quarry located approximately 6.5 km north of runway, accessible by road.	15 V 0519643 UTM 6905555	0 – 1.0	Sandy, gravel, cobbles, frozen, no visible ice, brown to grey.	(GF_e) Stratified sand and gravel.
3 Quarry located approximately 3.5 km north of runway, accessible by road.	15 V 0519062 UTM 6903826	0 – 1.5	Gravelly sand, some cobbles, some silt, frozen, no visible ice, brown to grey.	(T_p) Till Plain. Poorly sorted material ranging from clay to boulders.
4 Quarry located approximately 1 km east of south end of runway, accessible by road but requires crossing the runway.	15 V 0521587 UTM 6900683	0 – 1.75	Sandy, gravel, cobbles and boulders, frozen, no visible ice, brown to grey.	(T_v and R) Boulders and gravel 1 m to 3 m thick. Bedrock Precambrian igneous and metamorphic.
5 Quarry located approximately 3 km south east of south end of runway, accessible by road.	15 V 0523167 UTM 6898950	0 – 1.0	Sand and gravel, occasional cobbles and boulders, frozen, no visible ice, brown to grey.	(T_p) Till Plain. Poorly sorted material ranging from clay to boulders.

A review of Table 1 indicates the following soil stratigraphy at the five locations investigated.

6.1 Test Pit 1 (at Quarry No. 1 located approximately 10 km north of Runway, Road Accessible)-

The test pit encountered sand and gravel with cobbles, which extended to the entire depth investigated, i.e. 2.0 m (Photos A1 and A2). This deposit contains 12 percent clay and silt, 39 percent sand and 49 percent gravel (Figure 4). It contains 66 percent crushed particles.

6.2 Test Pit 2 (at Quarry No. 2 located approximately 6.5 km north of Runway, Road Accessible)

The surface deposit at this location is sand and gravel with cobbles, which extends to the entire depth investigated, i.e. 1 m (Photos A3 and A4). A grain-size analysis performed on sample of the material finer than 100 mm yielded a composition of 7 percent clay and silt, 38 percent sand and 55 percent gravel. (Figure 5). This material has 43 percent crushed particles.

6.3 Test Pit 3 (at Quarry No. 3 located approximately 3.5 km north of Runway, Road Accessible)

The surficial material encountered comprised of sand and gravel with cobbles (Photos A5 and A6). The gradation performed on a sample of the material finer than 100 mm obtained from the site indicates a soil composition of 25 percent clay and silt, 50 percent sand and 25 percent gravel (Figure 6). This material contains 79 percent crushed particles.

6.4 Test Pit 4 (Quarry No. 4 located approximately 1 km east of south end of the runway. Road accessible but requires crossing the runway.)

The surficial deposit encountered at this location consisted of sand and gravel with cobbles and boulders (Photos A7 and A8). It extended to the entire depth investigated, i.e. 1.75 m. This material comprises of 3 percent clay and silt, 52 percent sand and 45 percent gravel (Figure 7). The percentage of crushed particles for this sample was established as 70 percent.

6.5 Test Pit 5 (Abandoned quarry located approximately 3 km south of runway, accessible by road. Sample obtained by manually digging.)

This test pit revealed that the site contains sand and gravel with cobbles and boulders, which extends to the entire depth investigating 1.0 m (Photos A9 and A10). A grain-size analysis performed on this material yielded a soil composition of 0 percent clay and silt, 63 percent sand and 37 percent gravel (Figure 8). It contains 63 percent crushed particles.

A summary of the Laboratory Test Results can be found in Table 2.

Table 2: Laboratory Test Results						
Property	**Test Pit 1**	**Test Pit 2**	**Test Pit 3**	**Test Pit 4**	**Test Pit 5**	**Base Levelling Material Specifications (ASG-06)**
Gradation Sieve	**Percentage Passing**	**Percentage Passing**	**Percentage Passing**	**Percentage Passing**	**Percentage Passing**	**Percentage Passing**
75 mm	100	100	100	100		
50 mm					100	
37.5 mm					98.2	
25 mm	80.6	76.0	87.0	83.0	93.5	100
19 mm	74.0	71.0	85.7	79.1	91.2	75 - 100
9.5 mm	60.0	57.6	79.8	66.8	79.0	50 - 75
4.75 mm	52	46.5	76.3	58	64.7	30 - 50
2.00 mm						
0.425 mm	33	45	58	55	62	10 - 30
0.300 mm						
0.150 mm						10
0.075 mm	12.3	6.7	26.0	2.3	0.4	3
Liquid Limit (%) max.						25
Plasticity Index (%) max.	Non-plastic	Non-plastic	Non-plastic	Non-plastic	Non-plastic	6
Abrasion loss (%) max.						45
Flat or Elongated Particles (%) max.						15
Crushed Content (%) Min. 19.0 to 4.75 mm	66	43	79	70	63	60

7 Visual Examination of Apron, Taxiway and Runway

Representatives of EXP walked the runway end to end as well as the taxiway and apron, noting all the issues and drainage courses and their condition. Photographs collected during the walkthrough are attached in Appendix B.

Historically Whale Cove receives less than 400 mm of precipitation a year and so little water is present to cause a large amount of erosion.

The terminal is a small modular building (Photo B1).

7.1 Apron

The apron is a gravel pad, well compacted but uneven with a concrete parking pad for the aircraft at its center (Photo B2). The apron surface is ravelled (Photo B3). There are plug-in points along the north edge of the apron (Photo B4). The apron drains to the north and east. The north and east side slopes appear to be in good shape with little to no sign of erosion. A shallow ditch or swale runs along the toe of both slopes and shows no signs of ponding (Photo B5). The west side of the apron, north of the terminal, is level with the parking lot and access road. All apron lighting is in good condition and working and all apron lights have their snow markers attached (Photo B6). The south side of the apron/taxiway is comprised of a shallow slope that grades to natural ground leading to a ditch and a pond beyond, west of the south end of the runway (Photo B7).

7.2 Taxiway

The taxiway is located east of the apron extending easterly from the south side of the apron (Photo B8). It is about 80 m long and is well compacted. The surface is uneven with no apparent crown. The south side of the taxiway slopes down to the natural ground and a pond further south. The north side slope of the taxiway is a long, gentle slope. Taxiway lighting is in good condition with all snow markers attached. Signage for the runway/taxiway is missing. Wiring for the signage on both sides of the intersection of the taxiway and runway is in place, but no signs have been installed or they have been damaged and removed (Photo B9).

7.3 Runway

Generally, the runway has little to no crown, i.e. the crossfall is very shallow. There are several areas that exhibit raveling.

