Associated Engineering Alberta Ltd.

Bar U Ranch Workshop Replacement
Bar U Ranch National Historic Site, Municipal District of Foothills, Alberta

Geotechnical Assessment

Submitted by:

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Attention: Mr. Risto Protic, P.Eng.

August 28, 2015
Levelton File # R715-1384-00

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1 INTRODUCTION

Levelton Consultants Ltd. (Levelton) was retained by Associated Engineering Alberta Ltd. (Associated) to complete a geotechnical assessment for the Bar U Ranch Workshop replacement project at the Bar U Ranch National Historic Site in the Municipal District (MD) of Foothills, Alberta. Authorization to proceed was provided by Mr. Risto Protic of Associated on July 29, 2015.

The scope of work for the geotechnical assessment was completed in accordance with our proposal dated July 22, 2015, File No. P715-1787-00, and included the following items:

- Coordination and oversight of a geotechnical field program comprising of two test pits, and logging of soil and groundwater conditions encountered;
- Laboratory soil index testing on selected samples, including: moisture content tests, particle size analyses, and a water soluble sulphate concentration test; and
- Preparation of a geotechnical assessment report summarizing the subsurface ground and groundwater conditions encountered and providing comments and recommendations pertinent to the geotechnical design and construction aspects of the proposed development.

This report supersedes preliminary information that was provided to Associated by email on August 21, 2015, and presents analyzed results of the geotechnical investigation and provides comments and recommendations pertinent to the geotechnical aspects of the proposed development. The use of this report is subject to the *Terms of Reference* outlined in Appendix A, which form an integral part of this report.

A slope of some significance is located on the property. This assessment report does not provide evaluation, comment or recommendations regarding this slope as to how it may impact design or construction of the proposed development. A slope assessment is outside the scope of this project. Levelton can provide a slope assessment upon request.

2 SITE AND PROJECT DESCRIPTION

The project site is located approximately 15 Km south of Longview, Alberta at the Bar U Ranch National Historic Site within the MD of Foothills, Alberta and is bounded by undeveloped land with grass vegetation and an existing gravel road to the north, west and south. A slope with grasses, shrubs, coniferous and deciduous tree vegetation exists to the east. Based on visual observations, the slope angle is approximately 27 degrees (2.0 horizontal to 1.0 vertical) with maximum vertical height of approximately 10 m.

The project site is currently undeveloped and appeared to be relatively level. Surface water was not visible within the project site boundaries during the geotechnical investigation, however, a creek is located approximately 50 m to the northwest of the proposed site developments. It flows in a northwesterly direction.

Based on the information provided, we understand that the proposed site developments will consist of a new one storey workshop structure founded on shallow foundations, an interior concrete slab-on-grade, and a sewage holding tank.

3 INVESTIGATION METHODOLOGY

3.1 GEOTECHNICAL FIELD INVESTIGATION

On August 18, 2015, Levelton oversaw the excavation of two geotechnical test pits (TH15-01 & TH15-02) using rubber tired excavation equipment. The test pit locations were located approximately 5 m outside of the proposed workshop structure footprint and were selected based on our understanding of the proposed developments, excavator accessibility, and existing utility locations. The approximate test pit locations are shown on the Site Plan included in Appendix B, Figure 1. The subsurface conditions were logged as excavation proceeded and soil samples were obtained at selected depth intervals.

Test pit TH15-01 and Test pit TH15-02 were excavated to maximum depths of approximately 2.9 and 2.2 metres below ground surface (mbgs), respectively. Levelton left the project site prior to the test pits being backfilled, with the understanding, based on conversations with personnel from Parks Canada on site, that the test pits would be backfilled with soil cuttings and excess soil cuttings would be stockpiled beside the test pit locations. The soil stratigraphy, sampling sequences, and field and laboratory test results are shown on the Test Pit Records included in Appendix B.

3.2 LABORATORY TESTING

All soil samples obtained during the geotechnical investigation were transported to Levelton's soil and materials testing laboratory in Calgary for further identification, classification and index testing. The index testing program included: moisture content testing (6), particle size analyses (3), and one water soluble sulphate concentration test.

The laboratory test results are discussed within this report, provided on the Test Pit Records in Appendix B, and are attached in Appendix C.

4 SUBSURFACE CONDITIONS

4.1 SUBSURFACE GROUND CONDITIONS

A review of geological mapping[1] of the area in the vicinity of the project site indicated that the subsurface soil conditions were likely to consist of coarse sediments in the form of gravel and sand with minor silt beds. Sedimentary bedrock was expected at depth beneath the native granular soils.

