County Council
Budget Meeting
September 15th, 2021

SMOKY LAKE COUNTY

AGENDA: County Council **Budget Meeting** to be held on
Thursday, September 15th, 2021, at 9:00 A.M.,
in the County Council Chambers, Smoky Lake.

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1. **Meeting:**

   Call to Order.

2. **Agenda:**

   Acceptance of Agenda: As presented or subject to additions and/or deletions.

3. **Request for Direction:**

   3.1 2022 Budget Guidelines. ©

4. **Issues for Information:**

   4.1 Bridge Priorities

5. **Correspondence:**

   No Correspondence.

6. **Delegation(s):**

   6.1 Jen Plamondon, P.Eng., Project Engineer, Associated Engineering Alberta Ltd. 9:30am

7. **Executive Session:**

   No Executive Session.

Date and Time of Next Meeting:

Adjournment:

Backgrounder Sheet for Council Discussion or Direction	DATE	September 15, 2022 3.1

SUBJECT *Discussion Topic*	2022 Budget Guidelines

BACKGROUND

DEFINE THE TOPIC

Key Information
Key summary of existing information to understand the nature of the topic.

Policy 08-11-01 provides the guidelines for the budget process. The first step in budget creation is to get an understanding of Council's expectations for 2022 and future years. Below is the budget from the 5 yr financial plan.

Revenues	2021	2022
Sales of goods and services	940,563	959,375
Government transfers for operating	729,477	734,948
Investment income	285,100	290,802
Penalties and costs of taxes	74,095	75,577
Licenses and permits	30,000	30,600
Special levies and taxes	246,345	251,272
Natural Gas	2,691,744	2,830,079
Total Revenues	4,997,324	5,172,653
Expenses		
Legislative	512,218	522,462
Administration	2,393,867	1,799,744
Other Government Services	613,193	136,017
Protective Services	953,372	1,004,222
Transportation	6,649,284	6,730,071
Water/Sewer	572,524	583,974
Waste	693,563	591,389
FCSS	116,635	116,749
Planning	299,547	325,537
Agriculture Service Board	882,492	896,646
Economic Development	107,500	133,650
Recreation & Cultural Services	463,878	473,156
Natural Gas	2,796,744	2,852,679
Contingency	35,288	8,594
Total Expenses	17,090,105	16,174,890
Net Revenue (Expense) before reserve transfers	-12,092,781	-11,002,237
Net Transfer To/From Op Reserves	1,582,000	-231,000
Reverse Amortization	2,289,800	2,335,596
Net Operating Revenue (Expense)	-8,220,981	-8,897,641
Non Operating Items:		
Net Contribution to Capital	2,600,463	4,987,104
Net Transfer To - From Reserves	-1,212,713	-979,077
Financing /Debt Repayment	0	-1,000,000
Total Cash Requirements (for tax bylaw)	**9,608,731**	**11,905,668**

	These costs will need to be adjusted for a higher cost of living (3-4%). As well, there is a substantial increase in the capital funding required. ©1 For the past several years, we have been pushing capital purchases off to the next year. This has created an accumulation of capital on the list for 2022. In 2021, Smoky Lake County had Solid Earth Geotechnical conduct a study of the roads. The final report was presented to council earlier this summer, however a copy has been attached for easy reference. ©2 Attached is the road plan that was previously approved for 2022 with notes regarding some of the changes that will be incorporated. ©3 Council will need to discuss the study results and come to a census with how the County should proceed. Project forms will also be provided at the meeting for Council members to complete and submit for budget addition. Provincial changes expected are: ✓ Policing cost increase from $95.621 to $127,404 ✓ Decrease in MSI ✓ GIL should remain the same ✓ No increases to the operating grants (agriculture, fcss, etc.) Items that need to be discussed are: ❖ **Expected changes to service levels** ❖ **Cost of Living increase and upcoming negotiations for salaries (council may want to go into executive session)** ❖ **The policies that council would like reviewed with budget implications.** ❖ **Council projects for the five year road plan** ❖ **The Municipal Tax Rate** ✓ **Proposed assessment changes** ❖ **Funding major commitments currently under discussion** ✓ **Building capital repairs $1,600,000** These guidelines along with the strategic plan and meetings will be used to compile the five year road plan, capital budget, and operating budget, and the five year financial plan.
Relevant Observations *Note issues or opportunities related to the complexity of the topic.*	➢ The Canadian CPI as at July is 3.7% and for Alberta it is 3.7%. ➢ Residential assessment is based on market value as at July 2021. We would estimate that overall the residential assessment to experience another increase. ➢ Non-residential, industrial, machinery/equipment, and linear assessments continue to be a concern. These assessments have continually decreased over the years. Even if new oil and gas activity takes place in the county, it will not generate tax revenue for at least three years.

	➢ Contracts with CUPE will be negotiated this fall. We are asking council for an estimate to incorporate into the budget. ➢ Thus far, in 2021, Council has not directed any changes to services or programing, however, there have been discussions and concerns raised. If Council is thinking of changes, now is the time to look at how they will affect the budget.
Strategic Questions	There are many factors that will affect the 2022-2026 budgets. The guidelines provided by council today will be used as a starting point to build a plan and budget for 2022, 2023, 2024, 2025, and 2016. In order to meet MGA requirements, an interim budget must be approved before the Christmas break. In April, once we have the final assessment numbers and the school requisitions, we will be able to provide what will be the final budget for 2022 and then produce a 5 year plan.
Essential Question .	Council needs to answer these questions: ❖ **What are the priorities in the five year road plan? Council is asked to complete the attached capital sheets for any requested road projects.** ❖ **What changes does council expect in programming/services? (mowing, snow removal, shared services, planning department, ect)** ❖ **What is the expected outcome of union negotiations?** ❖ **Which Policies does Council wish to review?** ❖ **How will we fund building capital repairs recommended in the assessment $1,600,000©4** ❖ **How should we plan considering the Assessment uncertainty?**

DETERMINE DESIRED OUTCOMES

Key Result	2022 Budget and Five Year Financial Plan
Desired Benefits of Key Result	• The budget will be aligned with council priorities • The organization will know what tax increases are or are not required to balance • The County will be prepared with plans should further grants become available • The County will have a better sense of financial direction
Prerequisites	• Administration will hold several meetings to discuss capital and operating budgets • Council will provide administration with requests

	for capital purchases and road projects • Council and administration will have meetings throughout October, November, and December to prepare and adopt the 3 year road plan, Five year capital budget, and 2021 total function budget • Final meetings will be held in April to review budget changes and to set the tax rate for 2021
Unintended Outcomes	• Provincial changes, Union negotiations are examples of how the budget can change and be influenced • Expectations and guidelines may have to be changed to provide a balanced budget.

RESPONSE OPTIONS

Council to provide

1. Project requests
2. Service change requests
3. Specific costing research requests (e.g. purchase gavel vs mining)

CHIEF ADMINISTRATIVE OFFICER	

Appendix 2: Capital Budget

Smoky Lake County 2021 Capital Budget							
Dept		Budget 2021	Budget 2022	Budget 2023	Budget 2024	Budget 2025	
ADMIN	ADMIN BUILDING RESERVE			50,000	50,000	50,000	
ADMIN	BUILDING REPAIRS	857,000	1,600,000				2021 MSI 650,000 res 207,000
ADMIN	AERIAL PHOTOS RESERVE-remove	0	15,000	15,000	15,000	0	
ADMIN	AERIAL PHOTOS PURCH					80,000	$60,000 from reserves
ADMIN	FINANCE SOFTWARE	280,000					from reserves
ADMIN	HERITAGE SIGNS	15,000	15,000	15,000	15,000	15,000	
PS	FIRE EQUIPMENT REPLACEMENT RESERVE-rem	0	10,000	10,000	10,000	10,000	
PS	FIRE TRUCK RESERVE-remove in 2021	0	125,000	125,000	125,000	125,000	cost of PS vehicle average is $125,000/year
PS	FIRE BUILDING RESERVE-removed in 2021	0	75,000	75,000	75,000	75,000	
PS	REPLACE 403 WASK FIRE TRUCK			500,000			*500,000 from reserve
PS	REPLACE 407 SMOKY LAKE RESCUE TRUCK			205,000			* 205,000 from reserve
PS	REPLACE 445 SMOKY LAKE WATER TRUCK				130,000		* 130,000 from reserve
PS	REPLACE 222 TRUCK (ED) - Traverse	50,000					sell for $5,000, MSI
PS	REPLACE 221 ATV FOR BYLAW		19,890				
PS	RAPID ATTACK 6X6 UNIT W TRAILER	38,500					from reserve
PS	EQUIPMENT STORAGE SL	240,000					from reserve
PS	EQUIPMENT STORAGE WASK		15,000				
PW	REPLACE TRUCK 101 1/2 ton	45,000		61,950			sell truck $10,000/MSI
PW	REPLACE TRUCK 107 removed in 2021	0	65,000				sell current truck $1,000
PW	NEW DUMP TRAILER	17,000					sell unit 141 $1,000
PW	REPLACE 190 DUMP TRUCK SANDER/PLOW	355,000					sell unit for $20,000
PW	REPLACE 198 TRUCK	190,000					sell current truck $30,000
so so	GRADER REPLACEMENT 507 (160)	570,000	577,320	590,000	750,000	612,000	450000 from MSI sale 130,000
0	REPLACE 196 GRAVELTRAILER	65,000					sell current for
PW	REPLACE 633 TRACTOR	220,000					sell for $20,000/ 175,000 fr res
PW	WOBBLY PACKER removed in 2021	0	33,000	33,000	33,000		
PW	2 WASH BAY OVERHEAD DOORS	25,000					
PW	REPLACE TRUCK 108 PLOW TRUCK		95,000				
PW	PLOW FOR 108 REPLACEMENT		12,000				
PW	REPLACE TRUCK 105 SKID STEER CREW TRUCK		70,000				
PW	REPLACE EXCAVATOR 627		500,000				
PW	REPLACE 180 TRUCK		220,000				
PW	REPLACE TRUCK 104			60,112			
PW	REPLACE TRUCK 110 MECHANIC SERVICE TRUCK			61,285			
PW	REPLACE 114 STREET SWEEPER (JOINT)			124,800			currently $45,000 in reserves
PW	REPLACE 109 CREW TRUCK			62,000			
PW	REPLACE TRUCK 119			62,000			
PW	REPLACE TRUCK 122 CREW TRUCK			62,000			
PW	REPLACE 155 OIL TRUCK			169,950			
PW	REPLACE 111 BELLY DUMP			63,000			
PW	REPLACE 197 TRUCK			195,840			
PW	REPLACE 623 FORKLIFT			10,302			
PW	REPLACE 608 ROCK TRUCK			510,880			
PW				46,800			
PW	REPLACE 638 CAT COMPACTOR			187,200			
PW	REPLACE 164 PRESSURE WASHER			15,600			
PW	REPLACE 136 TRAILER			36,400			
PW	REPLACE 195 DUMP TRUCK SANDER/PLOW			360,000			
PW	REPLACE 194 OIL TRUCK				170,000		
PW	REPLACE TRUCK 115CREW TRUCK				61,000		
PW	REPLACE 170 TRUCK				175,000		

Smoky Lake County
2021 Capital Budget

Dept		Budget 2021	Budget 2022	Budget 2023	Budget 2024	Budget 2025	
PW	REPLACE 188 FIFTH WHEEL TRUCK				199,680		
PW	REPLACE 603 CAT RECLAIMER				520,000		*154,000 from
PW	REPLACE 602 BACKHOE LOADER				131,250		
PW	REPLACE 609 ROCK TRUCK				511,000		
PW	REPLACE 102 PICKUP TRUCK					60,000	
PW	REPLACE TRUCK 116 CREW TRUCK					61,285	
PW	REPLACE CREW TRUCK 117				61,880		
PW	RR130 WIDENING ANALYSIS	57,000					
PW	Blade for Truck	12,000					
W	REPLACE TRUCK 226	45,000					* sale 1,500/MSI
W	REPLACE TRUCK 239		50,490				
W	REPLACE TRUCK 227			50,985			
WASTE	REPLACE TRUCK 112 GARBAGE - lease for 12 months	0					
WASTE	GARBAGE TRUCK RESERVE TRANSFER		45,000	45,000	45,000	45,000	
WASTE	FENCE SPEDDEN TRANSFER SITE	4,200					* reserve
WASTE	TAKE IT OR LEAVE IT SHACK W OIL CONTAIN - VILNA	3,600					*reserve 1800 Vilna pay 50%
WASTE	TAKE IT OR LEAVE IT SHACK W OIL CONTAIN - BELLIS	3,600					* reserve
WASTE	TAKE IT OR LEAVE IT SHACK SPEDDEN	4,600					* reserve
WASTE	WASTE BIN			5,000	5,000	5,000	
AG	SELL SPRAY TRUCK - keep for 2021						
AG	REPLACE 455 JOHN DEER TRACTOR	150,000					* from MSI/sale
AG	REPLACE 454 TRAILER			12,137			
P&R	REPLACE 726				57,750		
P&R	SHOWER HOUSE					300,000	** try to get 50% grant
P&R	PIER		12,000				
P&R	TRAILER		11,000				
P&R	PLAYGROUND HANMORE WEST			25,000			*Grant $25,000
P&R	BEAR PROOF GARBAGE BINS 2x PER YEAR		2,500	2,500	2,500		
P&R	MONS LAKE RETAINING WALL/BEACH CARRYOVER	20,000					*20,000 from reserve
P&R	REPLACE MOWER		17,340	17,510			
P&R	PAKAN EMERGENCY BOAT LAUNCH CONCRETE (carr	13,000					
P&R	WARSPITE EMERGENCY BOAT LAUNCH (carry over)	25,000					
PW	PW CREW TRUCK (carry over)	40,000					
ADMIN	NUISANCE GROUND RECLAMATION	93,213					
MUNICIPAL CAPITAL		3,438,713	3,585,540	3,866,251	3,143,060	1,438,285	
GAS	INFRASTUCTURE LINE REPLACEMENT	50,000	50,000	50,000	50,000	50,000	
GAS	RMO STATION REPLACEMENT PLAN RESERVE	70,000		70,000		70,000	
GAS	RMO STATION REPLACEMENT PLAN		140,000		140,000		* 70,000 from reserve
GAS	MODEMS FOR RMO	22,000	22,000	22,000			* from reserve
GAS	POLESHED FOR PIPE	45,000					* from reserve
GAS	REPLACE TRUCK	65,000		66,000	67,000	68,000	* from reserve
GAS	REPLACE 233 TRAILER				16,619		
GAS	NEW TRUCK BOX	13,000		8,500	8,500	8,500	* from reserve
GAS	REPLACE AMR READING EQUIPM	5,000					
GAS	CARRY OVER RMO STATION PROJECT						
GAS CAPITAL		270,000	212,000	216,500	282,119	196,500	
TOTAL CAPITAL (2019 = $2,834,172)		3,708,713	3,797,540	4,082,751	3,425,179	1,634,785	
BRIDGE PROJECTS		602,000	3,082,434	508,000	38,000	1,400,000	
ROAD		1,893,000	2,040,758	2,122,212	2,164,656	2,207,949	
		6,203,713	8,920,732	6,712,963	5,627,835	5,242,734	

GEOTECHNICAL INVESTIGATION

Various County Road Failures
Smoky Lake County, Alberta

Prepared for:

Smoky Lake County

Date:

16 July 2021

Project File #: PG21-1575

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Table of Contents

Page

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation conducted for various county road failures within Smoky Lake County, Alberta. The work was carried out by SolidEarth Geotechnical Inc. (SolidEarth) at the authorization of Mr. Gene Sobolewski (CAO), C.E.T. of Smoky Lake County (County).

