

AGGREGATE RESOURCE ASSESSMENT NEW SEWAGE LAGOON ARVIAT, NU

FINAL REPORT REV. 1

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PROJECT NUMBER:

ARV-G2203

SUBMITTED:

June 16, 2022





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1.0 Introduction

Adaptive Baseline Geotechnical (ABG) has carried out the following assessment of the currently identified borrow sources in and around Arviat, NU. The purpose of the assessment was to evaluate the quantity and quality of available borrow material within these sources, to support planning of the upcoming sewage lagoon project in the community. It is noted that ABG has also carried out a geotechnical assessment of the proposed sewage lagoon site as part of this project, which has been reported under separate cover. Dillon Consulting Ltd. (Dillon) is currently working to confirm estimates on population growth such that sizing of the new lagoon can be established. Based on the initial schematic designs prepared by Stantec Consulting Ltd. (Stantec) and included with the RFP for this project, we estimate that the project will potentially require over 100,000 m³ of good quality engineered fill for construction.

2.0 Scope of Services

Based on our current understanding of the project requirements, the following scope of services was completed for this portion of the project:

- **Compilation and Review of Available Information:** ABG compiled and reviewed available information related to the currently identified borrow sources in and around the community, primarily focused on information contained within EBA Engineering's Granular Resource Study report for the community (EBA, 2012).
- **Aggregate Resource Assessment:** During the initial phase of our geotechnical field program for the sewage lagoon project (test pits of the lagoon site), ABG met with current Hamlet staff and the Senior Administrative Office (SAO) to discuss the current borrow sources and determine the most likely borrow source for the project. We then visited each borrow source to carry out a visual assessment of the current conditions and visited the preferred source (identified by the Hamlet) with an excavator to carry out a series of test pits prior to winter 2022.
- **Laboratory Testing:** ABG conducted a laboratory testing program sufficient to properly classify the borrow material encountered within the preferred source, verifying in-situ moisture contents and soil gradations.
- **Geotechnical Reporting:** ABG prepared this report summarizing the observations and findings from our aggregate resource related field work. The report discusses any surface features or drainage patterns of interest, surface and subsurface conditions encountered, anticipated volumes and laboratory test results/quality of the borrow material investigated.

3.0 Available Information

ABG has reviewed the following available information as part of this aggregate resource study:

1. (CGD, 2019b). Geotechnical Investigation, Wind Turbine Site, Arviat, NU;
2. (CGD, 2019c). Geotechnical Investigation, Solar Array Site, Arviat, NU;
3. (CGD 2018). Pile Installation Monitoring, Water Treatment Plant, Arviat, NU;



4. (exp, 2017). Geotechnical Investigation, Water Treatment Plant & Reservoir Expansion, Arviat, NU;
5. (EBA, 2012). Granular Resource Study, Arviat, NU;
6. Available satellite imagery, Google Earth (2003, 2004, 2006, 2011, 2017 and 2019);
7. Aerial photography, National Air Photo Library (1954, 1965, and 1998);
8. Available LiDAR survey data;
9. Environment Canada, historical weather data for the community of Arviat, NU; and
10. Studies and literature related to the distribution of saline permafrost and ground temperature data throughout Nunavut (i.e. Canadian Geotechnical Journals).

4.0 Field Program Methodology

ABG's representative arrived in the community on October 6, 2022 and met with the Hamlet staff and the SAO, to discuss the borrow sources previously identified by EBA (EBA, 2012). The locations of the aggregate prospects and eskers identified by EBA are shown on the attached Figure 1.

The SAO indicated that Aggregate Prospect # 2 would be the likely borrow source for the new sewage lagoon project. Aggregate Prospect # 3 was also identified to be the next potential borrow source for the community, with permitting of the southern portion yet to begin. ABG requested permission to carry out a series of test pits throughout both deposits; however, the SAO indicated that a detailed test pitting plan would be required before digging could take place in Aggregate Prospect # 3, which would then need to be presented at a council meeting for potential approval before any work could begin. Due to timing, it was determined that exploration of this potential borrow source using test pits would not be possible before winter. ABG was given permission to carry out test pits within the permitted area (eastern half) of Aggregate Prospect # 2.

The test pit investigation of Aggregate Prospect # 2 was carried out on October 8, 2022. A total of six test pits were excavated throughout the undisturbed section of the deposit using a local excavator. The test pit locations are shown on the attached Figure 2.

The test pits were spread throughout the undisturbed area of the borrow source in accordance with industry standards (test pits in an approximate grid pattern such that no two test pits are more than 100 m apart). The current open cut that runs lengthwise (west to east) through the active area of the borrow source was visually assessed to evaluate material remaining in that section. The footprint of the borrow material remaining within the deposit was approximately captured using a commercial grade GPS device (reported accuracy of +/- 3 m). The approximate areas were combined with the observed stratigraphy thicknesses to establish the volumes reported herein.

Test pit TP-BS2-05 was terminated at 1.0 meters below grade (mbg) due to practical refusal on boulders, whereas all the remaining test pits were terminated due to practical refusal on permafrost at depths ranging from 1.5 to 1.7 mbg. Three samples were taken in each test pits at depths chosen to identify soil types and/or consistency. The test pits were backfilled using excavated material and lightly compacted with the excavator bucket.



The test pitting operation was supervised on a full-time basis by a geotechnical engineer from ABG. The samples were visually examined and logged in accordance with the Unified Soil Classification System (USCS) and ASTM D 2488 (*Standard Practice for Description and Identification of Soils, Visual-Manual Procedure*). The samples were then stored in heavy duty bags and plastic bins for transportation to a southern laboratory for further classification and testing. Laboratory testing included determination of natural moisture contents, salinities, and grain-size analyses of all the soil samples.

The test pit locations were determined using the commercial grade handheld GPS device. The elevations of the test pits were not determined by our field engineer and all depths herein are referenced to depth below current grade.

5.0 Historical Climate and Permafrost Conditions

Arviat is located at approximately 61° 07' 34" N and 94° 10' 35" W on the western shore of Hudson Bay in the Kivalliq Region of Nunavut. Based on current permafrost mapping, the community is located within the zone of continuous permafrost.

Mean Annual Air Temperature (MAAT) and Indices: A review of Environment Canada climate records for the community revealed a relatively complete set of historical monthly air temperatures spanning the period from 1981 to 2010. The data indicates the mean annual air temperature (MAAT) over this time period was -9.2°C and the average thawing and freezing indices were about 953°C-days and 4312°C-days respectively.

Active Layer Thickness: Based on the above-noted historical air temperature data, simplified empirical methods and available active layer thickness information (including numerous community-specific thermistors we have recent data from), we estimate that the maximum active layer thickness currently varies between approximately 1.5 and 2.7 m, depending on site-specific variables (such as surficial cover, site drainage, sun exposure and in-situ moisture content).

6.0 Findings and Observations

6.1 Reported Status of Existing Borrow Sources

Airstrip Esker: The deposit has reportedly been a good source of favourable sand and gravel for construction; however, the deposit is reportedly almost depleted and is not expected to be available when construction of the sewage lagoon begins. ABG visited the deposit and observed open cuts of apparent well-graded sand and gravel, with most of the deposit visibly depleted at the time of our visit.

Aggregate Prospect # 1: The deposit was reportedly explored by the Hamlet and found to contain fine-grained sand with not enough gravel to be usable for construction purposes. ABG attempted to visit the borrow source; however, the area was not easily accessible, with surficial fine-grained sand throughout the eastern extent. This appeared to verify the Hamlets descriptions and no further exploration took place.

Aggregate Prospect # 2: As noted above, this deposit was identified by the Hamlet as the most likely potential source for the sewage lagoon project. The deposit has been borrowed from recently and the Hamlet informed our representative that portions of the deposit have tended to be finer-grained and



require two or three passes through the onsite crushing equipment before a more suitable gradation can be created for construction purposes. The western portion of the borrow source was not approved for use by the Nunavut Impact Review Board (NIRB) and the approved eastern portion is reportedly 50% depleted.