The runway surface close to the north end including the aircraft wheel paths is well compacted but is raveling (Photo B10). Another area that exhibits raveling is located north of the taxiway and extends in a

northerly direction from this location (Photo B11). This area is also well compacted under the wheel paths, but loose surficial gravel is evident between the wheel paths (Photo B12). From 60 m north of the taxiway, the centre part of the runway is raveled in a northerly direction (Photo B13).

The west half of the runway from the taxiway to Station 0+770 approximately drains to a pond located west of the runway (Photo B14). North of this location, the west half of the runway drains into a ditch located along the west side of the runway. This drainage ditch extends in an easterly direction at the north end of the runway (Photo B15) and drains into a pond located northeast of the runway (Photo B16). The east half of the runway generally drains to the low-lying area located east of the runway, and to a number of ponds beyond. These ponds eventually drain to the Hudson Bay (Photo B17).

8 Specification of Base Levelling Material

The purpose of the investigation was to identify potential sources of granular material, which can be processed (crushed and graded) to produce aggregate for overlay and for 12-year maintenance period. The aggregate to be used for airside maintenance work must comply to Canadian Standards and Recommended Practice, Airport Engineering, ASG-06. Pavement Construction: Materials Testing prepared by Public Works and Government Services Canada, Engineering Division, Airport Engineering, September 1996. These specifications have been listed on Table 2. A review of this table indicates that 100 percent of the material should pass 25 mm sieve, should be well graded and meet the percent passing requirements for the designated sieves and contain 3 to 10 percent of material passing 0.075 mm sieve. In addition, the maximum Liquid Limit and the maximum Plasticity Index should not exceed 25 percent and 6 percent respectively. The abrasion loss (ASTM C131) should not exceed 45 percent and the percentage of flat or elongated particles should not exceed 15 percent.

It is noted that for this material to bind better, it is necessary that the fines content is close to 10 percent.

9 Aggregate Source Selection Criteria and Source Recommendation

It is considered that the factors which will govern the selection of the aggregate source are:

1.) The source should be an existing quarry preferably located within the airport property. If the source is located outside of the airport property, a quarry permit may be required with potential of delays.

2.) The source should preferably be located close to the airport to minimize hauling costs.

3.) The source should contain sufficient quantity of aggregate to complete the airside surfaces overlay and produce a 12-year maintenance stockpile.

4.) The material should contain a high percentage of fines.

It is noted that Quarry No. 4 located approximately 1 km east of the south end of the runway satisfies most of the selection criteria listed above and therefore continued use of this source is recommended for the production of the base levelling material. However, this material contains a lower percentage of fines than desirable. Geologically, the quarry is located in the deposit described as RT_v, i.e. a thin veneer of till underlain by bedrock. The till has been described as gravelly, sandy, silty diamicton (i.e. unsorted to partly sorted). It is therefore possible that the percentage of fines may vary considerably with location and required percentage of fines may be achievable by mixing the finer material with the coarser material. However, if this is not successful, a source of finer material may have to be sought.

It is considered that a potential source of fines may be the geological deposit Till Plain, T_p (See Figure 3). This deposit is listed as containing less than 25 percent clay particles. A grain-size analysis performed on the sample from Test Pit 3 which is located in this geological deposit is given on Figure 6. A review of this figure indicates that the sample tested contains 25 percent material finer than 0.075 mm sieve. It is therefore considered that this quarry may be a potential source of fines if required. An additional investigation is required to accurately establish the quantity available at this location as well the quality of fines that can be borrowed from the location of Test Pit 3. This work is best to be completed in the summer months and using a backhoe instead of a loader.

10 Recommendations to Improve Runway Maintenance

A visual examination of the runway revealed that generally there is little to no crown to the runway. The condition of the runway is very poor, and rocks from the underlying base are penetrating the wear surface.

Moreover, the runway has ravelled. The cause of ravelling is considered to be the loss of fines from the surface material due to jet propeller blast, tire action and inadequate compaction. This results in loose surficial gravel being pushed aside under the wheels of the aircrafts resulting in ravelling.

There is no maintenance gravel stockpile available. However, it is understood that the material from the quarry located southeast of the runway (Test Pit 4) is used for runway surface maintenance.

Grain-size analysis on a sample obtained from the quarry has revealed that this material does not meet the Transport Canada specifications for Base Levelling Material. This material has particles greater in size than the maximum 25 mm permitted and does not contain sufficient finer material. As a result, the binding properties of the aggregate are compromised, and it is more susceptible to ravelling. It is noted that only one sample was obtained and tested; therefore, some potential of sampling error cannot be ruled out.

Based on the above observations, it is considered that the following steps can be undertaken to improve the maintenance procedures, which are expected to result in reduced maintenance requirements:

1.) The runway cross fall should be improved to between 1 percent and 1.5 percent to facilitate better drainage of the runway surface. The runway shoulders should be reinstated.

2.) Care should be exercised to ensure that loose gravel stripped from the runway as part of the maintenance is not mounded on the sides of the runway. It should be graded beyond the edges of the runway to assure that positive drainage of the runway is maintained.

3.) The base levelling material used for rehabilitation of the runways meets the gradation requirements of the Transport Canada specifications. The fines content should be kept close to 10 percent for better binding of the material.