2.0 PROJECT BACKGROUND AND SCOPE OF WORK

Based on information provided to SolidEarth, it was understood that 14 sections of various county roads are exhibiting signs of distress and failure. The alignments that were considered for this investigation were as follows:

- Alignment 1 – Range Road (RR) 200, 200 m south of Township Road (TWP) 602
- Alignment 2 – TWP 600, 600 m west of RR192
- Alignment 3 – TWP 600, 700 m west of RR191
- Alignment 4 – RR185, 300 m south of TWP 594
- Alignment 5 – TWP 592, 400 m east of RR180
- Alignment 6 – TWP 592, 100 m west of RR174
- Alignment 7 – RR175, 1,600 m south of TWP 590
- Alignment 8 – RR175, 2,400 m south of TWP 590
- Alignment 9 – TWP 584, 1,000 m east of RR175
- Alignment 10 – RR171, 50 m north of TWP 590
- Alignment 11 – RR171, 100 m south of TWP 592
- Alignment 12 – RR130, 800 m south of TWP 602
- Alignment 13 – RR130, 600 m north of TWP 604
- Alignment 14 – RR130, 700 m north of TWP 610

The purpose of the investigation was to assess the existing conditions of the subgrade at selected locations within each alignment, provide recommendations for subgrade rehabilitation requirements, and determine the required gravel pavement structure.

The scope of work completed by SolidEarth included drilling two to three boreholes within each alignment, conducting laboratory review and testing on recovered soil samples, undertaking geotechnical engineering analysis, and preparation of this report.

3.0 SITE DESCRIPTION

The roads were generally gravel surfaced with a few alignments surfaced with cold mix asphalt. The roads were generally elevated above the surrounding grades, and shallow side ditches were present along the majority of the roadway alignments. The roadway alignments were generally surrounded by agricultural lands.

The roadway alignments showed various degrees of deterioration (rutting in the wheel path, exposed organics within the subgrade, and fatigue cracking in cold mix surfaced areas). Ponding water was observed on the road surfaces (generally in the ruts). Some of the distressed sections were in areas were the surround topography was a low lying area.

A key plan showing the approximate location of the alignments on a 2020 aerial photograph is presented as Figure 1. Photographs showing site conditions that existed at the time of the field investigation are presented in Appendix A.

4.0 FIELD AND LABORATORY INVESTIGATION

4.1 GROUND DISTURBANCE AND SAFETY PERFORMANCE

Prior to field drilling, a SolidEarth representative completed internal ground disturbance procedures, which included placing Alberta One Calls. Before starting onsite work, a field level hazard assessment was conducted by the SolidEarth representative and was communicated with all workers involved during the tailgate meeting. The field work was completed without any near misses or incidents.

4.2 FIELD INVESTIGATION

SolidEarth subcontracted All Service Drilling of Nisku, Alberta to drill the boreholes. Drilling was completed using a truck-mounted auger drill rig utilizing 150 mm solid-stem continuous flight augers.

The field investigation was undertaken between 9 and 11 June 2021 and consisted of drilling a total of 38 boreholes along the selected alignments. The boreholes were generally drilled to an approximate depth of between 2.3 and 3.8 m below the existing road surface. Generally, two to three boreholes were advanced within each alignment, depending on field observations and findings.

The borehole locations were selected and marked in the field by SolidEarth based on project limits, conditions of the roadway, location of underground utilities, and traffic safety considerations. The borehole location plans on 2020 aerial photographs are presented as Figures 2 and 3.

During drilling, soil samples were collected at approximately 0.75 m intervals along the depth of the boreholes. Pocket penetrometer testing was conducted on selected cohesive soil samples to obtain an indication of the unconfined compressive strength of disturbed soil samples from the auger. Standard Penetration Tests (SPT) were conducted at selected depths within the boreholes (typically every 1.5 m) to assess the in-situ strength of the soils encountered. The soil sampling and testing sequences are shown on the borehole logs, Appendix B.

A SolidEarth geotechnical technologist monitored the drilling operations and logged the recovered soil samples from the auger cuttings and SPT samples. The soils were logged according to the Modified Unified Soil Classification System, which is described in the Explanation of Terms and Symbols in Appendix B. Due to the method by which the soil cuttings were returned to surface, the depths noted on the borehole logs may vary by ± 0.3 m from those recorded.

The lateral coordinates (northing and easting) of the borehole locations were recorded by the SolidEarth representative using a hand-held GPS unit. These coordinates are shown on the borehole logs, Appendix B.

Groundwater seepage conditions were monitored during and immediately following completion of drilling. All boreholes were backfilled with drill cuttings and capped with bentonite/rapid set concrete. No standpipes piezometers were installed at the borehole locations.

4.3 LABORATORY INVESTIGATION

All collected soil samples were submitted to the laboratory for further examination and testing. Laboratory testing on soil samples included visual examination and determination of the natural moisture content on all collected samples; Atterbergs limits, and grain size distribution tests on selected samples. The results of the soil laboratory testing are presented in the borehole logs.

5.0 SUBSURFACE CONDITIONS

The subsurface stratigraphy encountered at the borehole locations along the alignments generally consisted of roadway surfacing material followed by clay fill, followed by organic soil or buried organics, and underlain by clay till/clay. Sand was encountered at a few borehole locations.

A summary of the subsurface conditions encountered at each borehole location is summarized in Table 1. A brief description of the subsurface materials encountered at the borehole locations is presented below. A detailed description of the subsurface conditions encountered at each borehole location is provided on the corresponding borehole logs.

Roadway Surfacing Material

Gravel surfacing was encountered at the surface at most borehole locations. Cold mix asphalt underlain by gravel was encountered at a few borehole locations. The best estimate of the thickness of the cold mix asphalt and the gravel at each borehole location is shown on the borehole logs and is summarized in Table 1.

The approximate thickness of the cold mix asphalt ranged between 25 and 110 mm. The approximate thickness of the gravel ranged between 25 and 250 mm. Due to the drilling method used in the investigation (auger drilling), the exact thickness of the cold mix asphalt and the gravel layer could not be accurately determined as the soils were ground and mixed by the auger during drilling. Additionally, the quality of the gravel base material was variable and included high contents of sands and fines (silt and clay sizes), making it difficult to identify the interface between this material and the clayey soil below it.

Clay Fill

Clay fill was encountered below the roadway surfacing material at all of the borehole locations except at the locations of BH21-10A and -10B where sand fill was encountered. The approximate thickness and quality of the fill at each borehole locations are summarized in Table 1.

The clay fill contained organics of varying degree and was heterogeneous at the majority of the borehole locations. At a few locations, the upper portion of the fill was mineral in composition, while the bottom portion was heterogeneous. It should be noted that the thickness and quality of the fill along the alignments may vary from what was encountered at the borehole locations.

The clay fill was generally classified as "clay, and sand to sandy, and silt to silty, trace gravel", was medium plastic and grey-brown to black. The moisture content of the mineral fill ranged between 11 and 20 percent, with an average of 15 percent. The moisture content of the heterogeneous fill ranged between 11 and 30 percent, with an average of 19 percent.

Liquid and plastic limits of clay fill samples were in the order of 27 to 39 percent and 10 to 19 percent, respectively. Based on comparison with the plastic limit of the soil, it was expected that the average moisture content of the mineral clay fill was generally near the moisture content of the soil, while the average moisture content of the heterogeneous clay fill was higher than the optimum moisture content of the soil.

The consistency of the clay fill was assessed based on the SPT "N" and pocket penetrometer values to be generally firm to stiff.

Sand

Sand (fill and/or native) was encountered below the roadway surfacing materials at a few borehole locations. The sand was generally classified as "sand, some silt, trace to some clay", was poorly graded, fine grained, brown, and wet. The density of the sand was assessed based on the SPT "N" values to be loose.

Organic Soil and Buried Peat

Organic soil and/or buried peat were encountered below the fill at borehole locations within Alignments 1, 2, 4, 5, 6, 12 and 14. The majority of the organic soils were generally encountered at approximate depths ranging between 200 and 750 mm below the underside of the roadway surfacing material (and deeper at a couple of borehole locations).

The organic soil was generally classified as "clay, and sand to sandy, and silt to silty", was low to medium plastic, black, and wet. The approximate thickness of the organic soil ranged between 100 and 600 mm. The moisture content of the organic soil ranged between 24 and 53 percent, with an average of 33 percent. Liquid and plastic limits of two organic soil samples were in the order of 25 and 39 percent, and 16 and 22 percent, respectively. Based on comparison with the plastic limits of the soil, the average moisture content of the organic clay was much higher than the optimum moisture content of the soil. The consistency of the organic soil was assessed based on the SPT "N" values to be generally firm to stiff.

Buried peat was encountered at the locations of BH21-04A, -12C and -14A. The approximate thickness of peat ranged between 300 and 1,800 mm. The peat was generally classified as "highly decomposed, black" and was wet.

It should be noted that the thickness and locations of organic soil and/or buried peat along the alignments may vary from what was encountered at the borehole locations.

Clay Till and Clay

Clay or clay till was generally encountered below the fill or organic soil at all borehole locations and extended beyond the borehole exploration depths. The clay till was generally classified as "clay, and sand, silty to and silt, trace gravel", was medium plastic, grey-brown, and moist to very moist.

The moisture content of the clay till soils ranged between 13 and 29 percent, with an average of 19 percent. Liquid and plastic limits of samples of the clay till were in the order of 35 percent, and 10 to 15 percent, respectively. Based on comparison with the plastic limit, it was expected that the average moisture content of the clay till was near to or slightly higher than the optimum moisture content of the soil. The consistency of the clay till was assessed based on the SPT "N" and pocket penetrometer values to be generally firm.

The clay was generally classified as "clay, and sand, and silty", was brown, and very moist to wet. The moisture content of the clay ranged between 14 and 35 percent, with an average of 26 percent. The consistency of the clay was assessed based on a SPT "N" value to be firm.

Groundwater Conditions

As mentioned in Section 4.2, standpipe piezometers were not installed at the borehole locations as the boreholes were drilled within the roadway alignments. Standpipes with stickups could not be installed as they would have created a traffic safety hazard and flush mounted casing would have been destroyed by traffic and road maintenance operations.

All boreholes were dry at completion of drilling. The groundwater levels are expected to fluctuate seasonally depending upon several factors that include the local geology, hydrogeology, and surface infiltration. Based on field observations, a relatively shallow groundwater table was anticipated at most borehole locations.

6.0 GEOTECHNICAL ANALYSIS AND RECOMMENDATIONS

It was understood that the rehabilitation may include regrading and establishment of the side ditches, reconstruction of the road subgrade, and placement of the gravel pavement structure.

6.1 ROAD MATERIALS

6.1.1 Thickness of the Surfacing Layer

The thickness of the gravel layer at each borehole location is summarized in Table 1. With the exception of Alignment #10, the thickness of the gravel surfacing layer was generally less than 150 mm, and as low as 25 to 50 mm at a few borehole locations.

6.1.2 Subgrade Material, Moisture, and Strength

The existing near surface subgrade soils encountered at the borehole locations generally consisted of clay fill followed, by organic soil or buried organics, and underlain by clay till/clay. The clay fill contained organics of varying degrees and was generally heterogeneous at most borehole locations. The heterogeneous clay fill of the road subgrades was considered poor material for subgrade support.

The approximate separation between the underside of the roadway surfacing material (top of subgrade) and the top of the organic soil or buried organics at the borehole locations ranged between approximately 200 and 750 mm. Generally, where organic soils were present, the separation between the gravel and top of the organic soil was minimal.

The moisture content of the mineral portion of the clay fill was generally near to its optimum moisture content. The moisture content of the heterogeneous portion of the clay fill was higher

than the optimum moisture content of the soil. The moisture content of the organic soil was generally very high.

The consistency of the near surface clay fill and the organic clays was assessed to be firm to stiff based on SPT "N" and pocket penetrometer values.

Given the above, weak subgrade conditions generally existed along the alignments, particularly where near surface heterogeneous clay fill and buried organic soils were present.

6.1.3 Frost Susceptibility of Subgrade Soils

Frost heave of the subgrade soils is generally related to the particle size distribution of the soils, moisture content, and the presence of a relatively shallow groundwater table. The near surface soils encountered along the alignments were generally of medium plasticity. The grain size distribution of these soils generally consisted of approximately 4 to 24 percent by weight of clay size particles with the remaining portions as silt and sand size particles. Overall, the near surface soils were generally considered to be moderate to highly susceptible to frost heaving and formation of ice lenses in the presence of water.

The average moisture content of the near surface clayey soils was generally higher than the optimum moisture content of the soil. No long-term groundwater measurements were completed, as all of the boreholes were backfilled following drilling. However, as indicated earlier, a generally shallow groundwater table was anticipated at most borehole locations.

Given the above, and with proper drainage and surface water management, the risk of frost heaving and formation of ice lenses was considered to be generally high. It is to be noted that poor surface drainage leading to water inundating the subgrade soils will significantly increase the risk levels.

6.1.4 Overall Assessment

Based on the findings at the borehole locations, it was assessed that:

- The thickness of the gravel surfacing layer was generally less than 150 mm, and as low as 25 to 50 mm at a few locations. An exception to this was Alignment #10.
- The near surface clay fill subgrade encountered at the borehole locations contained varying degrees of organics and was generally heterogeneous, with moisture content higher than its optimum moisture content. The heterogeneous subgrade was generally weak and wet.
- Where organic soils were present below the road subgrade, generally low separation was noted between the top of the organic soil and underside of the gravel (generally between 200 and 750 mm).