The actual subsurface stratigraphy encountered at the test pit locations from the field and laboratory test results are shown on the Borehole Records included in Appendix B. The soil profile encountered at the discrete test pit locations generally consisted of topsoil, overlying silt and sand, overlying gravel. The Test Pit Records present our interpretation of the materials encountered. It is noted that the subsurface stratigraphy may be variable between test pit locations and across the project site. A description of the subsurface soil strata encountered is provided in the following sections.

[1] Quaternary Geology, Southern Alberta; I. Shetsen; 1987.

4.2 TOPSOIL

Topsoil was encountered at ground surface in both test pits and extended to a depth of approximately 150 mm in both test pits. The specific thickness of topsoil may vary across the site. The topsoil consisted of moist, dark brown, clayey silt, with trace sand and trace organics. The organic portion mostly comprised of rootlets.

4.3 SAND

Sand was encountered in test pit TP15-01 below topsoil and extended to a depth of approximately 1.5 mbgs. The sand was light brown in colour, compact, silty, and contained trace clay and trace to some gravel. Cobbles were encountered at a depth of approximately 1.2 m.

Two moisture content tests were performed on sand samples recovered at selected depths. Moisture content test results of 23.9% and 11.4% were recorded, indicating damp to moist condition.

One particle size analysis was performed on a sand sample collected at a depth range of approximately 0.9 to 1.2 mbgs. The test results indicated that the sample comprised of 1.1% gravel, 59.3% sand, and 39.6% silt and clay.

4.4 SILT

Silt was below topsoil in test pit TP15-02 and extended to a depth of approximately 0.9 mbgs. The silt was light brown in colour, compact, and contained trace clay and trace sand.

Two moisture content tests were performed on silt samples recovered at selected depths. Moisture content test results of 17.6% and 19.2% were recorded, indicating moist condition.

4.5 GRAVEL

Gravel was encountered below sand in test pit TP15-01 and below silt in test pit TP15-02 and extended to the termination depths of the test pits at approximately 2.9 and 2.2 mbgs, respectively. The gravel contained cobbles and was light brown in colour, compact, and contained sand ranging from some sand to sandy, trace clay, and trace silt.

Two moisture content tests were performed on gravel samples recovered at selected depths. Moisture content test results of 6.5% and 7.2% were recorded, indicating moist to wet condition.

Two particle size analyses were performed on gravel samples. The test results are presented in Table 1 below.

Table 1 Particle Size Analysis Test Results – Gravel

Borehole No.	Sample Depth From – To (mbgs)	Gravel Content (%)	Sand Content (%)	Silt/Clay Content (%)
BH14-01	2.1 – 2.4	66.3	26.2	7.5
BH14-02	1.2 – 1.5	58.8	15.9	25.3

4.6 SUBSURFACE GROUNDWATER CONDITIONS

Groundwater was encountered during excavations of TP15-01 and TP15-02 at approximately 2.2 and 1.9 mbgs, respectively. Due to the relatively close proximity of the project site to a creek with flowing water, and considering the permeable nature of the subsurface soils, it is possible that the project site groundwater levels will vary with changes in the creek water levels. Some other variables that may affect groundwater levels include: precipitation, changes in climatic conditions, surface infiltration, neighbouring developments, and puncture of perched water horizons. The evaluation of potential variations in groundwater levels is beyond the scope of this investigation and report.

5 COMMENTS AND RECOMMENDATIONS

This section of the report provides engineering information for the geotechnical design aspects of the project, based on our interpretation of the test pit information from Levelton's geotechnical investigation, review of available information, and on our understanding of the project requirements. The recommendations provided are intended as guidance for planning and design by design engineers and architects. Where comments are made on construction, they are provided to highlight aspects of construction that could affect the design of the project. Parties requiring information beyond the scope or purpose of this report must make their own interpretation of the information provided.

5.1 KEY GEOTECHNICAL ASPECTS

Based on the field and laboratory test results, the key geotechnical aspects for the proposed development can be described as follows:

- The native gravel soil will provide suitable shallow foundation bearing conditions for the proposed workshop structure;
- Excavations into the silt, sand, and gravel will tend to slough and ravel and will not stand steeply in an unsupported manner; therefore excavations deeper than 1.5 m and shallower than 3.0 m will need to be cut back or sloped at an angle at least 45^{o} (1.0 horizontal to 1.0 vertical) measured from the vertical, from the bottom of the excavation. Excavation deeper than 3.0 m will require a slope assessment.
- Groundwater was encountered during test pit excavations at depths of approximately 2.2 and 1.9 mbgs. During wetter times of the year or during spring runoff, the water level may rise. The groundwater level should be maintained a minimum of 0.5 m below excavations at all times.
- The project site is in close proximity to a slope standing at an angle of approximately 27 degrees (1.0 vertical to 2.0 horizontal). The MD of Foothills' Land Use Bylaws pertaining to slope stability and slope setback as this relates to new development should be reviewed. Additional field reviews and geotechnical assessments can be carried out by Levelton for the purpose of establishing safe building sites, relative to potential slope stability hazards.