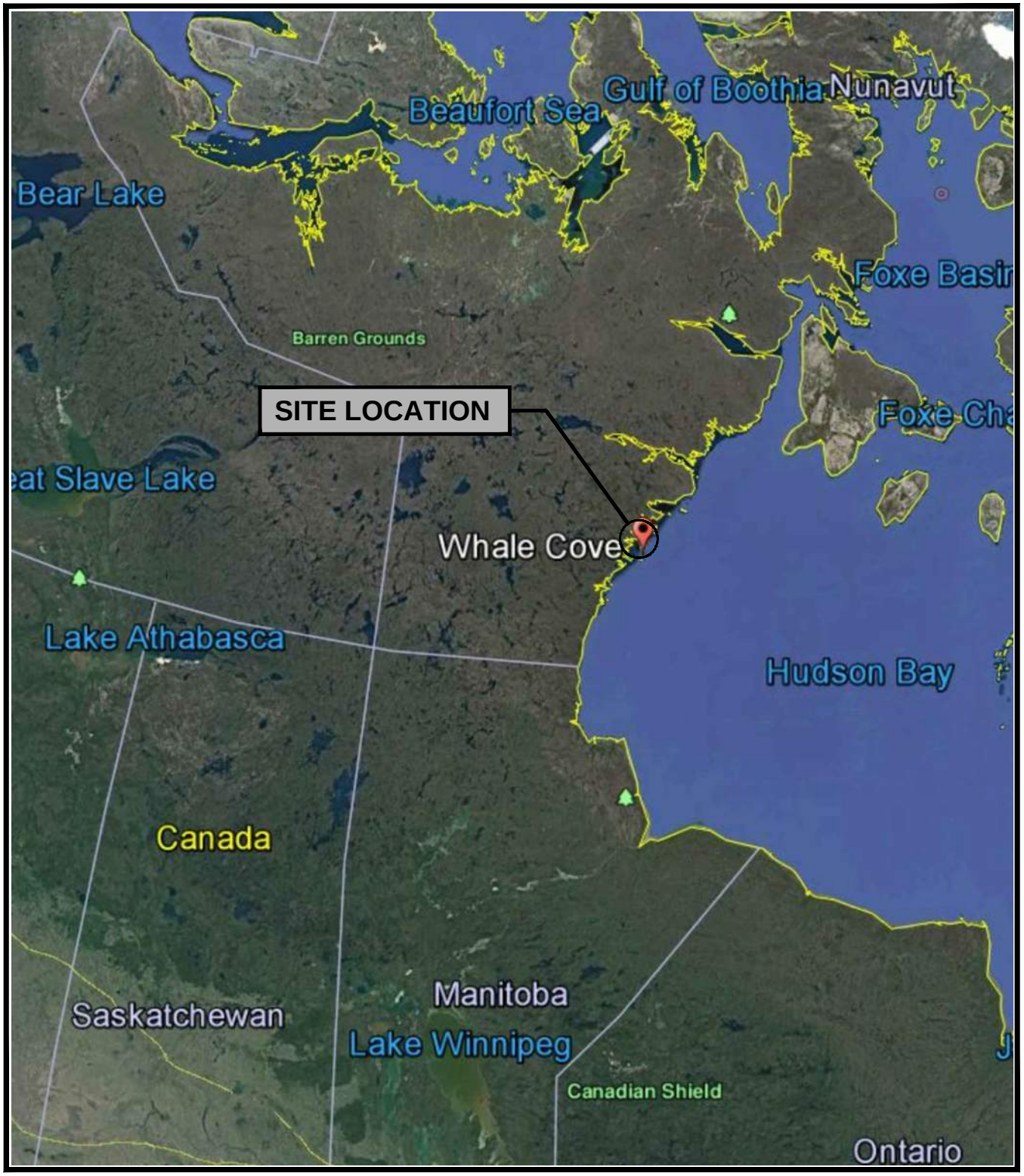
4.) After removal of the loose surficial gravel and prior to placement of the base leveling material, the surface of the runway should be thoroughly compacted. The required thickness of base levelling material to maintain the pavement structure should then be placed and compacted to at least 100 percent of Standard Proctor Maximum Dry Density in accordance with ASTM D-698-12e2 (SPMDD).

5.) Consideration may be given to the use of base stabilizing materials, such as Envirokleen or EK35 by Midwest or equivalent. This material binds the runway surface, which also results in significant increase in strength of the surficial layer. For this purpose, manufacturers of the various stabilizing compounds should be consulted to obtain an appreciation of the performance of these materials in the Arctic climate, associated costs and anticipated reduction in maintenance requirements.

11 Closure

An additional investigation should be completed during the summer months to accurately establish the volume of the available aggregate from Quarry No. 4 and to evaluate the quality of fines that can be borrowed from the location of Quarry No. 3 or other potential till plain areas. The additional work should be completed using a backhoe instead of a loader.

Figures



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drawn by: A.O.		

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CAUTION
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE	BY	APPD

SCALE: 0 250m 500m 1000m HORIZONTAL 1:25000

NORTH

DESIGNED BY:

REVIEWED BY:

CLIENT: GOVERNMENT OF NUNAVUT
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BASEPLAN	GN
DESIGN	MO
CHECKED	---
CAD	JH
PROJECT MANAGER	IPC
APPROVED	---

PROJECT: AIRSIDE SURFACE REHABILITATION
WHALE COVE AIRPORT, NUNAVUT

TITLE: AGGREGATE SEARCH & AIRSIDE SURFACES CONSTRUCTION ASSESSMENT TEST-PIT LOCATION + OVERALL SITE PLAN

PROJECT No.	OTT-249103-A0
SURVEY	JH
DATE	OCT 2018
DRAWING No.	C-100B

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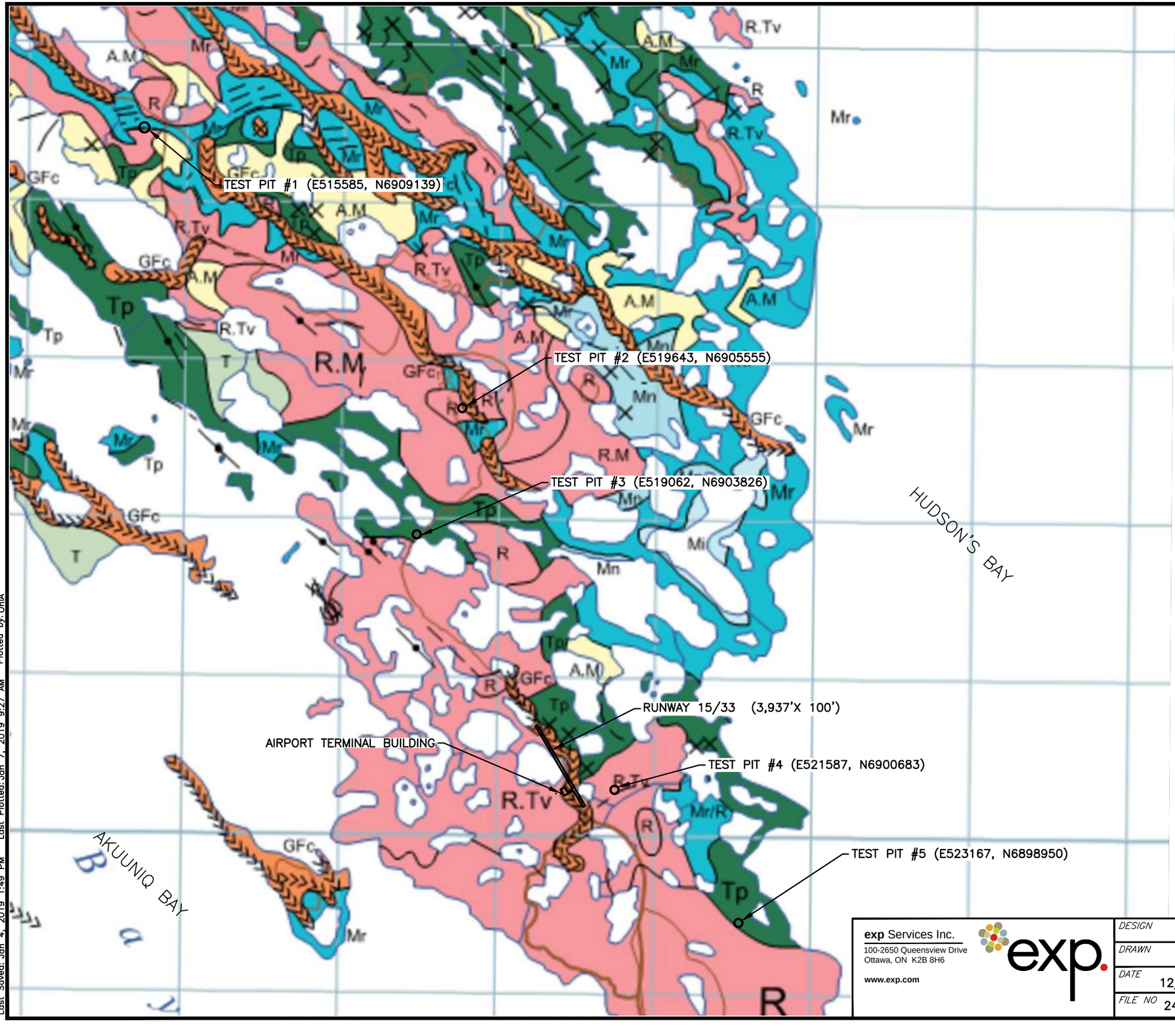