- The subgrade soils were considered to be highly susceptibility to frost heaving and the formation of ice lenses. Weakening of the subgrade during freeze/thaw seasons should be anticipated.

6.2 CONSIDERATIONS FOR ROADWAY REHABILITATION

6.2.1 Rehabilitation Options and Requirements

Based on the subsurface conditions encountered at the boreholes, the road failures were considered predominantly due to subgrade failure and could be attributed to a combination of the following:

- Weak and wet near surface subgrade.
- Low separation between the top of the organic weak soils (where encountered) and roadway subgrade.
- High susceptibility of the subgrade to frost heaving and formation of ice lenses, resulting in wakening of the subgrade during freeze/thaw seasons.

Three main options may be considered to rehabilitate the portions of the alignment exhibiting distress, including: (i) subgrade improvement and/or modification, (ii) raising the roadway grade by placement of grade raising mineral fill, and (iii) increasing the thickness of the granular layer. Each of these options is discussed below.

Option 1: Subgrade Improvement and/or Modification

Subgrade improvement and modification may include: (a) sub-cutting the existing subgrade, replacing the poor soil with mineral fill, air drying the excavated wet mineral soils, and re-building the subgrade as engineered fill; or (b) cement stabilization of the subgrade. This option is considered a long-term solution.

Sub-excavating into and disturbing the existing fill and organics may result in softening and significant disturbance of the subgrade. Based on the findings at the borehole locations, this option will likely require extensive earthworks effort and was considered less attractive and is not recommend by SolidEarth for Alignments #1 to 11. This option, however, may be considered for Alignments 12 to 14.

It is to be noted, that the near surface subgrade was considered sensitive to disturbance by heavy rubber-tire construction equipment. Construction traffic on the unprotected subgrade should be kept to a minimum and restricted to low pressure track equipment to the extent possible. The use of heavy rubber-tire equipment (such as rock trucks) during construction will likely lead to significant disturbance to the subgrade and should be avoided to the extent possible.

To avoid sub-excavating into the subgrade and to reduce the risk of softening and significant disturbance of the subgrade, cement stabilization may be considered as part of subgrade modification. The general practice for cement stabilization is to mix the soil with 5 to 7 percent by weight of Type GU cement (General Use Hydraulic Cement). As such, to create a 250 to 300 mm thick layer, it is recommended to mix the soils with 25 to 30 kg of cement per square metre of finished surface. The required water content of the matrix after mixing and prior to compaction should generally be between optimum and 3 percent above the optimum moisture content of the soil.

The stabilized soils should be compacted to a minimum of 98 percent of SPMDD. The compaction should be initiated as soon as practical after mixing but not more than 60 minutes from start of mixing.

It is recommended that a laboratory trial mix be completed prior to initiating construction activities. This will help refine the amount of cement required and the optimal moisture content of the mix to achieve the desired strength.

Cement stabilization of the subgrade may be attractive and economical where rehabilitation of some sections are required and where significant earthworks are not ideal.

It is recommended that following achievement of design rough grades and prior to placement of grade raising fill, the subgrade should be inspected by the geotechnical engineer. The inspection may include a proof-roll test to confirm that deflections from construction traffic are minimal. Soft and weak areas identified during inspection, should be strengthened and improved.

Option 2: Raising the Roadway Grades

This option involves the placement of grade raising mineral fill above the existing roadway subgrade. This will increase the separation above the poor soils and will lead to mineral soil placed as engineered fill in the near surface roadway subgrade. This option is considered a long-term solution.

In general, it is recommended to maintain a minimum of 0.6 to 0.9 m of dry mineral clay fill between the final subgrade and top of any weak/wet layer or buried organic soils (if encountered). Excavating test-pits along the portions of the roadway alignment where buried organics were identified may be beneficial to further delineate the lateral and vertical extent of those soils, and to confirm the extent and thickness of grade raising fill required. All grade-raising fill should be placed and compacted as engineered fill. Requirements for engineered fill are discussed below.

Based on the findings at the borehole locations, this option may be considered for all alignments and is recommend for Alignments #1 to 11.

It is recommended that following achievement of design rough grades the exposed subgrade should be inspected by the geotechnical engineer. The inspection may include a proof-roll test to confirm that deflections from construction traffic are minimal. Soft and weak areas identified during inspection, should be strengthened and improved.

Option 3: Increasing the Thickness of the Granular Layer

This option involves the placement of additional gravel above the existing roadway surface. This will increase the separation above the poor soils and will increase the roadway structure. With this option, minimal subgrade preparation and grade modification will be required.

This option is considered a short-term fix only. It may be considered for portions of the alignments where only minor to moderate distress are encountered. This option is not anticipated to be affective in areas with severe rutting and subgrade softening.

6.2.2 Requirements of Engineered Fill

All fill placed on site (from scarifying and re-compacting or imported material) should be placed as engineered fill. Engineered fill should consist of low to medium plastic clay or a well-graded granular material. Silt or sand which is uniformly graded, or which contains more than 10 percent passing the 0.080 mm sieve are not recommended as these materials are generally frost susceptible and are difficult to compact (require strict control of moisture content). All fill soils should be free from any organic materials, contamination, deleterious construction debris, and stones greater than 150 mm in diameter.

The mineral low to medium plastic clayey soils encountered at the borehole locations generally appeared suitable for re-use as engineered fill. Very moist soils need to be moisture conditioned before being used as engineered fill. Soil containing organics should be discarded and not re-used as engineered fill.

Engineered fill should be thawed and placed during non-frozen conditions. If winter construction is proposed, SolidEarth can provide additional recommendations at the time and once the overall development plan has been finalized.

All engineered fill should be compacted to a minimum of 95 percent of SPMDD. The standard of compaction should be increased to 98 percent of SPMDD for the upper 300 mm of the subgrade soil (below the underside of the granular base). This preparation and compaction should occur over the entire width of the roadways at the same time, as this would aid in creating a more competent subgrade for the pavement structure.

The engineered fill should be compacted in maximum lift thicknesses of 300 mm (loose), and within two percent of the optimum moisture content of the soil. Fill placement procedures and quality of the fill soils should be monitored by geotechnical personnel on a full-time basis. Field monitoring should include compaction testing at regular frequencies.

6.2.3 Surface Water Management Considerations

Provision of uniform and adequate grades for surface water drainage is potentially the most important design element for establishing long term stable pavement structures for roads. To minimize the potential for water ponding and seepage leading to saturation and degradation of the subgrade (during and following construction), a minimum grade of two percent is recommended at the subgrade level (cross slope or crowning the center of the road). The final pavement grade should also be adequately sloped to accommodate surface water runoff.

It is recommended that the gravel base be allowed to drain (day-lighted) into the side ditches so that any accumulated water within the base gravel will be allowed to drain away and not pond on top of the subgrade.

Positive drainage away from the road surface is particularly important during the spring thaw and snow melt season. If water from melting snow is allowed to remain on the road surface and subsequently freezes, significant damage to the road surface (and formation of potholes) may be encountered.

6.3 RECOMMENDED GRAVEL STRUCTURE

Recommendations presented above regarding subgrade preparation and inspection should be followed. The recommendations provided in this section were based on having a stable subgrade below the pavement structures. It was also assumed that only highway legal traffic will be allowed on the new pavement structures.

No traffic count or forecast was available at the time of preparation of this report. As such, the recommended pavement sections provided below were based on an assumed traffic loading. It was also assumed that the gravel pavement section will have a 10 year design life.

Two options are provided for the gravel pavement based on design traffic loading of $2.5x10^4$ (light duty) and $1x10^5$ (heavy duty) Equivalent Single Axle Load (ESAL). The recommended pavement sections were based on an expected subgrade Resilient Modulus of 25 to 30 MPa.

The minimum recommended gravel structure is 250 and 400 mm for light and heavy duty traffic, respecively. The gravel should consist of 20 mm Crushed Surfacing Aggregate, as defined by Alberta Transportation, Designation 4 Class 20. The recommendations were based on the AASHTO method for gravel road design assuming the following:

- The allowable serviceability loss (ASL) assumed as 15 kPa.
- The allowable rutting depth assumed as 25 mm.
- Gravel base elastic modulus (EBS) was assumed as 210 MPa.

Thinner gravel sections could be used, but such sections may experience greater distress (frequency and severity) compared to that which is recommended. It should be recognized that periodic maintenance, which would include the placement of additional lifts of gravel, may be required.

Alternate gravel gradation may be acceptable and should be submitted to the geotechnical engineer for review and approval. The granular course (20 mm material) should be placed in maximum 150 mm thick lifts and uniformly compacted to a minimum of 100 percent of SPMDD at moisture contents within two percent of the optimum moisture content of the soil. Reduced lift thicknesses may be required depending on the ability of the compaction equipment available to achieve the required densities.

7.0 TESTING AND INSPECTION

Recommendations presented in this report may not be valid if adequate engineering inspection and testing programs during construction are not implemented. Testing and inspection programs would consist of full-time monitoring and compaction testing during site grading and fill placement.

8.0 CLOSURE

The recommendations presented in this report were based on the results of soil sampling and testing at 38 borehole locations within 14 roadway alignments. Soil conditions by nature can vary across any given site. If different soil conditions are encountered at subsequent phases of this project, SolidEarth should be notified immediately and given the opportunity to evaluate the situation and provide additional recommendations as necessary.

The recommendations presented in this report should not be used for another site or for a different application at the same site. If the intended application of the site is changed or if the assumptions outlined in this report become invalid, SolidEarth should be notified and given the opportunity to assess if the recommendations presented should be modified.

This report has been prepared for the exclusive use of the Smoky Lake County and their authorized users for the specific application outlined in this report. No other warranties expressed or implied are provided. This report has been prepared within generally accepted geotechnical engineering practices.

Respectfully submitted,
SolidEarth Geotechnical Inc.

PROFESSIONAL ENGINEER INDRANIL DEYSARKAR ALBERTA

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2021-07-16

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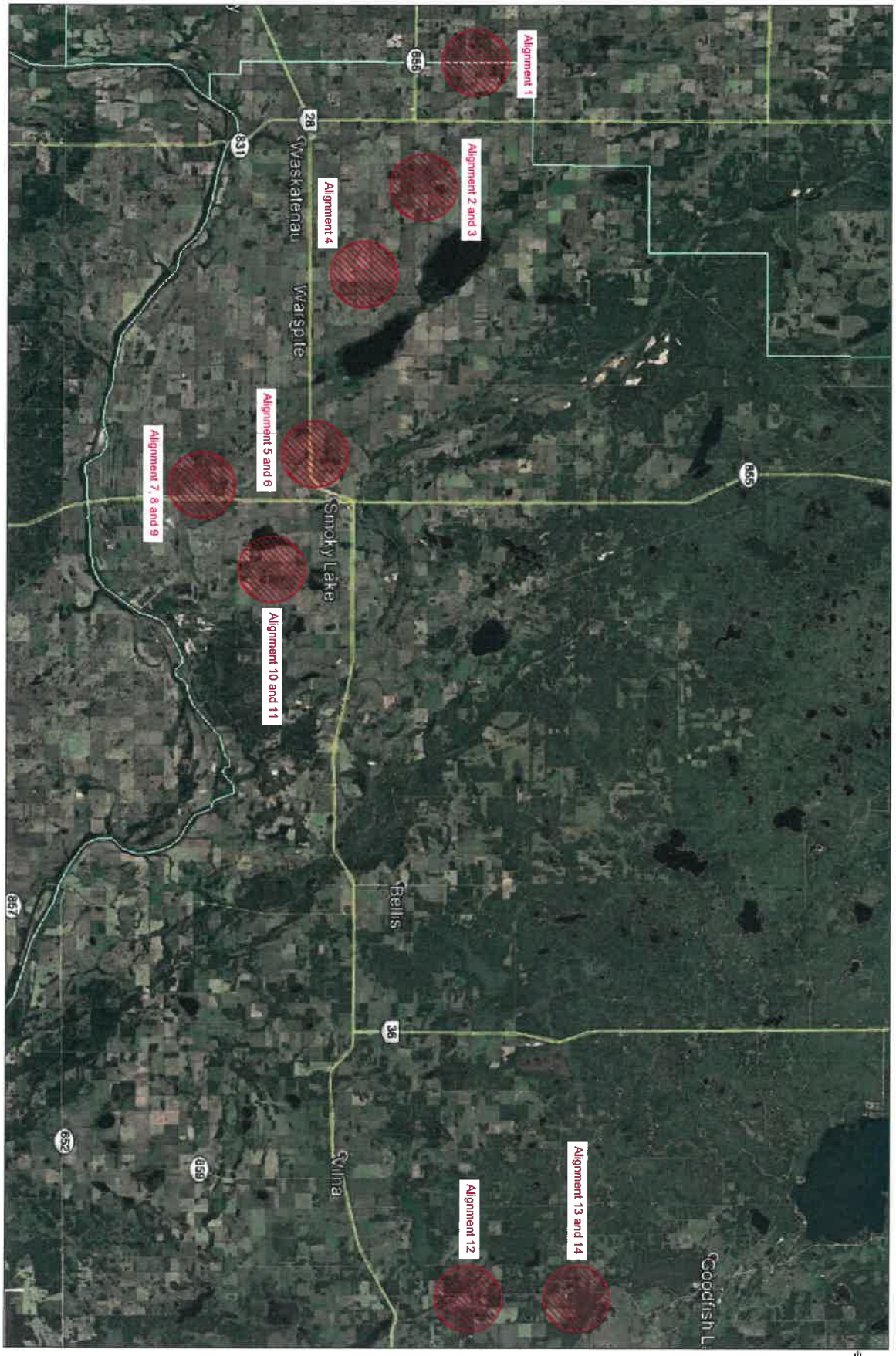
APEGA Permit Number 11884

2021-07-16 ID#: 78563

Figures



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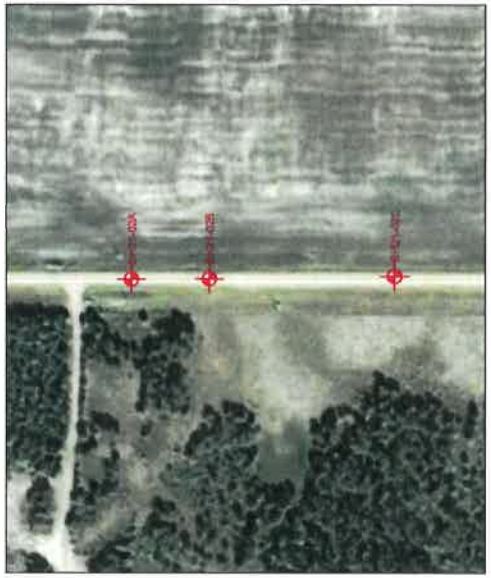
DATUM: -	DATE: June 2021	PROJECT No.: PG21-1552			
SolidEarth Geotechnical Inc. #105, 4604 50 Street, Cold Lake, AB, T9M 1S6		SolidEarth GEOTECHNICAL		DRAWING TITLE: Key Plan on a 2020 Aerial Photograph	