5.2 GEOTECHNICAL MATERIAL PARAMETERS

Based on the results of the geotechnical field investigation and our experience with similar subsurface conditions, the estimated material parameters presented in Table 2 were developed and used in our geotechnical analysis.

Table 2 Estimated Material Parameters

Subsurface Stratum	In-situ Unit Weight γ (kN/m³)	Submerged Unit Weight γ' (kN/m³)	Undrained Shear Strength (kPa)	Angle of Internal Friction – Drained (°)	Cohesion – Drained (kPa)
Sand, compact	19	10	0	30	0
Silt, compact	19	10	0	27	0
Gravel, compact	20	11	0	33	0

5.3 Frost Penetration Depth and Frost Susceptibility

The near-surface soil units encountered at the site generally consisted of topsoil overlying sand and silt, overlying gravel. The qualitative frost susceptibility of a soil is typically assessed using guidelines developed by Casagrande (1932) on the basis of the percentage by weight of the soil finer than 0.02 mm and its plasticity index. This classification system has been adapted by the U.S. Army Corps of Engineers and the Canadian Foundation Engineering Manual (CFEM)[2]. Soils are classed as F1 through F4 in order of increasing frost susceptibility. The surface soil encountered at the project site is to be classified as a non-frost susceptible soil, Frost Group F3.

The maximum seasonal frost penetration depth was calculated for the near-surface soils using the procedure described in CFEM. A mean freezing index of 1,000°C days was used for the site. The maximum seasonal frost penetration depth is estimated to be approximately 2.0 m. The estimated frost penetration depth assumes a uniform soil type without topsoil and snow cover.

Foundation elements should have a minimum frost protection equivalent to a soil cover of at least 1.7 and 2.0 m for heated and unheated structures, respectively for frost protection purposes. Rigid insulation may be used to provide frost protection equivalent to the required soil cover. Insulation used for frost protection should be placed at a minimum depth of 0.6 m below the finished ground surface and the top 0.6 m of backfill should be ignored for equivalent frost penetration calculation purposes. The surface of the insulation should be sloped such that groundwater contacting the impervious sheets is directed away from the buildings.

5.4 Site Preparation

All existing fill material, vegetation, organic material, topsoil and other deleterious material, where encountered, should be removed from beneath the proposed structure and where engineered fill is needed to bring the project site to final grade. The exposed subgrade should be reviewed by Levelton geotechnical engineering staff prior to placement of any new fill or concrete to confirm suitability for load bearing purposes.

It is recommended that engineered fill, necessary to bring the subject site to design grade consist of in-situ gravel or imported clean, well-graded, granular material. All fill materials must be free of oversized rocks, organics, roots, debris, and other deleterious materials.

Prior to any fill placement, the upper 300 mm of exposed subgrade should be scarified and re-compacted to minimum 98% Standard Proctor Maximum Dry Density (SPMDD) using a large vibratory drum roller. New fill

[2] Canadian Geotechnical Society; Canadian Foundation Engineering Manual, Fourth Edition; 2006

material must not be placed on frozen soil. Fill should be placed in lifts not exceeding 200 mm thickness (loose measure), at a moisture content of 0 to +/-2% of its optimum moisture content for compaction purposes. Each lift should be compacted to at least 98% SPMDD. Moisture conditioning may be required during compaction to achieve the desired density.

5.5 FOUNDATION DESIGN AND CONSTRUCTION CONSIDERATIONS

Shallow foundations in the form of spread and strip footings bearing on native compact gravel are considered suitable for the soil conditions encountered at the project site. A geotechnical bearing resistance at Ultimate Limit States (ULS) for spread and strip foundations bearing on gravel with widths ranging from 0.5 to 1.5 m can be taken as 400 kPa. A resistance factor (ϕ) of 0.5 as per CFEM should be applied to determine the factored bearing resistance at ULS, resulting in a factored bearing resistance at ULS of 200 kPa. When applying the factored ultimate bearing resistance to gravel, total and differential settlements are expected to be within 25 and 20 mm, respectively. Thus, the bearing pressure at Serviceability Limit States (SLS) may be taken as 200 kPa for spread and strip footings bearing on the native compact sandy gravel.