LEGEND

R — BEDROCK, UNDIFFERENTIATED: PRECAMBRIAN INTRUSIVE IGNEOUS AND METAMORPHIC ROCKS, RED VOLCANIC ROCKS, AND UNMETAMORPHOSED SEDIMENTS; SURFACE COMPRISES MORE THAN 80% OUTCROP; VEGETATION SPARSE; SURFACE MAY BE GLACIALLY ROUNDED OR COVERED BY FELSENMEER; BEDROCK (20% TO 80% OUTCROP) IS MANTLED WITH LESS THAN 1m OF THE SURFICIAL DEPOSIT INDICATED IN COMPLEX POLYGONS.

A — ALLUVIAL SEDIMENTS, UNDIFFERENTIATED: SILT, SAND AND GRAVEL; VARIABLE THICKNESS; WHEN ASSOCIATED WITH MARINE SEDIMENTS THEY OCCUR AS FLAT AREAS CONSISTING OF MODERN ALLUVIUM MIXED WITH SILT AND SAND THAT WERE WASHED FROM SLOPES BY WAVE ACTION OR DEPOSITED IN THE SEA BY MELTWATER STREAMS; SURFACE GENERALLY COVERED BY 40cm TO MORE THAN 1m OF FIBROUS PEAT ON WHICH MOSSES, SEDGES, AND GRASSES GROW; MAXIMUM ACTIVE LAYER IS 15 TO 50cm DEEP; SURFACE CHARACTERIZED BY FROST POLYGONS AND THAW PONDS RELATED TO VERTICAL ICE WEDGES EXTENDING TO A DEPTH OF 2 TO 3m.

T — TILL UNDIFFERENTIATED: DIAMICTON; VARIABLE THICKNESS; ASSOCIATED WITH COMPLEX MAP UNITS OF TILL–CORED LANDFORMS BLANKETED BY MARINE SEDIMENTS; BASED SOLELY ON AERIAL PHOTO INTERPRETATION.

Tp — TILL PLAIN: GENERALLY SANDY, SILTY DIAMICTON WITH LESS THAN 25% CLAY SIZED PARTICLES; NONCALCAREOUS; GREY; VARIABLE THICKNESS; FORMS TILL PLAINS; INCLUDES AREAS OF CLAY–RICH RED TILL; VEGETATION (SHRUBS, MOSSES, GRASSES) GROWS IN ELEVATED PEATY RINGS AROUND BARE OR LICHEN–COVERED MUDBOILS 1–2m DIAMETER; MAY EXHIBIT STRIPED PATTERN ON CLAY–RICH RED TILL AS OBSERVED ON AERIAL PHOTOS.

Mr — BEACH SEDIMENTS: SAND, GRAVEL, AND BOULDERS; VARIBLE THICKNESS; DEPOSITED IN THE TYRRELL SEA BY GLACIAL STREAMS, AND DURING REGRESSION BY NONGLACIAL STREAMS; INCLUDES MODERN STREAMS ENTERING HUDSON BAY; SURFACE MAY BE CHARACTERIZED BY SPARSE VEGETATION AND POLYGONAL FROST CRACKS.

GFc — ICE–CONTACT SEDIMENTS: SAND AND GRAVEL; VARIABLE THICKNESS; STRATIFIED, DEPOSITED NEAR ICE MARGINS IN, OVER, OR AROUND ICE OR IN ICE TUNNELS, COMMONLY AS ESKERS BUT INCLUDES ISOLATED HUMMOCKY DEPOSITS OR UNCERTAIN ORIGIN; MANY ESKERS ARE BEADED OR INTERRUPTED AT IRREGULAR INTERVALS BY MAJOR BULGES MARKING POSITIONS WHERE DELTAIC OR SUBAQUEOUS FAN DEPOSITION OCCURRED DURING PERIODS OF SLOWED ICE RETREAT .

Mn — NEARSHORE SEDIMENT: SAND; VARIABLE THICKNESS; THIN SHEET DEPOSITED BY A MIGRATING SHORELINE; THOUGHT TO BE A LAG DEVELOPED BY WAVE REWORKING OF MARINE CLAYEY SAND OR SILTY SAND, GENERALLY ASSOCIATED WITH Mi; CHARACTERIZED ON SOME AERIAL PHOTOS BY A MOTTLED PATTERN RESULTING FROM PERIGLACIAL PROCESSES OR GULLYING BY STREAMS OR TIDAL CURRENTS.

Tv — TILL VENNER: TILL, 1 TO 3m THICK; BOLDERS AND GRAVEL ON BEDROCK; SURFACE CONCENTRATION RESULTING FROM WASHING OUT FINES BY MELTWALTER FLOW.