Alignment 1 (RR 200)



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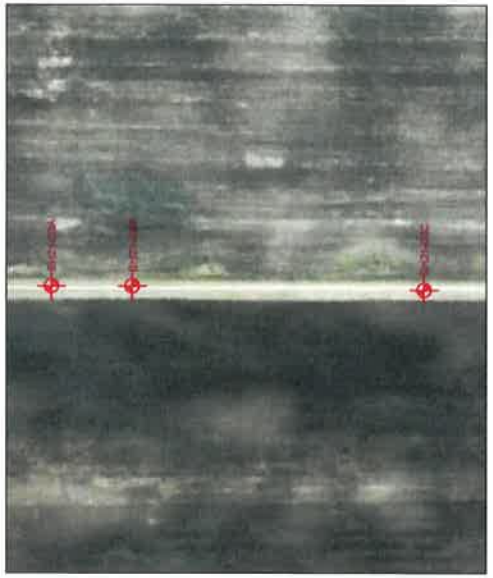

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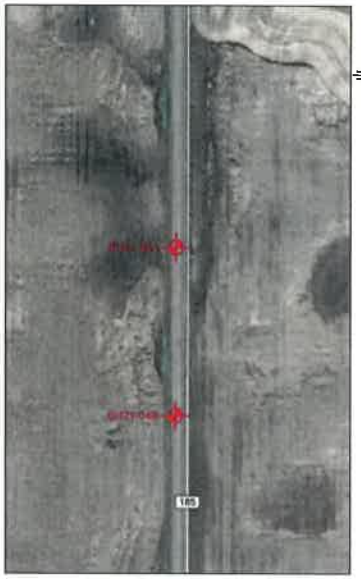

Alignment 4 (RR 185)

Alignment 5 (TWP 592)

Alignment 6 (TWP 592)

Alignment 7 (RR 175)

Alignment 8 (RR 175)

CLIENT: Smoky Lake County

PROJECT NAME: Roadway Failure Investigation
Smoky Lake County, Alberta

DRAWING TITLE: Borehole Location Plans on Aerial Photographs

SCALE:	DRAWN BY:	FIGURE No.:	REVISION No.:
NTS	MH	2	0
DATUM:	DATE:	PROJECT No.:	
-	June 2021	PG21-1575	

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SCALE: NTS	DRAWN BY: MH		
DATUM: -	DATE: June 2021	PROJECT No.: PG21-1575	
		FIGURE No.: 3	REVISION No.: 0

SolidEarth Geotechnical Inc.
#105, 4604 50 Street, Cold Lake, AB, T9M 1S6

PROJECT NAME: Roadway Failure Investigation
Smoky Lake County, Alberta

DRAWING TITLE: Borehole Location Plans on Aerial Photographs

CLIENT:

Tables

Table 1: Summary of Subsurface Soil Conditions

Table 1. Summary of Subsurface Soil Conditions

Alignment No.	BH No.	Roadway Surfacing Material		Subsurface Material					Comments
		Cold Mix Asphalt	Gravel	Layer 1 (Embankment Fill)		Layer 2 (Buried Organic Soil)		Layer 3 (Native Clay/Sand)	
		Thickness (mm)	Thickness (mm)	Thickness (mm)	Description	Thickness (mm)	Description	Description	
1	BH21-01A	-	100	200	Clay mixed with organics (heterogeneous), very moist	500	Organic silt, firm, wet	Clay till, moist	Poor road subrade (clay mixed with organics) Low seperation above organic soil
	BH21-01B	-	150	450	Clay mixed with organics (heterogeneous), firm, very moist	-	-	Clay till, very moist	Poor road subrade (clay mixed with organics)
	BH21-01C	-	125	500	Clay, mineral, some organics, stiff, moist to very moist	500	Organic clay, wet	Clay till, firm, very moist	
2	BH21-02A	-	125	200	Clay mixed with organics (heterogeneous), moist	200	Organic clay, wet	Clay till, firm to stiff, very moist	Poor road subrade (clay mixed with organics) Low seperation above organic soil
	BH21-02B	-	75	400	Clay, mineral, some organics, moist	400	Organic clay, stiff, very moist	Clay till, firm, very moist	Low seperation above organic soil Very thin granular layer
	BH21-02C	-	25	300	Clay mixed with organics (heterogeneous), moist	200	Organic clay, very moist	Clay till with interbedded wet sand, firm, very moist	Poor road subrade (clay mixed with organics) Low seperation above organic soil Very thin granular layer
3	BH21-03A	-	150	350	Clay, mineral, some organics, moist	-	-	Clay till, firm, very moist	
	BH21-03B	-	125	200	Clay mixed with organics (heterogeneous), moist	-	-	Moist sand followed by firm and moist to very moist clay till	Poor road subrade (clay mixed with organics)
	BH21-03C	-	150	450	Clay mixed with organics (heterogeneous), moist	-	-	Stiff and moist clay till, followed by very moist sand and clay mix, underlain by very moist clay	Poor road subrade (clay mixed with organics)
4	BH21-04A	-	175	300	Clay mixed with organics (heterogeneous), moist	300	Peat, highly decomposed	Clay till, firm, moist to very moist	Poor road subrade (clay mixed with organics) Low seperation above burid organics
	BH21-04B	-	225	300	Clay mixed with organics (heterogeneous), moist	-	-	Clay till, firm, very moist	Poor road subrade (clay mixed with organics)
	BH21-05A	-	75	400	Clay mixed with organics (heterogeneous), moist	600	Organic clay, stiff, wet	Firm and very moist clay, underlain by moist clay till	Poor road subrade (clay mixed with organics) Low seperation above organic soil Very thin granular layer

Alignment No.	BH No.	Roadway Surfacing Material		Subsurface Material						Comments
		Cold Mix Asphalt	Gravel	Layer 1 (Embankment Fill)		Layer 2 (Buried Organic Soil)		Layer 3 (Native Clay/Sand)		
		Thickness (mm)	Thickness (mm)	Thickness (mm)	Description	Thickness (mm)	Description	Description		
5	BH21-05B	-	125	400	Clay mixed with organics (heterogeneous), moist	-	-	Clay till, firm, moist to very moist		Poor road subrade (clay mixed with organics)
	BH21-05C	65	-	500	Clay mixed with organics (heterogeneous), moist	-	-	Clay till, stiff to firm, moist to very moist		Poor road subrade (clay mixed with organics) Very thin granular layer
6	BH21-06A	-	125	400	Clay, mineral, some organics, moist	-	-	Clay till, firm, wet		Lower part of road subrade was poor (clay mixed with organics)
				400	Clay mixed with organics (heterogeneous), moist to very moist					
	BH21-06B	-	125	400	Clay, mineral, trace organics, moist	600	Organic clay, stiff, wet	Clay till, wet to moist		Low seperation above organic soil
	BH21-06C	-	125	400	Clay mixed with organics (heterogeneous), moist	600	Organic clay, stiff, wet	Clay till, stiff, moist		Poor road subrade (clay mixed with organics) Low seperation above organic soil
7	BH21-07A	-	75	700	Clay mixed with organics (heterogeneous), firm, very moist	-	-	Clay till, firm, moist to very moist		Poor road subrade (clay mixed with organics) Very thin granular layer
	BH21-07B	-	50	750	Clay mixed with organics (heterogeneous), firm, moist to very moist	-	-	Clay till, firm, very moist		Poor road subrade (clay mixed with organics) Very thin granular layer
8	BH21-08A	-	150	150	Clay, mineral, some organics, moist	-	-	Clay till, stiff, wet		Lower part of road subrade was poor (clay mixed with organics)
				500	Clay mixed with organics (heterogeneous), stiff, wet					
	BH21-08B	-	175	300	Clay, mineral, some organics, moist	-	-	Clay till, firm, very moist		
	BH21-08C	-	50	450	Clay, mineral, some organics, stiff, moist to very moist	-	-	Clay till, firm, very moist		Lower part of road subrade was poor (clay mixed with organics) Very thin granular layer
				600	Clay mixed with organics (heterogeneous), very moist					

Alignment No.	BH No.	Roadway Surfacing Material		Subsurface Material					Comments
		Cold Mix Asphalt	Gravel	Layer 1 (Embankment Fill)		Layer 2 (Buried Organic Soil)		Layer 3 (Native Clay/Sand)	
		Thickness (mm)	Thickness (mm)	Thickness (mm)	Description	Thickness (mm)	Description	Description	
9	BH21-09A	-	125	800	Clay, mineral fill, some organics, stiff, moist	-	-	Clay till, firm, moist to very moist	
	BH21-09B	-	50	650	Clay mixed with organics (heterogeneous), very stiff, moist	100	Topsoil	Clay till, firm, moist	Poor road subrade (clay mixed with organics) Very thin granular layer
	BH21-09C	50	100	450	Clay, mineral, some organics, moist	-	-	Clay till, stiff to firm, moist	
10	BH21-10A	-	250	650	Sand mixed with organics (heterogeneous), loose, very moist	-	-	Compact and wet sand, underlain by wet clay till	Poor road subrade (clay mixed with organics)
	BH21-10B	-	250	550	Sand mixed with organics (heterogeneous), moist	-	-	Loose and wet sand, underlain by moist clay till	Poor road subrade (sand mixed with organics)
	BH21-10C	-	225	350	Clay, mineral, some organics, moist	-	-	Loose and wet sand, underlain by very moist clay till	
11	BH21-11A	-	125	450	Clay mixed with organics (heterogeneous), moist	-	-	Clay till, firm, very moist	Poor road subrade (clay mixed with organics)
	BH21-11B	-	200	400	Clay mixed with organics (heterogeneous), stiff, moist	-	-	Clay till with interbedded sand, firm, moist	Poor road subrade (clay mixed with organics)
	BH21-11C	-	75	200	Clay mixed with organics (heterogeneous), moist	-	-	Clay till, firm, moist	Poor road subrade (clay mixed with organics) Very thin granular layer
				300	Clay, mineral, some organics, firm, moist				
12	BH21-12A	110	90	1,000	Clay, mineral, trace organics, stiff, moist	-	-	Stiff and moist clay, underlain by moist clay till	
	BH21-12B	100	50	750	Clay, mineral, stiff, moist	400	Organic clay, stiff, wet	Moist clay underlain by moist clay till	
	BH21-12C	90	-	1,000	Clay, mineral, firm, moist	1,800	Peat, highly decomposed, followed by organic clay	Clay, very moist	

Alignment No.	BH No.	Roadway Surfacing Material		Subsurface Material						Comments
		Cold Mix Asphalt	Gravel	Layer 1 (Embankment Fill)		Layer 2 (Buried Organic Soil)		Layer 3 (Native Clay/Sand)		
		Thickness (mm)	Thickness (mm)	Thickness (mm)	Description	Thickness (mm)	Description	Description		
13	BH21-13A	25	100	550	Clay, mineral, trace organics, stiff, moist	-	-	Clay till, stiff, moist		
				400	Clay mixed with organics (heterogeneous), moist					
	BH21-13B	25	125	650	Clay, mineral, trace organics, stiff, moist to very moist	-	-	Clay till, firm, moist		
14	BH21-14A	25	125	1,550	Clay, mineral, stiff to very stiff, moist	1,100	Peat, highly decomposed	Clay, very moist to wet		
				400	Clay mixed with organics (heterogeneous), very moist					
	BH21-14B	25	50	1,600	Clay, mineral, some organics, stiff, moist	-	-	Wet clay underlain by very moist clay till		Very thin granular layer
				500	Clay mixed with organics (heterogeneous), very moist					

Appendix A

Site Photographs Taken During the Field Investigations

Photograph 1: Looking north at BH21-01A within Alignment 1

Photograph 2: Looking south at BH21-01C within Alignment 1

Photograph 3: Looking at exposed organic soil within Alignment 1

Photograph 4: Looking east towards BH21-02A within Alignment 2

Photograph 5: Looking west along Alignment 2.

Photograph 6: Looking east towards BH21-03A within Alignment 3

Photograph 7: Looking east along Alignment 3.