The recommended geotechnical design bearing parameters have been determined for vertical, concentric loading, as described in CFEM. For footings subjected to eccentric loads, the following equivalent footing width shall be used to calculate the design values (i.e. bearing resistance and bearing pressure) of the footing:

$$B' = B - 2e$$
$$L' = L - 2e$$

Where B' is the equivalent footing width; B is the actual footing width; L' is the equivalent footing width, L is the actual footing width, and e is the eccentricity of the load. Effects of inclined loads, if any, shall also be considered as discussed in the CFEM.

Bearing surfaces shall be protected from ingress of free water. Additionally, footings must not be placed on fill, organic, disturbed, or frozen soil. Bearing material that becomes frozen, dried or softened must be removed and replaced with concrete, or the footings shall be extended to reach material in an unaffected condition. It is also essential that the foundation soil not be allowed to freeze after the concrete for footings has been placed.

Levelton should be given the opportunity to review the final design drawings to confirm compliance with the geotechnical report recommendations.

5.6 SLABS ON GRADE

Cast-in-place concrete slabs–on-grade should be placed on native sand or gravel or engineered fill material. Care should be taken to confirm that slab-on-grade structures are not placed over top of organic or topsoil materials.

Levelton recommends to support concrete slabs-on-grade using a levelling course comprising a minimum 150 mm thickness of compacted, well-graded, 25 mm minus crushed gravel or sand placed over properly prepared, competent subgrade soils. The crushed gravel levelling course material should be placed in lifts not exceeding 200 mm in thickness (loose measure) and compacted uniformly to 100% of its SPMDD. The moisture content of the crushed gravel at placement should be within ±3% of its optimum moisture content (OMC) for compaction purposes.

Slabs-on-grade should not be structurally connected to load-bearing walls or columns in order to minimize the potential for damage from differential settlement between these elements.

Where required, slabs-on-grade that are constructed in unheated areas may be frost-protected by using rigid insulation. Design recommendations and details using rigid insulation can be provided upon request.

It is important that the subgrade surface be protected from moisture changes and freezing temperatures both during and after construction in order to minimize the potential of frost heave/thaw and softening action on the subgrade soils.

It should be noted that even for properly compacted engineered fill, consolidation may occur over time which may result in settlement of surface supported structures.

5.7 TEMPORARY EXCAVATIONS AND UTILITY TRENCHES

Temporary excavations at the site should be sloped or shored for worker and foundation protection. Construction must conform to good practice and comply with regulations, such as the Alberta Construction Safety Regulations. According to the Occupational Health and Safety Code Part 32, the sandy gravel soils are to be classified as “soft, sandy or loose soil”; therefore, excavation walls should be sloped at an angle of not less than 45° measured from the vertical, from the bottom of the excavation. Excavations deeper than 3.0 m depths should be subject to a detailed slope assessment to determine minimum slope angles or other means to provide a safe temporary work environment.

Excavations must be protected from rain, snow, or any ingress of free water. Prolonged exposure of excavated areas should be avoided to prevent deterioration of exposed soil with resultant slope instability. Similarly, excavated materials should be stockpiled away from the excavations to avoid slope instability and to prevent materials from falling into excavations. Temporary surcharge loads, such as stockpiles of material or heavy equipment, should be kept back from excavation faces a distance equal to at least one-half the excavation depth.

Based on conditions encountered during excavations, seepage is anticipated in excavations up to approximately 1.8 m. If seepage is encountered during construction, it is anticipated that groundwater may be controlled by sump and pump methods. The groundwater level should be maintained a minimum of 0.5 m below excavation grade at all times.

During construction, the prepared subgrade surface should be shaped to prevent ponding of water on the site. Excess water should not be allowed to pond and should be drained or pumped from within the building footprint and areas subject to surface improvements as quickly as possible.

5.8 SURFACE AND SUBSURFACE DRAINAGE

We understand that the proposed development does not include structures with below grade (basement) levels. Final grading of the site should promote surface water to drain away from any building structures. Site grades should be sloped no less than 2% away from any building structures, for a minimum distance of 3 m.

5.9 SLOPE STABILITY

Based on site observations, the slope located to the east and south of the proposed structure stands at an angle of approximately 27 degrees (2.0 horizontal to 1.0 vertical) at a height of approximately 10 m, above the site grade.

As noted in Section 5.1 above, Levelton can complete a slope stability assessment for the proposed development upon request.