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DATE	12/2018
FILE NO	249103

AIRSIDE SURFACE REHABILITATION
WHALE COVE AIRPORT, WHALE COVE

WHALE COVE SURFICIAL GEOLOGY

SCALE 1:50,000

SKETCH NO FIG 3

Filename: P:\Projects\Civil\249000\OTT-00249103-A0 - Airside Surface Rehab - 3 communities - GN\60-EXECUTION\64-DWG\GEO\Surf.Whale Cove.dwg
Last Saved: Jan 4, 2019 1:49 PM Last Plotted: Jan 7, 2019 9:27 AM Plotted by: OntA

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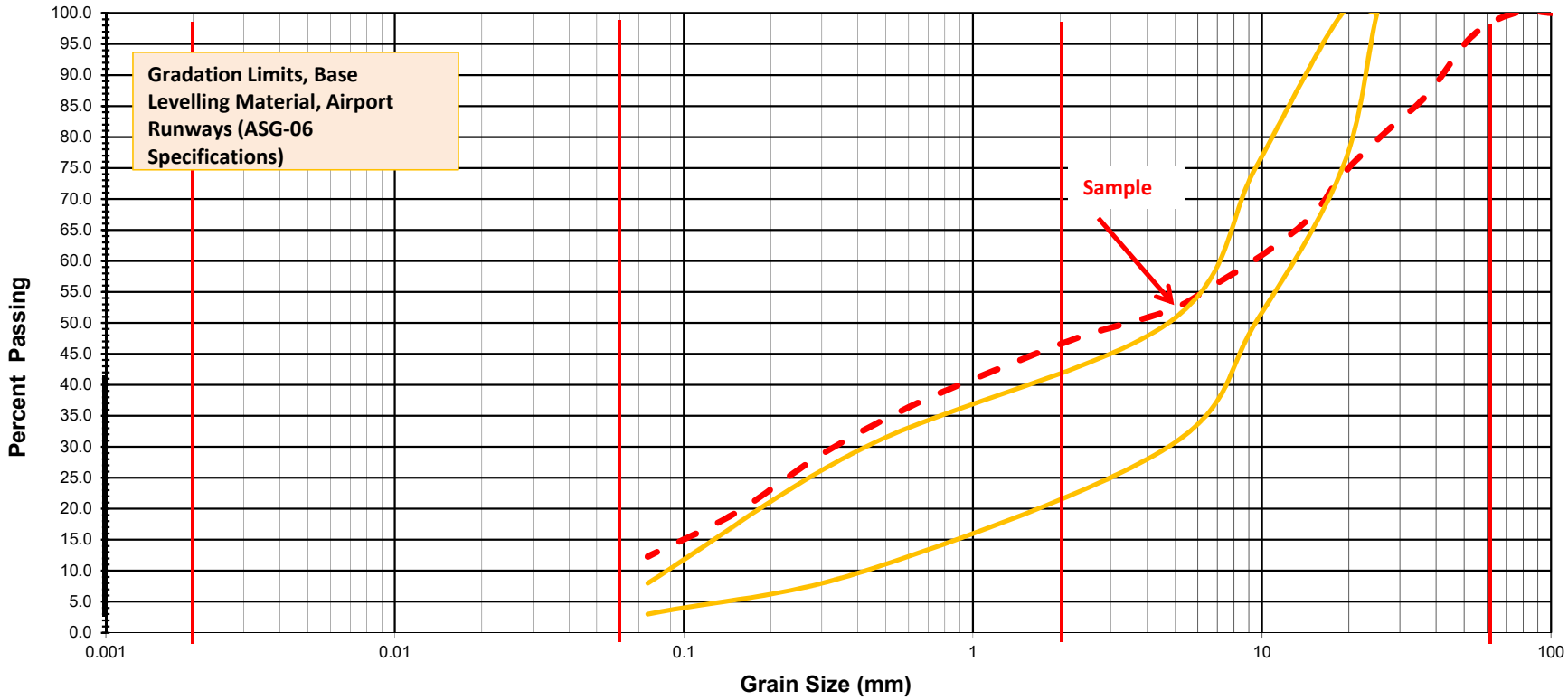
Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL		
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse



Exp Project No.:	**OTT-00249103-A0**	**Project Name :**	**Airside Surfaces Rehabilitation, Condition Assessment & Aggregate Search**				
Client :	**Government of Nunavut**	**Project Location :**	**Whale Cove Airport, Hamlet of Whale Cove, Nunavut**				
Date Sampled :	**October 1, 2018**	**Source:**	**Quarry Test Pit #1**	**% Crushed**	**66**	**Plasticity Index:**	**Not Plastic**
Sample Description :	**Gravelly Sand, Some Silt**					**Figure :**	**4**

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Grain-Size Distribution Curve

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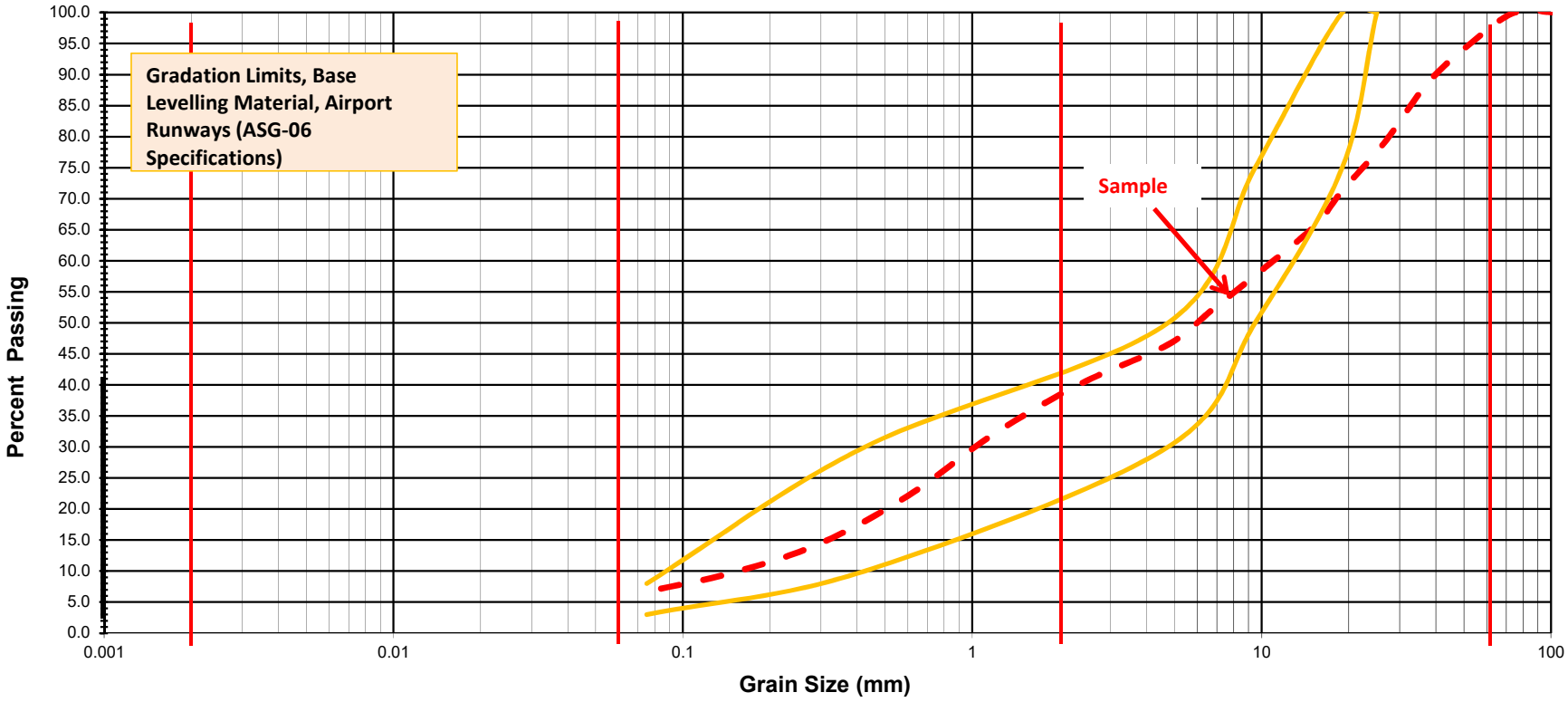
ASTM C-136 (LS-602)