Photograph 8: Looking south towards BH21-04A within Alignment 4

Photograph 9: Looking east towards BH21-05A within Alignment 5

Photograph 10: Looking at the organics at BH21-05A within Alignment 5

Photograph 11: Looking at ruts within Alignment 5

Photograph 12: Looking towards BH21-06A within Alignment 6

Photograph 13: Looking at the ruts within Alignment 6

Photograph 14: Looking at the organics at BH21-06B within Alignment 6

Photograph 15: Looking north towards BH21-07B within Alignment 7

Photograph 16: Looking at the west ditch within Alignment 7

Photograph 17: Looking north along Alignment 7

Photograph 18: Looking south towards BH21-08C within Alignment 8

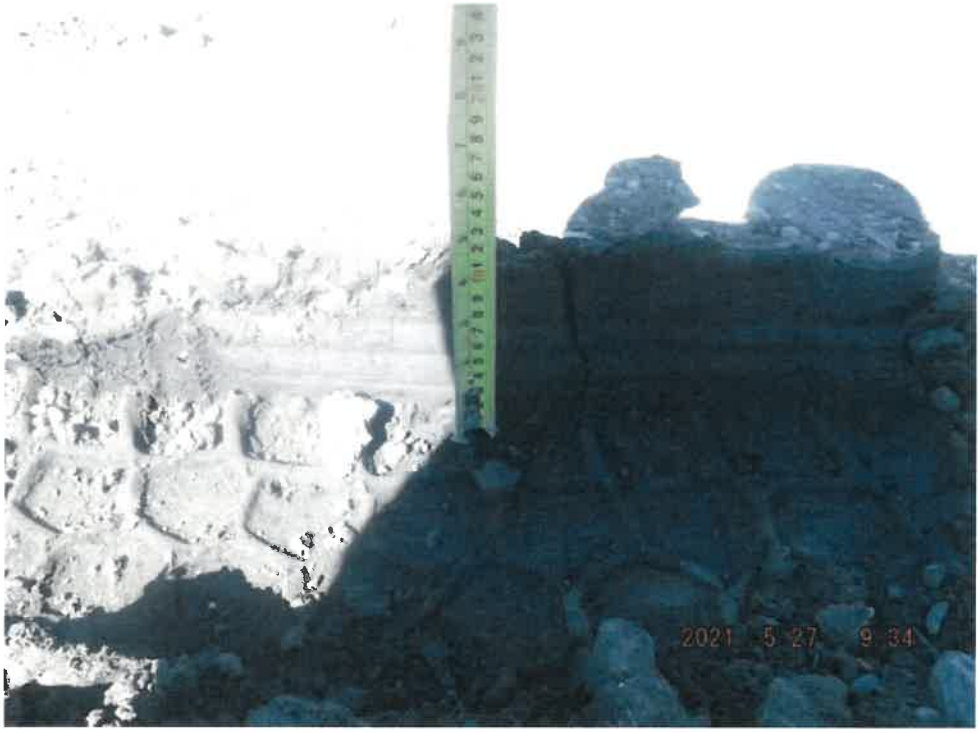
Photograph 19: Looking north along the ditch within Alignment 8

Photograph 20: Looking north along Alignment 8

Photograph 21: Looking east towards BH21-09A within Alignment 9

Photograph 22: Looking north along Alignment 9

Photograph 23: Looking south towards BH21-10B within Alignment 10



Photograph 24: Looking at the ruts within Alignment 10

Photograph 25: Looking north along Alignment 10

Photograph 26: Ruts within BH21-11A within Alignment 11

Photograph 27: Looking south towards BH21-11C within Alignment 11

Photograph 28: Thick ruts within Alignment 11

Photograph 29: Looking south towards BH21-12A within Alignment 12

Photograph 30: Looking south along Alignment 12

Photograph 31: Looking north towards BH21-13B within Alignment 13

Photograph 32: Looking at the west ditch along Alignment 13

Photograph 33: Looking north towards BH21-14A within Alignment 14

Photograph 34: Looking south along Alignment 14

Appendix B

Borehole Logs
Explanation of Terms and Symbols

Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6004332 Easting: 379194
Elevation:

Borehole #: **BH21-01A**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-9

SPT N Value
20 40 60 80
Plastic M.C. Liquid
20 40 60 80
Pocket Pen (kPa)
100 200 300 400

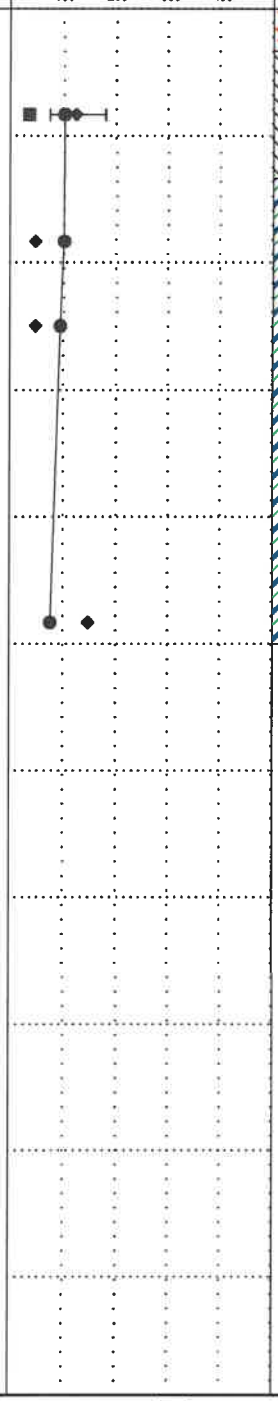
Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~100 mm)**					RR 200 - Approximately 850 m south of Twp Rd 602	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, some sand, some silt, trace gravel, medium plastic, black, very moist		1			Partially frozen soils encountered between 0.9 and 1.5 m below road surface	
		OL	**ORGANIC SILT**, and sand, trace clay, black, wood debris, wet		2	6		Grain Size Distribution Sand: 41% Silt: 49% Clay: 10%	
1		CI	**CLAY (TILL)**, and sand, silty, trace gravel, medium plastic, grey-brown, trace oxides, moist		3				1
2			- coal pockets		4				2
			COMPLETION DEPTH: 2.3 m below ground surface At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

Z:\PROJECTS\GEOTECHNICAL PROJECTS\2021\PG21-1575-COUNTY OF SMOKY LAKE ROADS\PG21-1575 - SMOKY LAKE.GPJ 21-07-16 01:59 PM (SEG-FINAL)

Project Name: Roadway Failures Investigation	Borehole #: **BH21-01B**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 6004376 Easting: 379196	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~150 mm)**					RR 200 - Approximately 810 m south of Twp Rd 602	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, and sand, silty, trace gravel, firm, medium plastic, grey-black, organic lenses, very moist		1	7		Partially frozen soils encountered between 0.9 and 1.5 m below road surface	
1		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, medium plastic, brown, trace oxides, very moist		2			Liquid Limit: 36% Plastic Limit: 15% Grain Size Distribution Gravel: 1% Sand: 47% Silt: 34% Clay: 18%	1
					3				
2			- becoming moist		4				2
3			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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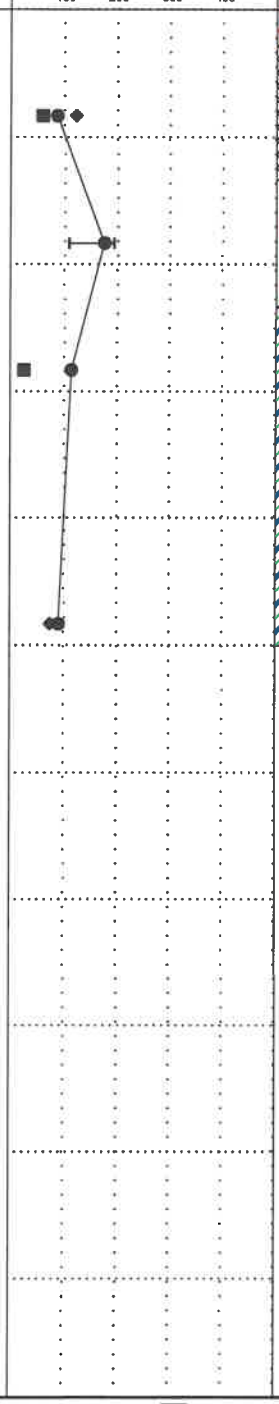
Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6004446 Easting: 379198
Elevation:

Borehole #: **BH21-01C**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-9
Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~125 mm)**					RR 200 - Approximately 740 m south of Twp Rd 602	0
		FILL	**FILL (CLAY)**, and silt, sandy, trace gravel, stiff, medium plastic, grey-black, some organics, moist to very moist		1	12			
		OR	**ORGANIC CLAY**, and sand, and silt, black, wood debris, wet		2			Liquid Limit: 39% Plastic Limit: 22% Grain Size Distribution Gravel: 1% Sand: 46% Silt: 42% Clay: 11%	
1		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, brown, trace oxides, very moist		3	5			1
2			- becoming moist		4				2
			COMPLETION DEPTH: 2.3 m below ground surface At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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3

2022 Road Projects

OIL TREATMENT / PAVING

Project Name	Code	# Days	Length	Res #'s	Estimate Costs	Actual Cost	Funding
RR 130 between Twp 603- Twp 604	P2211	2	1.0		$ 135,000.00		MSI/MO
Twp 590 between RR 174(n)- RR 180(s)	P1813	2	1.25		$ 150,000.00		MSI/MO
		4		Total	$ 285,000.00	$	

changed to MG see below

CHIP SEAL

Project Name	Code	# Days	Length	Res #'s	Estimate Costs	Actual Cost	Funding
							MSI/MO
				Total		$	

REHABILITATION / BASE STABILIZATION

Project Name	Code	# Days	Length	Res #'s	Estimate Costs	Actual Cost	Funding
Twp 592 between RR 145- RR 150	R2212	2	1.0		$ 22,000.00		MSI/MO
Twp 592 between RR 142- RR 143	R2222	2	1.0		$ 22,000.00		MSI/MO
RR 155 between Twp 601A- Twp 610	R2614	6	4.5		$ 103,000.00		MSI/MO
Twp 594 between RR 194A- RR 200	R1425	2.5	1.5		$ 35,000.00		MSI/MO
RR 191 between Twp 602- Twp 604	R1525	3	2.0		$ 45,000.00		MSI/MO
Twp 602 between RR 195- RR 200	R2215	1.5	1.0		$ 22,000.00		MSI/MO
Twp 620 between RR 141- RR 142	MG2211	2	1.0		$ ~~25,000.00~~	75000	MSI/MO
RR 144 between Twp 585- Hwy 652	MG2212	7	5.0		$ 70,000.00		MSI/MO
Twp 592 between RR 183- RR 182A	MG2213	1	0.5		$ 10,000.00		MSI/MO
Twp 590 between Hwy 855- RR 170	MG2233	5	3.25		$ 60,000.00		MSI/MO
Twp 600 between RR 181- RR 182	MG2215	2	1.0		$ 25,000.00		MSI/MO
		34		Total	$ 439,000.00	$	

CONSTRUCTION

Project Name	Code	# Days	Length		Estimate Costs	Actual Cost	Funding
Twp 590 between RR 150(s)- RR 150A	C2212	7	0.5		$ 60,000.00		MSI/MO
Twp 590 between RR 154(s)- RR 154A	C2222	4	0.25		$ 15,000.00		MSI/MO
RR 200 between Twp 592- Twp 593	C1715	12	1.0		$ 130,000.00		MSI/MO
Twp 592 between RR 200- RR 195A	C2215	6	0.5		$ 50,000.00		MSI/MO
		29		Total	$ 255,000.00	$	

MG HAUL ROADS - PW57

Project Name	Code	# Days	Length/ miles		Estimate Costs	Actual Cost	Funding
Twp 584 between Hwy 855- RR 165	MG2023	4	5.5		$ 121,000.00		Aggregate Reserve
Twp 582A & 582 between Hwy 855- RR 172A	MG2033	3	2.0		$ 44,000.00		Aggregate Reserve
		7		Total	$ 165,000.00	$	

GRAVELLING

Miles per Division	Code	Recommended miles	Recommended Gravel	Estimate Costs	Actual Gravel	Actual Cost	Funding
144.0	PW45	44.5	7,422.5	$ 155,872.50			RTG
218.5	PW46	78.5	12,835.0	$ 295,205.00			RTG
159.5	PW47	46.5	7,455.5	$ 104,377.00			RTG
167.0	PW48	58.0	9,218.5	$ 138,277.50			RTG
219.0	PW49	64.0	10,232.0	$ 153,480.00			RTG
968.0 miles		291.5	47,163.5	$ 847,212.00			
Contingency:			5,000.0	$ 90,000.00			
Total			52,163.5	$ 937,212.00			
Road Repair PW50:							Unbudgeted- Cost of gravel only

Five-Year Road Plan: Year 2020-2025

Proposed additions

RR 130 Twp 603-604 base stabilization 25000

Twp 590 RR 174-180 25,000

Twp 612 RR 174-184 10,000

Twp 612 RR 174A-180 22000

RR 180 Twp 612A 614 27000

Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6001798 Easting: 385104
Elevation:

Borehole #: **BH21-02A**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-9
Page 1 of 1

SPT N Value 20 40 60 80
Plastic M.C. Liquid 20 40 60 80
Pocket Pen (kPa) 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~125 mm)**					Twp 600 - Approximately 560 m west of RR 192	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, brown-black, moist		1				
		OR	**ORGANIC CLAY**, and sand, and silt, medium plastic, black, wet		2				
			CLAY (TILL), and sand, and silt, trace gravel, firm, medium plastic, brown, very moist		3	6			
1			- becoming stiff, coal pockets		4	11			1
		CI							
2					5				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6001796 Easting: 385140
Elevation:

Borehole #: **BH21-02B**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-9

SPT N Value
20 40 60 80
Plastic M.C. Liquid
20 40 60 80
Pocket Pen (kPa)
100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~75 mm)**					Twp 600 - Approximately 525 m west of RR 192	0
		FILL	**FILL (CLAY)**, and sand, and silt, trace gravel, medium plastic, grey-black, some organics, moist		1				
		OR	**ORGANIC CLAY**, and sand, silty, low to medium plastic, black, very moist		2	10		Liquid Limit: 38% Plastic Limit: 12% Grain Size Distribution Gravel: 1% Sand: 41% Silt: 36% Clay: 22%	
1		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, grey-brown, trace oxides, very moist		3	6		Liquid Limit: 25% Plastic Limit: 16% Grain Size Distribution Sand: 62% Silt: 34% Clay: 4%	1
			- becoming moist						
2					4				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-02C**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 6001795 Easting: 385225	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid: 20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes
0			**GRAVEL SURFACING (~25 mm)**					Twp 600 - Approximately 440 m west of RR 192
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, and sand, silty, trace gravel, medium plastic, grey-black, moist		1			
		OR	**ORGANIC CLAY**, and sand, silty, medium plastic, black, very moist		2			
		CI	**CLAY (TILL)**, and sand, silty, trace gravel, firm, medium plastic, grey-brown, very moist		3	6		Liquid Limit: 34% Plastic Limit: 10% Grain Size Distribution Sand: 44% Silt: 38% Clay: 18%
1		SP	**SAND**, fine grained, some silt, some clay, loose, poorly graded, brown, wet		4	7		
			- becoming brown, sand lenses					
		CI			5			
2					6			
			COMPLETION DEPTH: 2.3 m below ground surface At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.					
3								
4								
5								

Depth (m)