ABG visited the eastern (approved) portion of the deposit and observed it to be a narrow boulder rich esker running from west to east. Development of this resource began from the west side of the deposit (where the road cuts through) and is moving eastward. As borrowing continues it will be bounded by ponds, which can be expected to limit the overall extent of what can be removed successfully. Of particular concern is a pond to the south of the undisturbed area, which is at a higher elevation than the north side of the deposit. This will require careful planning to ensure the pond is not disturbed and will obviously limit the amount of material available from the south side of the esker. Setback requirements included in the NIRB permit may further limit the accessible areas of the deposit (the permit was not available for review at the time of this report).

Aggregate Prospect # 3: The deposit is also an esker with a road running along the crest and several cabins currently placed along the road. It is located approximately 4.0 km northwest of the community. As noted above, ABG requested permission from the Hamlet to access and prove out this deposit using test pits; however, due to time constraints and permission required from Council, further investigation of this deposit was not possible before winter 2022.

6.2 Aggregate Prospect # 2 – Test Pit Investigation and Assessment

The test pit investigation focused on the undisturbed areas of the deposit where the surface remained vegetated and strewn with surficial boulders. The open cut of the active portion runs the full length of the disturbed area and was visually assessed by ABG's field engineer as part of our site work. Photos of the active cut and excavated test pits are attached. The principal strata encountered within our test pits are summarized in the following table:

TABLE 1 – Aggregate Prospect # 2 – Test Pit Summary

Test Pit No.	Total Depth (m)	Thickness (m)		
		Topsoil/Rootmat	SAND with gravel to GRAVEL with sand	Silty SAND
TP-BS2-01	1.6	0.0 – 0.4	0.4 – 1.0	1.0 – 1.6
TP-BS2-02	1.5	0.0 – 0.2	0.2 – 0.4	0.4 – 1.5
TP-BS2-03	1.6	0.0 – 0.2	0.2 – 0.9	0.9 – 1.6
TP-BS2-04	1.7	0.0 – 0.2	0.2 – 0.6	0.6 – 1.7
TP-BS2-05	1.0	0.0 – 0.2	0.2 – 1.0	-
TP-BS2-06	1.5	0.0 – 0.2	0.2 – 0.5	0.5 – 1.5

NOTES: Thickness refers to the thickness of the layer encountered in the test pit. The layers may continue further than the pit limits.

6.2.1 Surficial Layer

A surficial layer of dark brown silty sand intermixed with vegetation, topsoil and rootlets, as well as frequent cobbles and surficial boulders was encountered in all test pits, ranging in thickness from 0.2 to 0.4 m. This surficial layer had apparently been removed from the active portion of the deposit.



6.2.2 Sand and Gravel

A layer of medium brown sand (often fine-grained) with gravel to gravel with sand, containing frequent cobbles and boulders was encountered below the darker brown surficial layer noted above. The thickness of this layer was observed to be between 0.2 and 0.8 m. Test pit TP-BS2-05 was terminated within this layer due to practical refusal on abundant boulders. This layer had also been apparently removed from the active portion of the deposit. Laboratory test results for the samples obtained from this layer are summarized in the following table.

TABLE 2 – Sand and Gravel Laboratory Testing Result Summary

Test Pit No.	Cobbles/ Boulders (%) ⁽¹⁾	Sample No.	Sample Depth (m)	Grain-Size Analyse (sampled soil matrix)			Moisture Content (%)
				Gravel (%)	Sand (%)	Silt (%)	
TP-BS2-01	20 – 40	S1	0.5 – 0.6	20	77	3	3.8
		S2	0.9 – 1.0	18	77	5	4.6
TP-BS2-02	30 – 50	S1	0.2 – 0.3	52	46	2	3.5
TP-BS2-03	40 – 60	S1	0.3 – 0.4	36	61	3	6.2
		S2	0.8 – 0.9	41	56	3	5.5
TP-BS2-04	30 – 50	S1	0.2 – 0.3	26	68	6	7.1
TP-BS2-05	50 – 70	S1	0.2 – 0.3	49	49	2	2.9
		S2	0.5 – 0.6	13	80	7	5.0
		S3	0.9 – 1.0	20	75	5	4.3
TP-BS2-06	40 – 60	S1	0.2 – 0.3	20	70	10	12.5

Notes: Percent cobbles and boulders (crushable rock) estimated based on visual assessment of excavated material.
 This material was not sampled due to size.

Grain-size analysis results for the samples listed above are attached to this report and are compared against our recommended Type 2 and Select Subgrade specification limits (as defined herein).

6.2.3 Silty Sand

A layer of grey silty sand (fine-grained) containing frequent cobbles and boulders was encountered below the brown sand/gravel layer noted above (undisturbed area) and was exposed at surface throughout the full extent of the active portion of the deposit.

The thickness of this layer within our test pits (undisturbed area) was observed to range between 0.6 and 1.1 m. Test pit TP-BS2-05 encountered practical refusal on boulders prior to reaching this layer and the remaining five test pits terminated due to practical refusal on permafrost within this layer. The active portion of the deposit had an approximately 3 to 4 m high cut face that divided the northern portion (approximately fully depleted) and the southern portion (seemingly stripped to the top of this grey silty sand layer). The surface of both the higher and lower cuts, as well as the open face was observed to consist of similar grey silty sand, rich with cobbles and boulders. Laboratory test results for the samples obtained from this layer are summarized in the following table.



TABLE 3 – Silty Sand Laboratory Testing Result Summary

Test Pit No.	Cobbles/Boulders (%) ⁽¹⁾	Sample No.	Sample Depth (m)	Grain-Size Analyse (sampled soil matrix)			Moisture Content (%)
				Gravel (%)	Sand (%)	Silt (%)	
TP-BS2-01	20 – 40	S3	1.4 – 1.5	11	73	16	9.3
TP-BS2-02	30 – 50	S2	0.8 – 0.9	6	71	23	8.5
		S3	1.4 – 1.5	10	69	21	11.0
TP-BS2-03	40 – 60	S3	1.5 – 1.6	12	69	19	9.8
TP-BS2-04	30 – 50	S2	0.8 – 0.9	11	64	25	7.6
		S3	1.6 – 1.7	11	59	30	13.5
TP-BS2-06	40 – 60	S2	0.7 – 0.8	22	59	19	8.2
		S3	1.3 – 1.4	10	66	24	10.7

Notes: Percent cobbles and boulders (crushable rock) estimated based on visual assessment of excavated material.
This material was not sampled due to size.

Grain-size analysis results for the samples listed above are attached to this report and are compared against our recommended Type 2 and Select Subgrade specification limits (as defined herein).

6.2.4 Bedrock

Bedrock was not encountered in any of the six test pits.

6.2.5 Groundwater

Minimal to moderate groundwater was encountered in four the six test pits, the other two test pits were dry. It is anticipated that groundwater flow will take place through the active layer during warmer months (during thaw) and groundwater levels will fluctuate with seasonal weather trends or site usage, as well as proximity to any nearby ponds at higher elevation.

6.2.6 Permafrost

Permafrost was encountered in five of the six test pits at depths between 1.5 and 1.7 mbg. Permafrost was not reached in TP-BS2-05 due to practical refusal on boulders.

6.2.7 Estimated Material Volume (proven by ABG)

The handheld GPS device was used to approximately capture the perimeter of the remaining undisturbed area of the deposit and the remaining (higher) portion of the disturbed area of the deposit to generate approximate areas of 26,000 m² and 16,000 m², respectively. These areas have been used to generate the approximate volumes presented below.

Upper Sand (fine-grained) or Gravel with Cobbles and Boulders: The average thickness of the upper sand or gravel layer encountered within our test pits was 0.5 m (beneath the surficial overburden). Based on the approximate area of the undisturbed portion of the deposit, we estimate an approximate volume of **13,000 m³ sand or gravel** remains within the accessible areas of the deposit.