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL		
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse



Exp Project No.:	**OTT-00249103-A0**	**Project Name :**	**Airside Surfaces Rehabilitation, Condition Assessment & Aggregate Search**				
Client :	**Government of Nunavut**	**Project Location :**	**Whale Cove Airport, Hamlet of Whale Cove, Nunavut**				
Date Sampled :	**October 1, 2018**	**Source:**	**Quarry Test Pit #2**	**% Crushed**	**43.2**	**Plasticity Index:**	**Not Plastic**
Sample Description :	**Sandy Gravel, Trace Silt**					**Figure :**	**5**

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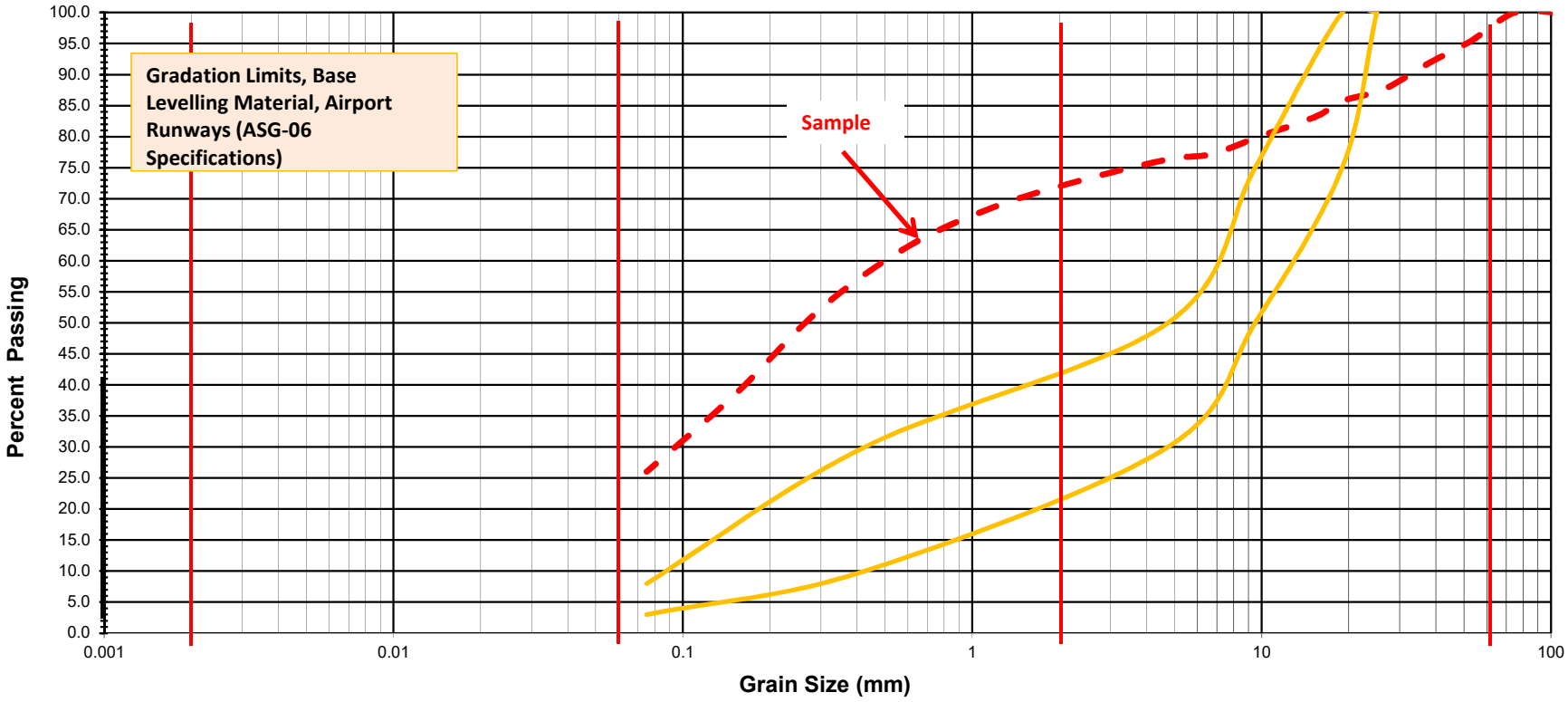
Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL		
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse



Exp Project No.:	OTT-00249103-A0	Project Name :	Airside Surfaces Rehabilitation, Condition Assessment &Aggregate Search			
Client :	Government of Nunavut	Project Location :	Whale Cove Airport, Hamlet of Whale Cove , NU			
Date Sampled :	October 1, 2018	Source:	Quarry Test Pit #3	% Crushed	79	Plasticity Index: Not Plastic
Sample Description :	Silty Gravelly Sand					Figure : 6