5.10 SEISMIC SITE CLASSIFICATION

Available information was reviewed to assess the seismic classification of the project site. The reviewed information included the Borehole Records, the NBCC and CFEM.

The site classification for Seismic Site Response is provided in Sections 4.1.8.4 of the NBCC and in Chapter 6 of the CFEM and is determined using the Standard Penetration Resistance within the soil profile. Based on the available information, the average ground properties in the upper 30 m at the site are inferred to comprise of stiff soil, corresponding to Class D as per Table 6.1A in CFEM.

For the design earthquake it is unlikely that the soils observed in our field investigation would be subject to liquefaction behavior.

5.11 SULPHATE

One gravel sample was submitted for testing to determine its water soluble sulphate concentration. Results of the test indicated a soluble sulphate concentration of 0.044% which is below the limit for sulphate attack on concrete in contact with the soil (CSA A23.1-09, Table 3). As such, concrete in contact with the site soil does not require special considerations for sulphate exposure.

We note that sulphate concentrations may vary across the project site. In addition, any imported soils should be tested to determine water soluble sulphate concentrations and associated sulphate exposure classification.

6 CLOSURE

This geotechnical assessment has been prepared by Levelton Consultants Ltd. exclusively for Associated Engineering Alberta Ltd. The report reflects our judgement in light of the information available to us at the time when it was prepared. Any use of the report by third parties, or any reliance on or decisions made based on it, are the responsibility of such third parties. Levelton Consultants Ltd. does not accept responsibility for damages suffered, if any, by a third party as a result of their use of this report. The attached Terms of Reference are an integral part of this geotechnical report.

We trust the information contained in this report meets your present requirements. Should you require any inspection services or any further information regarding the geotechnical aspects of this project, please contact the undersigned.

Yours truly,

Levelton Consultants Ltd.

August 28/2015

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28 August 2015

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August 28/2015

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PERMIT TO PRACTICE
LEVELTON CONSULTANTS LTD.
Signature
Date 28 August 2015
APEGA PERMIT
NUMBER: P8696

APPENDIX A
TERMS OF REFERENCE

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LEVELTON

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TERMS OF REFERENCE FOR GEOTECHNICAL REPORTS ISSUED BY LEVELTON CONSULTANTS LTD. (continued)

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b. **Reliance on information**: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site investigation and field review and on the basis of information provided to Levelton. Levelton has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Levelton cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

c. **Additional Involvement by Levelton**: To avoid misunderstandings, Levelton should be retained to assist other professionals to explain relevant engineering findings and to review the geotechnical aspects of the plans, drawings and specifications of other professionals relative to the engineering issues pertaining to the geotechnical consulting services provided by Levelton. To ensure compliance and consistency with the applicable building codes, legislation, regulations, guidelines and generally-accepted practices, Levelton should also be retained to provide field review services during the performance of any related work. Where applicable, it is understood that such field review services must meet or exceed the minimum necessary requirements to ascertain that the work being carried out is in general conformity with the recommendations made by Levelton. Any reduction from the level of services recommended by Levelton will result in Levelton providing qualified opinions regarding adequacy of the work.

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APPENDIX B
SITE PLAN AND TEST PIT RECORDS

C:\HES\Levelton\R715-1384-00 (Bar U Ranch Workshop)\R715-1384-00 site plan v1.00.dwg [FIGURE 1] August 28, 2015 - 9:38:40 am (BY: OWNER)

LEGEND

APPROXIMATE TEST PIT LOCATION

SOURCE: MARSHALL TITTEMORE ARCHTECTS, MARCH 27, 2015

LEVELTON

LEVELTON CONSULTANTS LTD.

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TITLE: Test Pit Location Plan

PROJECT: Bar U Ranch Workshop Replacement
Bar U Ranch National Historic Site
Municipal District of Foothills, Alberta

CLIENT: Associated Engineering Alberta Ltd.

DES. AB	DR. LCH
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APP. DN	DATE Aug. 28, 15
PROJECT NO. R715-1384-00	
FIGURE NO. 1	

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www.levelton.com

Bar U Ranch National Historic Site
Municipal District of Foothills, Alberta
Bar U Ranch Workshop Replacement

TP15-01

Project No: R715-1384-00

Depth (m)	Depth (ft)	Description	C	N	Type	Water Level
		Dark brown, clayey **SILT**, trace sand, trace organics, rootlets, moist **TOPSOIL**			G	
	2	Light brown, compact, silty **SAND**, trace clay, trace gravel, moist			G	
	4	From 1.0 m: damp From 1.2 m: some gravel, cobbles, difficulty excavating			G	
	6	Dark brown, compact, **GRAVEL**, some sand, trace clay, trace silt, cobbles, wet			G	
2	8				G	Aug 18 2015
	10	End of test pit at 2.9 m. Approximately 0.7 m of water in test pit upon completion.			G	
	12					
4	14					
	16					
	18					
6	20					
	22					
	24					
8	26					
	28					
	30					
	32					