Lower Silty Sand (fine-grained) with Cobbles and Boulders: The average thickness of the lower silty sand we were able to prove at our test pit locations was 0.75 m (with more anticipated below our depth of practical refusal on frozen ground). For the purpose of volume estimation, we have assumed half the



average observed height (approximately 2.0 m) of the open cut running through the disturbed portion of the deposit can be taken from the remainder of that area, resulting in an approximate total volume of **51,500 m³** remaining throughout the entire deposit.

7.0 Discussion and Recommendations

The intention of the assessment was to evaluate the availability of good quality borrow material for use during construction of the new sewage lagoon project. For the purpose of this assessment, we have assumed that good quality borrow material for the project, should consist of well-graded sand and gravel meeting the requirements of Select Subgrade or Type 2 material as defined in the following table.

TABLE 4 - Recommended Gradation for Type 1, Type 2 and Select Subgrade Materials

Property	ASTM Test Method	Type 2 (Sub-Base)	Type 1 (Base)	Select Subgrade
Gradation (sieve/% passing)	–	–	–	–
150 mm	C136	–	–	100
75.0 mm	C136	100	–	–
37.5 mm	C136	–	–	–
25.0 mm	C136	50 – 100	100	50 – 100
19.0 mm	C136	–	75 – 100	45 – 100
9.5 mm	C136	–	50 – 85	–
4.75 mm	C136	20 – 55	35 – 65	20 – 70
2.0 mm	C136	–	25 – 50	–
0.425 mm	C136	5 – 35	15 – 30	5 – 45
0.300 mm	C136	–	–	–
0.150 mm	C136	–	–	–
0.075 mm	C117	0 – 8	5 – 8	0 – 20

Aggregate Prospect # 2: Based on our findings, the majority of the current material within Aggregate Resource # 2 contains elevated fines (silt/clay) and/or fine-grained sand, such that the material mostly falls outside our recommended gradation limits for Select Subgrade. The material is predominantly too fine as shown on the attached gradation test results.

Fortunately, the deposit was also observed to contain a high percentage of cobbles and boulders throughout (estimated to be 20% to 70% by volume based on our visual assessment), which should be usable to create additional gravel size particles that can potentially be blended with the native soil matrix to drive down the fine-grained sand and fines content to within our preferred limits. ABG confirmed the presence of the following pieces of crushing equipment onsite within the active area of the deposit:



- **Lokotrack LT106** – Mobile jaw crusher. The specifications available online indicate this equipment has a feed opening width of 1.06 m and is capable of crushing cobbles and large boulders down into particles ranging in size from 200 to 70 mm.
- **Lokotrack ST3.8** – Mobile double deck screener. This equipment is typically used to separate specific grain sizes, such that larger particles can be fed back through a cone crusher or finer particles can be removed.
- **Lokotrack LT200HP** – Mobile cone crusher. This equipment is typically used in series with the jaw crusher and/or screen deck to further crush/alter gravel and sand to fill gaps of missing particle sizes within specified gradations.

As part of our assessment, we have carried out a theoretical analysis of the gradation test results presented herein. Based on our analyses, if the cobbles and boulders are successfully crushed into something similar to our specified Type 2 gradation, it should be possible to blend this additional gravel with the native sand matrix at an approximate ratio of 50/50, to create a material well within our Select Subgrade gradation limits. This agrees well with the statement from the SAO (noted above) that Aggregate Resource # 2 requires two or three passes through their onsite crushing operation to become more suitable for use as engineered fill.

Based on the above, we anticipate the onsite crushing operation is capable of producing Select Subgrade material (or better) from the borrow materials remaining within the Aggregate Resource # 2; however, it is recommended that the project team work with the Hamlet next summer to identify an opportunity to revisit the deposit and obtain a proper representative sample of fully processed material. If the Hamlet does not plan to produce any material from the deposit next season, it is recommended that a trial production run be organized to verify the actual gradation of what can be produced. The process of crushing down larger boulders, cobbles and gravels during production will alter the overall gradation of the material produced and generate additional fines beyond those observed within the bulk samples obtained and evaluated herein.

With regards to volume estimation, it is noted that although the total volume estimates presented herein serve as a good starting point, these volumes are very approximate and based on areas determined using our handheld GPS device and stratigraphy at the test pit/open cut locations only. Based on our observations onsite and our test pit findings, ABG has proven only **64,500 m³ of potentially suitable borrow material remaining within Aggregate Prospect # 2 (pending gradation test results of the fully processed material)**. It is noted that this volume estimation has been determined based on the following assumptions:

- The upper 200 mm of the undisturbed portion (eastern) deposit is wasted as the organic material and rootlets are removed (overburden).
- All material present (boulders, cobbles, gravel, sand and fines) within the deposit will be processed through the crusher and blended with the current soil matrix to drive down the fine-grained sand and fines content, and produce a more suitable Select Subgrade type material.
- The deposit can be borrowed to within the approximate extents shown on our figure. We have not reviewed the NIRB permit to confirm the approved extent of the deposit and the ponds surrounding the area will affect the Hamlets ability to remove some areas beyond what we anticipate at this time.



The volume estimation has not taken the following items into consideration, in an effort to provide some additional level of conservatism to account for the many unknowns listed above and also the potential ongoing borrowing of Aggregate Prospect # 2 by the Hamlet for other projects ahead of lagoon construction:

- Suitable borrow material present below the depths of our test pits was not included. The bedrock surface was not encountered in any of the test pits and all test pits were terminated due to refusal on either permafrost or boulders; therefore, the full extent of usable overburden at these locations is unknown. Based on our observations onsite and available LiDar survey (approximate elevations) it appears that there may be another 26,000 to 63,000 m³ (0.5 to 1.5 m thickness) worth of borrow material remaining beneath the excavated depths observed by ABG.
 - The quality/quantity of that unseen material will depend on consistency of the deposit at depth and various limitations on what can be removed successfully.
- Bulking factors have not been considered. It is anticipated that the processed and stockpiled volumes will be greater than the in-situ (excavated) volumes.

Based on the above, it is apparent that Aggregate Prospect # 2 does not currently contain a sufficient quantity of good quality material for the project. Furthermore, based on preliminary input from the Hamlet SAO it is anticipated that most or all of the deposit will be used for other projects during the 2023 and 2024 construction seasons. For these reasons, it is recommended that Aggregate Prospect # 3 be approved for further evaluation during the summer of 2023, via additional test pits.

Aggregate Prospect # 3: At the time of this revision, ABG has been in communication with the Hamlet SAO and CGS Lands department representatives regarding further investigation of the Aggregate Prospect # 3. On March 2, 2023, we provided both offices with a plan showing the extent of the prospect we propose to assess further and our approximate grid of proposed test pit locations (see attached Figure 3). Both offices confirmed receipt and there was immediate action from CGS Lands to try and confirm the actual extent of the deposit to be permitted at this time with the Hamlet. Unfortunately, as of this revision, we are not aware of any further progress on the part of the Hamlet SAO or CGS Lands. As such, ABG has been unable to confirm the actual extent of interest to all parties or receive any authorization to proceed with test pits this summer as part of this project (per our previous recommendations and intentions). Furthermore, the Hamlet SAO office stopped responding to our emails or phone calls over a month ago and at that time we requested assistance from Dillon and the GN to help move this approval process along if possible. Currently, there has been no further apparent progress and time is tight if Council approval is in fact required before we test pit the deposit. It is recommended that this be given the highest priority by the project team, as our personnel are ready and waiting to carry out the work with an ability to adapt the program as required to suit actual areas of interest for permitting purposes. In fact, our investigation may provide valuable input on actual areas of most interest for permitting at this time.

It is noted that the recommendations presented herein are based only on the available information and the crushing contractor may have further insights that should be considered. Note that these summary comments are not to be interpreted as pit operation management plan directives. Rather they are provided for information purposes. A separate pit management operations plan should be considered to address excavation and operations procedures, including any environmental constraints that may be present adjacent to the deposits and in accordance with the permits for development.