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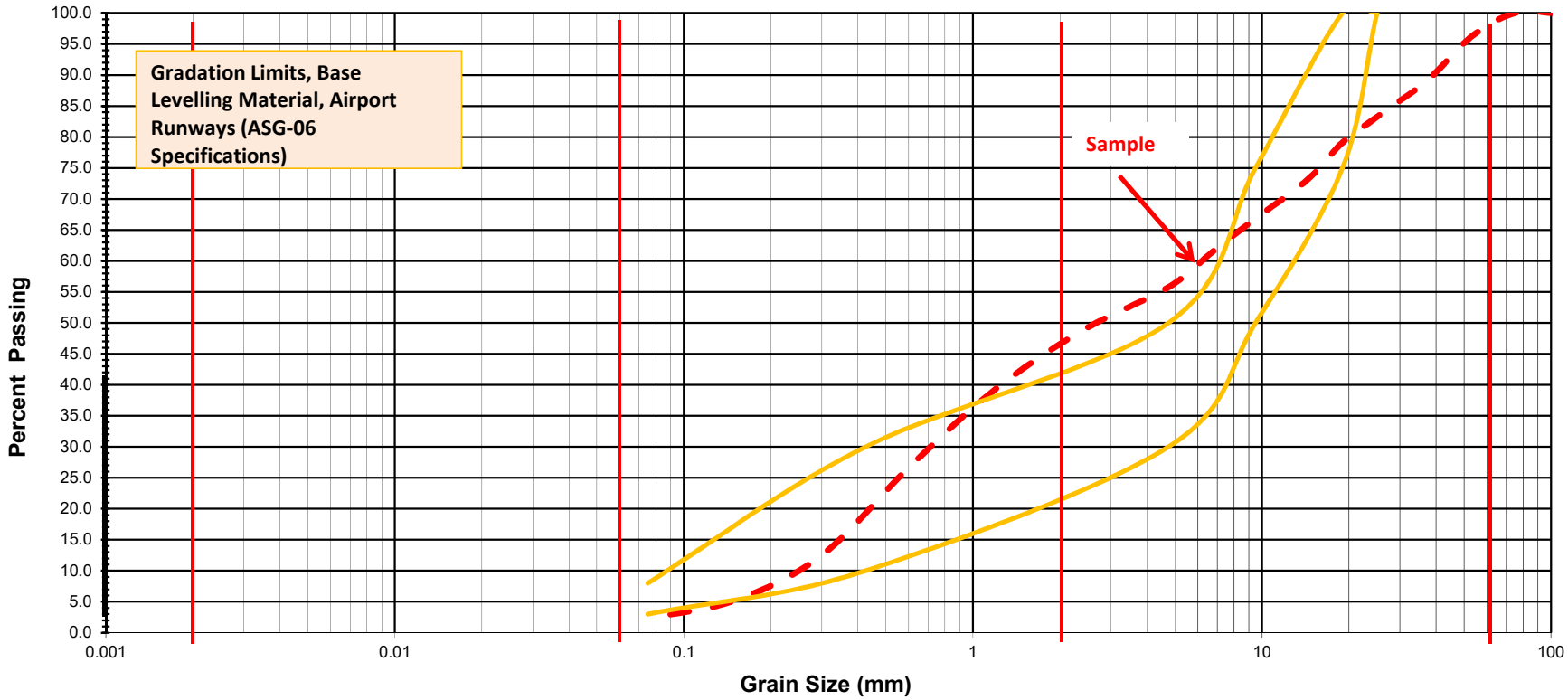
Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL		
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse



Exp Project No.:	**OTT-00249103-A0**	**Project Name :**	**Airside Surfaces Rehabilitation, Condition Assessment & Aggregate Search**				
Client :	**Government of Nunavut**	**Project Location :**	**Whale Cove Airport, Hamlet of Whale Cove, Nunavut**				
Date Sampled :	**October 1, 2018**	**Source:**	**Quarry Test Pit #4**	**% Crushed**	**70.1**	**Plasticity Index:**	**Not Plastic**
Sample Description :	**Sandy Gravel, Trace Silt**					**Figure :**	**7**

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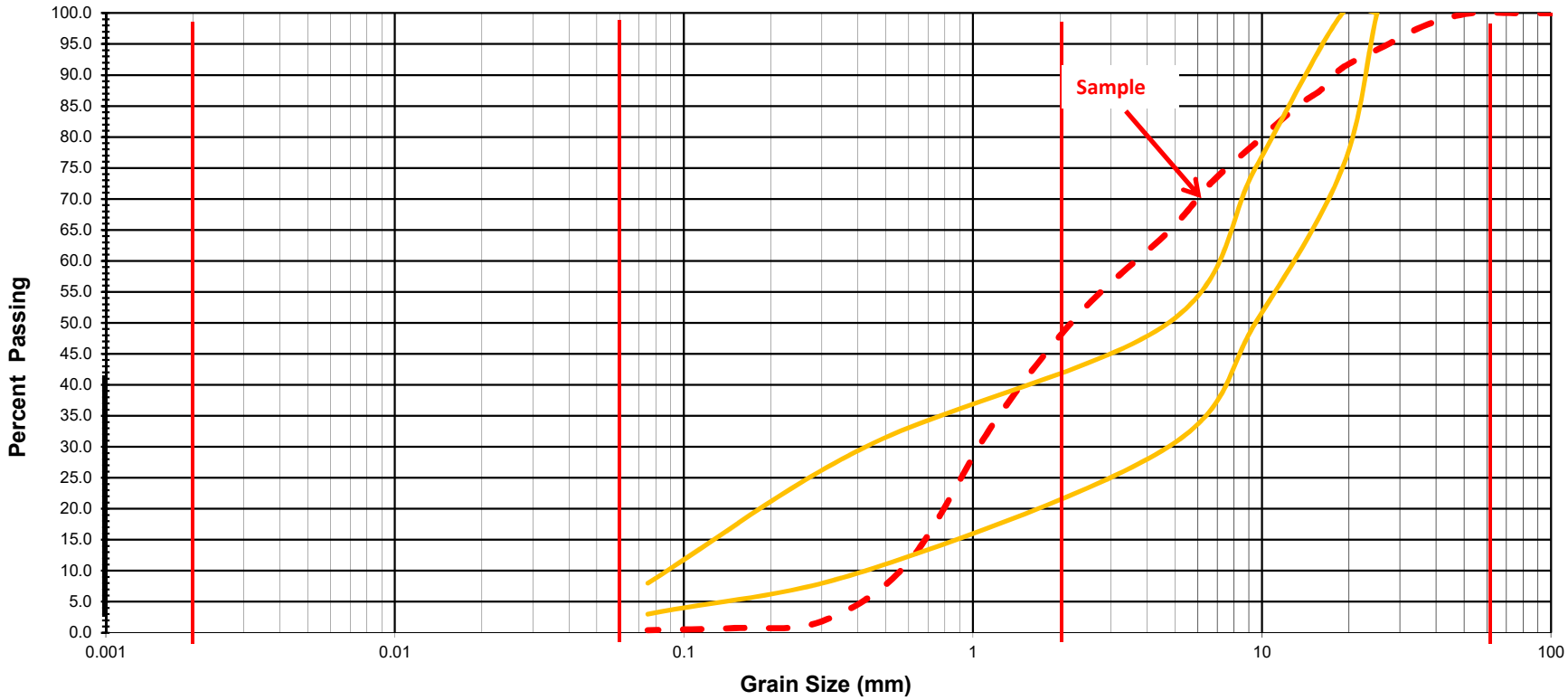
Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL		
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse



Exp Project No.:	**OTT-00249103-A0**	**Project Name :**	**Airside Surfaces Rehabilitation, Condition Assessment & Aggregate Search**				
Client :	**Government of Nunavut**	**Project Location :**	**Whale Cove Airport, Hamlet of Whale Cove, Nunavut**				
Date Sampled :	**October 1, 2018**	**Source:**	**Quarry Test Pit #5**	**% Crushed**	**62.6**	**Plasticity Index:**	**Not Plastic**
Sample Description :						**Figure :**	**8**

Appendix A: Photos of Test Pit Locations and Collected Samples

Photo A1: Location of Test Pit 1-

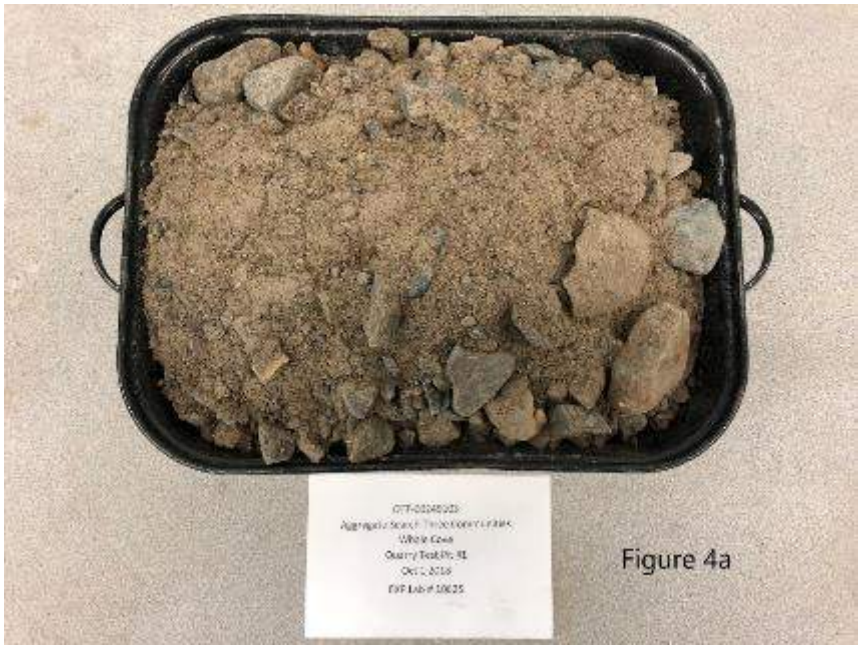


Photo A-2 Photo of Sample Collecetd from Test Pit 1

Photo A3: Location of Test Pit No. 2

Photo A4: Photo of Sample Collected From Test Pit No. 2

Photo A5: General Location of Test Pit 3

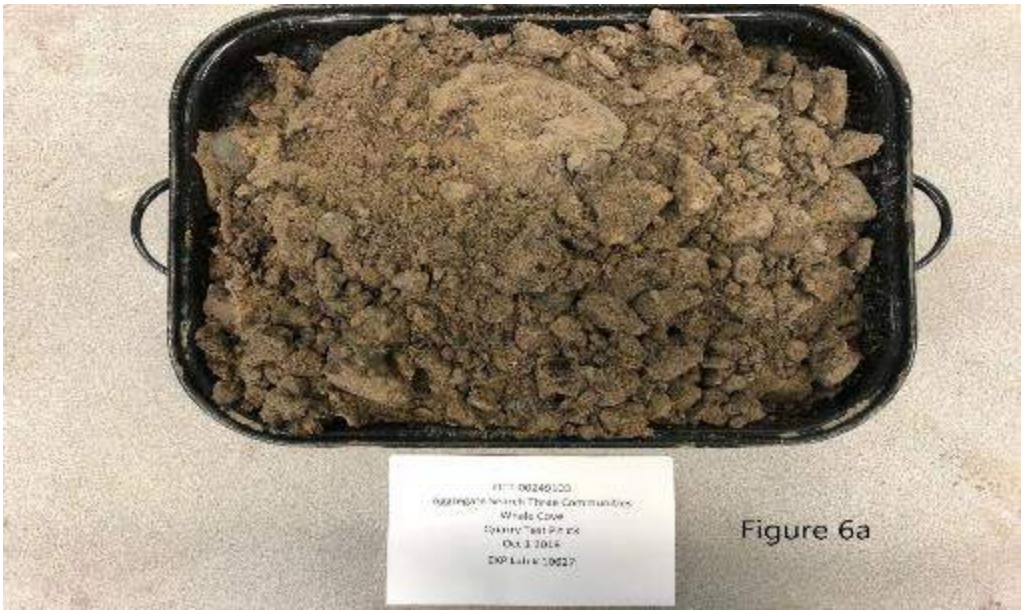


Photo A6: of Sample Collected From Test Pit 3

PhotoA7:General Location of Test Pit 4

Photo A8: Photo of Sample collected from Test Pit 4

Photo A9 General Location of Test Pit 5

Photo A10 Photo of Sample Collected From Test Pit 5

Appendix B: Photos of Airside Surfaces

Photograph No. B1
Whale Cove Air Terminal looking northwest

Photograph No. B2
Apron with the concrete parking pad, looking northeast

Photograph No. B3
Raveled, uneven ground of the apron, looking north

Photograph No. B4
Plug in points on the north side of the apron, looking northeast

Photograph No. B5
Slope on the north side of the apron, draining to the swale, looking east

Photograph No. B6
Apron lights in good condition with snow markers attached, looking northeast

Photograph No. B7
South side of apron / taxiway side slope, looking east

Photograph No. B8
Taxiway and apron, looking west

Photograph No. B9
Taxiway / runway signage wiring, looking northeast

Photograph No. B10
North end of runway, looking south

Photograph No. B11
Raveling at the center of the runway, looking north

Photograph No. B12
Runway north of the taxiway, looking north

Photograph No. B13
North runway from 60 m north of the taxiway, looking north

Photograph No. B14
Pond, west of the north runway, looking northwest

Photograph No. B15
Ditch flowing east around the north end of the runway, looking east

Photograph No. B16
Ditch flowing east to the ponds northeast of the runway, looking east

Photograph No. B17
Pond southeast of the runway, looking southeast

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