10 20 30 40 50 60 70 80 90

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
FP : Fixed Piston
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:

- Moisture Content %
- Plastic Limit %
- Liquid Limit %
- Ground Water Level
- Shear strength in kPa (Torvane or Penetrometer)
- Shear strength in kPa (Unconfined)
- Shear strength in kPa (field vane)
- Remolded strength in kPa
- Percent Passing # 200 sieve

Drill Method: Test Pit
Date Drilled: 18/08/2015
By: AB

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TP15-02

Bar U Ranch National Historic Site
Municipal District of Foothills, Alberta
Bar U Ranch Workshop Replacement

Project No: R715-1384-00

Depth (m)	Depth (ft)	Description	C	N	Type	Water Level
		Dark brown, clayey **SILT**, trace sand, trace organics, rootlets, moist **TOPSOIL**			G	
	2	Light brown, compact, **SILT**, trace clay, trace sand, moist			G	
	4	Light brown, compact, silty **GRAVEL**, some sand, trace clay, cobbles, moist			G	
	6	From 1.5 m: dark brown, sandy, wet			G	
2					G	Aug 18 2015
	8	End of test pit at 2.2 m. Approximately 0.3 m of water in test pit upon completion.				
	10					
	12					
4						
	14					
	16					
	18					
6						
	20					
	22					
	24					
8						
	26					
	28					
	30					
	32					

10 20 30 40 50 60 70 80 90

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
FP : Fixed Piston
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:

- ● Moisture Content %
- ▶ Plastic Limit %
- ◀ Liquid Limit %
- ▼ Ground Water Level
- (X) Shear strength in kPa (Torvane or Penetrometer)
- X Shear strength in kPa (Unconfined)
- ⊗ Shear strength in kPa (field vane)
- ☒ Remolded strength in kPa
- ■ Percent Passing # 200 sieve

Drill Method: Test Pit
Date Drilled: 18/08/2015
By: AB

APPENDIX C
LABORATORY TEST RESULTS

Levelton Consultants Ltd.
6919 32nd Avenue N.W., Calgary, AB
Tel. No. (403) 247-1813, FAX No. (403) 247 - 1814

Sieve Analysis

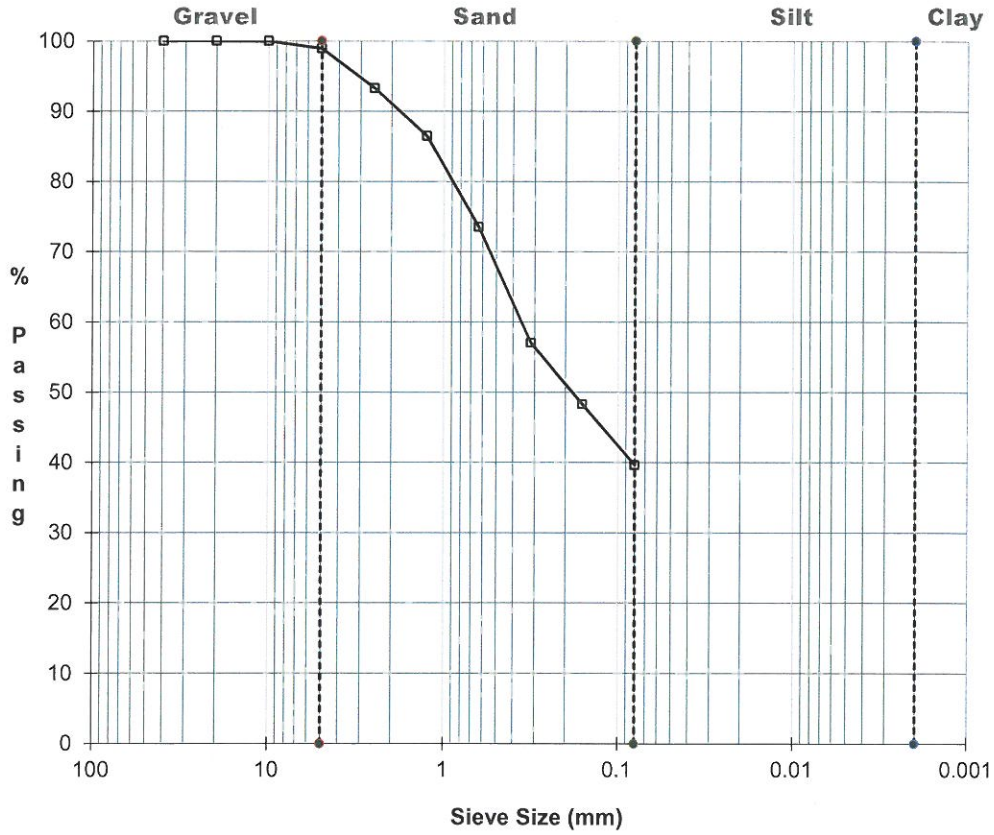
Report Date: Aug. 25, 2015
Project Number: R715-1384-00
TRN: 404