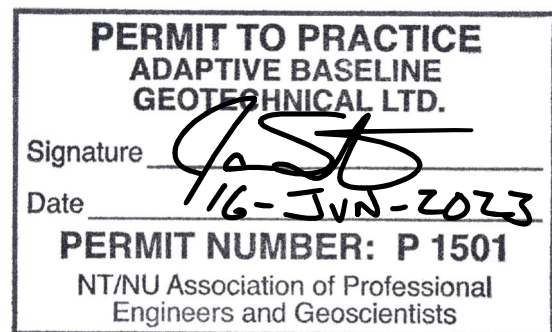
8.0 Closure

The use of this report is subject to the statement of general conditions provided in the attachments. It is the responsibility of Dillon Consulting Ltd., who is identified as “the Client” within the statement of general conditions and its agents to review the conditions and to notify Adaptive Baseline Geotechnical Ltd. should any of these not be satisfied. The statement of general conditions addresses; use of the report, basis of the report, standard of care, interpretation of site conditions, varying or unexpected site conditions, planning, design, and construction.

We trust the information contained herein is adequate for your present purposes. Should you have any questions about the contents of this report, or if we can be of any further assistance, please do not hesitate to contact the undersigned at your convenience.

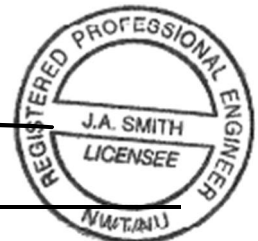
Sincerely,

Adaptive Baseline Geotechnical Ltd.



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Aggregate Resource Assessment Rev. 1
New Sewage Lagoon
Arviat, NU
ARV-G2203



ATTACHMENTS



Photograph 1 - October 7, 2022
Active area of Aggregate Prospect # 2 (looking east).



Photograph 2 - October 7, 2022
Active area of Aggregate Prospect # 2 (looking west).



Photograph 3 - October 8, 2022
Digging TP-BS2-01.



Photograph 4 - October 8, 2022
Pit wall of TP-BS2-01.



Photograph 5 - October 8, 2022
TP-BS2-01 after being left open for 2 hours.



Photograph 6 - October 8, 2022
Digging TP-BS2-02.



Photograph 7 - October 8, 2022
Pit wall of TP-BS2-02.



Photograph 8 - October 8, 2022
Backfilling TP-BS2-02.



Photograph 9 - October 8, 2022
Digging TP-BS2-03.



Photograph 10 - October 8, 2022
Pit wall of TP-BS2-03.



Photograph 11 - October 8, 2022
TP-BS2-03.



Photograph 12 - October 8, 2022
Digging TP-BS2-04.



Photograph 13 - October 8, 2022
Pit wall of TP-BS2-04.



Photograph 14 - October 8, 2022
Ice crystals in TP-BS2-04.



Photograph 15 - October 8, 2022
Digging TP-BS2-05.



Photograph 16 - October 8, 2022
Pit wall of TP-BS2-05.



Photograph 17 - October 8, 2022
TP-BS2-05.



Photograph 18 - October 8, 2022
Pit wall of TP-BS2-06.



Photograph 19 - October 8, 2022
TP-BS2-06.



Photograph 20 - October 8, 2022
Backfilling TP-BS2-06.



ADAPTIVE BASELINE GEOTECHNICAL LTD.

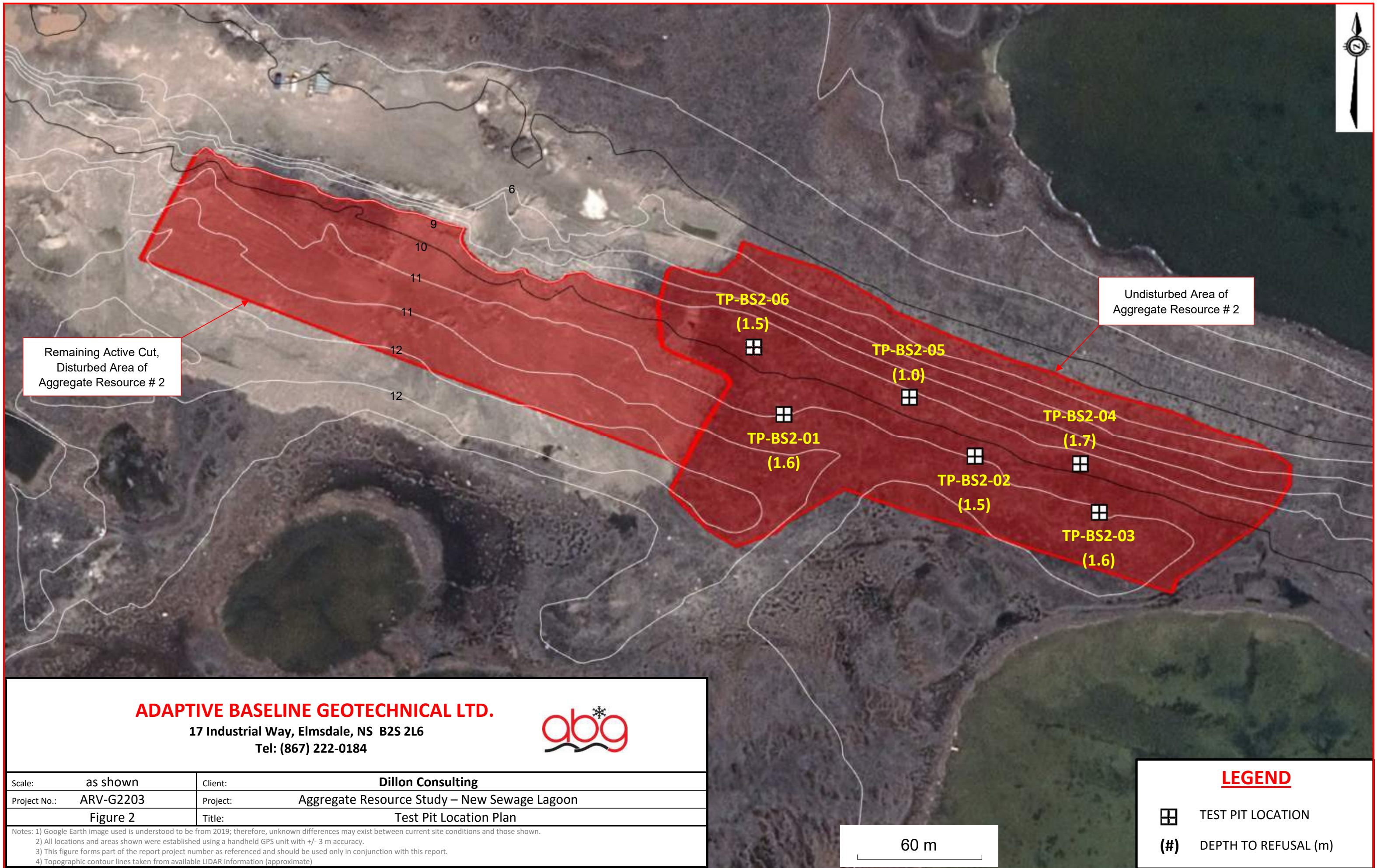
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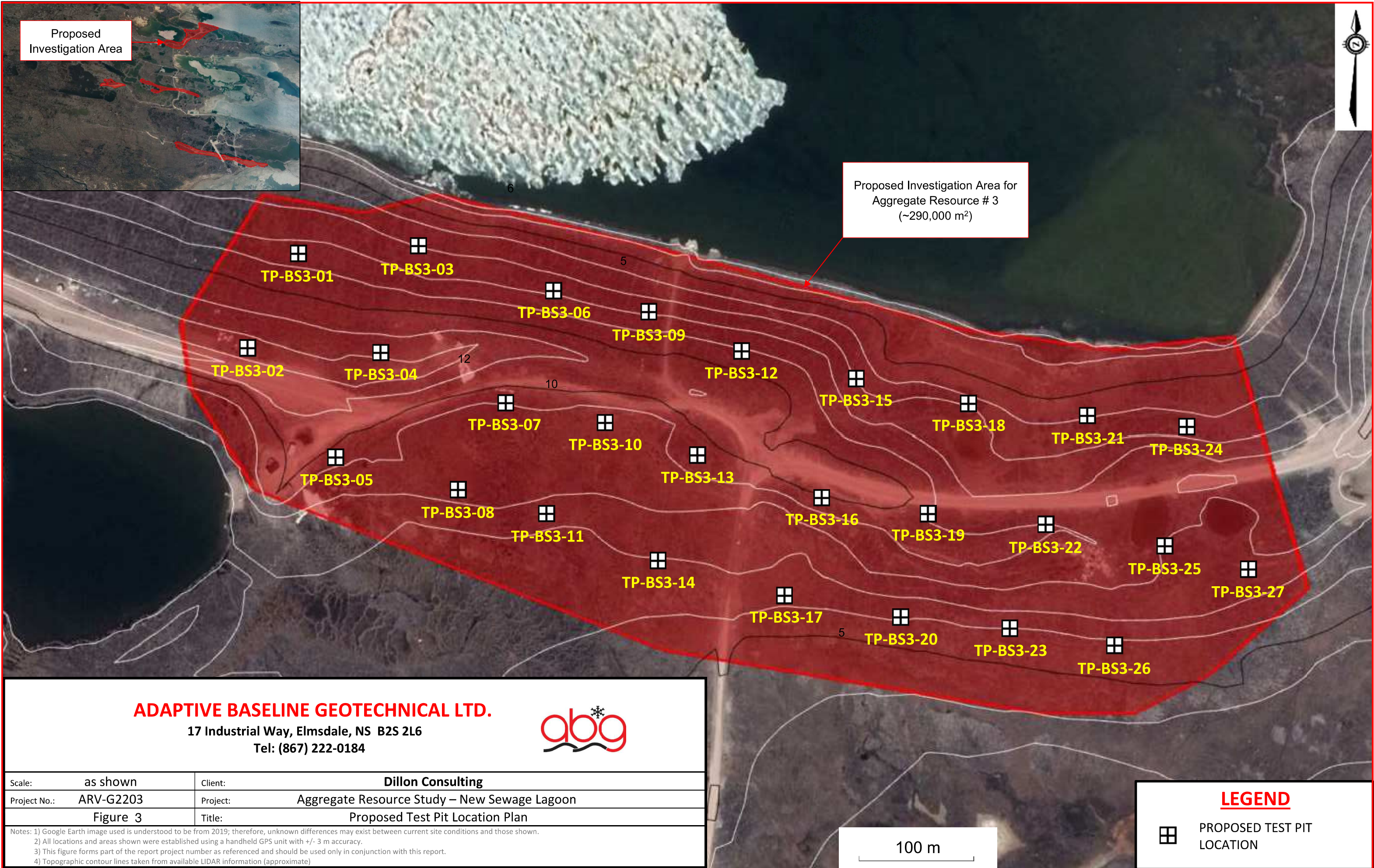
Tel: (867) 222-0184