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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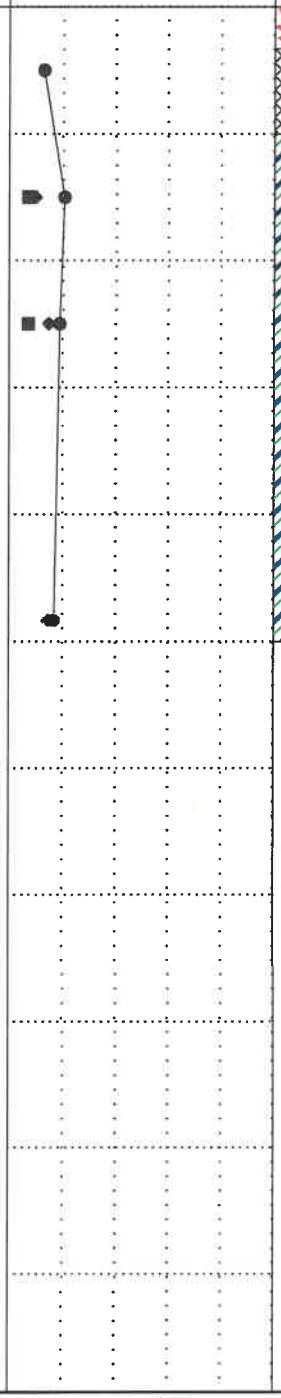
Project Name: Roadway Failures Investigation	Borehole #: **BH21-03A**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 6001762 Easting: 386576	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~150 mm)**					Twp 600 - Approximately 720 m west of RR 191	0
		FILL	**FILL (CLAY)**, sandy, silty, trace gravel, medium plastic, grey-black, some organics, moist		1				
1			**CLAY (TILL)**, and silt, sandy, trace gravel, firm, medium plastic, grey-brown, trace oxides, very moist		2	7			1
					3	7			
2		CI	- becoming and sand, sand pockets, coal pockets, moist		4				2
3			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-03B**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 6001762 Easting: 386613	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid
20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~125 mm)**					Twp 600 - Approximately 685 m west of RR 191	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, grey-black, moist		1				
		SP	**SAND**, fine grained, trace silt, trace clay, poorly graded, brown, moist		2				
		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, brown, trace oxides, moist to very moist		3	5			
1					4	5			1
2					5				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6001757 Easting: 386747
Elevation:

Borehole #: **BH21-03C**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-9

SPT N Value
20 40 60 80
Plastic M.C. Liquid
20 40 60 80
Pocket Pen (kPa)
100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~150 mm)**					Twp 600 - Approximately 550 m west of RR 191	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, and sand, and silt, trace gravel, low to medium plastic, grey-black, moist		1				
		CI	**CLAY (TILL)**, and sand, silty, trace gravel, stiff, medium plastic, brown, trace oxides, moist		2	13		Liquid Limit: 29% Plastic Limit: 13% Grain Size Distribution Sand: 47% Silt: 36% Clay: 17%	
1		SC	**SAND & CLAY**, silty, trace gravel, loose, brown, trace oxides, very moist		3	5			1
		CL	**CLAY**, and sand, and silt, low plastic, brown, very moist		4				
2			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						2
3									3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-04A**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5998130 Easting: 390475	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

Depth (m)	SPT N Value / Plastic M.C. Liquid / Pocket Pen (kPa)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0			GR	**GRAVEL SURFACING (~175 mm)**					RR 185 - Approximately 300 m south of Twp Rd 594	0
			FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, grey-black, moist		1				
			PT	**PEAT**, highly decomposed, black, saturated		2	8			
1			CI	**CLAY (TILL)**, and silt, sandy, trace gravel, firm, medium plastic, grey, trace oxides, moist to very moist		3				1
						4	6			
2				- becoming brown, coal pockets		5				2
				COMPLETION DEPTH: 2.3 m below ground surface At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3										3
4										4
5										

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5998054 Easting: 390473
Elevation:

Borehole #: **BH21-04B**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-9

SPT N Value
20 40 60 80
Plastic M.C. Liquid
20 40 60 80
Pocket Pen (kPa)
100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~225 mm)**					RR 185 - Approximately 370 m south of Twp Rd 594	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, black, moist		1				
			CLAY (TILL), and silt, sandy, trace gravel, firm, medium plastic, brown, trace oxides, very moist		2	7		Liquid Limit: 35% Plastic Limit: 14% Grain Size Distribution Sand: 22% Silt: 55% Clay: 23%	
1			- becoming moist, coal pockets		3	7			1
		CI			4				
2			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						2
3									3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-05A**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5994983 Easting: 398979	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid: 20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes
0		GR	**GRAVEL SURFACING (~75 mm)**					Twp 592 - Approximately 390 m east of RR 180
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, grey-black, moist		1			
		OR	**ORGANIC CLAY**, and sand, and silt, medium plastic, black, wood debris, wet		2	9		Liquid Limit: 29% Plastic Limit: 12% Grain Size Distribution Gravel: 2% Sand: 45% Silt: 40% Clay: 13%
1		CL	**CLAY**, and sand, and silt, firm, low plastic, brown, sand lenses, very moist		3	5		
2		CI	**CLAY (TILL)**, and silt, sandy, trace gravel, medium plastic, brown, trace oxides, moist		4			
			COMPLETION DEPTH: 2.3 m below ground surface					
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.					
3								
4								
5								

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5994985 Easting: 398991
Elevation:

Borehole #: **BH21-05B**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-9
Page 1 of 1

Depth (m)	SPT N Value / Plastic M.C. Liquid / Pocket Pen (kPa)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0			GR	**GRAVEL SURFACING (~125 mm)**					Twp 592 - Approximately 405 m east of RR 180	0
			FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, black, moist		1				
1			CI	**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, brown, trace oxides, moist to very moist		2	5			1
						3	5			
2						4				2
				COMPLETION DEPTH: 2.3 m below ground surface						
				At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3										3
4										4
5										

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-05C**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5994979 Easting: 399024	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid: 20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		ASPH	**COLD MIX ASPHALT (~65 mm)**					Twp 592 - Approximately 435 m east of RR 180	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, black-brown, moist		1				
1			**CLAY (TILL)**, and sand, silty, trace gravel, stiff, medium plastic, brown, sand lenses, moist		2	9			1
		CI	- becoming and silt, sandy, firm, very moist to wet		3	5			
2					4				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings, bentonite plug, and asphalt cap.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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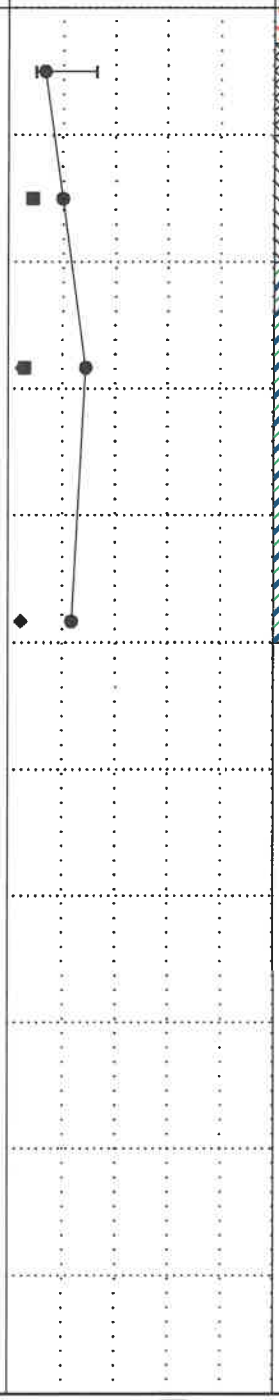
Project Name: Roadway Failures Investigation	Borehole #: **BH21-06A**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5994945 Easting: 401644	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~125 mm)**					Twp 592 - Approximately 210 m west of RR 174	0
		FILL	**FILL (CLAY)**, and sand, and silt, trace gravel, medium plastic, grey-black, some organics, moist		1				
		FILL	**- becoming mixed with organics,** some sand, some silt, stiff, black, moist to very moist		2	9		Liquid Limit: 33% Plastic Limit: 10% Grain Size Distribution Sand: 48% Silt: 33% Clay: 19%	
1		CI	**CLAY (TILL)**, and silt, sandy, firm, medium plastic, brown, wet		3	6			1
2			- becoming very moist		4				2
			COMPLETION DEPTH: 2.3 m below ground surface At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol	Shelby Tube	No Recovery	SPT Test (N)	Grab Sample	Split-Pen	Core	
Backfill Symbol	Bentonite	Pea Gravel	Slough	Grout	Drill Cuttings	Sand	

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5994944 Easting: 401657
Elevation:

Borehole #: **BH21-06B**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-9
Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid: 20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~125 mm)**					Twp 592 - Approximately 195 m west of RR 174	0
		FILL	**FILL (CLAY)**, sandy, silty, trace gravel, medium plastic, grey-brown, trace organics, moist		1			Partially frozen soils encountered between 0.9 and 1.5 m below road surface	
		OR	**ORGANIC CLAY**, and sand, silty, stiff, medium plastic, black, wet		2	9			
1		CI	**CLAY (TILL)**, and sand, silty, trace gravel, medium plastic, brown, trace oxides, sand pockets, wet		3			SPT sampler in contact with rock	1
2			- becoming moist		4				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-06C**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5994941 Easting: 401736	Driller: All Service Drilling Ltd.	Completion Date: 21-6-9
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid: 20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~125 mm)**					Twp 592 - Approximately 115 m west of RR 174	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, grey-black, moist		1				
		OR	**ORGANIC CLAY**, and sand, silty, medium plastic, black, wet		2	8			
1		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, stiff, medium plastic, brown, trace oxides, moist		3	8			1
2					4				2
			COMPLETION DEPTH: 2.3 m below ground surface At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5989959 Easting: 401450
Elevation:

Borehole #: **BH21-07A**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-10

SPT N Value 20 40 60 80
Plastic M.C. Liquid 20 40 60 80
Pocket Pen (kPa) 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~75 mm)**					RR 175 - Approximately 1,380 m north of Twp Rd 584	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, and sand, and silt, trace gravel, firm, medium plastic, grey-black, very moist		1				
					2	6		Liquid Limit: 39% Plastic Limit: 19% Grain Size Distribution Gravel: 1% Sand: 42% Silt: 47% Clay: 10%	
1		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, brown, moist to very moist		3	5			1
					4				
2			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						2
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5989931 Easting: 401450
Elevation:

Borehole #: **BH21-07B**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-10
Page 1 of 1

SPT N Value
20 40 60 80
Plastic M.C. Liquid
20 40 60 80
Pocket Pen (kPa)
100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~50 mm)**					RR 175 - Approximately 1,355 m north of Twp Rd 584	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, firm, medium plastic, grey-black, moist to very moist		1				
					2	7			
1			**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, brown, very moist		3	6			1
		CI	- becoming sandy, moist		4				
2			**COMPLETION DEPTH: 2.3 m below ground surface**						2
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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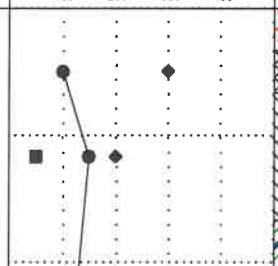
Project Name: Roadway Failures Investigation	Borehole #: **BH21-08A**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5989378 Easting: 401440	Driller: All Service Drilling Ltd.	Completion Date: 21-6-10
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes
0		GR	**GRAVEL SURFACING (~150 mm)**					RR 175 - Approximately 800 m north of Twp Rd 584
		FILL	**FILL (CLAY)**, sandy, silty, trace gravel, medium plastic, grey-black, some organics, moist		1			
			- becoming mixed with organics, some sand, some silt, stiff, black, wet		2	10		
		FILL						
1			**CLAY (TILL)**, and sand, and silt, trace gravel, stiff, medium plastic, brown, wet		3	8		
		CI						
2			- becoming moist		4			
			COMPLETION DEPTH: 2.3 m below ground surface					
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.					
3								
4								
5								

Depth (m) duplicated: 0, 1, 2, 3, 4

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5989338 Easting: 401439
Elevation:

Borehole #: **BH21-08B**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-10
Page 1 of 1

SPT N Value
Plastic M.C. Liquid
Pocket Pen (kPa)

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~175 mm)**					RR 175 - Approximately 765 m north of Twp Rd 584	0
		FILL	**FILL (CLAY)**, and sand, and silt, trace gravel, medium plastic, grey-black, some organics, moist		1				
			CLAY (TILL), and sand, and silt, trace gravel, firm, medium plastic, brown, very moist		2	6		Liquid Limit: 31% Plastic Limit: 14% Grain Size Distribution Gravel: 1% Sand: 41% Silt: 40% Clay: 18%	
1			- becoming moist		3	7			1
		Cl			4				
2			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						2
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5989279 Easting: 401439
Elevation:

Borehole #: **BH21-08C**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-10
Page 1 of 1

SPT N Value
Plastic M.C. Liquid
Pocket Pen (kPa)

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~50 mm)**					RR 175 - Approximately 700 m north of Twp Rd 584	0
		FILL	**FILL (CLAY)**, sandy, silty, trace gravel, medium plastic, grey-black, some organics, moist		1				
		FILL	**- becoming mixed with organics,** some sand, some silt, stiff, black, wet		2	9			
1		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, stiff, medium plastic, brown, very moist		3	5			1
2			- becoming moist		4				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-09A**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5988545 Easting: 402292	Driller: All Service Drilling Ltd.	Completion Date: 21-6-10
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid: 20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes
0		GR	**GRAVEL SURFACING (~125 mm)**					Twp 584 - Approximately 870 m east of RR 175
		FILL	**FILL (CLAY)**, and sand, and silt, trace gravel, stiff, medium plastic, grey-black, some organics, moist		1			
					2	13		Liquid Limit: 30% Plastic Limit: 16% Grain Size Distribution Gravel: 1% Sand: 41% Silt: 43% Clay: 15%
1		CI	**CLAY (TILL)**, and sand, silty, trace gravel, firm, medium plastic, brown, moist to very moist		3	5		
2					4			
			COMPLETION DEPTH: 2.3 m below ground surface					
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.					
3								
4								
5								

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5988548 Easting: 402318
Elevation:

Borehole #: **BH21-09B**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-10
Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid: 20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~50 mm)**					Twp 584 - Approximately 895 m east of RR 175	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, firm, medium plastic, grey-black, moist		1				
					2	15			
		OR	**TOPSOIL (~75 mm)**						
1		CI	**CLAY (TILL)**, and sand, silty, trace gravel, firm, medium plastic, grey-brown, moist		3	6			1
2					4				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-09C**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5988544 Easting: 402342	Driller: All Service Drilling Ltd.	Completion Date: 21-6-10
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

Depth (m)	SPT N Value / Plastic M.C. Liquid / Pocket Pen (kPa)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0			ASPH	**COLD MIX ASPHALT (~50 mm)**					Twp 584 - Approximately 920 m east of RR 175	0
			GR	**GRAVEL BASE (~100 mm)**						
			FILL	**FILL (CLAY)**, sandy, silty, trace gravel, medium plastic, grey-black, some organics, moist		1				
1			CI	**CLAY (TILL)**, and sand, silty, trace gravel, stiff, medium plastic, brown, sand pockets, moist		2	11			1
				- becoming firm		3	6			
2						4				2
				COMPLETION DEPTH: 2.3 m below ground surface						
				At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings, bentonite plug, and asphalt cap.						
3										3
4										4
5										

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5991641 Easting: 406680
Elevation:

Borehole #: **BH21-10A**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-11
Page 1 of 1

SPT N Value 20 40 60 80
Plastic M.C. Liquid 20 40 60 80
Pocket Pen (kPa) 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING/OILED GRAVEL (~250 mm)**					RR 171 - Approximately 30 m north of Twp Rd 590	0
		FILL	**FILL (SAND MIXED WITH ORGANICS)**, some silt, some clay, loose, black, very moist		1	8			
1		SP	**SAND**, fine grained, some silt, trace clay, compact, poorly graded, grey-brown, wet		2	17		SPT sampler in contact with rock	1
					3				
2		CI	**CLAY (TILL)**, and silt, some sand, trace gravel, medium plastic, brown, coal seams, sand pockets, wet		4				2
3			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-10B**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5991654 Easting: 406681	Driller: All Service Drilling Ltd.	Completion Date: 21-6-11
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value: 20 40 60 80
Plastic M.C. Liquid: 20 40 60 80
Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING/OILED GRAVEL (~250 mm)**					RR 171 - Approximately 45 m north of Twp Rd 590	0
		FILL	**FILL (SAND MIXED WITH ORGANICS)**, some silt, trace clay, black, moist		1			SPT sampler in contact with rock	
1		SP	**SAND**, fine grained, some silt, some clay, loose, poorly graded, brown, very moist		2				1
			- becoming trace clay, wet		3	5			
2		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, medium plastic, brown, sand pockets, moist		4				2
3			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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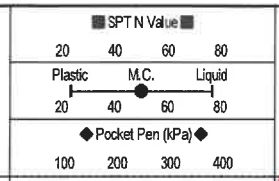
Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5991723 Easting: 406681
Elevation:

Borehole #: **BH21-10C**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-11
Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes
0		GR	**GRAVEL SURFACING (~225 mm)**					RR 171 - Approximately 110 m north of Twp Rd 590
		FILL	**FILL (CLAY)**, and sand, silty, trace gravel, medium plastic, black-brown, some organics, moist		1			
			SAND, fine grained, some silt, trace clay, loose, poorly graded, brown, very moist to wet		2	6		Liquid Limit: 27% Plastic Limit: 10% Grain Size Distribution Sand: 51% Silt: 31% Clay: 18%
1		SP	- becoming compact		3	10		
2		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, medium plastic, brown, very moist		4			
			COMPLETION DEPTH: 2.3 m below ground surface At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.					
3								
4								
5								

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-11A**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5994654 Easting: 406748	Driller: All Service Drilling Ltd.	Completion Date: 21-6-11
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value: 20 40 60 80 | Plastic M.C. Liquid: 20 40 60 80 | Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING/OILED GRAVEL (~125 mm)**					RR 171 - Approximately 205 m south of Twp Rd 592	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, black-brown, moist		1				
1			**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, brown, sand pockets, very moist		2			SPT sampler in contact with rock	1
			- becoming moist						
2		CI			3	5			2
					4				
3			**COMPLETION DEPTH: 2.3 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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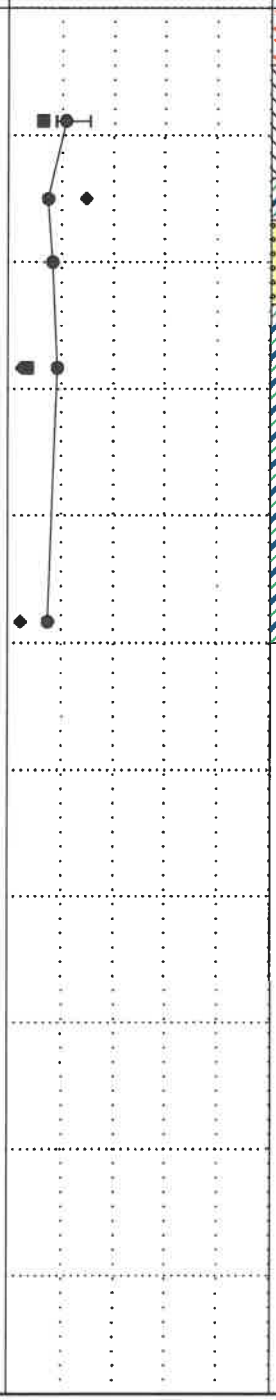
Project Name: Roadway Failures Investigation	Borehole #: **BH21-11B**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 5994669 Easting: 406748	Driller: All Service Drilling Ltd.	Completion Date: 21-6-11
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes
0		GR	**GRAVEL SURFACING (~200 mm)**					RR 171 - Approximately 190 m south of Twp Rd 592
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, and sand, and silt, trace gravel, medium plastic, stiff, black, moist		1	13		Liquid Limit: 31% Plastic Limit: 18% Grain Size Distribution Sand: 50% Silt: 40% Clay: 10%
		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, medium plastic, grey-brown, moist		2			
1		SP	**SAND**, fine grained, some silt, trace clay, poorly graded, brown, very moist to wet		3			
			- becoming firm, low plastic, sand lenses		4	7		
		CI						
2					5			
			COMPLETION DEPTH: 2.3 m below ground surface					
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.					
3								
4								
5								

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 5994719 Easting: 406746
Elevation:

Borehole #: **BH21-11C**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-11
Page 1 of 1

SPT N Value 20 40 60 80
Plastic M.C. Liquid 20 40 60 80
Pocket Pen (kPa) 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		GR	**GRAVEL SURFACING (~75 mm)**					RR 171 - Approximately 140 m south of Twp Rd 592	0
		FILL	**FILL (CLAY MIXED WITH ORGANICS)**, sandy, silty, trace gravel, medium plastic, black, moist		1				
		FILL	**FILL (CLAY)**, sandy, silty, trace gravel, firm, low to medium plastic, grey-black, some organics, moist		2	6			
1		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, brown, moist		3	5			1
2					4				2
			COMPLETION DEPTH: 2.3 m below ground surface At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
3									3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6003199 Easting: 447581
Elevation:

Borehole #: **BH21-12A**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-10
Page 1 of 1

SPT N Value
20 40 60 80
Plastic M.C. Liquid
20 40 60 80
Pocket Pen (kPa)
100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		ASPH	**COLD MIX ASPHALT (~110 mm)**					RR 130 - Approximately 685 m south of Twp Rd 602	0
		GR	**GRAVEL BASE (~90 mm)**						
		FILL	**FILL (CLAY)**, and sand, silty, trace gravel, stiff, medium plastic, grey-brown, trace organics, moist		1				
					2	10		Liquid Limit: 31% Plastic Limit: 10% Grain Size Distribution Sand: 40% Silt: 48% Clay: 12%	
1			- becoming grey-black, some organics, very moist		3				1
		CL	**CLAY**, and sand, silty, stiff, low plastic, grey, moist						
		CI	**CLAY (TILL)**, and silt, sandy, trace gravel, medium plastic, brown, trace oxides, moist		4	9			
2					5				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings, bentonite plug, and asphalt cap.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-12B**	SolidEarth GEOTECHNICAL	
Client Name: Smoky Lake County	Project #: PG21-1575		
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF		
Northing: 6003171 Easting: 447581	Driller: All Service Drilling Ltd.	Completion Date: 21-6-10	
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1	

SPT N Value: 20 40 60 80 | Plastic M.C. Liquid: 20 40 60 80 | Pocket Pen (kPa): 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		ASPH	**COLD MIX ASPHALT (~100 mm)**					RR 130 - Approximately 710 m south of Twp Rd 602	0
		GR	**GRAVEL BASE (~50 mm)**						
		FILL	**FILL (CLAY)**, and sand, silty, trace gravel, stiff, low to medium plastic, grey-brown, moist		1				
					2	10			
1		OR	**ORGANIC CLAY**, and sand, silty, medium plastic, black, wet		3	12			1
		CL	**CLAY**, and sand, silty, low plastic, grey, moist		4				
		CI	**CLAY (TILL)**, and silt, sandy, trace gravel, medium plastic, brown, trace oxides, moist						
2					5				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings, bentonite plug, and asphalt cap.						
3									3
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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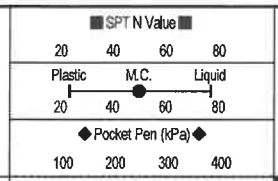
Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6003147 Easting: 447582
Elevation:

Borehole #: **BH21-12C**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-10
Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		ASPH	**COLD MIX ASPHALT/OILED GRAVEL (~90 mm)**					RR 130 - Approximately 735 m south of Twp Rd 602	0
		FILL	**FILL (CLAY)**, and sand, silty, trace gravel, firm, low to medium plastic, brown, trace organics, trace oxides, moist		1				
			- becoming some organics, grey-black		2	7			
1		PT	**PEAT**, highly decomposed, black, wood debris, wet		3	17			1
					4				
2		OR	**ORGANIC CLAY**, and sand, silty, medium plastic, black, wet		5				2
3		CI	**CLAY**, and silt, some sand, medium plastic, grey, very moist		6				3
4			**COMPLETION DEPTH: 3.8 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings, bentonite plug, and asphalt cap.						4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6007685 Easting: 447628
Elevation:

Borehole #: **BH21-13A**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-10
Page 1 of 1

Depth (m)	SPT N Value / Plastic M.C. Liquid / Pocket Pen (kPa)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0			ASPH	**COLD MIX ASPHALT (~25 mm)**					RR 130 - Approximately 565 m north of Twp Rd 604	0
			GR	**GRAVEL BASE (~100 mm)**						
			FILL	**FILL (CLAY)**, and sand, silty, trace gravel, stiff, medium plastic, grey-brown, trace organics, moist		1				
						2	8			
			FILL	**- becoming mixed with organics,** sandy, grey-black, organic lenses, wood debris, very moist		3				
1			CI	**CLAY (TILL)**, and silt, sandy, trace gravel, stiff, medium plastic, grey-brown, moist		4	9			1
2						5				2
				COMPLETION DEPTH: 2.3 m below ground surface						
				At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings, bentonite plug, and asphalt cap.						
3										3
4										4
5										

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6007730 Easting: 447630
Elevation:

Borehole #: **BH21-13B**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL

Completion Date: 21-6-10

SPT N Value
20 40 60 80
Plastic M.C. Liquid
20 40 60 80
Pocket Pen (kPa)
100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		ASPH	**COLD MIX ASPHALT (~25 mm)**					RR 130 - Approximately 610 m north of Twp Rd 604	0
		GR	**GRAVEL BASE (~125 mm)**						
		FILL	**FILL (CLAY)**, and silt, sandy, trace gravel, stiff, medium plastic, brown, trace organics, moist		1				
			- becoming some organics, grey-black, very moist		2	13			
1		CI	**CLAY (TILL)**, and sand, and silt, trace gravel, firm, medium plastic, brown, moist		3	7		Liquid Limit: 35% Plastic Limit: 15% Grain Size Distribution Sand: 37% Silt: 39% Clay: 24%	1
2					4				2
			COMPLETION DEPTH: 2.3 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings, bentonite plug, and asphalt cap.						
3									3
4									4
5									

Sample Symbol: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

Backfill Symbol: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

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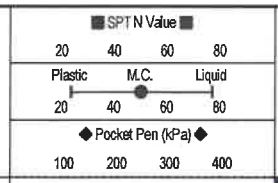
Project Name: Roadway Failures Investigation
Client Name: Smoky Lake County
Site: Smoky Lake County, Alberta
Northing: 6011227 Easting: 447666
Elevation:

Borehole #: **BH21-14A**
Project #: PG21-1575
Logged By: DC / Reviewed By: TF
Driller: All Service Drilling Ltd.
Drill Method: 150 mm Solid Stem Auger

SolidEarth GEOTECHNICAL
Completion Date: 21-6-10
Page 1 of 1



Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0	ASPH GR		**COLD MIX ASPHALT (~25 mm)** **GRAVEL BASE (~125 mm)**					RR 130 - Approximately 875 m north of Twp Rd 610	0
		FILL	**FILL (CLAY)**, and sand, and silt, trace gravel, stiff, medium plastic, brown, trace organics, moist		1				
1					2	11		Liquid Limit: 32% Plastic Limit: 13% Grain Size Distribution Sand: 40% Silt: 39% Clay: 21%	1
					3	15			
		FILL	**- becoming mixed with organics,** and silt, some sand, grey-black, wood debris, very moist		4				
2		PT	**PEAT**, very highly decomposed, trace clay, black, saturated						2
					5				
3		CH	**CLAY**, and silt, trace sand, high plastic, grey-black, very moist to wet						3
					6				
4			**COMPLETION DEPTH: 3.8 m below ground surface** At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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Project Name: Roadway Failures Investigation	Borehole #: **BH21-14B**	SolidEarth GEOTECHNICAL
Client Name: Smoky Lake County	Project #: PG21-1575	
Site: Smoky Lake County, Alberta	Logged By: DC / Reviewed By: TF	
Northing: 6011305 Easting: 447665	Driller: All Service Drilling Ltd.	Completion Date: 21-6-10
Elevation:	Drill Method: 150 mm Solid Stem Auger	Page 1 of 1

SPT N Value 20 40 60 80 | Plastic M.C. Liquid 20 40 60 80 | Pocket Pen (kPa) 100 200 300 400

Depth (m)	Soil Symbol	USCS	Material Description	Sample Symbol	Sample #	SPT (N-Value)	BACKFILL DETAILS	Additional Data & Notes	Depth (m)
0		ASPH	**COLD MIX ASPHALT (~25 mm)**					RR 130 - Approximately 950 m north of Twp Rd 610	0
		GR	**GRAVEL BASE (~50 mm)**						
		FILL	**FILL (CLAY)**, and sand, silty, trace gravel, stiff, medium plastic, grey-black-brown, sand lenses, trace to some organics, moist		1				
1					2	8			1
					3				
					4	12			
		FILL	**- becoming mixed with organics,** and silt, sandy, grey-black, very moist		5				
2		CH	**CLAY**, and silt, trace sand, high plastic, grey-black, wet		6				2
		CI	**CLAY (TILL)**, and silt, trace sand, medium plastic, brown, very moist		7				
3									3
			COMPLETION DEPTH: 3.8 m below ground surface						
			At Completion No accumulation of water or slough material. Borehole backfilled with drill cuttings and bentonite plug.						
4									4
5									

Sample Symbol: Shelby Tube | No Recovery | SPT Test (N) | Grab Sample | Split-Pen | Core

Backfill Symbol: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

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EXPLANATION OF TERMS & SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and laboratory testing are described on the following two pages.