To: Associated Engineering Alberta Ltd.

Project: Bar U Ranch Workshop Replacement

Borehole No. : TP15-01
Sample I.D.: -
Sample Depth: 0.9 - 1.2 m
Sampled By: AB
Tested By LF

August 18, 2015	August 21, 2015	August 18, 2015



Sieve Size (mm)	Percent Passing
40.000	100.0
20.000	100.0
10.000	100.0
5.000	98.9
2.500	93.3
1.250	86.5
0.630	73.5
0.315	57.0
0.160	48.3
0.080	39.6

Gravel	=	1.1
Sand	=	59.3
Silt/Clay	=	39.6

Sample Description: Silty sand, trace clay, trace gravel
Remarks:

Per:

Levelton Consultants Ltd.
6919 32nd Avenue N.W., Calgary, AB
Tel. No. (403) 247-1813, FAX No. (403) 247 - 1814

Sieve Analysis

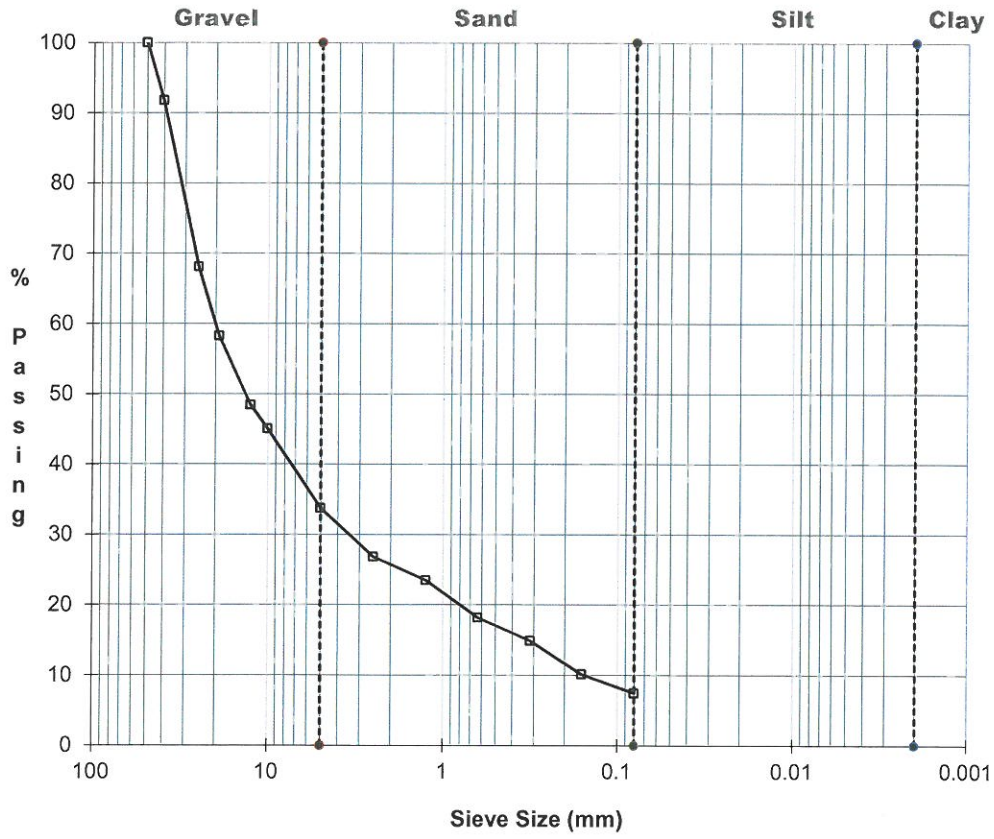
Report Date: Aug. 25, 2015
Project Number: R715-1384-00
TRN: 404

To: Associated Engineering Alberta Ltd.