Scale:	as shown	Client:	Dillon Consulting
Project No.:	ARV-G2203	Project:	Aggregate Resource Study – New Sewage Lagoon
Figure 1		Title:	Site Location Plan

Notes: (1) Google Earth image used is understood to be from 2019; therefore, unknown differences may exist between current site conditions and those shown.
(2) Outlines of aggregate prospects and eskers are approximated from EBA, 2012, Figure 1 titled "Site Plan", Project "Granular Program Study", Project No. Y14101361, Rev 0, dated January 31, 2012.
(3) This figure forms part of the report project number as referenced and should be used only in conjunction with this report.







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TEST PIT LOG

TP-BS2-01

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CLIENT Dillon Consulting
PROJECT NUMBER ARV-G2203
DATE STARTED 2022.10.08 COMPLETED 2022.10.08
EXCAVATION CONTRACTOR EPLS
EXCAVATION METHOD Excavator
LOGGED BY MS CHECKED BY MS

PROJECT NAME New Sewage Lagoon
PROJECT LOCATION Arviat, NU
GROUND ELEVATION n/a
NOTES UTM: 15V 440672 m E 6776876 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	<div>▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 □ FINES (%) □</div>
							GRAVEL	SAND	FINES			
	Dark brown ROOTMAT/Topsoil -Frequent cobbles and boulders											
0.40												
	Brown poorly graded to well-graded SAND with gravel -Frequent cobbles and boulders											
					S1	4.0	20	77	3	3.8		
			SP									
1.00					S2	3.5	18	77	5	4.6		
	Grey silty SAND -Frequent cobbles and boulders -Minor seepage at bottom of pit											
			SM									
					S3	2.0	11	73	16	9.3		
1.60												
	Test Pit Terminated at 1.6 m - Refusal on permafrost											
2												



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TP-BS2-02

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PROJECT NUMBER ARV-G2203
DATE STARTED 2022.10.08 COMPLETED 2022.10.08
EXCAVATION CONTRACTOR EPLS
EXCAVATION METHOD Excavator
LOGGED BY MS CHECKED BY MS

PROJECT NAME New Sewage Lagoon
PROJECT LOCATION Arviat, NU
GROUND ELEVATION n/a
NOTES UTM: 15V 440763 m E 6776853 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			20 40 60 80	20 40 60 80
	Dark brown ROOTMAT/Topsoil -Frequent cobbles and boulders												
0.20	Brown poorly graded GRAVEL with sand -Frequent cobbles and boulders		GP		S1	3.5	52	46	2	3.5		●	
0.40	Grey silty SAND -Frequent cobbles and boulders -Minimal seepage at bottom of pit												
					S2	2.5	6	71	23	8.5		●	□
1			SM										
					S3	6.0	10	69	21	11.0		●	□
1.50													
	Test Pit Terminated at 1.5 m - Refusal on permafrost												
2													



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TP-BS2-03

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CLIENT Dillon Consulting
PROJECT NUMBER ARV-G2203
DATE STARTED 2022.10.08 COMPLETED 2022.10.08
EXCAVATION CONTRACTOR EPLS
EXCAVATION METHOD Excavator
LOGGED BY MS CHECKED BY MS

PROJECT NAME New Sewage Lagoon
PROJECT LOCATION Arviat, NU
GROUND ELEVATION n/a
NOTES UTM: 15V 440823 m E 6776826 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			20 40 60 80	20 40 60 80
												PL MC LL	20 40 60 80
												□ FINES (%) □	20 40 60 80
0.20	Dark brown ROOTMAT/Topsoil -Frequent cobbles and boulders												
	Brown poorly graded SAND with gravel -Frequent cobbles and boulders		SP		S1	3.0	36	61	3	6.2			
0.90	Grey silty SAND -Frequent cobbles and boulders -Minor seepage at 1.0 mbg		SM		S2	3.5	41	56	3	5.5			
1													
1.60					S3	4.0	12	69	19	9.8			
2	Test Pit Terminated at 1.6 m - Refusal on permafrost												



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TEST PIT LOG

TP-BS2-04

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CLIENT Dillon Consulting
PROJECT NUMBER ARV-G2203
DATE STARTED 2022.10.08 COMPLETED 2022.10.08
EXCAVATION CONTRACTOR EPLS
EXCAVATION METHOD Excavator
LOGGED BY MS CHECKED BY MS

PROJECT NAME New Sewage Lagoon
PROJECT LOCATION Arviat, NU
GROUND ELEVATION n/a
NOTES UTM: 15V 440814 m E 6776850 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			20 40 60 80	20 40 60 80
	Dark brown ROOTMAT/Topsoil -Frequent cobbles and boulders												
0.20	Brown poorly graded SAND with silt and gravel -Frequent cobbles and boulders		SP-SM		S1	5.0	26	68	6	7.1		●	
0.60	Grey silty SAND -Frequent cobbles and boulders -Visible ice from 1.6-1.7 mbg				S2	2.5	11	64	25	7.6		●	□
1			SM										
1.70					S3	2.0	11	59	30	13.5		●	□
2	Test Pit Terminated at 1.7 m - Refusal on permafrost												



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TEST PIT LOG

TP-BS2-05

PAGE 1 OF 1

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PROJECT NUMBER ARV-G2203
DATE STARTED 2022.10.08 COMPLETED 2022.10.08
EXCAVATION CONTRACTOR EPLS
EXCAVATION METHOD Excavator
LOGGED BY MS CHECKED BY MS

PROJECT NAME New Sewage Lagoon
PROJECT LOCATION Arviat, NU
GROUND ELEVATION n/a
NOTES UTM: 15V 440733 m E 6776882 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	<div>▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 □ FINES (%) □</div>
							GRAVEL	SAND	FINES			
0.20	Dark brown ROOTMAT/Topsoil -Frequent cobbles and boulders											
	Brown poorly graded SAND with gravel to poorly graded SAND with silt -Frequent cobbles and boulders		SP-SM		S1	10.0	49	49	2	2.9		
					S2	5.0	13	80	7	5.0		
1 1.00					S3	5.0	20	75	5	4.3		
	Test Pit Terminated at 1 m - Refusal on boulders											



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TP-BS2-06

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PROJECT NUMBER ARV-G2203
DATE STARTED 2022.10.08 COMPLETED 2022.10.08
EXCAVATION CONTRACTOR EPLS
EXCAVATION METHOD Excavator
LOGGED BY MS CHECKED BY MS

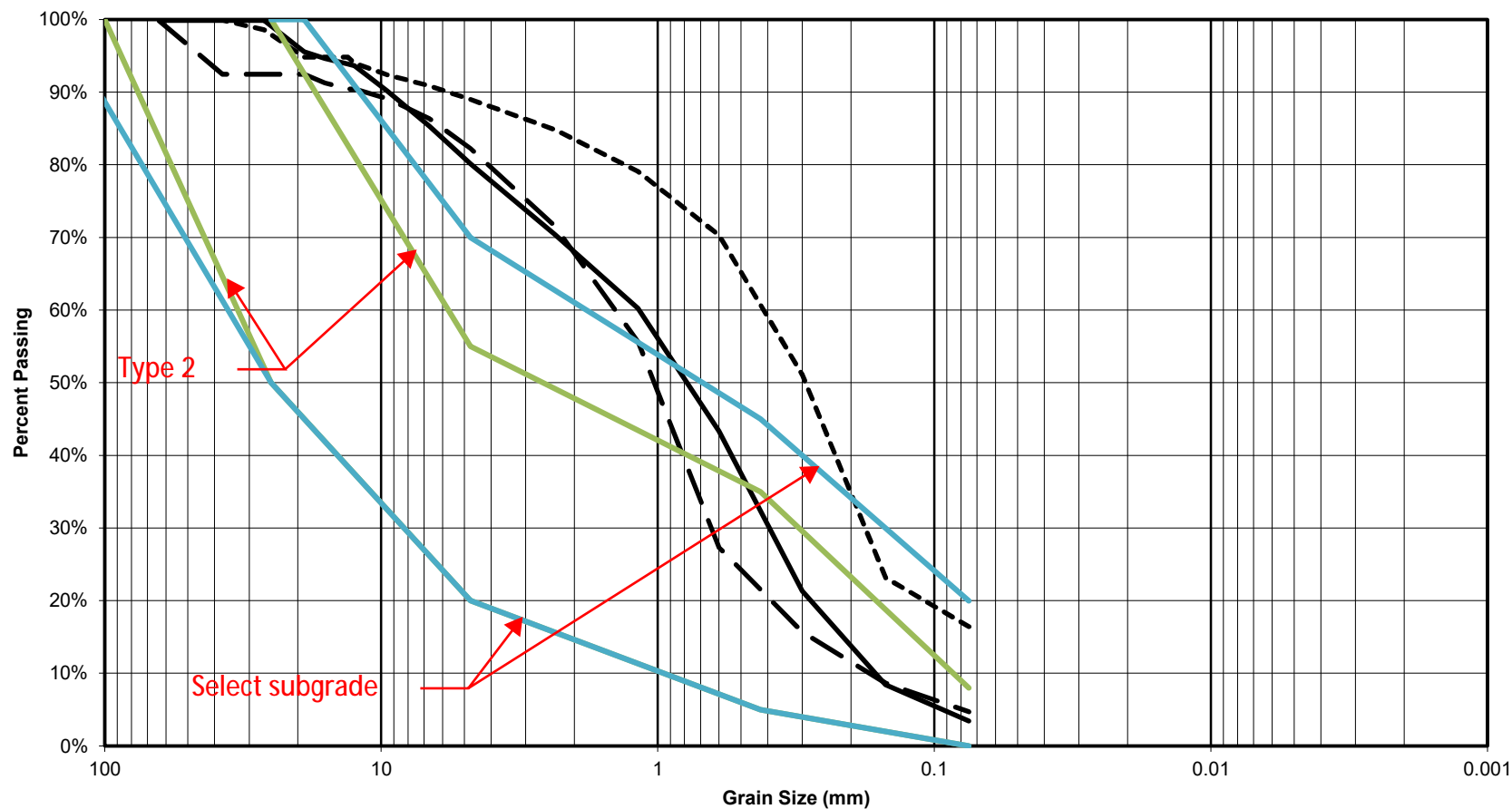
PROJECT NAME New Sewage Lagoon
PROJECT LOCATION Arviat, NU
GROUND ELEVATION n/a
NOTES UTM: 15V 440660 m E 6776909 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			20 40 60 80	20 40 60 80
	Dark brown ROOTMAT/Topsoil -Frequent cobbles and boulders											PL MC LL	20 40 60 80
0.20	Brown poorly graded SAND with silt and gravel -Frequent cobbles and boulders		SP-SM		S1	1.8	20	70	10	12.5			
0.50	Grey silty SAND to silty SAND with gravel -Moderate seepage at 0.2 mbg				S2	2.5	22	59	19	8.2			
1			SM		S3	2.0	10	66	24	10.7			
1.50													
	Test Pit Terminated at 1.5 m - Refusal on permafrost												
2													



Grain Size Analysis

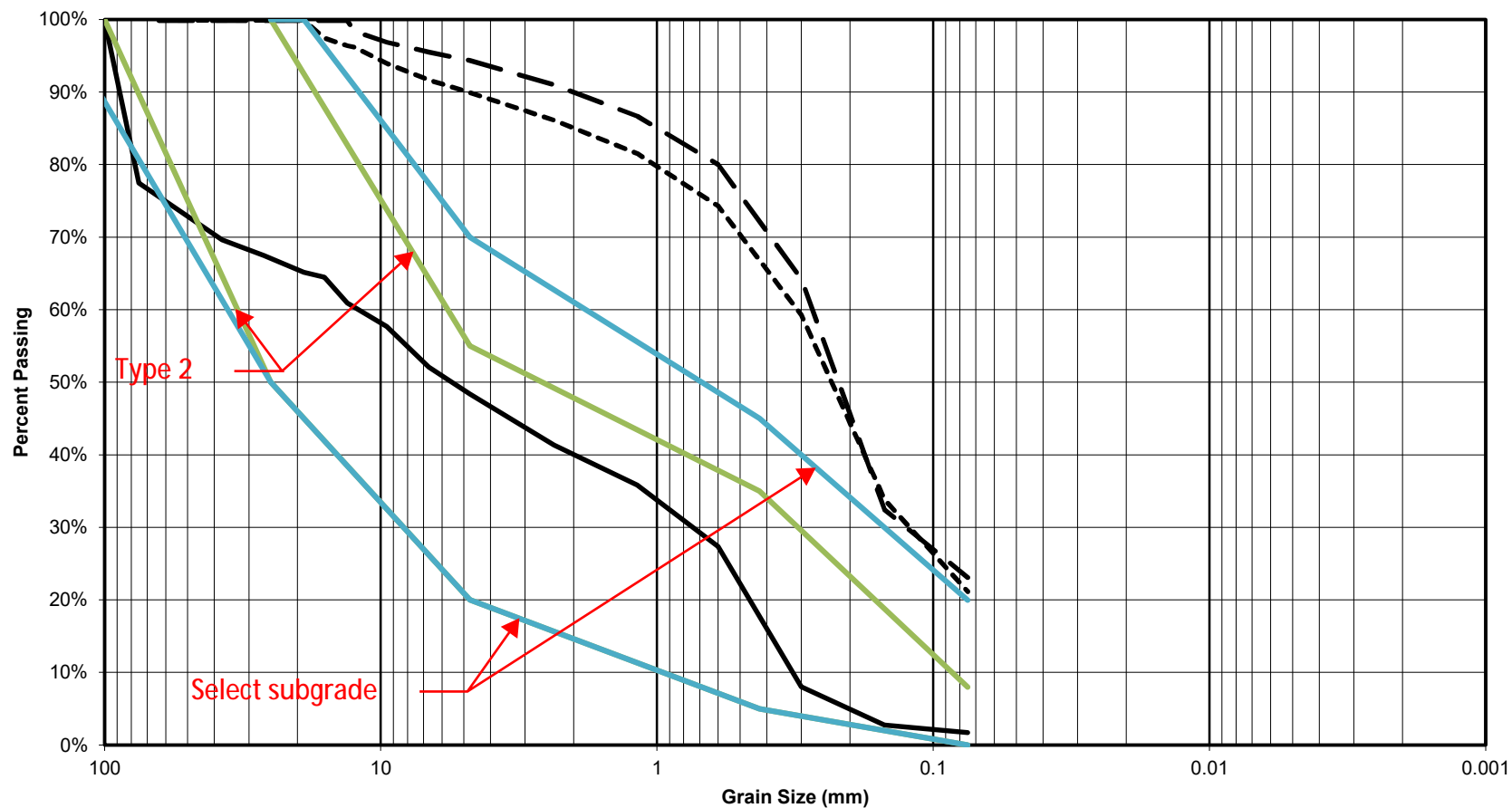
Project: ARV-G2203





Grain Size Analysis

Project: ARV-G2203



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

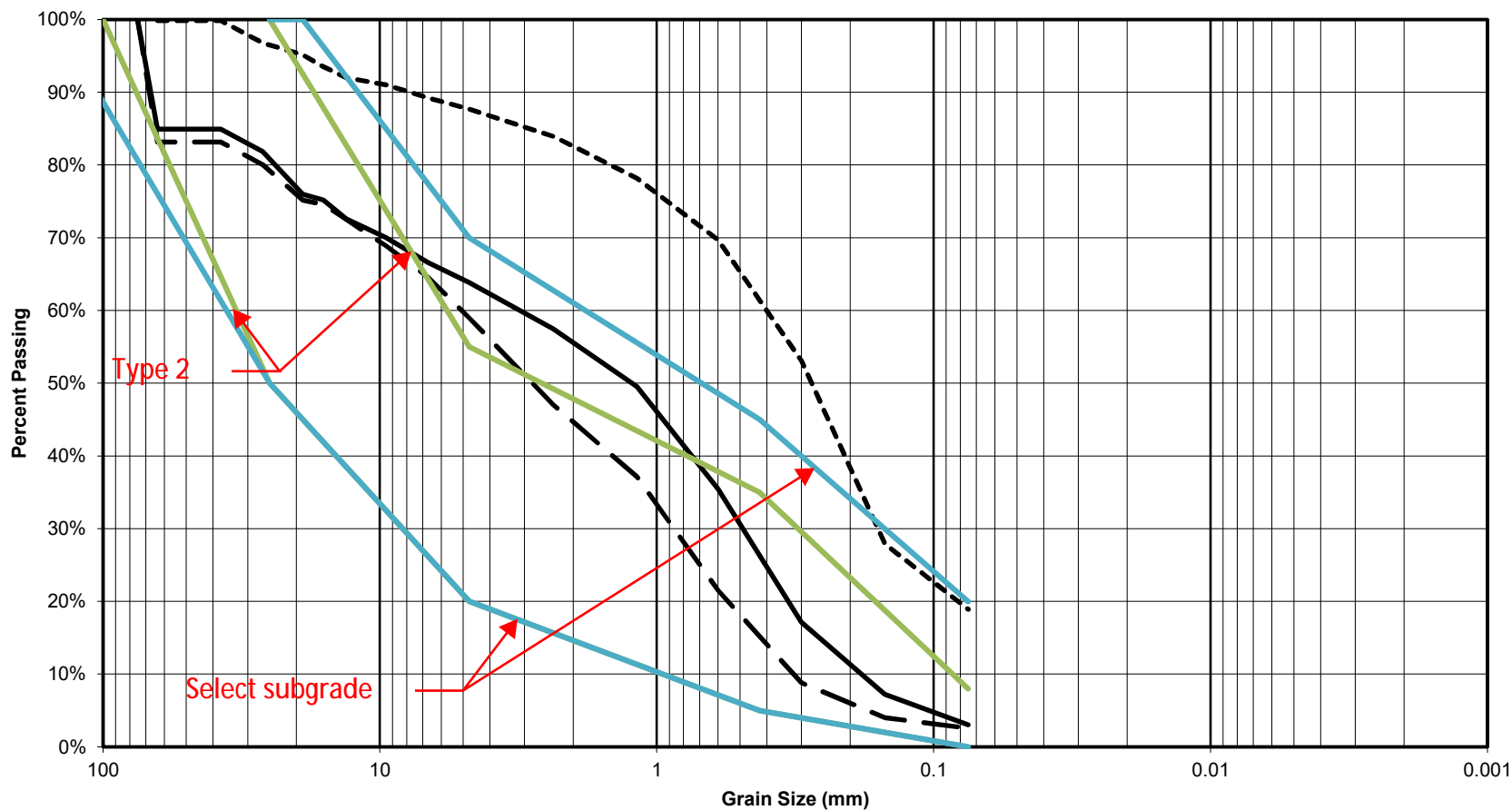
Unified Soil Classification System ASTM D 2487/2488

Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
—	TP-BS2-02	S1	0.2 - 0.3	52%	46%	2%	3.5%	Poorly graded GRAVEL with sand
- -	TP-BS2-02	S2	0.8 - 0.9	6%	71%	23%	8.5%	Silty SAND
----	TP-BS2-02	S3	1.4 - 1.5	10%	69%	21%	11.0%	Silty SAND



Grain Size Analysis

Project: ARV-G2203



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

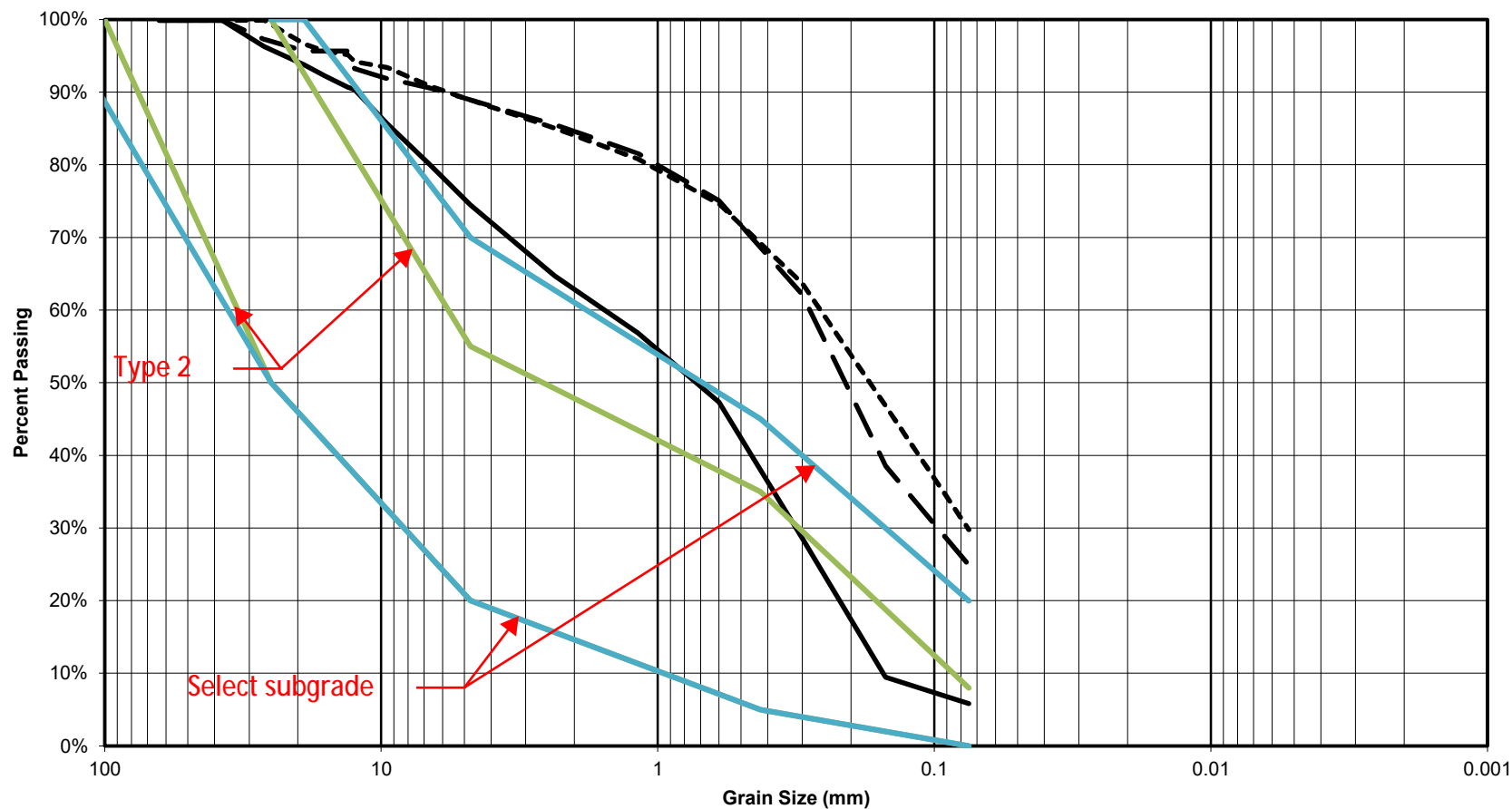
Unified Soil Classification System ASTM D 2487/2488

Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
—	TP-BS2-03	S1	0.3 - 0.4	36%	61%	3%	6.2%	Poorly graded SAND with gravel
- -	TP-BS2-03	S2	0.8 - 0.9	41%	56%	3%	5.5%	Poorly graded SAND with gravel
----	TP-BS2-03	S3	1.5 - 1.6	12%	69%	19%	9.8%	Silty SAND



Grain Size Analysis

Project: ARV-G2203



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

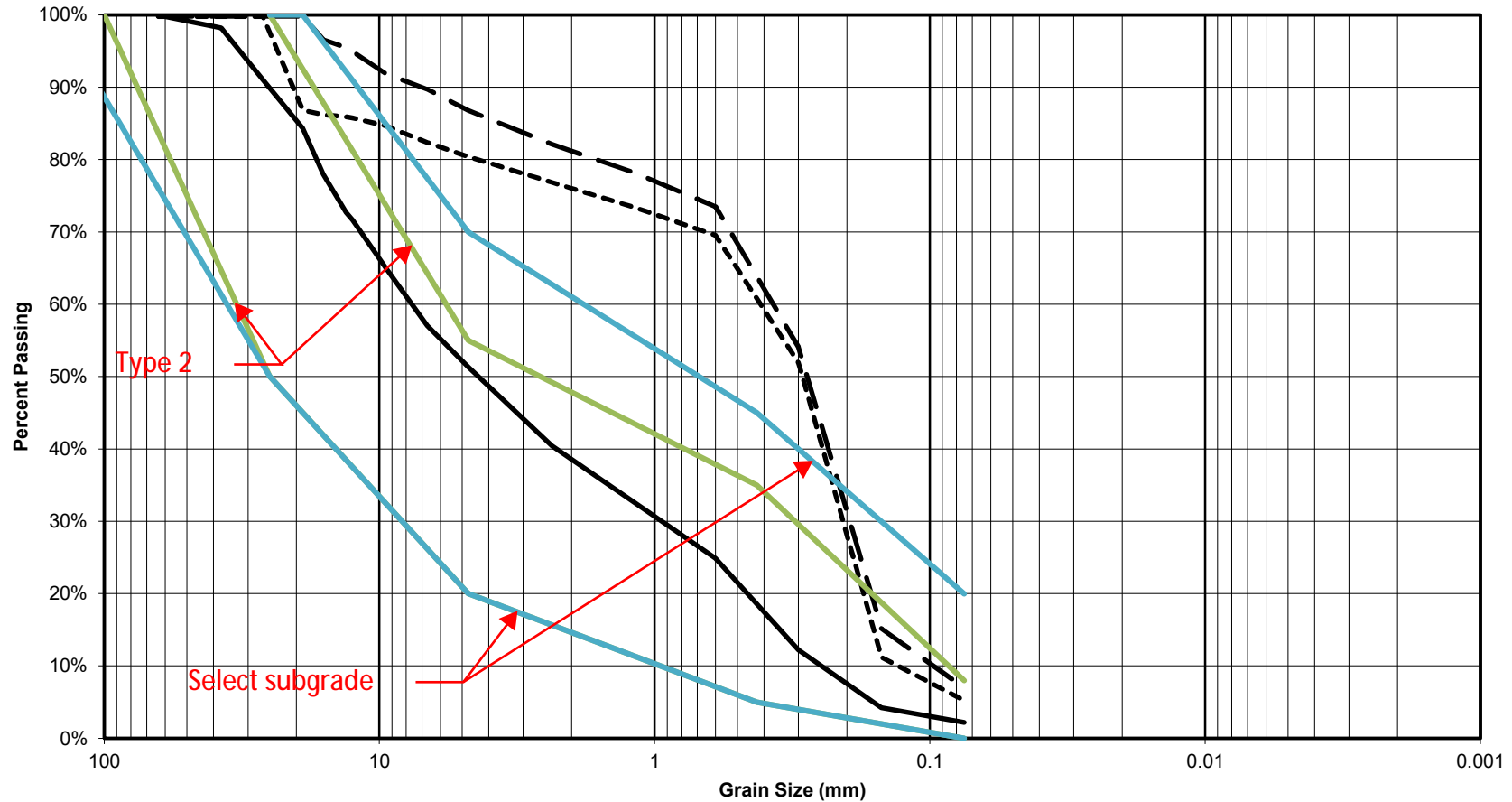
Unified Soil Classification System ASTM D 2487/2488

Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
—	TP-BS2-04	S1	0.2 - 0.3	26%	68%	6%	7.1%	Poorly graded SAND with silt and gravel
- -	TP-BS2-04	S2	0.8 - 0.9	11%	64%	25%	7.6%	Silty SAND
----	TP-BS2-04	S3	1.6 - 1.7	11%	59%	30%	13.5%	Silty SAND



Grain Size Analysis

Project: ARV-G2203



Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
————	TP-BS2-06	S1	0.2 - 0.3	20%	70%	10%	12.5%	Poorly graded SAND with silt and gravel
-- --	TP-BS2-06	S2	0.7 - 0.8	22%	59%	19%	8.2%	Silty SAND with gravel
----	TP-BS2-06	S3	1.3 - 1.4	10%	66%	24%	10.7%	Silty SAND



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