1. VISUAL TEXTURAL CLASSIFICATION ON MINERAL SOILS

CLASSIFICATION	APPARENT PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	> 200 mm	> 200 mm
Cobbles	75 mm to 200 mm	75 mm to 200 mm
Gravel	4.75 mm to 75 mm	5 mm to 75 mm
Sand	0.075 mm to 4.75 mm	Visible particles to 5 mm
Silt	0.002 mm to 0.075 mm	Non-plastic particles, not visible to naked eye
Clay	< 0.002 mm	Plastic particles, not visible to naked eye

2. TERMS FOR CONSISTENCY & DENSITY OF SOILS

Cohesionless Soils

DESCRIPTIVE TERM	APPROXIMATE SPT "N" VALUE
Very Dense	> 50
Dense	30 to 50
Compact	10 to 30
Loose	4 to 10
Very Loose	< 4

Cohesive Soils

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH	APPROXIMATE SPT "N" VALUE
Hard	>200 kPa	> 30
Very Stiff	100 to 200 kPa	15 to 30
Stiff	50 to 100 kPa	8 to 15
Firm	25 to 50 kPa	4 to 8
Soft	10 to 25 kPa	2 to 4
Very Soft	< 10 kPa	< 2

* SPT "N" Values – Refers to the number of blows by a 63.5 kg hammer dropped 760 mm to drive a 50 mm diameter split spoon sampler for a distance of 300 mm after an initial penetration of 150 mm.

3. SYMBOLS USED ON BOREHOLE LOGS

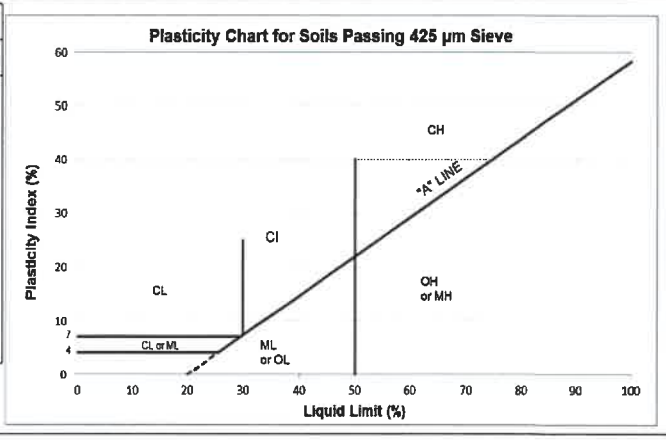
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
N(■)	Standard Penetration Test (CSA A119 1-60)	SO_4	Concentration of Water-Soluble Sulphate
N_d	Dynamic Cone Penetration Test	C_u	Undrained Shear Strength
pp (♦)	Pocket Penetrometer Strength	γ	Unit Weight of Soil or Rock
q_u	Unconfined Compressive Strength	γ_d	Dry Unit Weight of Soil or Rock
w (●)	Natural Moisture Content (ASTM D2216)	ρ	Density of Soil or Rock
w_L	Liquid Limit (ASTM D 4318)	ρ_d	Dry Density of Soil or Rock
w_P	Plastic Limit (ASTM D 4318)	▽	Short-Term Water Level
I_P	Plastic Index	▼	Long-Term Water Level

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75 µm)	GRAVELS (MORE THAN HALF COARSE GRAINS LARGER THAN 4.75mm)	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u = D_{60}/D_{10} > 4$ $C_c = (D_{30})^2/(D_{10} \times D_{60}) = 1$ to 3	
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		GRAVELS (WITH SOME FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE I_p LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE I_p MORE THAN 7
	SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75mm)	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = D_{60}/D_{10} > 6$ $C_c = (D_{30})^2/(D_{10} \times D_{60}) = 1$ to 3	
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW	
		SANDS (WITH SOME FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE I_p LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE I_p MORE THAN 7
FINE GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75 µm)	SILTS (BELOW 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 50$ %	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50$ %	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS		
	CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 30$ %	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS		
		30 % < W_L < 50 %	CI	INORGANIC CLAYS OR MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50$ %	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS (BELOW 'A' LINE)	$W_L < 50$ %	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		$W_L > 50$ %	OH	ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE	
BEDROCK			BR	SEE REPORT DESCRIPTION		

Soil Components

Component	Size Range (mm)	Descriptor	% by Weight
Cobbles	> 76	and	> 35
Gravel	76 to 4.75		
Coarse	76 to 19	-y, -ey	35 to 20
Fine	19 to 4.75		
Sand	4.75 to 0.075	some	20 to 10
Coarse	4.75 to 2		
Medium	2 to 0.425	trace	10 to 1
Fine	0.425 to 0.075		
Fines (Silt or Clay)	< 0.075		



8 Summary of Recommendations

A summary of the prioritized recommendations and opinions of probable costs is presented below. "Immediate" are considered risks to the public's safety, "high" is within 1 to 5 years, "medium" is within the next 5 to 10 years, and "low" is within the next 15 to 20 years. Values are probable costs in 2018 dollars and are assumed to be combined with other scope items.

Costs do not include investigation and remediation of asbestos and hazardous materials.

Table 8-1
Summary of Estimated Costs

Work Description	Priority	Estimated Cost
Janitor Room requires 1hr fire separation: Replace existing door with new fire-rated door, frame, and hardware, and apply fire stopping and fire sealant around openings	Immediate	$3,500
Replace the existing access door in the Boiler Room to the crawlspace with new fire-rated door, frame, and hardware, and apply fire stopping and fire sealant around openings	Immediate	$3,000
Replace the existing access door to lower Mechanical Room to the crawlspace with new fire-rated door, frame, and hardware, and apply fire stopping and fire sealant around openings	Immediate	$3,000
Conduct investigation on fire blocks of crawlspace	Immediate	$2,500
Testing and disposing of expelled masonry insulation and sealing the sources within masonry	Immediate	$20,000
Repairs to the dislodging blocks on masonry walls	Immediate	$10,000
Install a backflow preventer to meet CAN/CSA-B64.10 on the domestic water service	Immediate	$3,500
Provide exhaust for ladies and men's washrooms located in north wing, and Janitor Room located in east wing	Immediate	$1,500
Utility fuse box replacement*	Immediate	$4,000
Move items in front of electrical equipment	Immediate	$500
Repair exterior receptacles, install JB covers, secure EHT	Immediate	$1,500
Secure wiring in basement crawlspace	Immediate	$1,000
TOTAL IMMEDIATE PRIORITY ITEMS		**$54,000**
Replace entire roof system including downspouts and splash pads and replace any unsuitable sheathing.	High	$600,000

Work Description	Priority	Estimated Cost
Replace non-vented soffits with perforated prefinished metal soffits	High	$50,000
Provide and install power door opener for the main entrance door	High	$2,000
Replace existing wood siding and building paper with new near the main entrance	High	$15,000
Patch missing exterior wall finishes with new, seal around wall penetrations and cracks on wall surfaces	High	$2,500
Miscellaneous repairs to masonry walls including dislodged masonry blocks, sealing of cracks, re-pointing of joints as required, and patching of wide crack	High	$20,000
X-ray the incoming water pipes examining the condition	High	$1,000
Replacing incoming water pipe to CPVC including excavation and backfill	High	$15,000
Install grates to missing floor drains	High	$500
Provide concrete splash pad at storm downspouts	High	$1,000
Replace heating distribution pumps with new variable flow pumps, total of 2	High	$15,000
Replace washrooms exhaust fans with new fans, total of 5	High	$2,500
Replace refrigerant in rooftop air conditioning units with R-410A, total of 5	High	$5,000
Provide concrete pad for condenser unit on grade	High	$500
Install UL-555 fire dampers on all duct penetrations of fire-rated walls	High	$1,500
Replace existing receptacles within 1.5m of sink with GFI receptacle	High	$1,000
Electrical support for rooftop HVAC unit replacement	High	$1,300
Upgrade exterior lights to LED (c/w Photo Cell)	High	$15,000
TOTAL HIGH PRIORITY ITEMS		**$748,800**
Replace brick stone walkway with concrete sidewalks	Medium	$20,000
Miscellaneous crack repairs to concrete sidewalks	Medium	$2,000
Replace all existing wall finishes and building papers with new including 4" new rigid insulation and air/vapour barrier	Medium	$500,000

Work Description	Priority	Estimated Cost
Replace all exterior wood doors and frames with new insulated hollow metal doors and frames including hardware	Medium	$45,000
Replace all exterior windows and frames with new triple glazed windows and frames	Medium	$120,000
Replace all interior floor finishes with new	Medium	$270,000
Replace damaged ceiling tiles and plaster ceilings	Medium	$3,000
Miscellaneous concrete repairs to strip footings	Medium	$10,000
Concrete apron repairs	Medium	$10,000
Replace heating terminal elements including baseboard heaters, force flow heaters, unit heaters and heating coils	Medium	$120,000
Replace rooftop air conditioning units with new high efficiency units, total of 5	Medium	$60,000
Building Electrical Load Assessment	Medium	$6,000
Upgrade interior lights to LED	Medium	$179,500
Upgrade Electrical Distribution Equipment (re-use existing cables)	Medium	$160,000
TOTAL MEDIUM PRIORITY ITEMS		**$1,505,500**
Replace heating boilers within the next 15 years, total of 2	Low	$90,000
Replace fan coils unit with associated condenser unit within the next 12 years	Low	$20,000
Insulate domestic hot and cold water (optional)	Low	$20,000
Test existing Ethernet outlets, replace faulty outlets and Ethernet cable (assuming a minimum of 10 runs to be replaced)	Low	$10,000
Add new ceiling mounted receptacle at entrance	Low	$2,200
Replace exit lights with new "running man" lights	Low	$3,500
Fire Alarm system installed as per ULC-524	Low	$35,000
TOTAL LOW PRIORITY ITEMS		**$180,700**

*The presence of asbestos and hazardous materials is expected within the buildings masonry and potentially in other sources. It is recommended that testing be performed by a hazardous materials consultant prior to design and construction.

SMOKY LAKE COUNTY 2022 BRIDGE PROGRAM BUDGET SUMMARY - Draft

1 2022 INSPECTIONS

Type	Season	Number	Unit Cost	Engineering	Total	AT Share	County Share
Level 1	Spring/Fall	40	$ 350	$ 14,000	$ 14,000		$ 14,000
Level 2	Spring	5	$ 2,650	$ 13,250	$ 13,250		$ 13,250
Major Bridge Inspec	Spring	0	$ 1,200	$ -			$ -

SUMMARY TOTAL INSPECTIONS	Engineering	Total Cost	AT Share	County Share
	$ 27,250	$ 27,250	$ -	$ 27,250

2 2022 ENGINEERING ASSESSMENTS

	Season		Engineering	Total	AT Share	County Share
7814	Spring		$ 10,000	$ 10,000		$ 10,000
8199	Winter		$ 10,000	$ 10,000		$ 10,000
76552	Spring	2022	$ 10,000	$ 10,000		$ 10,000
80532	Winter	2022	$ 10,000	$ 10,000		$ 10,000

SUMMARY TOTAL ENGINEERING	Engineering	Total Cost	AT Share	County Share
	$ 40,000	$ 40,000	$ -	$ 40,000

3 2021 AEP GRANT FUNDED CONSTRUCTION

	Season	Engineering	Total	AEP Share	County Share
Proposed 2021 AEP Applications:					
5 BF78004	-		$ 34,625	$ 34,625	$ -

SUMMARY TOTAL ENGINEERING	Engineering	Total Cost	AT Share	County Share
	TBD	TBD	TBD	$ -

4 2021 CONSTRUCTION CARRY OVER

	Construction	Engineering	Total	AT Share	County Share
BF13398 Construction	$ 752,928	$ 152,713	$ 905,641	$ 679,231	$ 226,410
Total Anticipated 2021 Construction Residual	$ -	$ -	$ 905,641	$ 679,231	$ 226,410
Lien holdback	$ -	$ -	$ -	$ -	$ -

SUMMARY TOTAL CONSTRUCTION CARRY	Construction	Engineering	Total Cost	AT Share	County Share
	$ 752,928	$ 152,713	$ 905,641	$ 679,231	$ 226,410

5 2022 CONSTRUCTION

			Construction	Engineering	Total	AT Share	County Share
Proposed 2021 STIP Applications:							
9	BF01772 Construction		$ 543,048	$ 101,457	$ 644,505	$ 483,379	$ 161,126
1	BF70923 Construction		$ 186,675	$ 33,325	$ 220,000	$ 165,000	$ 55,000
3	BF72828 Construction		$ 135,600	$ 26,950	$ 162,550	$ 121,913	$ 40,638
4	BF74018 Construction		$ 69,850	$ 10,500	$ 80,350	$ 60,263	$ 20,088
6	BF77862 Construction		$ 37,500	$ 5,625	$ 43,125	$ 32,344	$ 10,781
5	BF78004 Construction		$ 130,833	$ 7,667	$ 138,500	$ 103,875	$ 34,625
2	BF80532 Construction	TBD	$ 165,000	$ 35,000	$ 200,000	$ 150,000	$ 50,000

SUMMARY TOTAL CONSTRUCTION	Construction	Engineering	Total Cost	AT Share	County Share
	$ 1,268,506	$ 220,524	$ 1,489,030	$ 1,116,772	$ 372,257

6 2021 BRIDGE PROGRAM MANAGEMENT

	Hours	Rate	Engineering	Total	AT Share	County Share
Budget Meetings	2	$ 1,200	$ 2,400	$ 2,400		$ 2,400
Bridge Program Management	160	$ 177	$ 28,320	$ 28,320		$ 28,320

SUMMARY TOTAL BRIDGE PROGRAM	Engineering	Total Cost	AT Share	County Share
	$ 30,720	$ 30,720	$ -	$ 30,720

2021 BRIDGE PROGRAM BUDGET SUMMARY

	Construction	Engineering	Total Cost	Total AT Share	Total County Share
1 2021 INSPECTIONS		$ 27,250	$ 27,250	$ -	$ 27,250
2 2021 ENGINEERING		$ 40,000	$ 40,000	$ -	$ 40,000
3 2020 CONSTRUCTION CARRY OVER	$ -	$ -	$ 905,641	$ 679,231	$ 226,410
4 2021 CONSTRUCTION	$ 1,268,506	$ 220,524	$ 1,489,030	$ 1,116,772	$ 372,257
5 2021 BRIDGE PROGRAM MANAGEMENT		$ 30,720	$ 30,720	$ -	$ 30,720

TOTAL 2021 BUDGET SUMMARY	Construction	Engineering	Total Cost	Total AT Share	Total County Share
	$ 3,190,120	$ 546,230	$ 3,736,350	$ 2,410,830	$ 879,390