Project: Bar U Ranch Workshop Replacement

Borehole No. : TP15-01
Sample I.D.: -
Sample Depth: 2.1 - 2.4 m
Sampled By: AB
Tested By LF

August 18, 2015	August 21, 2015	August 18, 2015



Sieve Size (mm)	Percent Passing
50.000	100.0
40.000	91.8
25.000	68.1
19.000	58.3
12.500	48.4
10.000	45.0
5.000	33.7
2.500	26.8
1.250	23.5
0.630	18.2
0.315	14.9
0.160	10.2
0.080	7.5

Gravel	=	66.3
Sand	=	26.2
Silt/Clay	=	7.5

Sample Description: Gravel, some sand, trace silt, trace clay
Remarks:

Per:

Levelton Consultants Ltd.
6919 32nd Avenue N.W., Calgary, AB
Tel. No. (403) 247-1813, FAX No. (403) 247 - 1814

Sieve Analysis

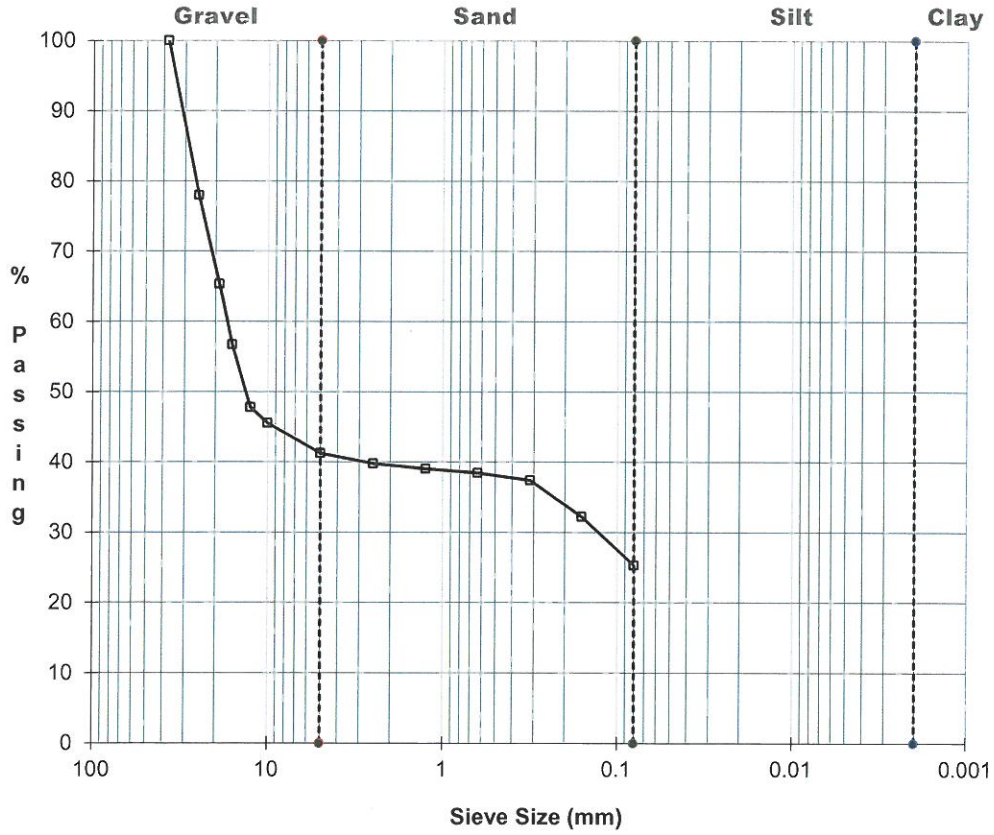
Report Date: Aug. 25, 2015
Project Number: R715-1384-00
TRN: 404

To: Associated Engineering Alberta Ltd.

Project: Bar U Ranch Workshop Replacement

Borehole No. : TP15-02
Sample I.D.: -
Sample Depth: 1.2 - 1.5 m
Sampled By: AB
Tested By LF

August 18, 2015 | August 21, 2015 | August 18, 2015



Sieve Size (mm)	Percent Passing
37.500	100.0
25.000	78.0
19.000	65.3
16.000	56.7
12.500	47.8
10.000	45.6
5.000	41.2
2.500	39.8
1.250	39.0
0.630	38.5
0.315	37.4
0.160	32.2
0.080	25.3
Pan	0.0

Gravel	=	58.8
Sand	=	15.9
Silt/Clay	=	25.3

Sample Description: Silty gravel, some sand, trace clay
Remarks:

Per: