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APPENDIX 2

Geotechnical Evaluation

TETRA TECH

Geotechnical Evaluation
MacLaine Acres Area Structure Plan
Section 28 TWP 9 RGE 21 W4M
Lethbridge County, Alberta



PRESENTED TO
Rick Aldoff

OCTOBER 2021
ISSUED FOR USE
FILE: ENG.LGEO04408-01

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LIMITATIONS OF REPORT

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1.0 INTRODUCTION

This report presents the results of a geotechnical evaluation conducted by Tetra Tech Canada Inc. (Tetra Tech) for the proposed subdivision development of the MacLaine Acres Subdivision Area Structure Plan to be located in the Lethbridge County, Alberta (Figure 1). The legal description of the site address is Section 28 TWP 9 RGE 21 W4M.

The scope of work for the geotechnical evaluation was outlined in a revised proposal (Tetra Tech File No. PENG.LGEO04385-01) issued to Mr. Matt Redgrave, of Martin Geomatic Consultants Ltd. (MGCL), on August 20, 2021. The objective of this evaluation was to determine the general subsurface stratigraphy and groundwater conditions in the area of the proposed development and to provide general recommendations for the geotechnical aspects of the development.

A Phase I Environmental Site Assessment was also conducted for the proposed development and issued in a separate report.

A Preliminary Septic Disposal Field Feasibility (PSDFF) was also conducted for the proposed development and issued in a separate report as well.

Authorization to proceed with the evaluation was provided by Mr. Richard Aldoff, the landowner, via a signed Services Agreement dated August 24, 2021.

2.0 PROJECT DESCRIPTION AND SCOPE OF WORK

It is understood that the proposed project will be a residential subdivision with major development components including foundations, stormwater utilities, pavement structures, site grading, and lot development. The total planned area is approximately 32 hectares (79.3 acres).

Shallow foundations with a floor slabs-on-grade system are typically considered for residential structures in the Lethbridge area. A deep pile foundation system, such as bored cast-in-place (CIP) piles or screw piles, is generally considered for commercial structures with heavy load or some residential dwellings where subsurface conditions are not feasible for shallow foundations.

It is understood that the proposed development will be designed and constructed to the Lethbridge County Engineering Guidelines & Minimum Servicing Standards.

The scope of work for this evaluation comprised the drilling of 14 boreholes, a laboratory program to assist in classification of the subsurface soils, and this report providing the following design and construction recommendations:

- Design parameters for shallow foundations and below-grade structures.
- Design parameters for pile foundations including bored CIP concrete piles.
- Casing and dewatering during construction.
- Design and installation of floor slabs-on-grade.
- Site classification for seismic site response.
- Construction for underground utilities.
- Trench excavation and backfill.

- General site grading.
- Special considerations if fill is encountered.
- Volumetric changes of soil due to changes in moisture content and/or frost.
- Mitigation for high water table, if encountered.
- Construction of subgrades, backfill materials, and compaction.
- Concrete type for structured elements in contact with soil.
- Asphalt pavement structure as per the Lethbridge County Engineering Guidelines & Minimum Servicing Standards.

3.0 GEOTECHNICAL FIELD AND LABORATORY WORK

The fieldwork for this evaluation was carried out on September 9, 2021. A truck-mounted drill rig was contracted from Chilako Drilling Services Ltd. of Coaldale, Alberta. The rig was equipped with 150 mm diameter solid stem continuous flight augers. Tetra Tech's field representative was Mr. Victor Okwodu, E.I.T. Buried utility locating was carried out through Alberta One-Call and private utility locating was carried out by LandScan.

A total of 14 boreholes (referred to as 21BH001 through 21BH014) were drilled within the proposed development. The boreholes were drilled to depths ranging from 5.1 m to 9.6 m below existing ground elevation. The borehole locations are depicted on Figure 2.

Borehole locations were laid out using a handheld GPS and borehole ground elevations were obtained by MGCL and provided to Tetra Tech for use in this report. The borehole coordinates and ground elevations are shown on the borehole logs in Appendix B.

In all boreholes, disturbed grab samples were obtained at depth intervals of approximately 600 mm. Standard Penetration Tests (SPT) using an automatic SPT hammer (with an efficiency of 90%) were completed at intervals of 1.5 m. All soil samples were visually classified in the field, and the individual soil strata and the interfaces between them were noted. The borehole logs are presented in Appendix B. An explanation of the terms and symbols used on the borehole logs is also included in Appendix B.

Slotted 25 mm diameter polyvinyl chloride (PVC) standpipes were installed in each of the boreholes in order to monitor the groundwater levels. Auger cuttings were used to backfill around the standpipes and the boreholes were sealed at the ground surface with bentonite chips.

Soil classification tests, including natural moisture content, Atterberg Limits, and soluble sulphate content, were subsequently performed in the laboratory on samples collected from the boreholes to aid in the determination of engineering properties. The results of the laboratory tests are presented on the borehole logs in Appendix B.

4.0 SITE CONDITIONS

4.1 Surface Features

The proposed site configuration is bounded by farmland to the north; by an irrigation channel to the west; by Highway 843 to the east; and by residential properties, a farmstead, and farmland to the south.

According to information provided by MGCL, the proposed site comprises of three lots to be subdivided; Lot 1 Block 1 Plan 927 LK in the northeast, Lot 2 Block 1 Plan 927 LK in the southeast, and Lot 1 Block 2 Plan 8010198 in the southwest.

Lot 1 Block 1 Plan 927 LK comprises of a farmstead and a dugout in the southeast corner of the lot, a fenced off area in the east that appeared to be used for livestock and/or horses with decomposing bails of hay or straw, while the rest of the lot comprises of a vacant field with a wheel irrigation system. The land is relatively flat with drainage tending to the northeast.

Lot 2 Block 1 Plan 927 LK comprises of a barn/shed in the southwest corner, while the rest of the lot comprises of a wheel irrigated agricultural field. South half of the dugout noted above in Lot 1 Block Plan 927 LK was within the northeast extent of the lot. The land is relatively flat with drainage tending to the northeast and east.

Lot 1 Block 2 Plan 8010198 comprises of a farmstead in the northwest corner of the lot, a residence at the north central extent of the lot, a dugout and farm structures in the northeast corner of the lot, an old horse racetrack in the south half of the lot, a dry dugout just north of the horse racetrack, and a pond/dugout at the south-central extent of the lot. The land is relatively flat with the drainage tending to the northeast. From the topography provided by MGCL, a localized low-lying area was noted on the lot near the dry dugout just north of the horse racetrack.

Regional drainage is generally towards the northeast to east.

As part of the evaluation, Tetra Tech reviewed historical aerial photographs of the site and surrounding area from 1950 to 2021. The following observations were noted:

Lot 1 Block 1 Plan 927 LK

- 1950, agricultural land.
- 1960, agricultural land.
- 1970, similar to 1960.
- 1980, a dugout and a structure are visible in the southeast corner of the lot.
- 1991, a farmstead is visible near the dugout in the southeast corner of the lot.
- 1999, the east of the lot above the farmstead is fenced off.
- 1999 to 2021, no visible changes were noted.

Lot 2 Block 1 Plan 927 LK

- 1950, agricultural land.
- 1960, agricultural land, with a structure in the north central extent of the lot.
- 1970, similar to 1960 except the structure is no longer visible.
- 1980 to 2015, no visible changes.
- 2017, a structure is visible in the southwest corner of the lot.
- 2017 to 2021, no visible changes were noted.

Lot 1 Block 2 Plan 8010198

- 1950, a winding irrigation channel runs through the northwest corner of the lot, with a large low-lying area located at the northeast corner of the lot with structures just north of the low-lying area. A dugout is visible at the south-central extent of the lot.
- 1960, a farmstead is visible north of the low-lying area. Water is visible in the low-lying area.
- 1970, a new dugout is visible just east of the farmstead.
- 1980, the irrigation channel no longer runs through the northwest corner of the lot, that has been infilled and the irrigation channel is now on the west extent of the lot. The large low-lying area is no longer visible and appears to be infilled. The farmstead is no longer visible.
- 1991, structures are visible around the dugout in the northeast corner of the lot.
- 1999, a residence is visible at the north-central extent of the lot.
- 2012, a farmstead is visible in the northwest corner of the lot.
- 2015, the horse racetrack is visible at the south half of the lot, with the dugout just north of it.
- 2018, the area just east of the farmstead in the northwest corner appears to be graded.
- 2018 to 2021, no visible changes were noted.

4.2 Mining Activity

Research was conducted on the possible existence of mine workings within the boundary of the site, including a review of the Alberta Energy Regulator (AER) coal mine mapping archive and various documents contained in Tetra Tech's library regarding the coal mining industry in the surrounding area of the proposed development. The literature indicates no mine workings within the vicinity of the proposed site.

4.3 Soil Stratigraphy

The general subsurface stratigraphy of the site comprised of a surficial layer of topsoil or clay fill (likely from historical agricultural activities) underlain by native clay and then clay till deposits with the occasional thin sand layer. The following subsections provide a summary of the stratigraphic units encountered at the specific borehole locations across the site. A more detailed description is provided on the borehole logs presented in Appendix B.

4.3.1 Topsoil/Clay Fill

Topsoil was encountered at the majority of the borehole locations, with a thickness ranging between 50 mm to 350 mm. The thickness of the topsoil layer should be expected to vary across the project site.

Of the 14 boreholes there were four boreholes (21BH001 through 21BH004) that did not have a surficial topsoil layer but rather a surficial clay fill layer ranging in thickness from 200 mm to 350 mm in thickness. The surficial clay fill layer is likely due to historical agricultural activity in the area and should be considered to be variable across the site. Deep clay fill and/or construction debris were not encountered at the borehole locations but may be expected locally (e.g., backfilled low-lying area, areas with historical structures removed).

4.3.2 Clay

A layer of native clay was encountered in the boreholes beneath the topsoil, extending to a depth ranging between 0.5 m and 1.5 m below grade. The clay was generally described as silty, trace to some sand, damp to very moist, very soft to very stiff, medium to high plastic, and light brown to brown or brown with grey brown mottling, dark brown or grey brown. Silt lenses/pockets, precipitates, trace rootlets, and dark brown high plastic clay laminations were noted in the clay. Moisture contents of the clay ranged between 11% and 31%. Atterberg Limits testing (two tests) within the clay indicated a Liquid Limit range between 36% and 47% with a Plastic Limit range between 16% and 17%; indicative of medium plasticity.

4.3.3 Clay Till

Clay till was encountered beneath the native clay at the borehole locations, extending to the borehole termination depths. The clay till was generally described as silty, trace to some sand, trace gravel, damp to very moist, very soft to very stiff, medium to high plastic (occasional high plastic), and light brown, brown, dark brown, or brown with grey brown mottling. Silt and sand pockets/layers up to 700 mm thick, precipitates, and coal and oxide specks/staining or coal fragments were encountered within the clay till. Moisture contents of the clay till ranged between 10% and 31%. Atterberg Limits testing (two tests) within the clay till indicated Liquid Limits ranging between 29% and 32%, and Plastic Limits ranging between 12% and 14%; indicative of low (high end of low plastic) to medium plastic.

SPT “N” values in the clay till ranged between 0 and 19 blows per 300 mm of penetration, indicative of very soft to very stiff consistency and is extremely variable.

4.4 Groundwater Conditions

During the field drilling, some sloughing was encountered in 21BH003 and 21BH004 at depths of 2.4 m and 3.0 m below existing ground elevation. Groundwater seepage was encountered in 21BH003, 21BH004, 21BH005, 21BH007, and 21BH010 at depths of 1.8 m, 1.5 m, 1.5 m, 1.5 m, and 6.1 m, respectively. The groundwater levels were measured on September 16, 2021. Table A summarizes the groundwater monitoring data.

Table A: Groundwater Monitoring Data – September 16, 2021

Borehole Number	Depth of Standpipe (m)	Borehole Elevation (m)	Depth to Groundwater (m)	Groundwater Elevation (m)
18BH001	6.6	901.59	1.44	900.15
18BH002	5.1	902.71	2.16	900.55
18BH003	6.6	903.30	0.77	902.53
18BH004	5.1	904.80	0.74	904.06
18BH005	5.1	900.98	1.21	899.77
18BH006	6.6	902.81	1.62	901.19
18BH007	5.1	904.32	1.54	902.78
18BH008	6.6	905.86	1.56	904.30
18BH009	5.1	906.38	3.38	903.00
18BH010	6.6	905.79	2.59	903.20
18BH011	6.6	906.75	5.21	901.54
18BH012	9.6	907.54	3.33	904.21

Table A: Groundwater Monitoring Data – September 16, 2021

Borehole Number	Depth of Standpipe (m)	Borehole Elevation (m)	Depth to Groundwater (m)	Groundwater Elevation (m)
18BH013	5.1	907.37	Dry	-
18BH014	9.6	907.56	2.91	904.65

5.0 RECOMMENDATIONS

The recommendations that follow provide varying options intended to aid in the development of project concepts and specifications. The recommendations are based on the understanding and condition that Tetra Tech will be retained to review the relevant aspects of the final design (drawings and specifications) and to conduct such field reviews as are necessary to ensure compliance with the geotechnical aspects of the 2019 National Building Code – Alberta Edition, Lethbridge County Engineering Guidelines & Minimum Servicing Standards, this report, and the final plans and specifications. Tetra Tech accepts no liability for any use of this report in the event that Tetra Tech is not retained to provide these review services.

Specific recommendations that apply to this project are provided for site development, compaction, excavations, subgrade preparation, pavement structures, foundation and floor slab systems, and stormwater management facilities.

5.1 Site Development

5.1.1 Topsoil Depth

The initial topsoil stripping depth should be considered as being of particular importance with regard to site subgrade grading design elevations. Based on the findings of the field drilling program, the surficial topsoil (A Horizon) layer thickness generally varies between 50 mm and 300 mm; however, may be variable in thickness due to historical cultivation practices of the land surface and/or depositional processes (i.e., wind). Consideration can be given however, to incorporating the underlying B Horizon layer (organic content <5%) into the fill mass during general site grading. Full-time monitoring by experienced personnel is recommended in order to avoid over-stripping and to ensure appropriate material mixing and placement. A detailed topsoil thickness investigation is suggested for estimation of the topsoil volume for site grading.

5.1.2 Lot Grading

The lot grading should be designed and carried out to the current Lethbridge County Engineering Guidelines & Minimum Servicing Standards. All lots should be graded for drainage at a minimum gradient of 2.0%. Backfill materials and compaction requirements, as to be discussed in Section 5.1.3, should be followed. Any organics, soft and/or wet soils, or deleterious materials must be removed, where encountered, to expose the underlying suitable clay soil. The excavated areas must be backfilled with general engineered fill.

It should be noted that this site will have some challenges with regards to moisture conditioning and competent subgrade soils for construction. Due to the wet and weak subgrade conditions encountered in the majority of the site. Special care and attention needs to be paid during the site grading efforts for the project. Although the low to medium plastic soils are suitable as backfill materials, soil moisture conditioning should be expected due to the wet subgrade conditions as encountered at most borehole locations. If the development is to consider a raised site grading, excessive settlement from weak subgrade soils due to the backfill surcharge may be expected. After the

completion of a raised site grading, if it is to be considered for the development, residence structures should be delayed to allow for the majority of the consolidation settlement to occur prior to construction. For a site increase in elevation or raise of over 1 m, a minimum six (6) months of waiting period should be provided.

5.1.3 Backfill Materials and Compaction

The existing site soils comprising the predominantly low to medium plastic clay and clay till are adequate for use as both landscape fill and general engineered fill materials, as defined in Appendix C. Any soil containing deleterious materials should be removed from site. Sand, silt, and high plastic clay soils should be separated and used for landscape fill. The final decision on approved backfill materials should be made during site construction.

The moisture content of the site soil materials is expected to be highly variable with respect to the optimum moisture content (OMC). It is anticipated therefore, that moisture conditioning will be required at the site for proper backfill placement. The earthworks contractor should make their own estimate of the requirements for moisture conditioning to the recommended standards and should consider such factors as weather and construction procedures. A contingency for importation of general engineered fill is recommended in the event that the site soils cannot be moisture conditioned.

General engineered fill materials should be moisture conditioned to within a range of OMC to +2% of the OMC prior to compaction and compacted to a minimum of 98% Standard Proctor Density (SPD). The compacted thickness of each lift of backfill shall not exceed 150 mm.

Further recommendations regarding backfill materials and compaction are contained in Appendix C.

5.1.4 Construction Excavations

Excavations should be carried out in accordance with Alberta Occupational Health and Safety Regulations. The depth for the trench excavations is unknown at this time and is anticipated to be less than 6 m below existing ground surface for below-grade structures and/or utility infrastructure. The following recommendations notwithstanding, the responsibility of all excavation cutslopes resides with the Contractor, who should take into consideration site-specific conditions concerning soil stratigraphy and groundwater. All excavations should be reviewed by the Contractor prior to personnel working within the base of the excavation.

Based on the findings of the drilling program, soft to stiff clay soils, in moist to very moist conditions, are generally anticipated to be encountered within 6.0 m below grade during excavation. All excavations which are to be deeper than 1.5 m should have the sides shored and braced or the slopes should be cut back no steeper than 1.0 horizontal to 1.0 vertical (1.0H:1.0V) for stiff clay and 1.5H:1V for soft to firm clay soils. In areas where seepage is encountered, or when excavations are deeper than 3.0 m, the cutslope may need to be flatter. When excavations are open for longer than one month, the slopes should be cut back flatter than the aforementioned slopes.

Any encountered groundwater seepage should be directed towards sumps for removal. Conventional construction sump pumps should be capable of groundwater control.

Spill piles or temporary surcharge loads should not be allowed within a distance equal to the depth of the excavation from an unsupported excavation face, while mobile equipment should be kept back at least 3.0 m. All excavations should be checked regularly for signs of sloughing, especially after rainfall periods. Small earth falls from the sideslopes are a potential danger to workers and must be guarded against.

General recommendations regarding construction excavations are contained in Appendix C.

5.1.5 Trench Backfill and Compaction

Trenches must be backfilled in such a way as to minimize the potential differential settlement and/or frost heave movements. A minimum compaction level of 95% of SPD is recommended for backfill within the pipe zone of the trench (to 300 mm above the top of pipe). For the remainder of the trench backfill, a minimum compaction standard of 98% of SPD should be utilized in all areas. The compacted thickness of each lift of backfill shall not exceed 150 mm. Moisture conditioning to OMC and 2% over OMC of the soils should be specified for general trench backfill. The upper 1.5 m of service trenches should be cut back at a maximum slope of 1.0H:1.0V to avoid an abrupt transition between backfill and in situ soil.

It should be noted that the ultimate performance of the trench backfill is directly related to the uniformity of the backfill compaction. In order to achieve the uniformity, the lift thickness and compaction criteria should be strictly enforced.

General recommendations regarding backfill materials and compaction are contained in Appendix C.

5.2 Pavement

5.2.1 Subgrade Preparation

Subgrade preparation should be undertaken prior to pavement construction. The recommended compaction standard for subgrade preparation is a minimum of 98% of SPD. Cohesive soils should be compacted at optimum to 2% over the OMC. Granular soils (base granular and sub-base granular layers) should be compacted with moisture content ±1% of the OMC. A minimum depth of subgrade preparation of 300 mm within the native clay is recommended for all paved areas.

Backfill to raise these areas to subgrade level should be general engineered cohesive fill materials, as defined in this report, moisture conditioned and compacted as noted previously. Proof-rolling of the prepared surface is recommended to identify localized soft areas and for an indication of overall subgrade support characteristics. Where soft subgrade conditions exist below the design subgrade elevation, these materials should be subexcavated and replaced with general engineered fill.

Depending on the construction scheduling for placement of the granular sub-base and base layers, and the asphalt concrete pavement surface, further subgrade preparation may be required if the placed subgrade materials dry out or weather. This should be determined prior to the placement of the pavement structure. Should the subgrade materials be shown to deteriorate from construction completion, a minimum 300 mm of subgrade preparation is recommended prior to pavement structure placement.

It is recommended to include a contingency for woven geotextile, should localized areas of subgrade instability be encountered. For very soft to soft subgrade aera, combigrid reinforcement should be considered, which would be a field decision during construction. Use of a woven geotextile should not be considered as an alternate for subgrade preparation as recommended, but an alternative, should subgrade instability exist after subgrade preparation. The woven geotextile should have a minimum grab tensile strength of 890 N.

The subgrade should be prepared and graded to allow drainage towards drainage trenches or catchbasins if available. It is imperative that positive surface drainage be provided to prevent ponding of water within the pavement structure and subsequent softening and loss of strength of the subgrade materials. Surrounding landscaping should be such that runoff water is prevented from ponding beside paved areas in order to avoid softening and premature failure of the pavement surface.

5.2.2 Pavement Design and Construction

The minimum materials required for the pavement structures of roadways for this project should meet the Lethbridge County Engineering Guidelines & Minimum Servicing Standards. Specific roadway pavement structures should be reviewed by the Transportation Business Unit based on the following: roadway use, traffic volumes, heavy vehicles, and equivalent single-axle loads, which information was not available at the time of writing the report.

For asphalt pavement structure, all asphalt paving lifts should be compacted to a minimum of Marshall Design Density, as per current County of Lethbridge Engineering Guidelines & Minimum Servicing Standards.

The pavement design should include provisions for subsurface drainage of the pavement granular layers. Subdrains will provide a means of evacuating water that infiltrates the pavement structure, either through cracks and vertical details (i.e., face of gutter), or from peripheral surface runoff. The subdrain should comprise a perforated flexible plastic drainpipe (100 mm diameter), complete with filter sock. The drain should be placed along the edge of the pavement section in a recessed area of the prepared subgrade.

5.3 Foundations

5.3.1 General

Based on the soil conditions encountered at the borehole locations, the clay soils at the potential shallow foundation depths were variable with consistency from very soft to very stiff. For areas with subgrade soils with firm or better consistency with SPT blow counts no less than 4, shallow foundations are considered acceptable for the proposed development. For areas with soft to very soft subgrade conditions with SPT blow counts less than 4 (e.g., 21BH003, 21BH005, 21BH007, and 21BH009), shallow foundations are not recommended due to the excessive settlement to be expected for such soils. For soft subgrade areas, deep foundations are technically feasible to transfer the structural load to competent soils in depth; however, due to relatively high cost for installing deep foundations for residence structures and only discrete boreholes drilled across the site, it is recommended that a site-specific geotechnical be completed for each of the proposed lots adjacent to the boreholes to confirm soil conditions within the building footprints. Deep pile foundations are considered to be a technical feasible option for all lots; however, may not be economically preferred due to the relatively high cost compared to a shallow foundation system. Deep pile foundations, such as helical or CIP concrete piles, are typically only considered for commercial buildings with heavy loads, or where foundation soils are not suitable for shallow foundations.

Upon review of the water levels within the boreholes there appears to be a relatively high perched water table, with most readings ranging between 0.7 m and 3.0 m below existing ground elevation. The irrigation, dugout pond, and historical agricultural land usage purposes in the area is likely a contributing factor to the high water table that was encountered. Due to the high water table encountered and its potential fluctuation, it is not recommended to use basement structures for the development.

All foundation design recommendations presented in this report are based on the assumption that an adequate level of monitoring by Tetra Tech will be provided during construction and that all construction will be carried out by suitably qualified contractors, experienced in foundation and earthworks construction. An adequate level of monitoring is considered to be the following:

- For shallow foundations; inspection of bearing surfaces prior to placement of concrete or mudslab, and design review during construction.
- For deep foundations, full-time monitoring and design review during construction.
- For earthworks; full-time monitoring and compaction testing.

Suitably qualified persons, independent of the Contractor, should carry out all such monitoring. One of the purposes of providing an adequate level of monitoring is to check that recommendations, based on data obtained at discrete borehole locations, are relevant to other areas of the site.

5.3.2 Limit States Design

The design parameters provided in the following sections may be used to calculate the ultimate foundation capacity in each case. For the Limit States Design (LSD) methodology, in order to calculate the factored load capacity, the appropriate Soil Resistance Factors must be applied to each loading condition as follows:

Factored Capacity = Ultimate Capacity x Soil Resistance Factors

In general, the soil resistance factors in Table B should be incorporated into the foundation design. These factors are considered to be in accordance with the Canadian Foundation Engineering Manual (CFEM) (2006) as well as the 2019 National Building Code – Alberta Edition

Table B: Soil Resistance Factors

Item	Soil Resistance Factor
Shallow Foundations	
Bearing Resistance	0.5
Passive Resistance	0.5
Horizontal Passive Resistance	0.5
Deep Foundations - Piles	
Static Axial Compressive Pile Capacity	0.4
Static Axial Uplift Pile Capacity	0.3
Lateral Pile Capacity	0.5

Under LSD methodology, foundations should be designed on the basis of factored Ultimate Limit States (ULS) parameters. In order to determine the applicable working capacity, Serviceability Limit States (SLS) must also be considered.

5.3.3 Shallow Foundations

Recommendations for shallow foundations in this section are only to be applicable for lots where firm to stiff foundations soils are to be encountered. Shallow footings should be constructed a minimum of 1.4 m below the final design ground surface (frost protection requirement for footings under heated structures). For unheated structures, the footings should be constructed a minimum of 2.1 m below grade.

Footings should be founded on native firm to stiff native soils only. The ultimate static bearing pressure may be taken as 150 kPa, subject to other recommendations in this report. Factoring should be considered as noted in the previous section. Footing dimensions should be in accordance with the minimum requirements of the 2019 National Building Code – Alberta Edition.

Specific bearing certification by a geotechnical engineer in conjunction with a site-specific geotechnical evaluation is recommended for each residential structure to ensure that the shallow foundations are placed on competent native soils. If weak soils are locally encountered at footing level, recommendations may be provided to remove the weak materials and bring the subcut back to design elevation with low strength lean mix concrete. Alternatively,

it may be possible to lower the footing elevation to more competent native soils but should be looked at on a case-by-case circumstance.

All fill (except for the general engineered fill, as discussed below) and construction debris materials if encountered, must be removed from the building footprint areas to expose native subgrade.

It is recommended that a grade-all bucket be used for final excavation to the foundation subgrade elevation to minimize disturbance of the founding soils. A 50 mm concrete mudslab should be placed immediately following excavation and inspection, to protect the bearing surface from disturbance and inclement weather.

Recommendations for minimum depth of cover for footings are presented under section heading 'Frost Protection'. Further recommendations regarding shallow foundations are given in Appendix C.

5.4 Bored Cast-In-Place Concrete Piles

Deep foundations may be considered for areas where soft foundation soils are encountered at potential shallow footing elevations. Bored CIP concrete piles, founded in the stiff to very stiff (occasional hard) clay till, may be designed to resist axial compressive loads on the basis of a combination of shaft and base resistances, as provided in Table C. For piles constructed in accordance with the recommendations made in this report, the following ultimate values of shaft and base resistances may be used, factored as recommended in Section 5.3.2

Table C: Geotechnical Design Parameters for Bored Cast-in-Place Concrete Piles

Depth (m)	Ultimate Shaft Resistance (kPa)	Factored Shaft Resistance (kPa)	Ultimate Base Resistance (kPa)	Factored Base Resistance (kPa)
0 to 3.0	N/A	N/A	N/A	N/A
3.0 to 6.0	30	12	N/A	N/A
Below 6.0	40	16	450	180

It is noted that stiff to very stiff clay till will require confirmation at pile bottom elevations for piles with end-bearing consideration, as local sand layers or inclusions may be encountered during pile installation and pose difficulties for belling if considered. Where weak conditions are encountered, lowering design pile bottom elevations to stiffer soils or only friction straight shaft piles may be considered.

Piles should be a minimum of 400 mm in diameter. Shaft resistance should be neglected for the top 3.0 m or the clay fill depth, whichever is deeper. End-bearing should not be used for small diameter (less than 760 mm base diameter) piles because of the difficulties associated with ensuring a clean base. End-bearing may only be considered in the design of under-reamed or belled piles if facilities are available for an adequate cleaning of the pile base. General recommendations for the design and construction of bored CIP concrete piles are included in Appendix C.

An overall concreted pile shaft length below final grade of not less than 6.0 m is recommended. A minimum ratio of depth of cover versus the base or bell diameter (D/B) of 2.5 has been assumed to determine the above end-bearing pressure. Should less cover be provided, the bearing pressure would have to be reduced. Minimum bell diameters should be twice the shaft diameter. Piles should be spaced no closer than 2.5 times the base diameter measured centre-to-centre.

Groundwater seepage and sloughing should be expected in the pile bores during construction. Casing should be on hand before drilling starts and used to seal off water and/or prevent sloughing of the hole when encountered. The piling contractor should make his or her own estimate of casing requirements and should consider such factors as construction procedures and bore diameter.

5.5 Helical Piles

Helical piles are considered as an alternative option for this development, in particular preferred for light loaded structures. It is recommended that helical piles be considered only for statically loaded foundations (i.e., no dynamic load component). Design and construction recommendations for helical piles are provided in this section; however, it is noted that for the final design of this type of pile consideration should be given to the installation methodology of the specialty contractor, as the design capacity of helical piles is a function of the pile installation methodology.

Tetra Tech recommends using the CFEM (2006) design method for helical piles (CFEM Section 18.2.1.4). Using this methodology, the geotechnical parameters required to calculate the ultimate foundation capacity are provided in Table D. A minimum recommended depth for the upper helix is 2.1 m below the existing grade.

Table D: Geotechnical Parameters for Helical Piles

Depth (m)	Bulk Unit Weight (kN/m^3)	Undrained Shear Strength Cu (kPa)	Friction Angle* (Degrees)
0 to 3.0	18	-	-
3.0 to 6.0	19	25	26
Below 6.0	19	50	27

*Only for long-term strength consideration with zero cohesion.

The total helical pile capacity is presented in the CFEM (Equation 18.10) as follows:

$$R = Q_t + Q_f$$

Where:

R = Total ultimate capacity of the pile (kN).

Q_t = Total ultimate multi-helix pile capacity (kN).

Q_f = Ultimate capacity due to pile shaft skin friction (kN) (for pile shafts greater than 100 mm diameter only).

To calculate the multi-helix bearing capacity, the individual bearing method presented in CFEM Equations 18.11 and 18.12 should be used, provided the helical bearing plates are spaced a minimum of three times the diameter of the largest helix. Otherwise, the cylinder shear method should be used, with consideration of overlapping stress zones between helices. This method sums up the bearing capacity of the bottom plate and the cylindrical shear capacity developed between the upper and lower plate(s).

The factored geotechnical capacity for each pile may be determined as follows, using the soil resistance factors presented in Section 5.2:

- Factored Pile Compression Capacity = 0.4R
- Factored Pile Uplift Capacity = 0.3R

For helical piles, the helix or helices should be founded in competent native clay or clay till and below the depth of frost penetration. Vertically installed helical piles generally require an enlarged shaft diameter in order to adequately resist lateral loads, where applicable. For bottom helices with load influence depths lower than the maximum borehole termination depth of 9.6 m, a field drill program should be conducted to confirm the soil conditions in depth. Should any of these parameters become limiting factors in the design, Tetra Tech should be contacted for more detailed review and analysis.

Construction of helical piles should consider, but not be limited to, the following recommendations:

- As the helical piles are installed, the rate of rotation and advancement should match the pitch of the helix plate. This will help to avoid "churning" of the foundation soils. It is critical that the foundation bearing soil is not excessively disturbed in order to minimize the risk of excessive foundation settlement.
- An estimate of pile capacity may be obtained by correlating capacity to installation torque. This method requires that an appropriate torque factor be selected by the pile designer (in consultation with the piling contractor). Torque factors are selected based on soil type as well as pile shaft size and shape. This method of estimating pile capacity should be used as a quality control check and is not suitable to replace proper design procedures. Installation torque should be recorded using calibrated equipment, and the piling contractor should provide a recent calibration certificate (conducted a maximum of 1 year from pile installation) for each piling setup used on site.
- It should be noted that a high torque value can sometimes mislead estimation of bearing capacity. The occurrence of soft zones beneath the final pile depth are not represented in the recorded torque value but may adversely impact the load carrying capacity of the helical pile.
- Pile load testing is recommended. The results of the pile load tests can be correlated to the measured installation torque to develop site-specific installation criteria. In addition, a higher geotechnical resistance factor for compressive loading of 0.6 can be used if pile load testing is conducted prior to construction.

If lateral loading is considered critical to the pile performance, care must be taken during pile installation to identify voids developing around the pile shaft. Due to the nature of the pile installation process, it is common to develop voids that can significantly influence lateral loading on a pile. If voids develop, they should be backfilled with granular fill, sand, fillcrete, or grout depending on the size of the voids.

5.5.1 Surface Grading and Drainage

Drainage of surface water away from residences should be maintained during and after construction. The finished grade of the proposed residences should be designed so that surface water is drained away from residence structures by the shortest route. All drains should discharge well clear of residence structures. For construction of roof drains, caution should be taken where downspouts discharge due to the high probability of ice forming in the winter. Downspouts may be discharged onto landscaped areas, provided the water is carried, by means of a concrete splash pad or extendable section so the point of discharge of the water is at least 2 m from the residence structures. Landscaped surfaces adjacent to buildings should be graded to slope away from the building at a gradient of at least 5% within 2 m of the residence structures' perimeter. General landscaped areas should have grades of no less than 2% to minimize ponding.

5.5.2 Foundation Perimeter Drainage Requirements

It is recommended that a weeping tile and sump system be constructed around the outside perimeter of the buildings (at the base of the footings, if selected) to maintain a relatively consistent moisture profile of the subgrade soils. The weeping tile system should comprise a perforated weeping tile, in turn surrounded with a minimum of 150 mm

thick blanket of washed rock (maximum size 20 mm), with the granular layer wrapped in non-woven geotextile. The weeping tile should have a minimum 0.5% slope leading to a sump.

5.5.3 Below-Grade Walls

All below-grade walls should be designed to resist lateral earth pressures in an "at-rest" condition. This condition assumes a triangular pressure distribution and may be calculated using the following expression:

$$P_o = K_o (\gamma H + Q)$$

Where:

P_o = Lateral earth pressure "at-rest" condition (no wall movement occurs at a given depth).

K_o = Coefficient of earth pressure "at-rest" condition (use 0.5 for cohesive backfill and 0.45 for sand and gravel backfill).

γ = Bulk unit weight of backfill soil (use 19 or 21 kN/m³ for cohesive or granular backfill, respectively).

H = Depth below final grade (m).

Q = Surcharge pressure at ground level (kPa).

It is assumed that drainage will be provided for all below-grade walls through the installation of a weeping tile system, as described above, and hydrostatic pressures will not be a factor in design. The weeping tile should have a minimum 0.5% slope leading to a sump. The preferred method would be to have provision to tie the sump into the property's on-site drainage system.

Backfill around concrete walls should not commence before the concrete has reached a minimum two-thirds of its design strength and first floor framing is in place or the walls are laterally braced. Only hand-operated compaction equipment should be employed within 600 mm of the concrete walls. Caution should be used when compacting backfill to avoid high lateral loads caused by excessive compactive effort. A compaction standard of 95% of SPD is recommended. To avoid differential wall pressures, the backfill should be brought up evenly around the walls. A minimum 600 mm thick clay cap should be placed at the ground surface to reduce the infiltration of surface water.

5.5.4 Floor Slab System

5.5.4.1 Floor Slabs-on-Grade

Construction of floor slabs-on-grade for this project (outside of basements) must consider the surficial clay noted within the development area. Construction may be considered feasible, provided the following precautions and construction recommendations are followed.

In native soils areas, following removal of topsoil, the subgrade should be scarified to a minimum depth of 300 mm, and moisture conditioned to a range of optimum to 2% over OMC. In areas of general engineered fill placed during site grading, a minimum depth of 150 mm subgrade preparation is recommended; if weathering is evident, 300 mm subgrade preparation is required. The minimum compaction should be 98% of SPD. The prepared subgrade should be proof-rolled and any soft or loose pockets detected should be reconditioned, as recommended above, or over-excavated and replaced with general engineered fill.

A levelling course of clean well-graded crushed gravel, at least 150 mm in compacted thickness, is recommended directly beneath the slabs-on-grade, unless a thicker course is required for structural purposes. The subgrade

beneath slabs-on-grade should be protected at all times from moisture or exposure which may cause softening or disturbance of the subgrade soils. This applies during and after the construction period (and before and after placement of the required general engineered fill). Should the exposed surface become saturated or disturbed, it should be reworked to achieve the above standards.

If a raised grading is to be considered, a waiting period prior to installation of floor slabs should be provided to reduce the potential settlement after construction. See Section 5.1.2 for more detailed discussion. Slabs-on-grade should be separated from bearing members to allow some differential movement. If this differential movement is unacceptable, the owner should consider a structurally supported floor.

Recommended procedures for compaction and backfill materials, and further recommendations for floor slabs-on-grade construction are included in Appendix C.

5.5.4.2 Structural Slabs

If slab movements cannot be tolerated, a structurally supported floor slab system is recommended as the preferred option for this development; however, with a structurally supported floor slab system, there is a risk of ground movement relative to the slab. This relative movement can lead to problems if piping and other utilities that are connected to the slab are embedded within the ground beneath the slab. Utilities beneath the structurally supported floor slabs should be protected from differential movement by placing utilities within boxes suspended from the structural slab. In addition, a void form is recommended below the floor slab in order to prevent transfer of uplift pressures due to swelling clay soil.

5.5.5 Seismic Design

The site classification recommended for seismic site response is Classification D, as noted in Table 4.1.8.4.a of the 2019 National Building Code – Alberta Edition.

5.5.6 Concrete Type

Based on soluble sulphate concentration test results from selected samples taken during the field program and Tetra Tech's experience on local soils, the properties of concrete for foundations in contact with soil shall meet the requirements of the Canadian Standards Association (CSA) A23.1-14, Class S-2 exposure including water/cementing materials (w/cm) ratio of 0.45, air entrainment of 4% to 7% (for 14 mm to 20 mm nominal maximum aggregate size), and a minimum specified 56-day compressive strength of 32 MPa.

For this exposure classification, alternatives include the usage of Type HS (sulphate-resistant) Portland Cement or blends of cement and supplementary cementing materials conforming to Type HSb cements.

5.5.7 Frost Protection

For protection against frost action, all perimeter footings must be placed a minimum of 1.4 m below final grade for heated structures, or 2.1 m for unheated structures.

CIP concrete or helical piles, if considered and exposed to frost action, should have a minimum length of 6 m and should have full-length steel reinforcement. A void form is recommended for all grade beams and pile caps, to accommodate movements due to frost or soil swelling.

Pipes buried with less than 2.1 m of soil cover should be protected with insulation to avoid frost effects that might cause damage to, or breakage of, the pipes. Rigid insulation placed under areas subject to vehicular wheel loadings should be provided with a minimum thickness of 600 mm of compacted granular base.

6.0 DESIGN AND CONSTRUCTION GUIDELINES

Recommended general design and construction guidelines are provided in Appendix C, under the following headings:

- Shallow Foundations
- Bored Cast-in-Place Concrete Piles
- Floor Slabs-on-Grade
- Construction Excavations
- Backfill Materials and Compaction

These guidelines are intended to present standards of good practice. Although supplemental to the main text of this report, they should be interpreted as part of the report. Design recommendations presented herein are based on the premise that these guidelines will be followed. The design and construction guidelines are not intended to represent detailed specifications for the works although they may prove useful in the preparation of such specifications. In the event of any discrepancy between the main text of this report and Appendix C, the main text should govern.

7.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully Submitted,
Tetra Tech Canada Inc.

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/tlp

PERMIT TO PRACTICE
TETRA TECH CANADA INC.

RM SIGNATURE: _____

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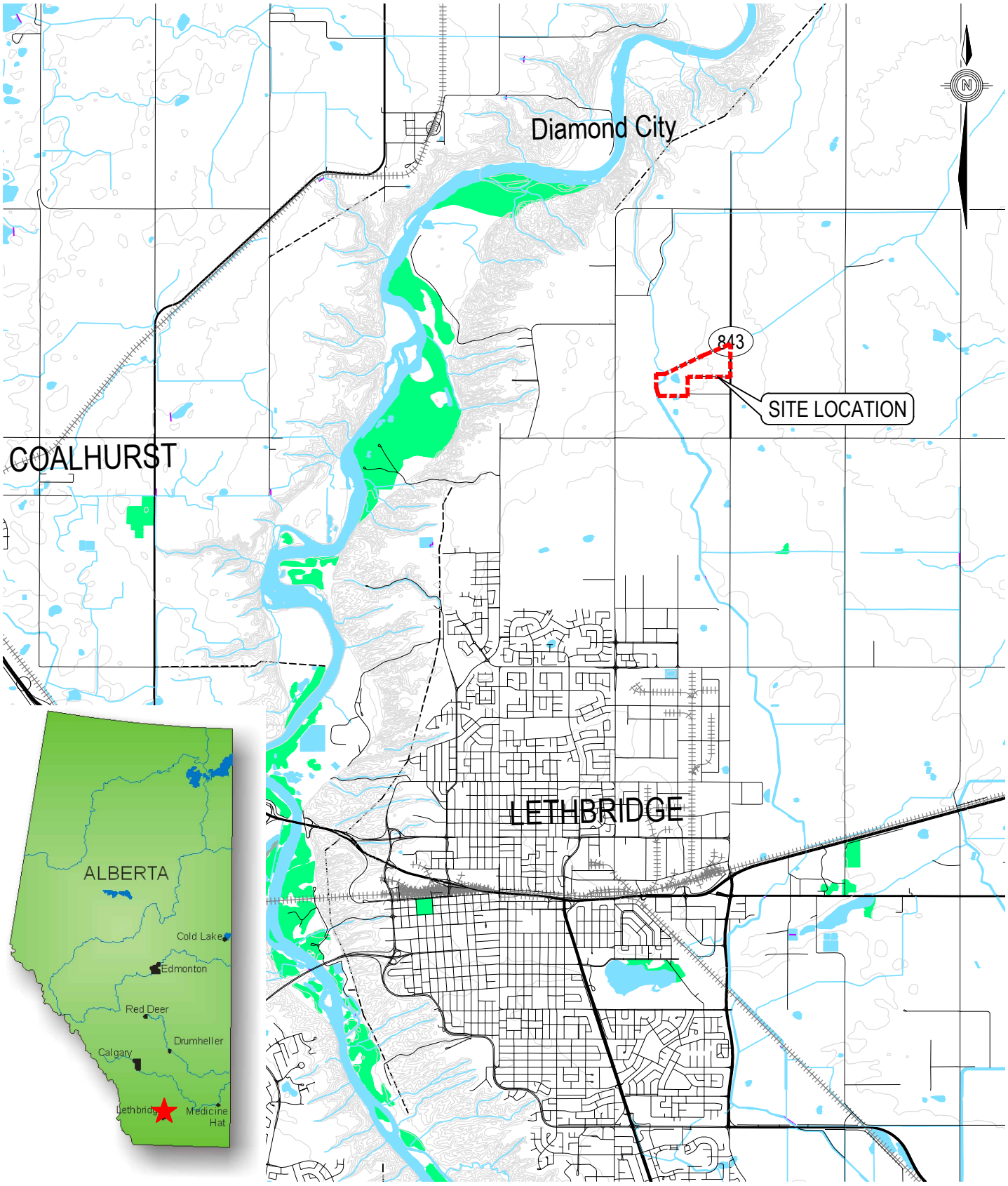
DATE: _____

PERMIT NUMBER: P013774
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

FIGURES



NOTES

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0 2,500m

Scale: 1:75,000 @ 8.5"x11"

CLIENT

Mr. Rick Aldoff

TETRA TECH

GEOTECHNICAL EVALUATION
MacLAINE ACRES ASP

SITE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
LGEO04408-01.001	LCH	VO	0

OFFICE	DATE
Tt Leth	October 2021

Figure 1

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LEGEND

SITE BOUNDARY

BOREHOLE LOCATION

0 200m

Scale: 1:4,000 @ 11"x17"

NOTES

GOOGLE EARTH IMAGERY DATED 2021.

BASE DRAWING PROVIDED BY CLIENT, DATED JULY 15, 2021.

CLIENT

Mr. Rick Aldoff

TETRA TECH

GEOTECHNICAL EVALUATION
MacLAINE ACRES ASP

BOREHOLE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
LGEO04408-01.001	LCH	VO	0

OFFICE: Tt Leth

DATE: October 2021

Figure 2

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APPENDIX A
LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this document, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to explore, address or consider and has not explored, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems, methods and standards employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historical environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional exploration and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity can impact structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques, and construction sequence are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, and the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function. Where temporary or permanent drainage systems are installed within or around a structure, these systems must protect the structure from loss of ground due to mechanisms such as internal erosion and must be designed so as to assure continued satisfactory performance of the drains. Specific design details regarding the geotechnical aspects of such systems (e.g. bedding material, surrounding soil, soil cover, geotextile type) should be reviewed by the geotechnical engineer to confirm the performance of the system is consistent with the conditions used in the geotechnical design.

1.16 DESIGN PARAMETERS

Bearing capacities for Limit States or Allowable Stress Design, strength/stiffness properties and similar geotechnical design parameters quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition used in this report. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions considered in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

1.18 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This document has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. TETRA TECH cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.

APPENDIX B
BOREHOLE LOGS

TERMS USED ON BOREHOLE LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N (blows per 0.3m)
Very Loose	0 TO 20%	0 to 4
Loose	20 TO 40%	4 to 10
Compact	40 TO 75%	10 to 30
Dense	75 TO 90%	30 to 50
Very Dense	90 TO 100%	greater than 50

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

FINE GRAINED SOILS (major portion passing 0.075mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (KPA)
Very Soft	Less than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

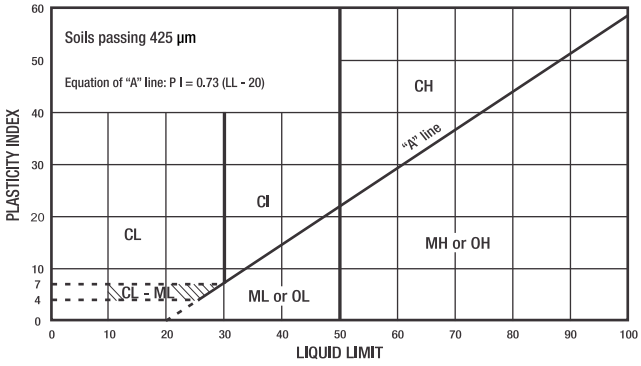
GENERAL DESCRIPTIVE TERMS

Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated - composed of thin layers of varying colour and texture.
Interbedded - composed of alternate layers of different soil types.
Calcareous - containing appreciable quantities of calcium carbonate.;
Well graded - having wide range in grain sizes and substantial amounts of intermediate particle sizes.
Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA		
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines: Less than 5% Pass 75 µm sieve; More than 12% Pass 75 µm sieve; 5% to 12% Pass 75 µm sieve. GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols	$C_U = D_{60} / D_{10}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above "A" line or plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines		$C_U = D_{60}/D_{10}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above "A" line or plasticity index greater than 7	
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS	Liquid limit <50	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity	For classification of fine-grained soils and fine fraction of coarse-grained soils.		
		Liquid limit >50	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			
	CLAYS Above "A" line on plasticity chart negligible organic content	Liquid limit <30	CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays			
		Liquid limit 30-50	CI	Inorganic clays of medium plasticity, silty clays			
		Liquid limit >50	CH	Inorganic clays of high plasticity, fat clays			
	ORGANIC SILTS AND CLAYS	Liquid limit <50	OL	Organic silts and organic silty clays of low plasticity			
		Liquid limit >50	OH	Organic clays of medium to high plasticity			
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils			

PLASTICITY CHART



*Based on the material passing the 75 mm sieve
Reference: ASTM Designation D2487, for identification procedure see D2488. USC as modified by PFRA

SOIL COMPONENTS

FRACTION	SIEVE SIZE PASSING	SIEVE SIZE RETAINED	DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS: PERCENTAGE	DESCRIPTOR
GRAVEL				
coarse	75 mm	19 mm	>35 %	"and"
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"
SAND				
coarse	4.75 mm	2.00 mm	10 to 20 %	"some"
medium	2.00 mm	425 µm		
fine	425 µm	75 µm	>0 to 10 %	"trace"
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior	

OVERSIZE MATERIAL

Rounded or subrounded

COBBLES	75 mm to 300 mm
BOULDERS	> 300 mm

Not rounded

ROCK FRAGMENTS	>75 mm
ROCKS	> 0.76 cubic metre in volume

Tt_Modified Unified Soil Classification.cdr

TETRA TECH

BOREHOLE KEYSHEET

Water Level Measurement

 Measured in standpipe, piezometer or well

 Inferred

Sample Types

 A-Casing

 Core

 Disturbed, Bag, Grab

 HQ Core

 Jar

 Jar and Bag

 NQ Core

 No Recovery

 Split Spoon/SPT

 Tube

Backfill Materials

 Asphalt

 Bentonite

 Cement/ Grout

 Drill Cuttings

 Grout

 Gravel

 Sand

 Slough

 Topsoil Backfill

Lithology - Graphical Legend[1]

 Asphalt

 Bedrock

 Cobbles/Boulders

 Clay

 Coal

 Concrete

 Fill

 Gravel

 Limestone

 Mudstone

 Organics

 Peat

 Sand

 Sandstone

 Shale

 Silt

 Siltstone

 Till

 Topsoil

1. The graphical legend is an approximation and for visual representation only. Soil strata may comprise a combination of the basic symbols shown above. Particle sizes are not drawn to scale

TETRA TECH

Martin Geomatic Consultants Ltd.

Borehole No: **21BH001**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 901.593 m
Lethbridge County, AB I N: 5514246 E: 371761	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		CLAY (FILL) - silty, some sand, moist, firm, medium plastic, dark grey, organics, trace rootlets.							901
		CLAY - silty, some sand, very moist, soft, medium plastic, light brown, trace rootlets.		B1		30.4			
1				B2		28.9			
		CLAY (TILL) - silty, some sand, trace gravel, very moist, soft, medium plastic, light brown, coal and oxide specks, very moist to wet sand pockets.		D1	4	29.9			900
2		... high plastic clay inclusions.		B3					
		... trace sand, soft, high plastic, light brown with dark brown mottling.		B4		30.8			899
3	Solid stem auger			D2	3	29.4			
		... some sand, trace gravel, firm, medium plastic, with high plastic clay pockets.		B5					898
4		... sand pockets.							
		... high plastic clay inclusions.		B6		28.9			
				D3	6				897
5				B7		24.6			
		... moist, stiff.		B8					896
6		... occasional sand pockets.		D4	12	17			
		End of Borehole at 6.6 m							895
7		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 6.6 m Indicated water level measured on September 16, 2021.							894
8									

2021-09-16

2021-09-16

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH002**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 902.708 m
Lethbridge County, AB I N: 5514138 E: 371678	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		CLAY (FILL) - silty, some sand, moist, firm, medium plastic, dark grey, organics, trace rootlets.							
		CLAY - silty, some sand, damp to moist, firm, medium plastic, light brown, silt lenses and trace rootlets.		B1		12.9			902
1		CLAY (TILL) - silty, some sand, trace gravel, moist, firm, medium plastic, brown, coal and oxide specks.		B2		14			
		... silt pockets, trace rootlets.							
		SAND, silty, trace clay, well graded, fine to medium grained, moist, loose, light brown.		D1	5				901
2	Solid stem auger	... silty, some sand, trace gravel, moist, soft, medium plastic, light brown, coal and oxide specks, with sand lenses throughout.		B3		16			
				B4		18.1			
3	2021-09-16	... wet sand layer (200mm), uniform, fine grained, moist, loose and light brown.		D2	5				900
				B5		18.1			899
4				B6					
		... moist, stiff.		D3	10	15.7			898
5		End of Borehole at 5.1 m							
		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 5.1 m Indicated water level measured on September 16, 2021.							897
6									
7									896
8									895

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 5.1 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH003**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 903.296 m
Lethbridge County, AB I N: 5514178 E: 371538	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		CLAY (FILL) - silty, trace to some sand, moist, firm, medium plastic, grey, trace rootlets.							903
		CLAY - silty, trace to some sand, very moist, very soft, medium to high plastic, light brown, trace rootlets.		B1		30.7			
1				B2		26.7			902
		CLAY (TILL) - silty, some sand, trace gravel, very moist, very soft, medium plastic, light brown, coal and oxide specks, high plastic clay inclusions.		D1	0				
2		... trace free water		B3		27.8			
		... some sand to sandy, low to medium plastic, intermixed with wet sand layer.							901
		... sand inclusions, coal staining.		B4		25.1			
3	Solid stem auger	... very moist to moist.		D2	7				900
				B5		18			
4				B6					899
		... moist, firm.		D3	7	17.9			
5		... coal and oxide staining.		B7					
				B8					898
6		... moist, stiff.							
		... soluble sulfate content = 0.474% @ 6.1m		D4	9	16.6			897
		End of Borehole at 6.6 m							
7		Seepage at 1.75 m. Sloughing up to 8 ft (2.4 m) on Completion of Borehole 1" Slotted PVC Pipe Installed to 2.4 m Indicated water level measured on September 16, 2021.							896
8									

2021-09-16

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH004**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 904.804 m
Lethbridge County, AB I N: 5514095 E: 371340	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		CLAY (FILL) - silty, some sand, trace gravel, moist, firm, medium plastic, grey, organics, trace rootlets and high plastic clay inclusions.							
		CLAY - silty, trace to some sand, very moist, soft, medium to high plastic, grey brown, trace rootlets.		B1		30.5			
1		2021-09-16		B2					904
		CLAY (TILL) - silty, some sand, trace gravel, moist to very moist, soft, medium plastic, brown, coal and oxide specks, wet sand inclusion.							
		... trace free water.		D1	4	22.1			
2	Solid stem auger	... very moist, soft to very soft, light brown		B3		23			903
		... wet sand layer (150mm), uniform, fine grained, loose, light brown.							
		... coal staining, silt and sand inclusions.		B4		22.3			
3		... moist, firm.		D2	8				902
				B5		19.2			
4				B6					901
		... moist, stiff, heavy coal and oxide staining.		D3	9	16.5			
5		End of Borehole at 5.1 m							900
		Seepage at 1.5 m. Sloughing up to 10 ft (3 m) on Completion of Borehole 1" Slotted PVC Pipe Installed to 3.0 m Indicated water level measured on September 16, 2021.							899
6									
7									898
8									897

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 5.1 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH005**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 900.977 m
Lethbridge County, AB I N: 5513965 E: 371849	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Elevation (m)
0		TOPSOIL- clay, silty, sandy, moist, brown, organics and trace rootlets.					
		CLAY - silty, some sand, moist, soft to firm, medium plastic, brown with grey brown mottling, trace rootlets.					
		... silt pockets.		B1		22.3	
1							900
		... very moist, very soft.		B2		27.2	
		CLAY (TILL) - silty, some sand, trace gravel, very moist, very soft, medium plastic, brown with grey brown mottling, coal and oxide specks.		D1	1		
		... trace free water.					
2	Solid stem auger	... moist to very moist, firm, silt pockets and trace gravel up to 14mm.		B3		20.4	899
		... coal fragments.		B4		22.6	
3				D2	5		898
		... sand pockets.		B5		22.1	
4							897
				B6			
		... trace gravel up to 20mm, oxide staining throughout.		D3	8	17.7	
5							896
		End of Borehole at 5.1 m					
		Seepage at 1.5 m. No Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 5.1 m Indicated water level measured on September 16, 2021.					
6							895
7							894
8							893

Plastic Limit / Moisture Content / Liquid Limit: 20 40 60 80

SPT (N): 20 40 60 80

Pocket Pen. (kPa): 100 200 300 400

2021-09-16

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 5.1 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH006**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 902.814 m
Lethbridge County, AB I N: 5513975 E: 371720	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		TOPSOIL - clay, silty, sandy, moist, grey, organics, trace rootlets.							
		CLAY - silty, some sand, moist to very moist, very soft, medium plastic, light brown, trace rootlets.		B1		29.2			
1									902
		... very moist, very soft.		B2					
		CLAY (TILL) - silty, some sand, trace gravel, moist, soft, medium plastic, brown, coal and oxide specks, sand and silt pockets, trace rootlets.		D1	4	18.3			
2		... soft to firm.		B3		18.4			901
				B4					
3	Solid stem auger	... moist to very moist, soft, occasional sand pockets, coal inclusions.		D2	4	21.6			900
		... light brown with dark brown mottling.		B5					
4									899
		... moist, soft to firm.		B6		18.6			
		... firm, sand inclusions.		D3	5				898
5				B7		18.3			
				B8					
6									897
		... stiff.		D4	11	16.8			
		End of Borehole at 6.6 m							896
7		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 6.6 m Indicated water level measured on September 16, 2021.							
8									895

2021-09-16

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH007**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 904.324 m
Lethbridge County, AB I N: 5513993 E: 371565	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		TOPSOIL - clay, silty, sandy, moist, dark grey, organics, trace rootlets.							
		CLAY - silty, some sand, moist, very soft, medium plastic, light brown, trace rootlets, high plastic clay inclusions.							
		... soft.		B1		22.7			
1				B2		24			903
		CLAY (TILL) - silty, some sand, trace gravel, very moist, very soft, medium plastic, dark brown, coal and oxide specks, high plastic clay inclusions.		D1	2	25.7			
2	Solid stem auger	... silt pockets & laminations, trace free water.		B3					
		... moist to very moist.		B4		23.7			902
3		... firm, sand inclusion / seam up to 25mm, well graded, fine to medium grained.		D2	8	16.4			
		SAND, silty, trace clay, well graded, fine grained, moist, loose, brown.							901
		... some sand, moist, firm, medium plastic, sand inclusions.		B5		18.3			
4				B6					900
		... moist, stiff, trace gravel up to 19mm.							
5		... sand inclusion - uniform, fine grained, very wet, loose to compact, light brown.		D3	14	15.5			
		End of Borehole at 5.1 m							899
		Seepage at 1.5 m. No Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 5.1 m Indicated water level measured on September 16, 2021.							
6									898
7									897
8									

2021-09-16 (Depth)

2021-09-16 (Elevation)

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 5.1 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: 21BH008

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 905.857 m
Lethbridge County, AB I N: 5513989 E: 371400	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		TOPSOIL - clay, silty, sandy, moist, grey, organics and trace rootlets							
		CLAY - silty, some sand, moist, firm, medium plastic, light brown, trace rootlets.		B1		20.1			905
1									
		CLAY (TILL) - silty, some sand, trace gravel, moist, firm, medium plastic, light brown, coal and oxide specks		B2					
		... moist, stiff, silt lenses and coal inclusions.		D1	9	16.6			
2		... sand pockets.		B3					904
		... light brown with dark brown mottling.		B4		15.9			
3	Solid stem auger			D2	9	16.6			903
		... moist, firm.		B5					
4				B6		16.5			902
		... stiff, sand pockets.		D3	14				
5		... trace gravel up to 20mm.		B7		15.5			901
				B8					
6									900
		... wet sand seam up to 35mm, poorly graded, fine to medium grained, loose, light brown.		D4	11	15.9			
		End of Borehole at 6.6 m							
7		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 6.6 m Indicated water level measured on September 16, 2021.							899
8									898

2021-09-16

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH009**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 906.377 m
Lethbridge County, AB I N: 5513913 E: 371204	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		TOPSOIL - clay, silty, sandy, moist, dark brown, organics and trace rootlets.							906
		CLAY - silty, trace sand, damp, stiff, high plastic, brown, white precipitates, silt lenses throughout, and trace rootlets							
		CLAY (TILL) - silty, trace to some sand, trace gravel, damp to moist, stiff, medium to high plastic, light brown, coal and oxide specks, silt lenses.		B1		9.9	●		
1		... white precipitates, trace rootlets							
		... some sand, trace gravel, moist, stiff, medium plastic, light brown with dark brown mottling.		B2				▲	905
		... moist to very moist, soft, saturated sand lenses.		D1	3	16	●	■	
2	Solid stem auger	... coal inclusions throughout.		B3				▲	
				B4		14.1	●	▲	904
3		... oxide staining.		D2	4	15.7	●	■	
	2021-09-16 ▼								903 ▼ 2021-09-16
		... moist, soft to firm, sand pockets.		B5		16.1	●	▲	
4				B6				▲	902
		... moist, firm.		D3	5	14.5	●	■	
5		End of Borehole at 5.1 m							901
		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 5.1 m Indicated water level measured on September 16, 2021.							
6									900
7									899
8									

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 5.1 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH010**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 905.791 m
Lethbridge County, AB I N: 5513936 E: 371104	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		TOPSOIL - clay, silty, sandy, moist, dark brown, organics, trace rootlets.							
		CLAY - silty, some sand, damp to moist, stiff, medium plastic, dark brown, silt lenses, oxide specks.		B1		12.7			905
1		CLAY (TILL) - silty, some sand, trace gravel, moist, firm, medium plastic, light brown, coal and oxide specks.		B2		18.6			
		... oxide staining throughout.		D1	7				904
2		... firm to stiff.		B3		18.2			
		... stiff, coal staining.		B4					
		2021-09-16							903
3	Solid stem auger	... sand lenses throughout.		D2	9	17.3			
		... trace sand, moist, firm, high plastic, light brown, coal inclusions.		B5					902
4				B6		18.5			
		... some sand, medium plastic, light brown with dark brown mottling and high plastic clay inclusions.		D3	8				901
5				B7		16.7			
				B8					
6		... oxide staining throughout ... trace free water.		D4	6	17.5			900
		End of Borehole at 6.6 m							
7		Seepage at 6.1 m. No Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 6.6 m Indicated water level measured on September 16, 2021.							899
8									898

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH011**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 906.75 m
Lethbridge County, AB I N: 5513829 E: 371106	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0		TOPSOIL - clay, silty, sandy, damp, dark brown, organics, trace rootlets.							
		CLAY - silty, some sand, damp to moist, firm, medium plastic, brown, silt lenses and laminations.		B1		15.5			906
1		CLAY (TILL) - silty, some sand, trace gravel, moist, firm, medium plastic, brown, coal and oxide specks.		B2		12.5			
		... sand and silt pockets.		D1	8	15			905
2		... sand inclusions.		B3					
		SAND, silty, trace clay, trace gravel, well graded, fine to medium grained, moist, loose, light brown, subrounded up to 50mm.		B4		7.2			904
3	Solid stem auger	... some sand, moist, firm, medium plastic, coal and oxide specks, sand inclusions.		D2	8	16.3			
		... moist, stiff, oxide staining.		B5					903
4		... trace gravel up to 40mm.		B6		16.3			
		... sand pockets.		D3	9				902
5		... coal staining.		B7		16.4			
				B8					901
6				D4	9	16.1			
		End of Borehole at 6.6 m							900
7		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 6.6 m Indicated water level measured on September 16, 2021.							899
8									

2021-09-16

2021-09-16

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH012**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 907.541 m
Lethbridge County, AB I N: 5513825 E: 370966	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	21BH012	Elevation (m)
0		TOPSOIL - clay, silty, sandy, moist, dark brown, organics and trace rootlets.								
		CLAY - silty, some sand, moist, firm, medium plastic, brown, silt lenses, trace rootlets.		B1		18.6				907
1				B2						
		CLAY (TILL) - silty, some sand, trace gravel, moist, firm, medium plastic, light brown, coal and oxide specks, sand pockets.		D1	6	19.3				906
2		... silt and sand pockets.		B3		16.5				
				B4						905
3		... moist to very moist, soft to firm.		D2	4	19.8				
										904
4	Solid stem auger	... moist, firm, light brown with grey brown mottling.		B5						
				B6		17.5				903
				D3	8					
5				B7		18				
				B8						902
6		... wet sand layer (up to 250mm), well graded, fine to medium grained, light brown.								
				D4	9	16.9				901
		... moist, stiff.								
		... oxide staining.		B9						
7										
				B10		15.4				900
				D5	10					
8		... wet sand layer (up to 200mm), well graded, fine to medium grained, light brown.		B11		16.1				
				B12						899
9										
		... sand pockets.		D6	14	14.7				
										898
		End of Borehole at 9.6 m								
10		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 9.6 m Indicated water level measured on September 16, 2021.								
										897
11										
										896
12										

2021-09-16

2021-09-16

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 9.6 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH013**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 907.373 m
Lethbridge County, AB I N: 5513715 E: 371198	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Elevation (m)
0		TOPSOIL - clay, silty, sandy, damp, brown, organics, trace rootlets.					907
		CLAY - silty, some sand, damp, very stiff, medium plastic, light brown, trace rootlets.		B1		10.7	
1		... soluble sulfate content = 0.006% @ 1.2m		B2		12.7	906
		CLAY (TILL) - silty, trace to some sand, trace gravel, damp, very stiff, medium to high plastic, brown, coal and oxide specks.		D1	19		
2	Solid stem auger	... damp to moist.		B3		10.2	
				B4		11.8	905
3		... high plastic clay inclusions.		D2	19		
							904
		... some sand, moist, stiff, medium plastic, brown, sand pockets.		B5		13.1	
4							
		... oxide staining.		B6			903
		... sand pockets, high plastic clay inclusions.		D3	14	16.6	
5		End of Borehole at 5.1 m					902
		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 5.1 m Borehole measured dry on September 16, 2021.					
6							901
7							
							900
8							

Plastic Limit / Moisture Content / Liquid Limit: 20 40 60 80

SPT (N): 20 40 60 80

Pocket Pen. (kPa): 100 200 300 400

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 5.1 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

Martin Geomatic Consultants Ltd.

Borehole No: **21BH014**

Project: MacLaine Acres ASP Prelim Septic FA - Geo Eval	Project No: 704-ENG.LGEO04408-01
Location: Latitude: 49.765717 Longitude: -112.783223	Ground Elev: 907.559 m
Lethbridge County, AB I N: 5513741 E: 370954	PROJECT ENGINEER: Jackson Meadows

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	21BH014	Elevation (m)
0		TOPSOIL - clay, silty, sandy, damp, dark brown, organics and trace rootlets.								
		CLAY - silty, some sand, very moist to moist, soft to firm, medium plastic, brown, silt pockets, trace rootlets.		B1		22.2				907
1		CLAY (TILL) - silty, some sand, trace gravel, moist to very moist, firm, medium plastic, light brown, coal and oxide specks, sand and silt pockets.		B2		20				
		... wet sand pockets.		D1	5					906
2		... coal staining, brown with grey brown mottling.		B3		19.1				
				B4		18.7				905
3		... moist, stiff, sand and silt pockets, oxide staining.		D2	10					
				B5		17.5				904
4	Solid stem auger			B6						
		... sand layer (100mm), well graded, fine to medium grained, moist, light brown.		D3	11	16.1				903
5				B7						
		... sand inclusion, oxide staining.		B8		15.6				902
6				D4	14					
		... trace gravel up to 50mm, subangular to subrounded.		B9		13.9				901
7				B10						
		... moist, very stiff, coal fragments.		D5	16	14.7				900
8				B11						
				B12						899
9		... sand pockets.		D6	17	14.2				
		End of Borehole at 9.6 m								898
10		No Seepage or Sloughing on Completion of Borehole 1" Slotted PVC Pipe Installed to 9.6 m Indicated water level measured on September 16, 2021.								
										897
11										
										896
12										

2021-09-16

2021-09-16

TETRA TECH

Contractor: CHILAKO DRILLING LTD.	Completion Depth: 9.6 m
Drilling Rig Type: 150 mm Solid Stem	Start Date: September 9, 2021
Logged By: VO	Completion Date: September 9, 2021
Reviewed By: JZ	Page 1 of 1

APPENDIX C
DESIGN AND CONSTRUCTION GUIDELINES

SHALLOW FOUNDATIONS

Design and construction of shallow foundations should comply with relevant Building Code requirements.

The term ‘shallow foundations’ includes strip and spread footings, mat slab, and raft foundations.

Minimum footing dimensions in plan should be in accordance with the applicable design code of the local jurisdiction.

No loose, disturbed or sloughed material should be allowed to remain in open foundation excavations. Hand cleaning should be undertaken to prepare an acceptable bearing surface.

Foundation excavations and bearing surfaces should be protected from rain, snow, freezing temperatures, excessive drying, and the ingress of free water before, during, and after footing construction.

Footing excavations should be carried down into the designated bearing stratum.

After the bearing surface is approved, a mud slab should be poured to protect the soil against inclement weather and provide a working surface for construction.

All constructed foundations should be placed on unfrozen soils, which should be at all times protected from frost penetration.

All foundation excavations and bearing surfaces should be inspected by a qualified geotechnical engineer to check that the recommendations contained in this report have been followed.

Where over-excavation has been carried out through a weak or unsuitable stratum to reach into a suitable bearing stratum or where a foundation pad is to be placed above stripped natural ground surface such over-excavation may be backfilled to subgrade elevation utilizing either structural fill or lean-mix concrete. These materials are defined below:

- “Structural engineered fill” should comprise clean, well-graded granular soils.
- “Lean-mix concrete” should be low strength concrete having a minimum 28-day compressive strength of 3.5 MPa.

BORED CAST-IN-PLACE CONCRETE PILES

Design and construction of piles should comply with relevant Building Code requirements.

Piles should be installed under full-time inspection of qualified geotechnical personnel. Pile design parameters should be reviewed in light of the findings of the initial bored shafts drilled on a site. Further design review may be necessary if conditions observed during site construction do not conform to design assumptions.

Where fill material or lenses or strata of sand, silt or gravel are present within the designed pile depth, these may be incompetent and/or water bearing and may cause sloughing. Casing should be on hand before drilling starts and be used, if necessary, to seal off water and/or prevent sloughing of the bore.

If piles are to be underreamed (belled), the underreams should be formed entirely in self-supporting soil and entirely within the competent bearing stratum. Where sloughing occurs at design elevation it may be necessary to extend the base of the pile bell to a greater depth. Piles may be constructed with bells having outside diameters up to approximately three times the diameters of their shafts. Piles with shaft diameters of less than 400 mm should not be underreamed due to difficulties associated with ensuring a clean base.

Prior to pouring concrete, bottoms of pile bells or of straight shaft end bearing piles should be mechanically cleaned of all disturbed material.

Pile bores should be visually inspected after completion to ensure that disturbed materials and/or water are not present on the base so that recommended allowable bearing and skin friction parameters may apply.

Other procedures to inspect the pile shafts may be used where shaft diameters of less than 760 mm (30 inch) are constructed, such as, inspection with a light or with the use of a downhole camera.

For safety reasons, where hand cleaning and/or 'down shaft' inspection by personnel are required, the pile shaft must be cased full length prior to personnel entering the shaft.

Reinforcing steel should be on hand and should be placed as soon as the bore has been completed and approved.

Longitudinal reinforcing steel is recommended to counteract the possible tensile stresses induced by frost action and should extend to a minimum depth of 3.5 m. A minimum steel of 0.5 percent of the gross shaft area is recommended or per applicable building code requirements.

Where a limited quantity of water is present on the pile base (<50 mm), it should be removed. Where significant quantities of water are present (>50 mm), and it is impracticable to exclude water from the pile bore, concrete should be placed by tremie techniques or a concrete pump.

A "dry" pile should be poured by "free fall" of concrete only where impact of the concrete against the reinforcing cage, which can cause segregation of the concrete, will not occur. A hopper should be used to direct concrete down the centre of the pile base and to prevent impact of concrete against reinforcing steel.

Concrete used for "dry" uncased piles should be self-compacting and should have a target slump of 125 mm. Where casing is required to prevent sloughing or seepage, the slump should be increased to 150 mm. The casing should be filled with concrete and then the casing should be withdrawn smoothly and continuously. Sufficient concrete should be placed to allow for the additional volume of the casing and reduction in level of the concrete as the casing is withdrawn. Concrete should not be poured on top of previously poured concrete, after the casing is withdrawn. In order to comply with maximum water:cement ratios for the concrete, the use of chemicals (or superplasticizers) to temporarily increase the slump may be required. Concrete for each pile should be poured in one continuous operation and should be placed immediately after excavation and inspection of piles, to reduce the opportunity for the ingress of free water or deterioration of the exposed soil or rock.

If piles cannot be formed in dry conditions then the concrete should be placed by tremie tube or concrete pump. Concrete placed by tremie should have a slump of not less than 150 mm. A ball or float should be used in the tremie tube to separate the initial charge of concrete from the water in the pile bore. The outlet of the tremie tube should be maintained at all times 1.0 m to 2.0 m below the surface of the concrete. The diameter of the tremie tube should be at least 200 mm. The tube should be water tight and not be made of aluminum. Smaller diameter pipes may be used with a concrete pump. The surface of the concrete should be allowed to rise above the cut off level of the pile, so that when the temporary casing is withdrawn and the surface level of the concrete adjusts to the new volume, the top of the uncontaminated concrete is at or above the cut off level. The concrete should be placed in one continuous smooth operation without any halts or delays. Placing the lower portion of the pile by tremie tube and placing the upper portion of the pile by "free fall" should not be permitted, to ensure that defects in the pile shaft at the top of the tremie concrete do not occur. As the surface of the concrete rises in the pile bore the water in the pile bore will be displaced upwards and out of the top of the pile casing.

When concreting piles by tremie techniques, allowance should be made for the removal of contaminated or otherwise defective concrete at the tops of the piles.

An accurate record of the volume of concrete placed should be maintained as a check that a continuous pile had been formed.

Concrete should not be placed if its temperature is less than 5°C or exceeds 30°C, or if it is more than two hours old.

Where tension, horizontal or bending moment loading on the pile is foreseen, steel reinforcing should be extended and tied into the grade beam or pile cap. The steel should be designed to transfer loads to the required depth in the pile and to resist resultant bending moments and shear forces.

Void formers should be placed beneath all grade beams to reduce the risk of damage due to frost effects or soil moisture changes.

Where the drilling operation might affect the concrete in an adjacent pile (i.e., where pile spacing is less than approximately three diameters) drilling should not be carried out before the previously poured pile concrete has set for at least 24 hours.

Where a group of four or more piles are used the allowable working load on the piles may need to be modified to allow for group effects.

Piles should be spaced no closer than 2.5 times the pile shaft diameter, measured centre-to-centre. Strict control of pile location and verticality should be exercised to provide accurate locations and spacings of piles. In general, piles should be constructed within a tolerance of 75 mm plan distance in any direction and within a verticality of 1%.

A detailed record should be kept of pile construction; the following information should be included, pile number, shaft/base diameter, date and time bored, date and time concreted, elevation of piling platform, depths (from piling platform level) to pile base and to concrete cut off level, length of casing used, details of reinforcement, details of any obstructions, details of any groundwater inflows, brief description of soils encountered in the bore and details of any unusual occurrences during construction.

If a large number of piles are to be installed, it may be possible to optimize the design on the basis of pile load tests or conducting high strain dynamic pile testing.

FLOOR SLABS-ON-GRADE

All soft, loose or organic material should be removed from beneath slab areas. If any local 'hard spots' such as old basement walls or abandoned pile foundation are revealed beneath the slab area, these should be over-excavated and removed to not less than 0.9 m below underside of slab level. The exposed soil should be proof-rolled and the final grade restored by engineered fill placement. If proof-rolling reveals any soft or loose spots, these should be excavated and the desired grade restored by engineered fill placement. The subgrade should be compacted to a depth of not less than 0.3 m to a density of not less than 98 percent Standard Proctor Maximum Dry Density (ASTM Test Method D698).

If, for economic reasons, it is considered desirable to leave low quality material in-place, such as existing fills, beneath a slab-on-grade, special ground treatment procedures may be considered, Tetra Tech could provide additional advice on this aspect if required.

A levelling course of well graded granular fill (with maximum size of 20 mm), at least 150 mm in compacted thickness, is recommended directly beneath all slabs-on-grade. The type of granular fill should be selected based on the design floor loadings. Alternatively a minimum thickness of 150 mm of 80 mm pit-run gravel overlain by a minimum thickness of 50 mm of 20 mm crushed gravel may be used. Coarse gravel particles larger than 25 mm diameter should be avoided directly beneath the slab-on-grade to limit potential stress concentrations within the slab. All levelling courses directly under floor slabs should be compacted to 100 percent of Standard Proctor Maximum Dry Density (ASTM Test Method D698).

Engineered fill, pit-run gravel and crushed gravel are defined under the heading 'Backfill Materials and Compaction' elsewhere in this Appendix.

The excavated subgrade beneath slabs-on-grade should be protected at all times from rain, snow, freezing temperatures, excessive drying and the ingress of free water. This applies before, during, and after the construction period.

CONSTRUCTION EXCAVATIONS

Construction should be in accordance with good practice and comply with the requirements of the responsible regulatory agencies.

All excavations greater than 1.5 m deep should be sloped or shored for worker protection.

Shallow excavations up to about 3 m depth may use temporary sideslopes of 1H:1V. A flatter slope of 2H:1V should be used if groundwater is encountered. Localized sloughing can be expected from these slopes.

Deep excavations or trenches may require temporary support if space limitations or economic considerations preclude the use of sloped excavations.

For excavations greater than 3 m depth, temporary support should be designed by a qualified geotechnical engineer. The design and proposed installation and construction procedures should be submitted to Tetra Tech for review.

The construction of a temporary support system should be monitored. Detailed records should be taken of installation methods, materials, in situ conditions and the movement of the system. If anchors are used, they should be load tested. Tetra Tech can provide further information on monitoring and testing procedures if required.

Attention should be paid to structures or buried service lines close to the excavation. For structures, a general guideline is that if a line projected down, at 45 degrees from the horizontal from the base of foundations of adjacent structures intersects the extent of the proposed excavation, these structures may require underpinning or special shoring techniques to avoid damaging earth movements. The need for any underpinning or special shoring techniques and the scope of monitoring required can be determined when details of the service ducts and vaults, foundation configuration of existing buildings and final design excavation levels are known.

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to the depth of the excavation, unless the excavation support system has been designed to accommodate such surcharge.

BACKFILL MATERIALS AND COMPACTION (GENERAL)

1.0 DEFINITIONS

"Landscape fill" is typically used in areas such as berms and grassed areas where settlement of the fill and noticeable surface subsidence can be tolerated. "Landscape fill" may comprise soils without regard to engineering quality.

"General engineered fill" is typically used in areas where a moderate potential for subgrade movement is tolerable, such as asphalt (i.e., flexible) pavement areas. "General engineered fill" should comprise clean, granular or clay soils.

"Select engineered fill" is typically used below slabs-on-grade or where high volumetric stability is desired, such as within the footprint of a building. "Select engineered fill" should comprise clean, well-graded granular soils or inorganic low to medium plastic clay soils.

"Structural engineered fill" is used for supporting structural loads in conjunction with shallow foundations. "Structural engineered fill" should comprise clean, well-graded granular soils.

"Lean-mix concrete" is typically used to protect a subgrade from weather effects including excessive drying or wetting. "Lean-mix concrete" can also be used to provide a stable working platform over weak subgrades. "Lean-mix concrete" should be low strength concrete having a minimum 28-day compressive strength of 3.5 MPa.

Standard Proctor Density (SPD) as used herein means Standard Proctor Maximum Dry Density (ASTM Test Method D698). Optimum moisture content is defined in ASTM Test Method D698.

2.0 GENERAL BACKFILL AND COMPACTION RECOMMENDATIONS

Exterior backfill adjacent to abutment walls, basement walls, grade beams, pile caps and above footings, and below highway, street, or parking lot pavement sections should comprise "general engineered fill" materials as defined above.

Exterior backfill adjacent to footings, foundation walls, grade beams and pile caps and within 600 mm of final grade should comprise inorganic, cohesive "general engineered fill". Such backfill should provide a relatively impervious surficial zone to reduce seepage into the subsoil against the structure.

Backfill should not be placed against a foundation structure until the structure has sufficient strength to withstand the earth pressures resulting from placement and compaction. During compaction, careful observation of the foundation wall for deflection should be carried out continuously. Where deflections are apparent, the compactive effort should be reduced accordingly.

In order to reduce potential compaction induced stresses, only hand-held compaction equipment should be used in the compaction of fill within 1 m of retaining walls or basement walls. If compacted fill is to be placed on both sides of the wall, they should be filled together so that the level on either side is within 0.5 m of each other.

All lumps of materials should be broken down during placement. Backfill materials should not be placed in a frozen state, or placed on a frozen subgrade.

Where the maximum-sized particles in any backfill material exceed 50% of the minimum dimension of the cross-section to be backfilled (e.g., lift thickness), such particles should be removed and placed at other more suitable locations on site or screened off prior to delivery to site.

Excavation and construction operations expose materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration of performance. Unless otherwise specifically indicated in this report, the walls and floors of excavations, and stockpiles, must be protected from the elements, particularly moisture, desiccation, frost, and construction activities. Should desiccation occur, bonding should be provided between backfill lifts. For fine-grained materials the previous lift should be scarified to the base of the desiccated layer, moisture-conditioned, and recompacted and bonded thoroughly to the succeeding lift. For granular materials, the surface of the previous lift should be scarified to about a 75 mm depth followed by proper moisture-conditioning and recompaction.

3.0 COMPACTION AND MOISTURE CONDITIONING

“Landscape fill” material should be placed in compacted lifts not exceeding 300 mm and compacted to a density of not less than 90% of SPD unless a higher percentage is specified by the jurisdiction.

“General engineered fill” and “select engineered fill” materials should be placed in layers of 150 mm compacted thickness and should be compacted to not less than 98% of SPD. Note that the contract may specify higher compaction levels within 300 mm of the design elevation. Cohesive materials placed as “general engineered fill” or “select engineered fill” should be compacted at 0 to 2% above the optimum moisture content. Note that there are some silty soils which can become quite unstable when compacted above optimum moisture content. Granular materials placed as “general engineered fill” or “select engineered fill” should be compacted at slightly below (0 to 2%) the optimum moisture content.

“Structural engineered fill” material should be placed in compacted lifts not exceeding 150 mm in thickness and compacted to not less than 100% of SPD at slightly below (0 to 2%) the optimum moisture content.

4.0 “GENERAL ENGINEERED FILL”

Low to medium plastic clay is considered acceptable for use as “general engineered fill,” assuming this material is inorganic and free of deleterious materials.

Materials meeting the specifications for “select engineered fill” or “structural engineered fill” as described below would also be acceptable for use as “general engineered fill.”

5.0 “SELECT ENGINEERED FILL”

Low to medium plastic clay with the following range of plasticity properties is generally considered suitable for use as “select engineered fill”:

Liquid Limit	= 20 to 40%
Plastic Limit	= 10 to 20%
Plasticity Index	= 10 to 30%

Test results should be considered on a case-by-case basis.

“Pit-run gravel” and “fill sand” are generally considered acceptable for use as “select engineered fill.” See exact project or jurisdiction for specifications.

The “pit-run gravel” should be free of any form of coating and any gravel or sand containing clay, loam or other deleterious materials should be rejected. No material oversize of the specified maximum sieve size should be tolerated. This material would typically have a fines content of less than 10%.

The materials above are also suitable for use as “general engineered fill.”

6.0 "STRUCTURAL ENGINEERED FILL"

Crushed gravel used as "structural engineered fill" should be hard, clean, well graded, crushed aggregate, free of organics, coal, clay lumps, coatings of clay, silt, and other deleterious materials. The aggregates should conform to the requirement when tested in accordance with ASTM C136 and C117. See exact project or jurisdiction for specifications. This material would typically have a fines content of less than 10%.

In addition to the above, further specification criteria identified below should be met:

"Structural Engineered Fill" – Additional Material Properties

Material Type	Percentage of Material Retained on 5 mm Sieve having Two or More Fractured Faces	Plasticity Index (<400 μm)	L.A. Abrasion Loss (percent Mass)
Various sized Crushed Gravels	See exact project or jurisdiction for specifications	See exact project or jurisdiction for specifications	See exact project or jurisdiction for specifications

Materials that meet the grading limits and material property criteria are also suitable for use as "select engineered fill."

7.0 DRAINAGE MATERIALS

"Coarse gravel" for drainage or weeping tile bedding should be free draining. Free-draining gravel or crushed rock generally containing no more than 5% fine-grained soil (particles passing No. 200 sieve) based on the fraction passing the 3/4-inch sieve or material with sand equivalent of at least 30.

"Coarse sand" for drainage should conform to the following grading limits:

"Coarse Sand" Drainage Material – Percent Passing by Weight

Sieve Size	Coarse Sand*
10 mm	100
5 mm	95 – 100
2.5 mm	80 – 100
1.25 mm	50 – 90
630 μm	25 – 65
315 μm	10 – 35
160 μm	2 – 10
80 μm	0 – 3

* From CSA A23.1-09, Table 10, "Grading Limits for Fine Aggregate", Class FA1

Note that the "coarse sand" above is also suitable for use as pipe bedding material. See exact project or jurisdiction for specifications.

8.0 BEDDING MATERIALS

The "Coarse Sand "gradation presented above in Section 7.0 is suitable for use as pipe bedding and as backfill within the pipe embedment zone, however see exact project or jurisdiction for specifications.

APPENDIX 3

Environmental Site Assessment

Phase I Environmental Site Assessment
MacLaine Acres
Portions of Section 28 TWP 9 RGE 21 W4M
Lethbridge County, Alberta

PRESENTED TO

Rick Aldoff c/o Martin Geomatic Consultants Ltd.

SEPTEMBER 30, 2021
ISSUED FOR USE
FILE: ENG.LGEO04408-01.002

Tetra Tech Canada Inc.
442 – 10 Street North
Lethbridge, AB T1H 2C7 CANADA
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EXECUTIVE SUMMARY

Foreword

Rick Aldoff care of Martin Geomatic Consultants Ltd. (MGCL) retained Tetra Tech Canada Inc. (Tetra Tech) to conduct a Phase I environmental site assessment (ESA) on the proposed MacLaine Acres, located within Section 28, Township 9, Range 21, West of the Fourth Meridian (28-009-21 W4M).

Tetra Tech understands this Phase I ESA is being conducted for due diligence in support of an area structure plan (ASP) and that the land proposed for MacLaine Acres consists of four legal properties: Plan 927 LK, Block 1, Lot 1 & Lot 2, Plan 801 0198, Block 2, Lot 1 and a portion of NW 28-009-21 W4M (Title No. 091 049 136).

The objective of the Phase I ESA is to comment on whether any past or present land use, either off -site or on-site, may have a potential to cause environmental impairment to the site.

The Phase I ESA was completed in general accordance with the Alberta Environment and Parks Alberta Environmental Site Assessment Standard and with the methods outlined in the document titled "*Canadian Standards Association Standard (CSA) Z768-01 Phase I ESA*", published by the CSA (reaffirmed 2016).

Findings and Conclusions

In general terms, there are two distinct types of potential environmental risk to any property. The first type of risk is from potential contamination from on-site land use. This would include potential accidental spills or site practices that may contaminate the property directly. The second type of risk is from contamination caused by adjacent property owners, which might then be transported through the subsurface soils by groundwater, or in overland runoff onto the site.

Potential for Impairment from On-Site Source(s)

There was one on-site source that might have potential to cause environmental impairment to the site through the historical or current land use. This source is where the old barrels are currently located on the central area of the southern portion of the site.

It is also noted that the former gas well site and associated infrastructure may be an area of concern if residual contamination was left on-site during reclamation activities in the early 2000s.

Potential for Impairment from Off-Site Source(s)

There were no off-site sources that might have a potential to cause environmental impairment to the site through historical and/or current land use.

Further Action/Rendering an Opinion

Based on the present study, Tetra Tech recommends that no further environmental investigation is required at this time. However, at the time of site re-development or when the old barrels are removed, the surficial soil in the area should be assessed to determine if proper disposal is required.

Tetra Tech recommends the following for consideration:

- Prior to extensive renovations or demolition, a hazardous building materials assessment should be undertaken.
- If buried debris or staining are encountered during future investigation or ground disturbance (i.e., near the former well site), a qualified environmental professional should be contacted.
- If soils containing organics are encountered during future investigation or ground disturbance, they should be removed from building footprints and not be reburied; a qualified environmental professional should be contacted.
- Any disturbance to surface waterbodies should be done in accordance with the Alberta Water Act.
- If encountered during future development, any water wells or septic systems should be appropriately decommissioned according to the relevant regulations.

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Rick Aldoff and his agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Rick Aldoff, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in Appendix A or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

1.1 General

Rick Aldoff care of Martin Geomatic Consultants Ltd. (MGCL) retained Tetra Tech Canada Inc. (Tetra Tech) to conduct a Phase I environmental site assessment (ESA) on the proposed MacLaine Acres, located within Section 28, Township 9, Range 21, West of the Fourth Meridian (28-009-21 W4M).

Tetra Tech understands this Phase I ESA is being conducted for due diligence in support of an area structure plan (ASP) and that the land proposed for MacLaine Acres consists of four legal properties: Plan 927 LK, Block 1, Lot 1 & Lot 2, Plan 801 0198, Block 2, Lot 1 and a portion of NW 28-009-21 W4M (Title No. 091 049 136).

The objective of the Phase I ESA is to comment on whether any past or present land use, either off-site or on-site, may have a potential to cause environmental impairment to the site.

The Phase I ESA was completed in general accordance with the Alberta Environment and Parks Alberta Environmental Site Assessment Standard and with the methods outlined in the document titled "*Canadian Standards Association Standard (CSA) Z768-01 Phase I ESA*", published by the CSA (reaffirmed 2016).

1.2 Authorization

Rick Aldoff provided written authorization to proceed with the present study to Tetra Tech on August 24, 2021.

1.3 Scope of Work

Tetra Tech conducted the following scope of work for the Phase I ESA:

- Conducted a records review for the site and surrounding properties, for a minimum search distance of 100 m. The records review included the following current and historical information searches:
  - Provincial regulatory information including the Alberta Safety Codes Authority (ASCA); Alberta Energy Regulator (AER) via Abacus Datagraphics Database (AbaData); Alberta Environment and Parks' (AEP) ESA Repository (ESAR), Online Water Well Database, Authorization Viewer; Historical Environmental Enforcement Search; and the Alberta Land Titles Spatial Information System (SPIN2).
  - Regional and municipal regulatory information, including Lethbridge County.
  - Historical information sources including business directories, fire insurance plans, land titles, and historical aerial photographs.
  - Geological and hydrogeological information including published topographic, geologic, soil, and groundwater maps and reports.
- Conducted a site visit to evaluate the extent and manner that current and historical surrounding activities may impact upon the site and the environment. Sampling was not included as part of the Phase I ESA scope of work.
- Conducted interviews with persons familiar with the site and surrounding properties.

- Evaluated the results and prepared this report discussing the site history and identified any potential for environmental concerns resulting from past or present land use on site and in the surrounding area.

1.4 Qualifications of Assessors

Jaymes Going, B.Sc., EP, conducted the site visit, historical review, and wrote this report. Jaymes is an Environmental Scientist with Tetra Tech's Environment and Water Practice and has over 13 years of experience in the environmental industry.

Henri Carriere, P.Eng., M.N.R.M., provided the senior review of this report. Henri is a Senior Project Engineer with Tetra Tech's Environment and Water Practice in Calgary, Alberta. He has more than 28 years of experience in the environmental industry.

1.5 General Site Details

The irregular shaped site is approximately 33.57 hectares (ha) in size and is located north of the City of Lethbridge within Lethbridge County and is currently zoned Lethbridge Urban Fringe.

The northern portion of the site consists of two legal properties (Plan 927 LK, Block 1, Lots 1 & 2) and is primarily pastureland with a private residence and dugout located on the eastern portion. A farm building (barn) is located near the southwest corner of this portion of the site.

The southern portion of the site also consists of two legal properties (Plan 801 0198, Block 2, Lot 1 and Title No. 091 049 136) and is also primarily pastureland. There are three private residences on these parcels: two on the northeast portion of the parcel that includes several farm buildings, and a dugout; and one on the northwest portion of the parcel. The latter private residence is the former location of a gas well site. On the central-east portion of this parcel were some old barrels and metal debris (pieces of an old grain bin) and a horse racetrack is located on the southern portion.

The site is bound to the north by an access road to the private residence located on the northwest portion of the site followed by agricultural land. Adjacent to the east of the site is Range Road 213 followed by rural residences and agricultural land. South of the northern portion of the site is an existing rural subdivision and south of the southern portion of the site is agricultural land including a small livestock operation. Adjacent to the west of the site is a St. Mary River Irrigation District (SMRID) irrigation canal followed by agricultural land.

Figure 1 shows the site location plan and Figure 2 shows the detailed site plan showing surrounding land use. Photographs of the site are provided in Appendix B.

2.0 RECORDS REVIEW

The results of regulatory searches are provided in Appendix C. Records were reviewed for the site and for adjacent properties within a minimum distance of 100 m from the site boundary.

2.1 Location, Size, and Ownership

The site is located in Lethbridge County, Alberta. The legal description, legal land description, size, and ownership are summarized in Table A.

Table A: Legal Description, Legal Land Description, Size, and Ownership

Legal Description	Legal Land Description	Size (ha)*	Ownership*
Plan 927 LK, Block 1, Lot 1	NE 28-009-21 W4M	8.10	1946291 Alberta Ltd.
Plan 927 LK, Block 1, Lot 2	NE 28-009-21 W4M	9.98	Kenneth Dale Smith
Plan 801 0198, Block 2, Lot 1	NW/NE/SW/SE 28-009-21 W4M	14.1	Richard Michael Aldoff and Carol Ann Aldoff
091 049 136 (title number)	NW 28-009-21 W4M	1.39**	Ryan Garret Van Eeden Petersman and Karen Virginia Van Eeden Petersman

Notes:
* Size and ownership were obtained from the current land title.
** Size obtained from Google Earth

2.2 Historical Records Review

A historical records review was undertaken for the site. The review dates were based on available records.

2.2.1 Historical Land Title Records

A historical and current land title search was initiated for the site. The results of the land title search had not been received at the time of report issuance. Should the review of the historical land tiles change the findings, an addendum letter will be issued. The current land titles are included in Appendix C.

Table B: Land Titles Summary

Year(s) of Ownership	Owner(s)	Tetra Tech Evaluation
Plan 927 LK, Block 1, Lot 1		
2016 to present	1946291 Alberta Ltd.	Based on the name, there is no obvious potential for environmental concern.
Plan 927 LK, Block 1, Lot 2		
2016 to present	Kenneth Dale Smith	Based on the name, there is no obvious potential for environmental concern
Plan 801 0198, Block 2, Lot 1		
1991 to present	Richard Michael Aldoff and Carol Ann Aldoff	Based on the name, there is no obvious potential for environmental concern
NW 28-009-021-W4M (Title No. 091 049 136)		
2009 to present	Ryan Garret Van Eeden Petersman and Karen Virginia Van Eeden Petersman	Based on the name, there is no obvious potential for environmental concern

2.2.2 Aerial Photographs

Aerial photographs provide visual evidence of site occupancy, operational activities, and general site details. Aerial photographs capture a view of the site and the surrounding areas at a given time. The results of the aerial photograph review are summarized in Table C.

Table C: Historical Aerial Photo Summary

Year	Scale	Observations
1950	1:40,000	**On-site:** Site appears to be predominately cultivated agricultural land with the western portion that appears as pastureland. Several small areas that appear to contain water are visible and an irregular shaped linear feature (SMRID canal) transects the western portion of the site.
		Off-site: The surrounding land use in all cardinal directions appears as cultivated agricultural land. Linear features are visible adjacent to the north site boundary (possible irrigation canal and present-day access road to private residences) and east site boundary (Range Road 213). The SMRID canal is visible to the north, west, and south of the site, but does not appear in its current configuration.
1960	1:31,680	**On-site:** Similar to the previous aerial photograph, although a dugout is visible on the northern area of the south portion of the site and several small structures are visible near this dugout (possible rural residence).
		Off-site: Similar to the previous aerial photograph, although several structures and a dugout are visible to the south of the site at the current location of the small livestock operation and several rural residences are visible on the east side of Range Road 213.
1970	1:31,680	**On-site:** Similar to the previous aerial photograph, although the dugout noted in 1960 has increased in size, and an additional small dugout is visible to the northeast (current day location).
		Off-site: Similar to the previous aerial photograph.
1981	1:60,000	**On-site:** The SMRID canal no longer transects the site and it appears in its current configuration. The large dugout is no longer visible and just appears as a low lying area; an additional dugout is visible on the east portion of the site (current day location). The footprint of the former well site is also visible on the western portion of the site.
		Off-site: Similar to the previous aerial photograph, although the SMRID canal has been re-aligned in its current configuration and two residences are visible to the south of the northern portion of the site.
1991	1:30,000	**On-site:** Some development appears in the area around the dugout on the north area of the southern portion of the site (land appears stripped or disturbed). There is also what appears to be an irregular shaped horse racetrack on the southern portion of the site, and the private residence on the eastern portion of the site is visible.
		Off-site: Similar to the previous aerial photograph, although additional rural residences are visible to the north and east of the site.
1999	1:30,000	**On-site:** Similar to the previous aerial photograph, although the well site is no longer visible on the western portion of the site and the footprint of the irregular shaped track feature has changed.
		Off-site: Similar to the previous aerial photograph.
2011	*	**On-site:** Similar to the previous aerial photograph, although various vehicle/equipment storage is visible in the area around the two private residences with the dugouts and the irregular shaped track feature is no longer visible.
		Off-Site: Similar to the previous aerial photograph, although it appears that most rural residences have been constructed to the south of the northern portion of the site.
2020	*	**On-site:** The private residence on the northwest portion of the site where the former well site was located has been constructed. A large oval shaped track is also visible on the southern portion of the site, and a smaller dugout is visible where the larger dugout was formerly located.
		Off-Site: Similar to the previous aerial photograph.

Notes:
To be read in conjunction with the accompanying report.
The aerial photographs are enlarged (where possible) for the review.
* Aerial photograph was obtained from Google Earth's satellite image archive

Based on the aerial photograph review, the site was predominantly agricultural land since 1950 with several dugouts visible throughout the aerial photograph review. A possible residence was visible as early as 1960 on the north area of the southern portion of the site. The SMRID canal alignment changed to its current configuration around 1981 moving west from onsite to offsite, and three of the four onsite private residences were visible in the 1991 aerial photograph with the third residence visible in the 2020 imagery.

The surrounding area has also been predominantly agricultural land since 1950 with the rural residences to the south of the northern portion of the site being constructed between 1981 to current with most being built around 2011. The small livestock operation to the south of the site with the dugout was visible as early as 1960.

2.2.3 Museum Archives

Tetra Tech inquired with the Galt Museum and Archives for indications of historical land use at the site and the surrounding area. Museum personnel indicated that there was no information specific to the site.

2.2.4 Business Directories

No business directories were available for Tetra Tech to review for the site.

2.2.5 Fire Insurance Plans

No fire insurance plans were available for Tetra Tech to review for the site.

2.2.6 Other Archival Records

No additional archival records were reviewed by Tetra Tech for the site.

2.3 Provincial Regulatory Information

This section describes the results of provincial regulatory searches. Copies of the search results and correspondence are provided in Appendix C.

2.3.1 Alberta Safety Codes Authority

Tetra Tech contacted the Alberta Safety Codes Authority (ASCA) regarding the potential for registered petroleum storage tanks (PSTs) at the site (Plan 927 LK, Block 1, Lot 1; Plan 927 LK, Block 1, Lot 2; Plan 801 0198, Block 2, Lot 1; and NW 28-009-21 W4M).

The ASCA indicated that no records exist for the site.

The ASCA requires that all underground storage tanks (USTs) be registered; however, only above ground storage tanks (ASTs) with a capacity greater than 2,500 L require registration. The database is based on a limited survey conducted in 1992 and voluntary information submitted thereafter; therefore, it is not considered a comprehensive inventory of PSTs in Alberta.

2.3.2 Alberta Energy Regulator

2.3.2.1 AbaData Database

Tetra Tech acquires AER database information through AbaData. The AbaData database was searched to determine if oil/gas wells and/or pipelines exist or have existed at the site and on the surrounding properties. The information provided by the AER indicated that there are available records for two high pressure gas lines (one active and one abandoned) on or transecting the site and one former well site location.

The active high pressure gas line (natural gas) is owned and operated by ATCO and is oriented north to south along the eastern site boundary. The abandoned high pressure gas line (natural gas) is licensed to Husky Oil Operations Limited (Husky) and enters the site from southwest corner and terminates at the former well site located where the current private residence is located. The former well site located on the northwest portion of the site, also licensed to Husky for gas, was drilled in 1976 and abandoned in 1991.

One record for a spill also exists to the north of the site within 16-28-009-21 W4M. This spill record was for a natural gas leak that occurred in 2014.

No other records for oil/gas wells and/or pipelines and spills/complaints were identified within 100 m of the site boundaries.

Several low-pressure gas lines (owned by ATCO Gas) are identified on-site and within 100 m of the site boundaries that service the rural residences.

High-pressure pipeline and well information provided by AbaData is current to September 3, 2021 and information on low-pressure pipelines is current to January 1, 2020.

The Coal Mine Atlas was reviewed, and it was determined that no abandoned or active coal mines are present at the site or within 100 m of the site.

2.3.3 Alberta Environment and Parks

2.3.3.1 Environmental Site Assessment Repository

The AEP ESAR is an online, searchable database that provides scientific and technical information about assessed sites throughout Alberta. The search of ESAR indicated that there was one record available for the site. The record was for a reclamation certificate, dated August 7, 2002 for the Husky well site located on the northwestern portion of the site within 11-28-009-21 W4M.

Tetra Tech notes that the ESAR map provided in Appendix C shows three records in close proximity to the site. All three of the records indicated on the map have the same information, the reclamation certificate for the former well site located on the site.

2.3.3.2 Online Authorization Viewer

The AEP Online Authorization Viewer allows the public to view approvals, licenses, registrations and permits issued under the Water Act and EPEA. There were 27 records available (current and expired) for pesticide service and rural waterworks. All of the records for the pesticide service are held by the SMRID, and the rural waterworks records are held by the County of Lethbridge Rural Water Association Limited.

2.3.3.3 Water Well Information Database

The AEP Water Well Database was searched to view records of water wells within the site or within an approximate 2,000 m radius surrounding the site. The search identified no records of water wells located on- or off-site within a 2,000 m radius.

2.3.4 Alberta Government – Alberta Land Titles Spatial Information System

The SPIN2 website map for the site and surrounding area shows the pipeline rights-of-way (ROWs) on-site and in the surrounding area as well as the irrigation canal ROW for the SMRID canal adjacent to the west and north site boundaries, and as part of the historical SMRID canal alignment. The SPIN2 map also shows utility and drainage ROWs on the rural residences to the south of the northern portion of the site.

2.3.5 Historical Environmental Enforcement Search

The historical environmental enforcement search provides records taken against a company or individual related to AEP's legislation. The search was conducted for each of the current site owners as per the land title records listed in Section 2.2.1. The search resulted in no records for the individuals or companies listed.

2.4 Regional and Municipal Regulatory Information

This section describes the results of regional and municipal regulatory searches. Copies of the search results and correspondence are provided in Appendix C.

2.4.1 Lethbridge County

Tetra Tech requested a site inquiry with Lethbridge County for information on the site. The response provided information on development permits and indicated that there are no records of storage tanks, chemical storage, spills, fires or landfills. The letter also indicated that there is a notice of violation for Plan 801 0198, Block 2, Lot 1 (northern portion of the site) for a large amount of old metal, concrete pipe, construction material, and equipment storage, however, there was no additional information available in the record. It is noted that during the site visit, this area of the site was pasture land.

During the site visit, a small amount of old metal, equipment storage, and several barrels were observed on this property. While most of the barrels appeared empty, one had a small amount of what was observed to be an oily substance and some staining was also observed in the area of this barrel.

A copy of the letter from Lethbridge County is attached in Appendix C.

2.5 Land Forms and Geology

2.5.1 Topography

Surface topography can influence the direction of migration of contaminants at the soil surface. The local topography is the topography at the site, whereas regional topography is the overall expression of the surface in a given region. The local topography of the site was generally flat with overall surface drainage in a north-easterly direction. The track area of the site was also slightly higher than the surrounding land, and a low lying area was apparent in the central area of the south portion of the site where the former larger dugout was located. Regional topography in the area is generally flat to undulating, and slopes northerly towards the Oldman River valley.

2.5.2 Surficial and Bedrock Geology

The surficial geology in the area is characterized by moraine till deposits with sporadic lenses of gravel, sand, and silt (Shetsen 1981).

The stratigraphy of the Lethbridge area is generally comprised of 65 m to 70 m of surficial deposits overlying bedrock. Bedrock in the Lethbridge area consists of strata from the upper Oldman Formation and the lower Bearpaw Formation, both of the late Cretaceous Age (Tokarsky 1974). The bedrock has a relatively flat surface dipping slightly to the northwest and is locally encountered at about geodetic elevation 843 m. The bedrock strata consist of thin beds of predominantly weak mudstones, siltstones, and sandstones with occasional bentonite and coal sea

2.5.3 Hydrogeology

Groundwater has the potential to be of significance as a means of contaminant transport. Regional groundwater flow is the overall direction of groundwater flow in a given region. Groundwater in a local area within the region, may travel in a different direction from the regional flow, due to influence by local topography and/or subsurface soil conditions.

There are currently two dugouts located at the site. Historically, there was an additional larger dugout located on the central area of the southern portion of the site and the SMRID canal also formerly transected a portion of the west side of the site. Several other dugouts and low-lying areas are located on the surrounding properties. The Oldman River is located approximately 3.75 km northwest of the site. Regional groundwater flow is expected to be westerly toward the Oldman River. Local groundwater flow direction is also interpreted to be westerly. Perched groundwater tables are common and have been encountered in many areas of southern Alberta. The depth to these perched tables can vary from approximately 2 m below ground level to considerable depths within gravel, sand, and/or silt seams. The flow of these perched tables can differ from regional flow direction, or be relatively stagnant, depending on the geometry and the extent of the sand and/or silt seams.

It should be noted that topography, geologic materials, land development (including the irrigation canal), and soil disturbances can also cause localized variances in groundwater movement and pattern. Also, groundwater levels will fluctuate seasonally and in response to climatic conditions.

2.6 Previous Reports

No previous environmental reports were available to review for the site.

2.7 Other Information Sources

There were no other information sources reviewed for the site.

3.0 SITE VISIT

Jaymes Going of Tetra Tech visited the site on September 9, 2021. Full access to all areas of the site was granted, however, the private residences and buildings were not accessed. Weather conditions were favorable (i.e., no snow cover) and the site was walked over with visual observations made of adjacent properties from the site boundaries.

3.1 Building Details and Site Servicing

There are currently several buildings on the site including private residences and farm outbuildings such as garages and barns. While the site buildings were not inspected, the dates of construction occurred between 1960 and 2016 based on the aerial photograph review and information provided by Lethbridge County.

The following table describes the site servicing.

Table D: Site Servicing

Item	Present	Type	Comments
Water Supply	Yes	Potable	Supplied by Lethbridge County rural waterworks.
Storm Sewer	No	N/A	Overland surface drainage would follow the local topography.
Sanitary Sewer	No	Septic	Private residences utilize septic systems for sanitary sewer.
Other Storage	Yes	Small amount of miscellaneous equipment storage observed.	Storage at the time of the site visit consisted of a small amount of metal, equipment, and several barrels located on the central area of the southern portion of the site.
Pits	Yes	Dugouts	Two dugouts are currently located at the site.
Lagoons	No	N/A	No lagoons were observed on the site.

3.2 Special Attention Items

Some construction materials contain compounds that may be hazardous to building occupants or users of the site. The following table summarizes these special attention items; further background information on these materials is provided in Appendix D.

Table E: Special Attention Items

Item	Presence/ Potential	Comments
Asbestos	Moderate	Based on age of some of the buildings at the site (prior to 1980), there is a potential that the buildings may contain asbestos and/or lead.
Lead	Moderate	
Urea Formaldehyde Foam Insulation (UFFI)	Low	No indication of UFFI at the site was observed. If this type of insulation was used, the fugitive emissions were likely the most harmful within two years of installation.
Ozone-depleting Substances (ODS)	Low	The private residences at the site may contain items that contain ODS such as air conditioning units. These items should be maintained regularly and disposed of appropriately when no longer functioning or required.
Polychlorinated Biphenyls (PCBs)	Low	Pole mounted transformers were observed at the site in the vicinity of the private residences. These are owned and maintained by the utility company.
Radon	Moderate to High	There was no radon gas testing reported for the site; however, natural radon concentrations are considered moderate to high in Alberta. A radon test was not completed by Tetra Tech as part of this investigation. There were no anthropogenic sources of radon gas identified.

Table E: Special Attention Items

Item	Presence/ Potential	Comments
Methane	Moderate	There was no methane gas testing reported for the site. Based upon information collected during this investigation (i.e., aerial photograph review, site reconnaissance), there is evidence of deposits of buried organics at the site that could produce methane (former large dugout and irrigation canal). Refer to Section 3.3.5 regarding potential fill areas.
Electromagnetic (EM)	Low	No high voltage transmission lines or other infrastructure which could generate significant EMFs were observed. No EMF assessment was completed by Tetra Tech for the site.
Noise and Vibration	Low	There were no major sources of noise or vibration on or adjacent to the site during the site visit.

The above evaluation is based on building age and basic site observations. Intrusive investigation and sampling are not within the scope of a Phase I ESA.

3.3 Site Observations

This section describes observations made of the site during the site visit on September 9, 2021.

3.3.1 Surficial Stains

A small amount of surficial staining was observed on the soil where several barrels were stored on the central area of the southern portion of the site. It is noted that the private residences were not inspected and that the entire site was not walked over due to the size of the site.

3.3.2 Vegetation

Vegetation at the site was predominantly pasture grasses with domestic trees and shrubs throughout. There was no evidence of stressed vegetation at the site, however, a large number of weedy species were observed on the southern portion of the site.

3.3.3 Ponding of Water

There was no ponded water observed other than in the two dugouts at the site. Surface drainage would be overland and follow the surface topography.

3.3.4 Washouts and Erosion

There were no washouts or indications of erosion observed.

3.3.5 Fill Areas and Soil Conditions

There was no evidence of fill materials having been brought to the site; however, the former large dugout and the irrigation canal that formerly transected the western portion of the site would have been filled in. The potential for methane generation is described in Section 3.2.

Further information on soil conditions can be found in the geotechnical evaluation report completed at the site by Tetra Tech (Tetra Tech 2021).

3.3.6 Oil/Gas Wells and Pipelines

There were no well sites observed at the time of the site visit. Signage for the two high pressure gas lines were observed on the western and eastern boundaries of the site.

Refer to Section 2.3.2 for AER information.

3.3.7 Chemical Storage

There were no hazardous chemicals or large drums observed at the site other than the old barrels located on the central area of the southern portion of the site. The majority of the barrels appeared empty; however, one was noted to contain a small amount of an oil substance.

It is also expected that the private residences would contain small amounts of household janitorial type chemicals.

3.3.8 Transformers

There were pole-mounted electrical transformers observed in the vicinity of the private residences. Generally, pole-mounted transformers are owned and maintained by the utility companies.

3.3.9 Hydraulic Elevators and Hoists

There were no hydraulic elevators or hoists observed at the site visit, however, the private residences were not inspected.

3.3.10 Vent Pipes and Underground Storage Tanks (USTs)

There were no vent pipes or USTs identified during the site visit.

3.3.11 Above-Ground Storage Tanks and Drum Storage

Several old barrels were observed to be stored on the central area of the southern portion of the site.

No ASTs were observed during the site visit.

3.3.12 Waste Storage

No waste storage areas were observed at the site during the site visit with the exception of the old barrels and metal debris (pieces of an old grain bin).

3.3.13 General Housekeeping

The general housekeeping of the site was in good condition and no obvious evidence of negligent acts or illegal dumping were observed during the site visit.

3.4 Off-Site Observations

The following table summarizes the surrounding land use.

Table F: Surrounding Land Use

Direction	Zoning*	Observations	Tetra Tech Evaluation
North	Lethbridge Urban Fringe	Agricultural land	No obvious concerns which may cause environmental impairment to the site were identified.
East		Agricultural land and rural residences	
South		Agricultural land and rural residences	
West		SMRID canal and agricultural land	

*Land use obtained from Lethbridge County: Lethbridge County - Online Maps (lethcounty.ca)

The surrounding land is primarily agricultural. Key surrounding land use is indicated on Figure 2.

4.0 PERSONNEL INTERVIEWS

Tetra Tech interviewed individuals familiar with the site and surrounding properties. Interviews were conducted by telephone. The findings of the personnel interviews, which have been incorporated into this report, are in general agreement with the records review conducted for the site.

Table G: Interview Summary

Item	Description
Interviewer	Jaymes Going
Interviewee Position	Property owner
Company	N/A
Length of Involvement with Site	Greater than 25 years.
Information Provided	The owner provided details of the property history and current activities. These details have been incorporated within this report.

5.0 DISCUSSION AND CONCLUSIONS

5.1 General

In general terms, there are two distinct types of potential environmental risk to any property. The first type of risk is from potential contamination from on-site land use. This would include potential accidental spills or site practices that may contaminate the property directly. The second type of risk is from contamination caused by adjacent property owners, which might then be transported through the subsurface soils by groundwater, or in overland runoff onto the site.

5.2 Potential for Impairment from On-Site Source(s)

There was one on-site source that might have potential to cause environmental impairment to the site through the historical or current land use. This source is where the old barrels are currently located on the central area of the southern portion of the site.

It is also noted that the former gas well site and associated infrastructure may be an area of concern if residual contamination was left on site during reclamation activities in the early 2000s.

5.3 Potential for Impairment from Off-Site Source(s)

There were no off-site sources that might have a potential to cause environmental impairment to the site through historical and/or current land use.

6.0 FURTHER ACTION/RENDERING AN OPINION

Based on the present study, Tetra Tech recommends that no further environmental investigation is required at this time. However, at the time of site re-development or when the old barrels are removed, the surficial soil in the area should be assessed to determine if proper disposal is required.

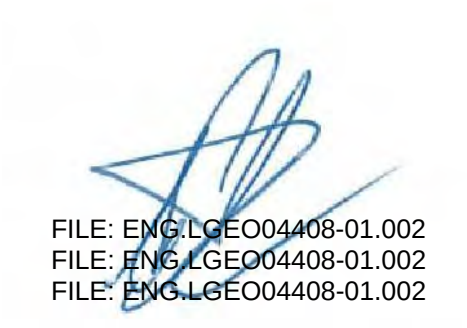
Tetra Tech recommends the following for consideration:

- Prior to extensive renovations or demolition, a hazardous building materials assessment should be undertaken.
- If buried debris or staining are encountered during future investigation or ground disturbance (i.e., near the former well site), a qualified environmental professional should be contacted.
- If soils containing organics are encountered during future investigation or ground disturbance, they should be removed from building footprints and not be reburied; a qualified environmental professional should be contacted.
- Any disturbance to surface waterbodies should be done in accordance with the Alberta Water Act.
- If encountered during future development, any water wells or septic systems should be appropriately decommissioned according to the relevant regulations.

7.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.



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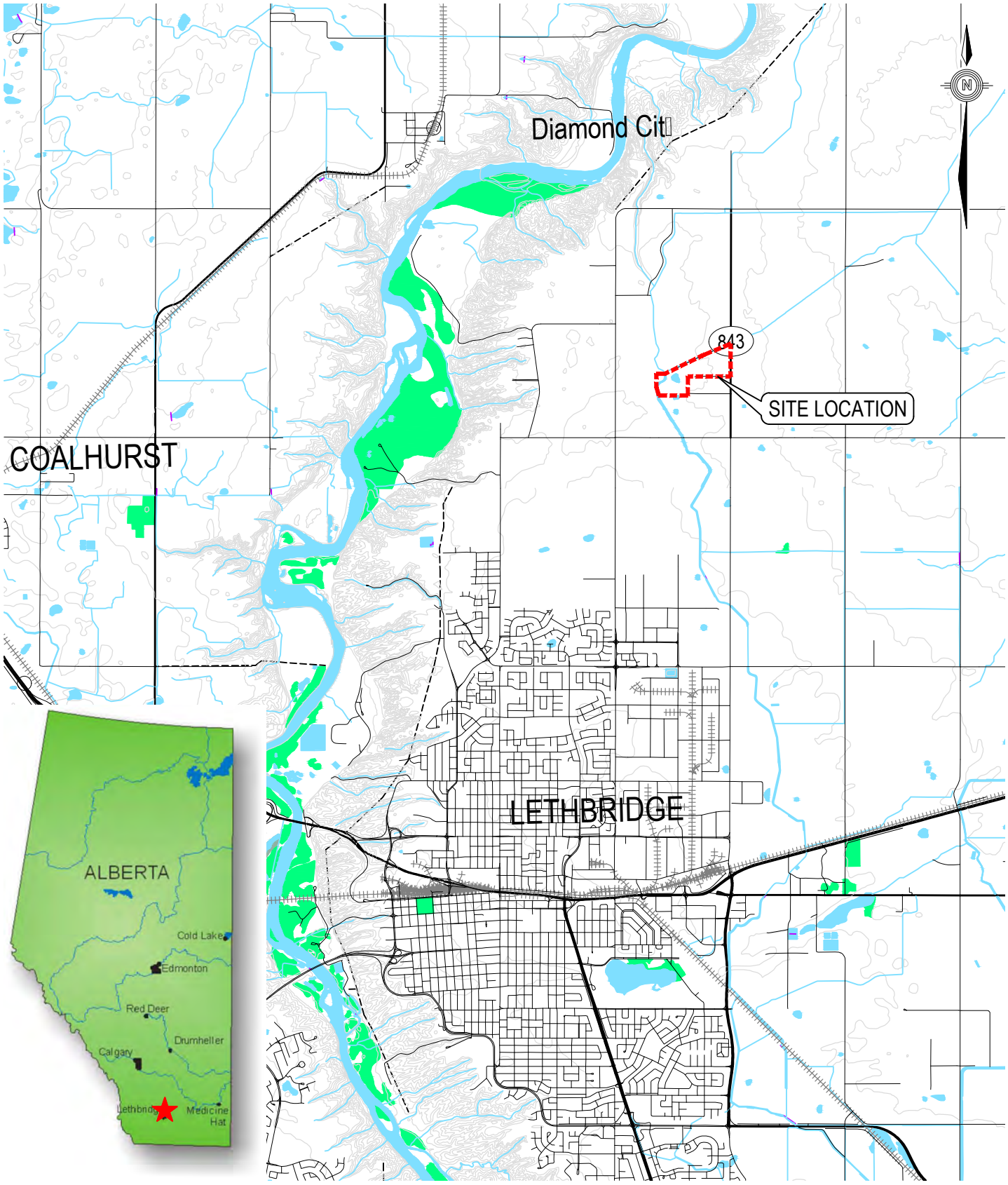
FIGURES



NOTES

DRAWING PROVIDED BY "© Department of Natural Resources Canada. All rights reserved."

0 2,500m

Scale: 1:75,000 @ 8.5"x11"

CLIENT

MARTIN GEOMATIC CONSULTANTS

TETRA TECH

PHASE I ENVIRONMENTAL ASSESSMENT
MacLAINE ACRES ASP LETH RI GE COUNT

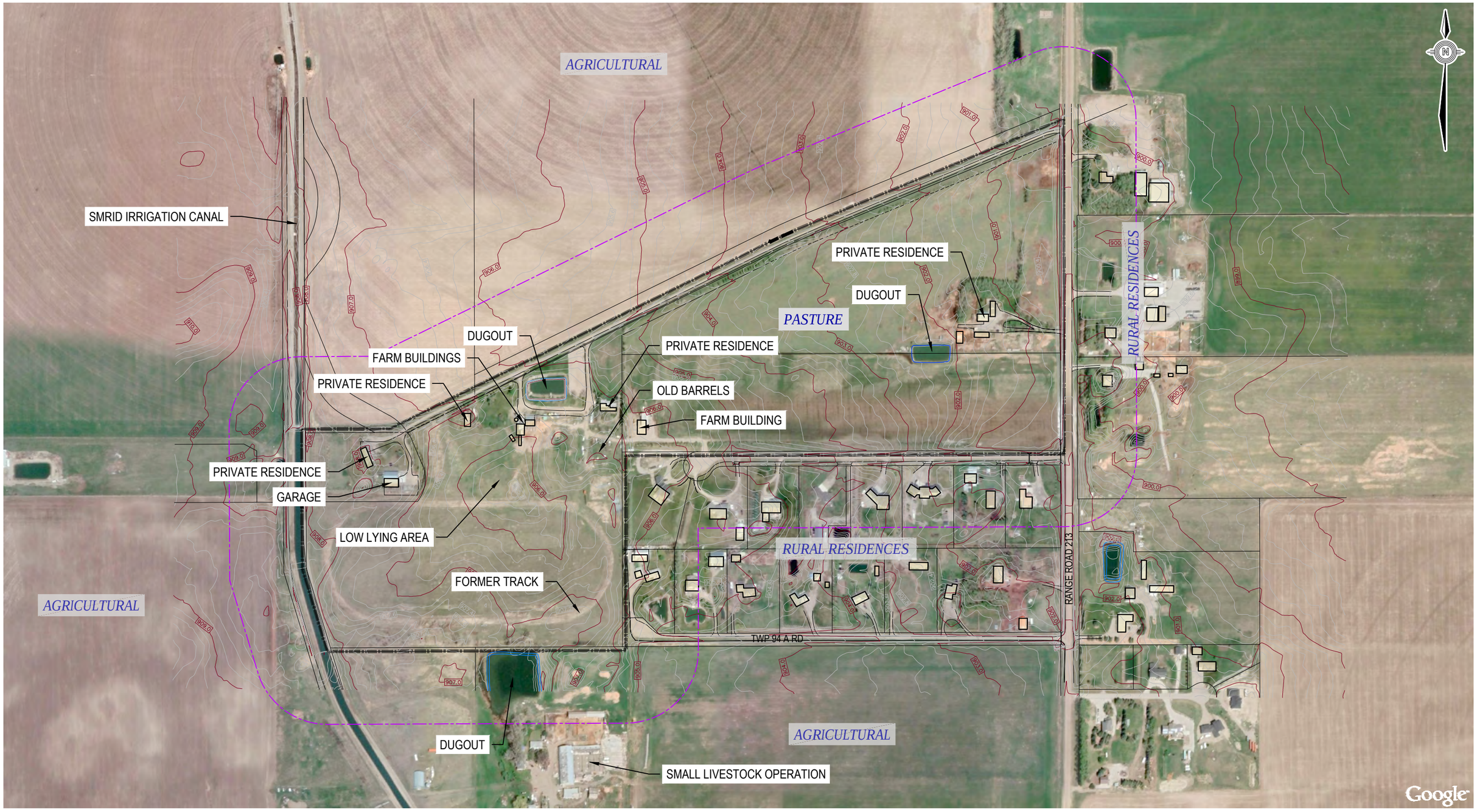
SITE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
LGEO04408-01.002	LCH	JG	0

OFFICE	DATE
Tt Leth	Augu t 2021

Figure 1

C:\Lethbridge\Drafting\ENG.LGEO\LGEO04408\CAD\LGEO04408-01-002 Figure 1.dwg [FIGURE 1] Se tember 01, 2021 - 2:07:51 m (BY: HUGHES, LEANNE)



LEGEND

- SITE BOUNDARY
- 100 m BOUNDARY
- 900.00 EXISTING MAJOR CONTOUR LINE
- 900.00 EXISTING MINOR CONTOUR LINE

0 250m

Scale: 1:5,000 @ 11"x17"

NOTES

GOOGLE EARTH IMAGERY DATED 2021.

BASE DRAWING PROVIDED BY CLIENT, DATED JULY 15, 2021.

CLIENT

MARTIN GEOMATIC CONSULTANTS

TETRA TECH

PHASE I ENVIRONMENTAL ASSESSMENT
MacLAINE ACRES ASP LETH RI GE COUNT

ETAILE SITE PLAN SHO ING SURROUN ING LAN USE

PROJECT NO.	DWN	CKD	REV
LGEO04408-01.002	LCH	JG	0

OFFICE	DATE
Tt Leth	Se tember 2021

Figure

C:\Lethbridge\Drafting\ENG.LGEO\LGEO04408\CAD\LGEO04408-01-002 Figure 2.dwg [FIGURE 2] Se tember 29, 2021 - 11:15:33 m (BY: HUGHES, LEANNE)

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

APPENDIX B

SITE PHOTOGRAPHS

Photo 1: View of the southern portion of the site looking northeast from the southwest corner of the site.

Photo 2: View of the southern portion of the site looking southeast from the northwest corner of the site.

Photo 3: View of the southern portion of the site looking northwest from the southeast corner of the site.

Photo 4: View looking west at near the central portion of the site. A shallow drainage channel is visible in the centre of the photograph and the visible soil was placed to allow vehicle access.

Photo 5: View looking westerly at the central portion of the site. The drill truck was being used for a geotechnical evaluation for the site.

Photo 6: View of some miscellaneous debris including several 40-gallon drums located near the eastern boundary of the central portion of the site.

Photo 7: View of equipment storage and various buildings on the east-central portion of the site.

Photo 8: View looking easterly at the central portion of the site.

Photo 9: View of private residence located on the northwest portion of the site.

Photo 10: View looking easterly at the northern portion of the site.

Photo 11: View looking east at the fence line located on the northern portion of the site.

Photo 12: View looking west at the northern portion of the site from the east site boundary.

Photo 13: View of the adjacent land use to the northern portion of the site (rural residences).

Photo 14: View of adjacent land use to the west of the site. Irrigation canal followed by agricultural land.

Photo 15: View of adjacent land use to the south of the site. Rural farm buildings and agricultural/pastureland.

Photo 16: View of adjacent land use to the north. Agricultural crop land.

APPENDIX C

REGULATORY SEARCHES AND RESPONSES

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0015 110 463	927LK;1;1	161 045 741

LEGAL DESCRIPTION
PLAN 927LK
BLOCK 1
LOT 1
EXCEPTING THEREOUT ALL MINES AND MINERALS
AND THE RIGHT TO WORK THE SAME
AREA: 9.98 HECTARES (24.65 ACRES) MORE OR LESS

ESTATE: FEE SIMPLE
ATS REFERENCE: 4;21;9;28;E

MUNICIPALITY: LETHBRIDGE COUNTY

REFERENCE NUMBER: 121 127 186

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
161 045 741	18/02/2016	TRANSFER OF LAND	$600,000	$600,000

OWNERS

1946291 ALBERTA LTD.
OF 94054 HWY 843
LETHBRIDGE
ALBERTA T1J 5R2
(DATA UPDATED BY: CHANGE OF ADDRESS 171243340)

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
8048GH .	02/01/1952	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED. AS TO PORTION OR PLAN:GL95 "16.5 FT. STRIP"
1648LO .	07/07/1972	CAVEAT

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		RE : EASEMENT CAVEATOR - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
851 074 023	08/05/1985	CAVEAT RE : EASEMENT CAVEATOR - THE BOARD OF DIRECTORS OF ST. MARY RIVER IRRIGATION DISTRICT. P.O. BOX 278, LETHBRIDGE ALBERTA T1J3Y7 AGENT - F J BREWIN
111 123 556	19/05/2011	UTILITY RIGHT OF WAY GRANTEE - ATCO GAS AND PIPELINES LTD.
161 045 742	18/02/2016	MORTGAGE MORTGAGEE - SERVUS CREDIT UNION LTD. 151 KARL CLARK RD NW EDMONTON ALBERTA T6N1H5 ORIGINAL PRINCIPAL AMOUNT: $450,000
161 045 743	18/02/2016	CAVEAT RE : ASSIGNMENT OF RENTS AND LEASES CAVEATOR - SERVUS CREDIT UNION LTD. 151 KARL CLARK RD NW EDMONTON ALBERTA T6N1H5 AGENT - SARAH A BAINBRIDGE
171 029 546	01/02/2017	WRIT CREDITOR - FRIEDA SANFORD 1601-25 AVE NORTH LETHBRIDGE ALBERTA T1H4N8 DEBTOR - PATRICK WAGNER RR 8, SITE 41, COMP 18 LETHBRIDGE ALBERTA T1J4P4 AMOUNT: $1,976 AND COSTS IF ANY ACTION NUMBER: 1606 00837

TOTAL INSTRUMENTS: 007

(CONTINUED)

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 2 DAY OF SEPTEMBER, 2021 AT 12:04 P.M.

ORDER NUMBER: 42532508

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0019 482 926	927LK;1;2	161 154 313

LEGAL DESCRIPTION
PLAN 927LK
BLOCK 1
LOT 2
EXCEPTING THEREOUT ALL MINES AND MINERALS
AND THE RIGHT TO WORK THE SAME
AREA: 8.1 HECTARES (20.02 ACRES) MORE OR LESS

ESTATE: FEE SIMPLE
ATS REFERENCE: 4;21;9;28;E

MUNICIPALITY: LETHBRIDGE COUNTY

REFERENCE NUMBER: 121 127 186 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
161 154 313	05/07/2016	TRANSFER OF LAND	$405,000	$405,000

OWNERS

KENNETH DALE SMITH
OF 5710-57 ST
TABER
ALBERTA T1G 1L1

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
8048GH .	02/01/1952	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED. AS TO PORTION OR PLAN:GL95 "16.5 FT STRIP"
1648LO .	07/07/1972	CAVEAT

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		RE : EASEMENT CAVEATOR - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
851 073 950	08/05/1985	CAVEAT RE : EASEMENT CAVEATOR - THE BOARD OF DIRECTORS OF ST. MARY RIVER IRRIGATION DISTRICT. P.O. BOX 278, LETHBRIDGE ALBERTA T1J3Y7 AGENT - F J BREWIN
111 123 556	19/05/2011	UTILITY RIGHT OF WAY GRANTEE - ATCO GAS AND PIPELINES LTD.

TOTAL INSTRUMENTS: 004

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 2 DAY OF SEPTEMBER, 2021 AT 12:04 P.M.

ORDER NUMBER: 42532508

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0016 608 770	8010198;2;1	911 153 848

LEGAL DESCRIPTION
PLAN 8010198
BLOCK 2
LOT 1
EXCEPTING THEREOUT ALL MINES AND MINERALS
AREA: 14.1 HECTARES (34.84 ACRES) MORE OR LESS

ESTATE: FEE SIMPLE
ATS REFERENCE: 4;21;9;28

MUNICIPALITY: LETHBRIDGE COUNTY

REFERENCE NUMBER: 861 107 528

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
911 153 848	16/07/1991	TRANSFER OF LAND	$45,000	SEE INSTRUMENT

OWNERS

RICHARD MICHAEL ALDOFF

AND
CAROL ANN ALDOFF
BOTH OF:
S S 1-2-49
LETHBRIDGE
ALBERTA T1J 4B3
AS JOINT TENANTS

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 021 660	08/03/1974	UTILITY RIGHT OF WAY GRANTEE - FORTISALBERTA INC. 320 - 17 AVENUE S.W.

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		CALGARY ALBERTA T2S2Y1 "30 FT STRIP" (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 001298059) (DATA UPDATED BY: CHANGE OF NAME 051006321)
761 133 668	29/10/1976	CAVEAT CAVEATOR - CONOCOPHILLIPS CANADA OPERATIONS LTD. P.O. BOX 4365, POSTAL STATION C CALGARY ALBERTA T2T5N2 AGENT - KATHY M TROFIN (DATA UPDATED BY: CHANGE OF ADDRESS 031242905) (DATA UPDATED BY: TRANSFER OF CAVEAT 091085519) (DATA UPDATED BY: TRANSFER OF CAVEAT 091210804)
791 020 979	09/02/1979	UTILITY RIGHT OF WAY GRANTEE - CONOCOPHILLIPS CANADA OPERATIONS LTD. "SW 1/4" (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 091205485)
791 020 980	09/02/1979	UTILITY RIGHT OF WAY GRANTEE - CONOCOPHILLIPS CANADA OPERATIONS LTD. "SW 1/4 OF SEC 28-9-21-4" (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 091205451)
791 020 981	09/02/1979	UTILITY RIGHT OF WAY GRANTEE - CONOCOPHILLIPS CANADA OPERATIONS LTD. "SW 1/4 SEC 28-9-21-4" (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 091205485)
971 093 143	05/04/1997	CAVEAT RE : EASEMENT CAVEATOR - THE BOARD OF DIRECTORS OF ST. MARY RIVER IRRIGATION DISTRICT. P.O. BOX 278, LETHBRIDGE ALBERTA T1J3Y7
991 292 262	07/10/1999	MORTGAGE MORTGAGEE - ALBERTA TREASURY BRANCHES. 601 MAYOR MAGRATH DR.S LETHBRIDGE ALBERTA

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		ORIGINAL PRINCIPAL AMOUNT: $55,000
001 225 359	12/08/2000	AMENDING AGREEMENT AMOUNT: $77,300 AFFECTS INSTRUMENT: 991292262
021 035 034	29/01/2002	UTILITY RIGHT OF WAY GRANTEE - COUNTY OF LETHBRIDGE RURAL WATER ASSOCIATION LIMITED.
021 365 728	18/10/2002	CAVEAT RE : OPTION TO PURCHASE CAVEATOR - ST MARY RIVER IRRIGATION DISTRICT. P.O. BOX 278 LETHBRIDGE ALBERTA T1J3Y7
111 222 936	31/08/2011	UTILITY RIGHT OF WAY GRANTEE - ATCO GAS AND PIPELINES LTD.

TOTAL INSTRUMENTS: 011

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 2 DAY OF SEPTEMBER, 2021 AT 12:04 P.M.

ORDER NUMBER: 42532508

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0031 401 425	4;21;9;28;NW	091 049 136

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 21 TOWNSHIP 9
SECTION 28
THAT PORTION OF THE SOUTHERLY 313 FEET IN PERPENDICULAR WIDTH THROUGHOUT OF THE NORTH WEST QUARTER WHICH LIES BETWEEN THE EAST LIMIT OF CANAL RIGHT OF WAY ON PLAN 0510395 AND THE EAST LIMIT OF CANAL RIGHT OF WAY ON PLAN IRR55
EXCEPTING THEREOUT ALL MINES AND MINERALS
AND THE RIGHT TO WORK THE SAME

ESTATE: FEE SIMPLE

MUNICIPALITY: LETHBRIDGE COUNTY

REFERENCE NUMBER: 061 010 978

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
091 049 136	23/02/2009	TRANSFER OF LAND	$345,000	$345,000

OWNERS

RYAN GARRET VAN EEDEN PETERSMAN

AND
KAREN VIRGINIA VAN EEDEN PETERSMAN
BOTH OF:
R.R. 8, SITE 41, COMP 15
LETHBRIDGE
ALBERTA T1J 4P4
AS JOINT TENANTS

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
7586LJ .	03/11/1972	CAVEAT

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		CAVEATOR - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
731 064 400	22/10/1973	UTILITY RIGHT OF WAY GRANTEE - FORTISALBERTA INC. 320 - 17 AVENUE S.W. CALGARY ALBERTA T2S2Y1 "PORTION DESCRIBED" (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 001299373) (DATA UPDATED BY: CHANGE OF NAME 051006146)
761 094 355	26/07/1976	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE ST. MARY RIVER IRRIGATION DISTRICT
911 208 327	17/09/1991	CAVEAT RE : EASEMENT CAVEATOR - THE BOARD OF DIRECTORS OF THE ST. MARY RIVER IRRIGATION DISTRICT BOX 278 LETHBRIDGE ALBERTA J1J3Y7
001 070 445	15/03/2000	EASEMENT OVER AND FOR BENEFIT OF: (SEE INSTRUMENT)

TOTAL INSTRUMENTS: 005

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 2 DAY OF SEPTEMBER, 2021 AT 12:04 P.M.

ORDER NUMBER: 42532508

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

THIS ELECTRONICALLY TRANSMITTED LAND TITLES PRODUCT IS INTENDED FOR THE SOLE USE OF THE ORIGINAL PURCHASER, AND NONE OTHER, SUBJECT TO WHAT IS SET OUT IN THE PARAGRAPH BELOW.

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Alberta Safety Codes Authority

A Division of the Safety Codes Council

September 7, 2021

Ms. Sophie Fitzowich
Tetra Tech
112 Bay View Dr SW
Calgary AB T2V 3N8

EMAIL: sophie.fitzowich@tetratech.com

Re: ASCA Storage Tank Search – Your File No. 704-ENGO04406-01

Dear Ms. Fitzowich,

As per your search request dated September 7, 2021, Alberta Safety Codes Authority (ASCA) has searched the storage tank database for existing and former installations of storage tank systems, as defined by the Fire Code, including those known to be inside structures at the following addresses:

1. Lot 1, Block 1, Plan 927LK, Section 28, Township 009, Range 21, Meridian 4, Lethbridge County AB
2. Lot 2, Block 1, Plan 927LK, Section 28, Township 009, Range 21, Meridian 4, Lethbridge County AB
3. Lot 1, Block 2, Plan 8010198, Section 28, Township 009, Range 21, Meridian 4, Lethbridge County AB
4. NW-28-009-21-4, Lethbridge County AB

The search of the storage tank database determined no records were available for the addresses requested.

The Freedom of Information and Protection of Privacy Act governs the information provided. Please note that the database is ***not*** complete. The main limitation of the database is that it only includes information reported through registration and permitting or a survey of abandoned sites completed in 1992 and should not be considered a comprehensive inventory of all past or present storage tank sites. ASCA's storage tank systems database is solely maintained based on information provided by owners and or operators of storage tank systems; therefore, the database may not reflect information related to all existing or former storage tank systems in Alberta. Further information on storage tank systems or investigations involving a spill/release or contamination may be filed with the local fire service or Alberta Environment.

Regards,

ASCA Associate
ascatanks@safetycodes.ab.ca

MacLaine ASP

Tuesday, August 31, 2021

1:9,825

0 115 230 460 m

AbaData

Well Information

100 / 11-28-009-21 W4 / 0

HUSKY OIL OPERATIONS LIMITED | 100 / 11-28-009-21 W4 / 0

Government Well Data Current To August 4, 2021

License #:	0056743	**License Date:**	January 22, 1976
Well Name:	HUSKY ETAL LETH. 11-28-9-21		
License Status:	RecCertified	**License Status Date:**	June 25, 2002
Within:	11-28-009-21 W4M	**H2S (%):**	
Spud Date:	January 24, 1976	**Final Drill Date:**	February 3, 1976
Status:	GAS ABD	**Abandoned Date:**	September 12, 1991
Surface:		**Downhole:**	
Offsets:	S 762.3 E 638.9	Offsets:	S 762.3 E 638.9
Latitude:	49.764067	Latitude:	49.764067
Longitude:	-112.792240	Longitude:	-112.792240
Ground Elevation:	908.9 m | 2982 '	Total Depth:	1319.80 m | 4330 '
Operator:	n/a		

Pipeline Information

HUSKY OIL OPERATIONS LIMITED | AB00012273 - 2

Government Pipeline Data Current to August 6, 2021

Permit Date:		**License Date:**	October 10, 1991
From Location:	11-28-9-21 W4M WE	**To Location:**	9-21-9-21 W4M RS
Length:	2.24 kms | 1.4 mi	**Status:**	A
Substance:	NG	**H_2S:**	0 mol/kmol | 0 ppm
Outside Diameter:	88.9 mm | 3.5 "	**Wall Thickness:**	3.18 mm | 0.13 "
Material:	S	**Type:**	5LX
Grade:	X42	**Max Operating Pressure:**	0 kPa | 0 psi
Joints:	W	**Internal Coating:**	U
Stress Level:	0 %	**Environment:**	
Original Permit Date:		**Construction Date:**	
Original License/Line No:	12273 - 2	**NEB Registration:**	
Last Occurrence Year:	1977	**Abacus No:**	85054

Pipeline Information

ATCO GAS AND PIPELINES LTD. | AB00002185 - 1

Government Pipeline Data Current to August 6, 2021

Permit Date:	April 30, 2008	**License Date:**	March 12, 2010
From Location:	16-28-9-21 W4M PL	**To Location:**	9-16-9-21 W4M PL
Length:	3.81 kms | 2.38 mi	**Status:**	O
Substance:	NG	**H_2S:**	0 mol/kmol | 0 ppm
Outside Diameter:	273.1 mm | 10.75 "	**Wall Thickness:**	6.4 mm | 0.25 "
Material:	S	**Type:**	5L
Grade:	X42	**Max Operating Pressure:**	2380 kPa | 345 psi
Joints:	W	**Internal Coating:**	U
Stress Level:	18 %	**Environment:**	
Original Permit Date:		**Construction Date:**	
Original License/Line No:	2185 - 1	**NEB Registration:**	
Last Occurrence Year:	1910	**Abacus No:**	85013

Low Pressure Pipeline Information

NATURAL GAS CO-OPERATIVE CONTACT INFORMATION

Data Current To January 1, 2020

Name:	Rocky Gas Co-op Ltd.		
Address:	Box 697 Rocky Mtn. House, T4T 1A5		
Phone #:	(403) 845-2766	**Alternate Phone #:**	
Website:	http://www.rockygas.ca		

Alberta Environment and Parks

The ESA marker represents an approximate location of a site where the Government of Alberta has received scientific and/or technical information. The marker is an arbitrary, 40 meter diameter circle centered on the property for which this information is attached. For locations or other site information, see the document results table

Spatial Search provided by the Alberta Land Titles SPIN 2 System

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A designated location identifies a site where Alberta Environment and Parks has received scientific or technical information for that site and does not imply anything regarding the current state or condition of the site. Please refer to the studies and reports to determine the condition of the site.

ATS

Meridian W -	4
Range	21
Township	009
Section	28
[Quarter]	

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Alberta
ENVIRONMENT

Regional Services
Southern Region

2nd Floor, Provincial Building
200 - 5th Avenue South
LETHBRIDGE, Alberta
T1J 4L1

Telephone: (403) 382-4253
Fax: (403) 382-4428

7 August 2002

Husky Oil Operations Ltd.
707 – 8th Avenue S.W.
Box 6525, Station D
CALGARY, Alberta T2P 3G7

Dear Sir or Madam:

RE: Husky et al Leth 11-28-9-21 well
N Sec. 28 Tp. 009 Rge. 21 W4M
File No.: S-03583

An inquiry was held on this location and enclosed for your records is a copy of the Reclamation Certificate.

If you have any concerns, please contact me at (403) 382-4253.

Sincerely

for Sherry Hazelaar
Conservation and Reclamation Inspector

cc: Richard Henry Boulton and Dorine M. Boulton (NW)
Ronald Olshaski (NW)
Scott Boulton (NE)

Alberta
ENVIRONMENT

Environmental Service

4th Floor, 9820-106th Street
Edmonton, Alberta
Canada T5K 2J6

Telephone (780) 427-5883
Fax (780) 422-4192

RECLAMATION CERTIFICATE NO. 00184781-00-00
EUB LICENSE NO. 0056743

This reclamation certificate is issued pursuant to section 123 of the Environmental Protection and Enhancement Act, following an inquiry on

June 25, 2002 . (Date)

This certifies that the surface of the land held by Husky Oil Operations Limited within N Sec. 28 Tp. 009 Rge. 21 W4M

in connection with or incidental to HUSKY ET AL LETH 11-28-9-21 WELL, as shown outlined in yellow on the attached plan(s), complies with the conservation and reclamation requirements of Part 5 of the Act.

Issued this 25 day of June , 2002

L. Hazelaar
Inspector(s)

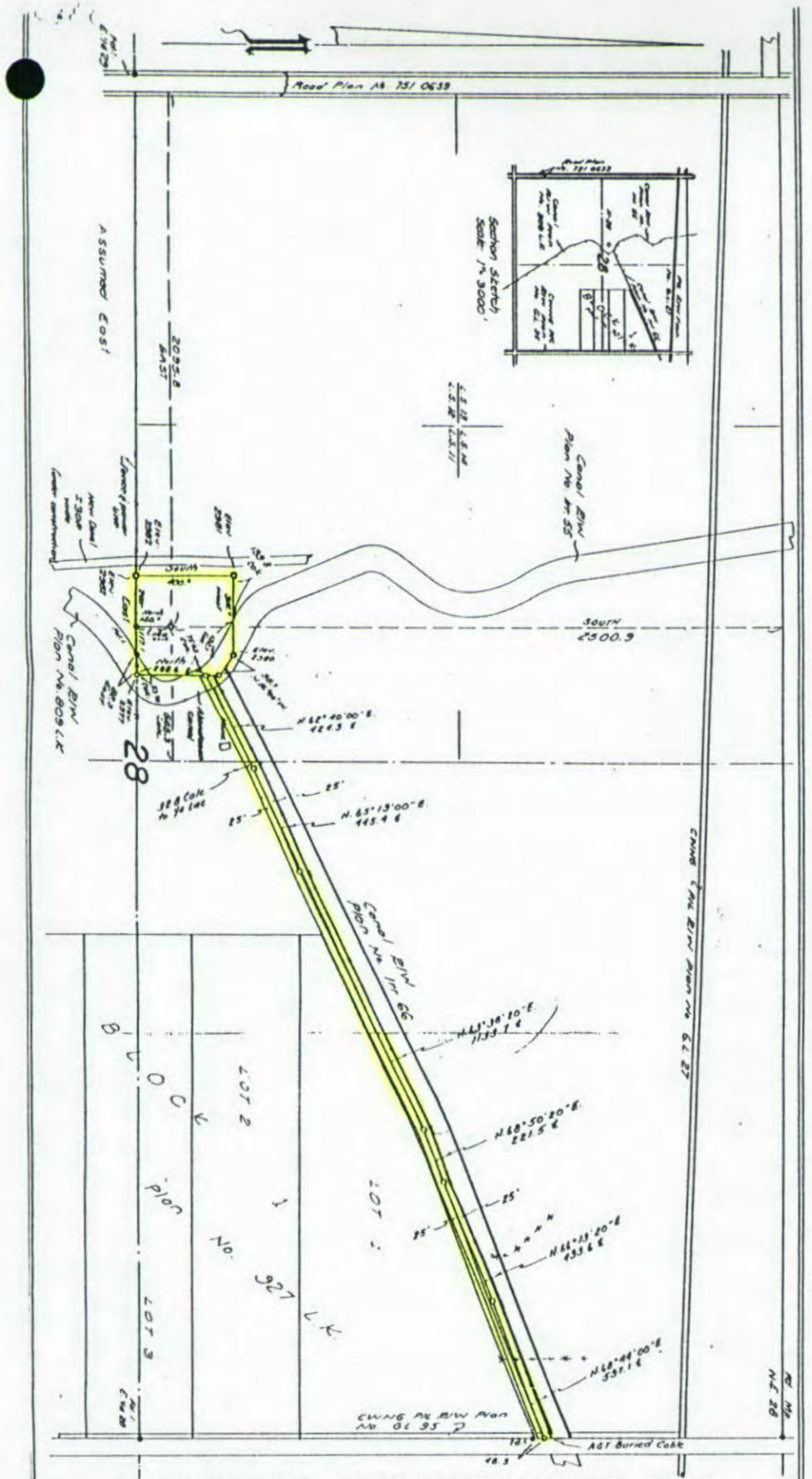
Henry Hazelaar
382-4253

Operator/Agent:

Husky Oil Operations Limited
BOX 6525 STN D 707 8 AVE SW
Calgary, Alberta
T2P 3G7

Section 84 of the Environmental Protection and Enhancement Act may provide a right of appeal against this decision to the Chair, Environmental Appeal Board There may be a strict time limit for filing such an appeal For further information contact the Board Secretary of the Environmental Appeal board at 3rd Floor, Peace Hills Trust Tower, 10011 - 109 Street, Edmonton, Alberta T5J 3S8, telephone (780)427-6207, fax (780)427-4693

TERM OR CONDITION ATTACHED _____ YES _____ NO



CANHUNTER PCP LETH 11·28·9·21

Well Site and Access Road

L.S. 11 Sec. 28 Tp. 9 Rge. 21 W.4 M.

I certify that the survey represented by this plan is correct to the best of my knowledge and was completed on the 13th day of January A.D. 1978

ELEVATION: 2982 Ground

CO-ORDS. 2500.3 South of North boundary } Sec. 28
2095.8 East of West boundary

Alberta Energy Regulator | Alberta Environment and Parks

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Authorization Viewer - Search Results

The Search Used the Following Values:

Legal Land Location:	28-009-21-W4
Act / Document Type:	Water Act, EPEA
Show Inactive Authorizations:	Yes

The resulting Authorizations based on the search criteria will be displayed below. A  will appear next to the Authorization when documentation is available for viewing or downloading. Please click Viewer Help if you encounter problems viewing the Authorization document.

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27 Result(s)

	Document 00016373-00-00 ST. MARY RIVER I.D. PESTICIDE SERVICE, LETHBRIDGE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
	Document 00016373-01-00 ST. MARY RIVER ID PESTICIDE SERVICE LETHBRIDGE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Registration is currently renewed.
	Document 00016373-02-00 ST. MARY RIVER ID PESTICIDE SERVICE LETHBRIDGE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Registration is currently renewed.
	Document 00016373-03-00 ST. MARY RIVER ID PESTICIDE SERVICE LETHBRIDGE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Registration is currently issued as of Mar. 22, 2016 and expires on Mar. 31, 2025.
	Document 00016376-00-00 ST. MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
	Document 00016376-00-01 ST. MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
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	Document 00016376-00-04 ST. MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
	Document 00016376-01-00 ST. MARY RIVER I.D. PESTICIDE SPECIAL USE, LETHBRIDGE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
	Document 00016376-01-01 ST. MARY RIVER IRRIGATION DISCTRICT, PEST SPECIAL, LETHBRIDG is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
	Document 00016376-02-00 ST. MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
	Document 00016376-02-01 ST. MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE - SPRAY WITHIN 30 METRES OF RESERVOIRS is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently expired.
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	Document 00016376-03-01 ST. MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE - USE OF ESCORT is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently expired.
	Document 00016376-03-02 ST. MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE - USE OF MAGNACIDE H is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently expired.
	Document 00016376-03-03 ST. MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE - EXTENSION is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently expired.
	Document 00016376-04-00 ST MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
	Document 00016376-05-00 ST MARY RIVER IRRIGATION DISTRICT PESTICIDE SPECIAL USE is held by St. Mary River Irrigation District, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently issued as of May. 13, 2020 and expires on Mar. 31, 2030.

	Document 00143241-00-00 COUNTY OF LETHBRIDGE RURAL WATERWORKS SYSTEM is held by County of Lethbridge Rural Water Association Limited, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
	Document 00143241-00-01 COUNTY OF LETHBRIDGE RURAL WATERWORKS SYSTEM - PHASE 2 is held by County of Lethbridge Rural Water Association Limited, under the provisions of the *Environmental Protection & Enhancement Act*. This Approval is currently renewed.
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	Document 00143241-01-01 COUNTY OF LETHBRIDGE RURAL WATERWORKS SYSTEM - ELECTRONIC REPORTING is held by County of Lethbridge Rural Water Association Limited, under the provisions of the *Environmental Protection & Enhancement Act*. This Registration is currently issued as of May. 07, 2012 and does not expire.
	Document 00143241-01-02 COUNTY OF LETHBRIDGE RURAL WATERWORKS SYSTEM - REVISED LEAD MAC NOTICE is held by County of Lethbridge Rural Water Association Limited, under the provisions of the *Environmental Protection & Enhancement Act*. This Registration is currently issued as of Feb. 14, 2020 and does not expire.
	Document 00184781-00-00 HUSKY ET AL LETH 11-28-9-21 WELL is held by Husky Oil Operations Limited, under the provisions of the *Environmental Protection & Enhancement Act*. This Reclamation Certificate is currently issued as of Jun. 25, 2002 and does not expire.
	Document 00192218-00-00 COUNTY OF LETHBRIDGE RURAL WATERWORKS/MUNICIPAL - TRANSMISSION MAIN EXTENSION, PHASE 2 is held by County of Lethbridge Rural Water Association Limited, under the provisions of the *Environmental Protection & Enhancement Act*. This Authorization is currently issued as of Jan. 03, 2003 and does not expire.

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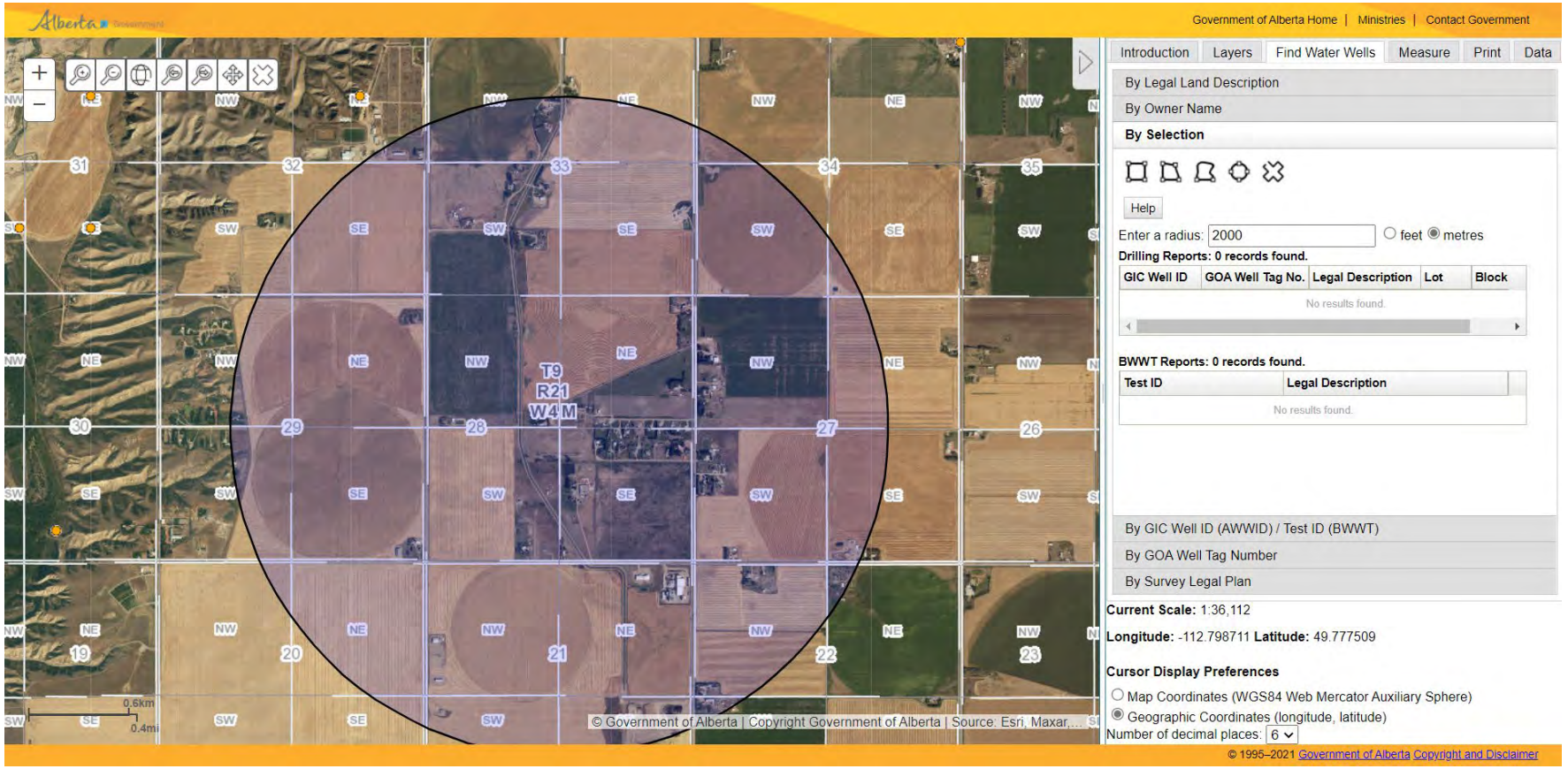
Comments regarding the Authorization Viewer page may be directed to the Regulatory Approvals Centre
RAC.Environment@gov.ab.ca.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Introduction
Layers
Find Water Wells
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Print
Data
By Legal Land Description
By Owner Name
By Selection
Help
Enter a radius: 2000
feet
metres
Drilling Reports: 0 records found.
GIC Well ID
GOA Well Tag No.
Legal Description
Lot
Block
No results found.
BWWT Reports: 0 records found.
Test ID
Legal Description
No results found.
By GIC Well ID (AWWID) / Test ID (BWWT)
By GOA Well Tag Number
By Survey Legal Plan
T9
R21
W4M
0.6km
0.4mi
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Current Scale: 1:36,112
Longitude: -112.798711 Latitude: 49.777509
Cursor Display Preferences
Map Coordinates (WGS84 Web Mercator Auxiliary Sphere)
Geographic Coordinates (longitude, latitude)
Number of decimal places: 6
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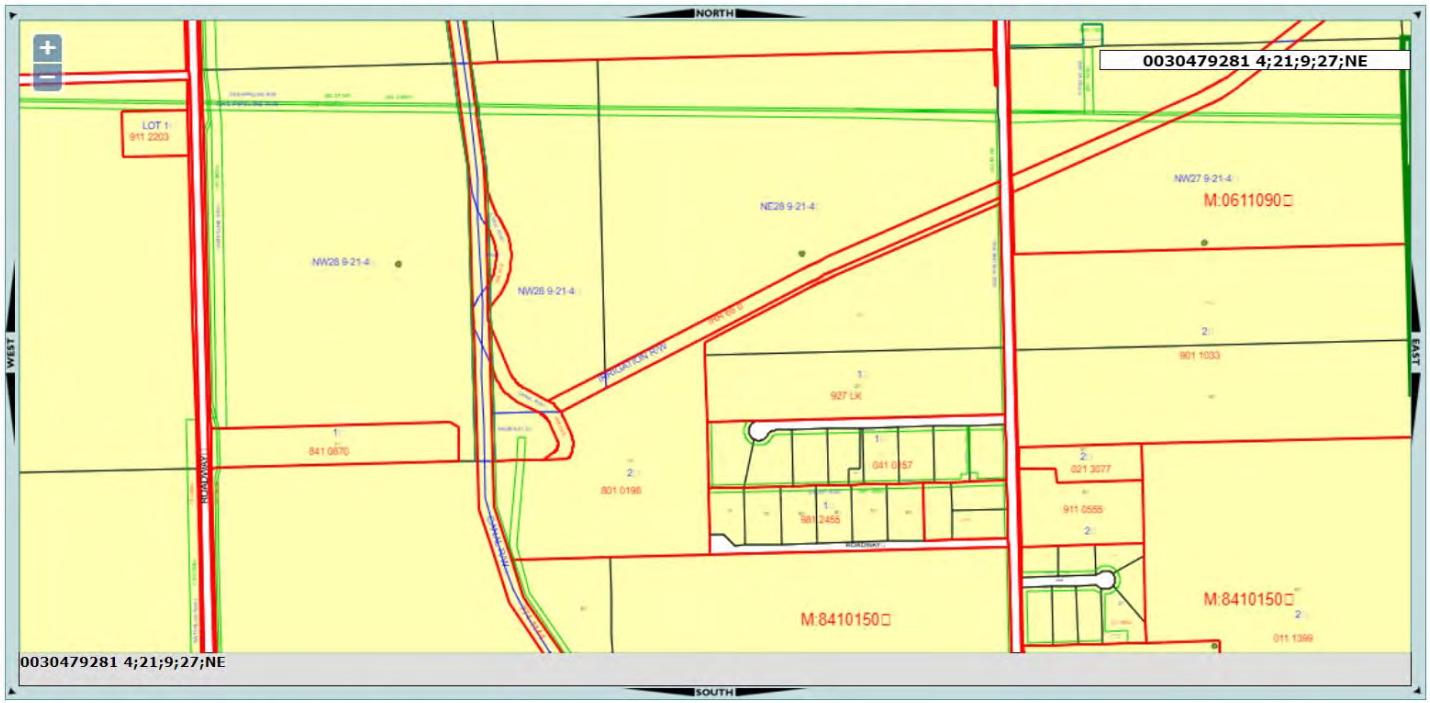

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Urban Detail	Regional Map

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LETHBRIDGE COUNTY

#100, 905 - 4th Avenue South, Lethbridge, Alberta T1J 4E4

September 8, 2021

Tetra Tech Environment and Water Practice
Attn: Jaymes Going
442 – 10 Street North
Lethbridge, AB T1H 2C7

Re: Environmental information regarding Portions of NW and NE-28-09-21-W4M
Legal Descriptions: Plan 927LK Block 1 Lot 1; Plan 927LK Block 1 Lot 2; Plan 8010198 Block 2 Lot 1; and Portion of NW-28-09-21-W4M

The following information is the County's response to your questions regarding the above-mentioned properties.

1. Below is a summary of the records the County holds that might potentially be of environmental concern on the above-noted properties.

    a. Plan 927LK Block 1 Lot 1 and Plan 927LK Block 1 Lot 2
        i. Both properties have a signed agreement for backslope dated September 26, 1988 in their respective land files. Bothh simply note that backsloping is required, approximately 1m.

    b. Plan 8010198 Block 2 Lot 1
        i. There is a Notice of Violation dated September 25, 2000, in the land file for this property stating that there was a large amount of old metals, concrete pipe, construction material, and equipment being stored on the property. There are no additional notes in the file to indicate if and/or when this matter was resolved.

2. Below is a summary of the developments that have been approved for each of the above-noted properties.

    a. Plan 927LK Block 1 Lot 1 – nothing in the file.

    b. Plan 927LK Block 1 Lot 2
        i. Development Permit 2016-137 – issued for a Farm equipment storage building (1500 sq. ft.), which contains a bathroom.

.../2

c. Plan 8010198 Block 2 Lot 1
    i. Development Permit 88-112 – issued for a second mobile home for a hired hand. The notes in the application state there is a barn for horses on the property, a primary residence, and two sheds.

d. Portion of NW-28-09-21-W4M
    i. Development Permit 2006-119 – issued for a 40 ft. by 60 ft. Shop, it appears from the application that a small landscaping business may have been run out of this shop/property but there is no Development Permit application for this Home Occupation business in the land file.

    ii. Development Permit 2007-138 – issued for a residence with attached garage

3. Apart from the above-noted documentation the County does not have any records of underground storage tanks, chemical storage, spills, fires, or landfills, for any of the above-noted properties. If a fire or spill has ever occurred on any of these properties they are located in the response area of the City of Lethbridge Fire Department.

If you have any other questions please contact Sarah Mitchell, Development Officer at 403-328-5525.

Regards,

Sarah Mitchell
Development Officer

APPENDIX D

SPECIAL ATTENTION ITEMS – BACKGROUND INFORMATION

D1 Asbestos

Construction materials used prior to the late 1970s were known to possibly contain asbestos (i.e., ceiling or floor tiles, drywall, and insulation for the walls, boiler, piping, and/or ducts). Asbestos is considered a health hazard if it is friable, airborne, and exposed to humans.

D2 Polychlorinated Biphenyls (PCBs)

The federal Environmental Contaminants Act (1976) has restricted the use and controlled the phase out of polychlorinated biphenyls (PCBs) in Canada. Additionally, the storage and disposal of PCBs is regulated. The Act prohibited the use of PCBs in electrical equipment installed after July 1, 1980. PCBs are commonly found in light ballasts, electrical transformers (pole or ground mounted) and various other types of electrical equipment (i.e., rectifiers) dating back to the early 1980s or earlier.

PCB containing light ballasts/electrical equipment should be disposed of appropriately at the end of their useful life.

D3 Ozone-Depleting Substances (ODS)

In December of 1998, The Government of Canada enacted the Ozone-depleting Substances (ODS) Regulations, which governs the use, handling and release of ODS. ODS may include, but are not limited to, chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl bromide. ODS are usually associated with operations such as: fire extinguishing systems; foam manufacturing; fumigant and pesticide application; prescription metered dose inhalers; refrigeration and air conditioning units; and solvent cleaning and degreasing facilities. ODS are not a health issue for people in the building but are more a maintenance issue to limit or prevent their release. This is accomplished by regular maintenance by trained personnel.

D4 Lead

Lead can be associated with paints, plumbing solder, pipes, and other products such as wall shielding in x-ray rooms. Lead-based paint was withdrawn from the market in the late 1970s. If present, lead-based paint is typically concealed beneath multiple layers of paint applied over the years during renovations. Lead-based paint and plumbing equipment are not a direct health risk when concealed (sealed behind layers of non-lead paint) and/or in good condition. It should, however, be considered when planning future renovations, when particles from lead-based paint could be released and/or ingested in the course of the work.

D5 Urea Formaldehyde Foam Insulation (UFFI)

Insulation materials used during the 1970s and 1980s were known to possibly contain urea formaldehyde foam insulation (UFFI). UFFI was banned in 1980 under the federal Hazardous Products Act.

D6 Radon

Radon gas is a product of the decay series that begins with uranium. Radon is produced directly from radium that is often found in bedrock that contains black shale and/or granite. The gas and its by-products occur naturally everywhere, in soil, water, and air, but usually in concentrations too low to pose a threat. Radon gas can migrate through the ground and enter buildings through porous concrete or fractures. Certain building materials including concrete, and gyprock can also release radon. Natural radon concentrations are low in Alberta and radon gas concentrations are usually well below target limits set for Canada. Potential anthropogenic sources of radon gas should be considered.

D7 Methane

Methane gas is a product of anaerobic decomposition of organic material (e.g., buried fill high in organic material). Methane is also associated with natural gas deposits. Methane gas can migrate through the ground and enter buildings through porous concrete, joints or fractures. Methane presents a potential explosive hazard when it accumulates to concentrations greater than the lower explosive limit (LEL) in the presence of an ignition source.

APPENDIX 6

Septic Feasibility Assessment

TETRA TECH

October 8, 2021

ISSUED FOR USE
FILE: ENG.LGEO04408-01.003

Rick Aldoff
255 – 31 Street North
Lethbridge, AB T1H 3Z4

Subject: Preliminary Septic Disposal Field Feasibility Assessment
Proposed MacLaine Acres Subdivision
Section 28 Range 9 Township 21 West of the 4th Meridian
Lethbridge County, Alberta

1.0 INTRODUCTION

Mr. Rick Aldoff, care of Martin Geomatic Consultants Ltd. (MGCL), retained Tetra Tech Canada Inc. (Tetra Tech) to conduct a septic disposal field feasibility assessment (SDFFA) within three (3) adjoining property parcels located within the Lethbridge County, legally described as Plans 927 LK, Block 1, Lots 1 and 2; as well as Plan 801 0198 Block 2 Lot 1 (hereinafter referred to as the site). The site is located within portions of legal land descriptions 6, 7, 9, 10, and 11 of 28-009-21 W4M, north of Lethbridge, Alberta.

The objective of this assessment was to determine the soil textures and restricting layers across the site in order to assess the feasibility for soil-based septic disposal fields (also known as a sewage treatment system). The SDFFA was completed in general accordance with the Alberta Private Sewage Systems Standard of Practice (APSSSoP), Third Edition, December 2015, published by the Safety Codes Council; however, as noted in (Part 3 of Section 7.1.1.3) a hydrogeological study may be required if on-site sewage systems exceeding 9 m³ per day design capacity, which is beyond the work scope of this assessment.

Authorization to proceed with the SDFFA was provided by Mr. Rick Aldoff via a signed Services Agreement with Tetra Tech on August 24, 2021.

2.0 PROJECT SCOPE OF WORK

The scope of work included a field assessment, desktop review, and reporting, which are detailed in the following subsections.

2.1 Field Assessment

The field assessment portion of the project was completed by Mr. Jamie LaMontagne, EP, of Tetra Tech, on September 9, 2021. The field assessment included the following:

- Completion of public above-ground and underground utility locates by Alberta One-Call, prior to the excavation of testpits. It was also identified that a potential abandoned ATCO line may be in the area; therefore, private locates were also completed by LandScan Locating Ltd. on September 7, 2021.
- Preparation of a site-specific safe work form prior to field assessment and a pre-job safety meeting was undertaken prior to the excavation of testpits.
- Excavation of 12 testpits at select locations on the site, to a maximum depth of 3.0 metres below ground surface (mbgs), by S & A Ditching Ltd. (SADL) of Barons, Alberta.

- Classification of soil profiles at each testpit location using the Canadian System of Soil Classification (CSSC). The individual soil strata and the interfaces between them were noted. In addition to the soil classification, a general description of site topography, vegetation (if observed), landscape position, and slope aspect was also included.
- Obtaining bulk soil samples from each excavation within each potential layer as well as where a restrictive layer[1] was potentially observed to be present. Potential restrictive layers were analyzed in our Lethbridge laboratory for hydrometer analysis.
- Installation of a 25 mm diameter PVC, screened standpipe within each testpit to determine whether seasonal water infiltration was present at each location. Water levels from each standpipe were obtained on September 16, 2021.
- Evaluation of the following:
  - Topography, landscape position, vegetation, and surface drainage characteristics.
  - Surface waters, rock outcrops, and other features of note.
  - Land uses and development within approximately 50 m of the proposed area of the proposed septic disposal fields.

2.2 Desktop Review/Reporting

To meet the objectives of the SDFFA, Tetra Tech undertook the following:

- Completed a site evaluation as per Section 7.1.1.2 of the APSSSoP including the following:
  - Reviewed available published resources including Abacus Datagraphics (AbaData), and the Online Water Well Database.
  - Reviewed geological and hydrogeological information including published topographic, geologic, soil, and groundwater maps and reports.
- Prepared this SDFFA report.

3.0 RESULTS

3.1 General

The proposed subdivision consists of approximately 24 lots which are to be located on vacant, agricultural land, adjacent to an existing 15-lot subdivision located north of the City of Lethbridge. A St. Mary's Irrigation District (SMRID) canal borders the site to the west. Highway 843 borders the site to the east with agricultural activities bordering the site to the north. The existing site has two dugouts that may need special attention during the site grading process if they are to be infilled.

The following subsections outline the results of the field observations and desktop review. The approximate testpit locations and surrounding land use are shown on Figure 1. The results of the hydrometer analysis are presented in Appendix A. Soil profile descriptions are presented in Appendix B.

[1] Defined by the APSSSoP as 'a soil horizon, soil layer, or other condition in the soil profile, or underlying strata, that restricts the downward movement of fluids that could cause a perched water table or saturated soil under the soil infiltration surface of the system'.

3.2 Rights-of-Way and Easements

AbaData identified a high-pressure ATCO natural gas pipeline transecting the far east portion of the site extending north and south through Lots 1 and 2, Block 1, Plan 927 LK. AbaData also identified a Huskey Natural gas pipeline that transects the west portion of Lot 1, Block 2, Plan 801 0198 and traverses the site north to south. It should also be noted that there is a canal right-of-way in the northwest corner of Lot 1, Block 2, Plan 801 0198; as well, there is a SMRID irrigation right-of-way that borders the north portion of the property.

3.3 Vegetation, Topography, and Drainage

The proposed site configuration is bounded by farmland to the north; by an irrigation channel to the west; by Highway 843 to the east; and by residential properties, a farmstead, and farmland to the south in the Lethbridge County.

The proposed site comprises of three parcels: Lot 1 Block 1 Plan 927 LK in the northeast, Lot 2 Block 1 Plan 927 LK in the southeast, and Lot 1 Block 2 Plan 8010198 in the southwest.

Lot 1 Block 1 Plan 927 LK comprises of a farmstead and a dugout in the southeast corner of the lot, a fenced off area in the east that appeared to be used for livestock and/or horses with decomposing bails of hay or straw, while the rest of the lot comprises of a vacant field with a wheel irrigation system. The land is relatively flat with drainage tending to the northeast.

Lot 2 Block 1 Plan 927 LK comprises of a barn/shed in the southwest corner, a dugout in the northeast extent of the lot, while the rest of the lot comprises of a wheel irrigated agricultural field. The land is relatively flat with drainage tending to the northeast and east.

Lot 1 Block 2 Plan 8010198 comprises of a farmstead in the northwest corner of the lot, a residence at the north central extent of the lot, a dugout and farm structures in the northeast corner of the lot, an old horse racetrack in the south half of the lot, a dry dugout just north of the horse racetrack, and a pond/dugout at the south-central extent of the lot. The land is relatively flat with the drainage tending to the northeast. From the topography provided by MGCL, a localized low-lying area was noted on the lot near the dry dugout just north of the horse racetrack.

Regional drainage is northeast to east. See soil profile in Appendix B for detailed descriptions regarding to vegetation, drainage, and slope details at each of the testpit locations.

3.4 Surficial Geology

The surficial geology in the area is characterized by moraine till deposits with sporadic lenses of gravel, sand, and silt (Shetsen 1981).

The stratigraphy of the Lethbridge area is generally comprised of 65 m to 70 m of surficial deposits overlying bedrock. Bedrock in the Lethbridge area consists of strata from the upper Oldman Formation and the lower Bearpaw Formation, both of the late Cretaceous Age (Tokarsky 1973). The bedrock has a relatively flat surface dipping slightly to the northeast and is locally encountered at about Geodetic Elevation 843 m. The bedrock strata consist of thin beds of predominantly weak mudstones, siltstones, and sandstones with occasional bentonite and coal seams.

A geotechnical evaluation was also completed for the site and reported under separate cover (ENG.LGEO04408-01, dated August 2018). The drilling assessment for this geotechnical evaluation identified clay fill material in 4 of the 12 boreholes drilled. The thickness of clay fill ranged from 0.2 m at the four (4) locations to 0.35 m within Lot 1, Block 1 Plan 927 k.

Rock outcrops were not observed across the site. Surficial drainage from the lots is regional and tends towards the northeast to east. No other natural features that could impact the application or design of the proposed treatment system were observed during the field investigation.

3.5 Surface Water and Water Wells

There are two dugouts located on the site, as well as several dugouts present on the adjacent properties. A SMRID canal borders the site to the west. The Oldman River is located approximately 4 kms west of the site. Regional groundwater flow is expected to be westerly, toward the Oldman River.

The Alberta Water Well Information Database[2] search did not list any record of water wells within the site boundaries; however, the search identified two water well records relating to water wells located off site, within a 3 km radius of the site. The following table summarizes the information of this water well.

Table A: Water Well Details

Location	Distance and Direction from Site*	Owner/Well ID	Drilling Dates	Depth	Use	Tetra Tech's Evaluation
NE 32-009-21 W4M	A minimum of 2 kms northwest of the site	Lethbridge Rendering /106353	1981	Unknown	Domestic	Due to the distance from the site, this well is not considered to be a concern to the site.
LSD 1-04-010-21 W4M	A minimum of 2.5 kms to the north of the site	Biantco Environmental / 1022402 (9 records under I.D)	2013	28.96 m to 64.62 m	Investigation / Monitoring / Other	Due to the distance from the site, these wells are not considered to be a concern to the site.

* Note: Specific well locations may potentially be located at any point within the quarter section provided, as the database will place the well in the centre of the quarter section if no specific location is provided in the drilling report.

3.6 Surrounding Land Use

Table B summarizes the surrounding land use.

Table B: Surrounding land Use

Direction	Land Use*	Observations
North	Agricultural Cropland	Undeveloped agricultural cropland. No buildings or structures noted within 100 m of the site boundaries.
South of Lot 2 Block 1 Plan 927 LK	Rural Residential Subdivision	Residential buildings and local road to the south.
South of Lot 1 Block 2 Plan 801 0198	Agricultural/residential	A dugout is located just south of the centre of the lot with pastureland on either side to the east and west of the remaining south border of the lot.

[2] Alberta Environment. 2013. Alberta Environment Groundwater Information System (Water Well Reports). Accessed at http://www.telusgeomatics.com/tgpub/ag_water/ May 2013.

Table B: Surrounding land Use

Direction	Land Use*	Observations
East	Secondary highway 843 and residential properties beyond	Secondary highway 843 to the east of the site with rural residential lots and houses beyond the Secondary Highway 843 to the east.
West	SMRID canal and agricultural Cropland Beyond	A SMRID open canal runs along the west side of the property with Agricultural cropland further to the west.

* Land use inferred from observations made during the site visit.

3.7 Laboratory Results

Tetra Tech performed soil texture analysis via hydrometer on 12 selected soil samples. The soil texture test results are summarized in Table C and laboratory certificates are included in Appendix A. The test results are consistent with the soil textures described on site and are considered representative of the soil profiles at the proposed septic disposal field locations.

Table C: Soil Texture Analysis

Testpit Number	Sample Depth (mbgs)	% Sand	% Silt	% Clay	Soil Classification
TP01	0.1 – 0.25	14	55	31	Silty Clay Loam (SICL)
TP02	0.25 – 0.83	3	68	29	Silty Clay Loam (SICL)
TP03	0.27 – 0.9	4	65	31	Silty Clay Loam (SICL)
TP04	0.19 – 1.3	2	72	26	Silty Loam (SIL)
TP05	0.29 – 1.2	23	49	28	Clay Loam (CL)
TP06	0.11 – 0.21	15	57	28	Silty Clay Loam (SICL)
TP07	0.5 – 0.7	20	49	31	Silty Clay Loam (SICL)
TP08	0.2 – 0.6	33	41	24	Loam (L)
TP09	0.3 – 0.95	42	32	25	Loam (L)
TP10	0.31 – 0.9	10	65	25	Silty Loam (SIL)
TP11	0.4 – 0.9	32	40	28	Clay Loam (CL)
TP12	0.45 – 0.7	22	54	24	Silt Loam (SIL)

3.8 Soil Profiles

The site is located in the Dark Brown Soil Zone of Alberta and soils on site consist of Calcareous Dark Brown Chernozems which are differentiated from the Orthic Dark Brown Chernozems by having a Bmk horizon where the primary alkaline earth carbonates have not been removed. Soil observations and soil profile logs for each testpit are included in Appendix B.

Twelve (12) testpits were excavated in the area of the proposed subdivision. The general CSSC profile descriptions of the soils at the site are summarized below:

- **Apk Horizon** (21TP01 through 21TP09) or **Ahk Horizon** (21TP10 to 21TP12) ranging in depths between 0.0 mbgs to 0.27 mbgs. The horizon generally consisted of very dark greyish to very dark brown soil with trace of faint mottling at some locations. The soil was exhibited a weak to moderate (Grades 1 to 2), fine to medium, granular structure. The soil was generally friable and dry to moist with no coarse fragments and weak effervescence. Soil texture within this horizon was described as clay loam. Some difficulty was encountered differentiating between the A and B Horizons at some locations. A buried A Horizon (Ahkb) was observed at 21TP07 (0.31 mbgs to 0.5 mbgs). Additionally, red shale inclusions were observed in the A horizon at 21TP01, 21TP02, 21TP03, and 21TP07 suggesting this horizon has been replaced at each location. This horizon has suitable soil textures and structure for soil-based treatment system.

- **Bmk Horizon** (within most testpits, excluding 21TP03) ranging in depths between 0.07 mbgs to 0.45 mbgs. The horizon generally consisted of brown and very dark brown to black soil with trace of faint mottling at some locations. The soil was exhibited a weak to moderate (Grades 1 to 2), fine to coarse, blocky or subangular blocky structure at most locations. The soil was generally firm to hard, friable, and dry to moist with no coarse fragments and weak to moderate effervescence. Soil texture within this horizon was described as clay loam or silty clay loam. Some difficulty was encountered differentiating between the A and B Horizons at some locations. A buried B Horizon (Bmkb) was observed at 21TP07 (0.5 mbgs to 0.7 mbgs). Additionally, red shale inclusions were observed in the B Horizon at 21TP01 and 21TP02, suggesting this horizon has been replaced at each location. This horizon has suitable soil textures and structure for soil-based treatment system.

- **Cca_1 Horizon** (within all testpits) ranging in depths between 0.19 mbgs to 1.30 mbgs. The horizon generally consisted of greyish brown to light olive brown soil with traces of faint mottling at some locations. The soil was exhibited a weak to moderate (Grades 1 to 2), fine to coarse, granular or blocky structure. The soil was firm to hard, friable, and moist to very moist with no coarse fragments and very strong effervescence. Soil texture within this horizon included loam, clay loam and silty clay loam. This horizon has suitable soil textures and structure for soil-based treatment system.

- **Cca_2 Horizon** (21TP03, 21TP07, 21TP08, 21TP10, 21TP11, and 21TP12) ranging in depths between 0.60 mbgs to 2.30 mbgs. The horizon generally consisted of greyish brown to very dark greyish brown soil with no mottling observed. The soil was structureless (Grade 0), fine to medium, and massive. The soil was friable and firm, and moist to very moist with no coarse fragments and moderate to strong effervescence. Soil texture within this horizon included clay loam, sandy clay loam, and silty clay loam. This horizon has suitable soil textures but massive soil structure and is considered a restricting layer for soil-based treatment system.

- **Ck_1 Horizon** (within all testpits) ranging in depths between 1.0 mbgs and 3.0 mbgs. The horizon generally consisted of dark greyish brown to dark olive brown soil with some faint mottling. The soil was described as structureless (Grade 0), fine to medium, and massive structure. The soil was soft to firm, friable, and moist with 2% to 5% coarse fragments and weak effervescence. Traces of coal and oxide specks were observed in the horizon. Soil textures within this horizon were described as clay loam, silty clay loam, and/or sandy clay loam. The soil within this horizon was saturated at 21TP01, 21TP02, and 21TP03, and groundwater was observed entering these testpits at approximately 1.2 mbgs. This horizon has suitable soil textures but massive structure and locally saturated. This horizon is considered a restricting layer for soil-based treatment system.

- **Ck_2 Horizon** (within 21TP01 through 21TP05, and 21TP09) ranging in depths between 1.8 mbgs and 3.00 mbgs. The horizon generally consisted of very dark greyish brown to dark olive brown soil with some faint mottling. The soil was described as structureless (Grade 0), fine to medium, and massive structure. The soil was friable and moist to very moist, with 2% to 5% coarse fragments and very weak effervescence. Traces of coal and oxide specks, and/or white precipitates were observed in the horizon. Soil textures within this horizon were described as clay loam (21TP02 and 21TP03), silty clay loam (21TP01 and 21TP05), and/or sandy clay loam (21TP04). Impermeable layers, such as bedrock and/or compaction, were not noted within the horizon; however, the soil at this depth was saturated at 21TP01, 21TP02, and 21TP03, and groundwater was observed entering these testpits at approximately 1.2 mbgs. This horizon has suitable soil textures but massive structure and locally saturated. This horizon is considered a restricting layer for soil-based treatment system.

3.9 Groundwater Seepage Conditions

Tetra Tech personnel visited the site on September 16, 2021 to measure the groundwater elevations within the standpipes with measurement results shown in Table D.

Table D: Seepage Conditions and Groundwater Measurement Results on September 16, 2021

Testpit Number	Depth of Standpipe (m)	Depth to Seepage (m)	Depth to Sloughing (m)	Borehole Elevation (m)	Depth to Groundwater (m)	Groundwater Elevation (m)
21TP001	3.0	1.2	1.2	901.17	1.36	899.81
21TP002	2.8	1.2	1.2	903.28	0.77	902.51
21TP003	3.0	1.2	1.2	904.38	0.69	903.69
21TP004	2.9	NE	NE	901.49	1.62	899.87
21TP005	3.0	NE	NE	903.53	2.17	901.36
21TP006	3.0	NE	NE	904.51	2.12	902.39
21TP007	3.0	NE	NE	906.27	NE	-
21TP008	3.0	NE	NE	907.37	NE	-
21TP009	3.0	NE	NE	907.51	NE	-
21TP010	3.0	NE	NE	907.46	NE	-
21TP011	3.0	NE	NE	906.72	NE	-
21TP012	3.0	NE	NE	906.62	NE	-

NE - Not Encountered

4.0 CONCLUSIONS AND RECOMMENDATIONS

In accordance with the requirements of APSSSoP, a minimum vertical separation distance between the soil infiltration surface and a restrictive layer for this site shall be no less than 1,500 mm when receiving primary treated effluent. The separation distance can be reduced to 900 mm when receiving secondary treated effluent (Level 2 or better) and using a pressure distribution lateral pipe system if the site is within 2 km of a lake, river, stream, or creek. If the minimum depth of a restrictive layer is greater than 1,500 mm (600 mm embedded depth plus 900 mm separation), a field system is considered suitable. If the minimum depth of a restrictive layer is less than 1,500 mm, a mound system may be required to maintain 900 mm separation. According to the aforementioned requirement and soil findings at the testpit locations, the assessment results of suitability of the soils for a soil-based treatment and recommended treatment system as well as design parameters are provided in Table E. To obtain Level 2 or better effluent quality, a sand filter of a minimum of 300 mm is generally considered above soil-based treatment system using pressure distribution lateral pipe. The recommended treatment system in Table E is based on the existing site conditions and need to be further reviewed if a site grading is to be conducted for the project.

Table E: Assessment Results of Site Suitability and Soil-Based Treatment System

Testpit Number	Restricting Layer/Depth (mbgs)	Separation Distance (mm)	Feasible Soil-Based Treatment System	Effluent Quality	Effluent Lading Rate (L/Day/sq. m)	Hydraulic Linear Loading Rate (L/Day/m)
21TP001	Massive CL (0.83)	830	Soil-based Treatment with Treatment Mound	Level 2 or better with pressure distribution lateral pipe	13.2	44.7
21TP002	Massive SCL (0.83)	830	Soil-based Treatment with Treatment Mound	Level 2 or better with pressure distribution lateral pipe	13.2	44.7
21TP003	Massive CL (2.3)	2,300	Soil-Based Treatment	Level 1 or better	8.8*	44.7
21TP004	Massive CL (1.3)	1,300	Soil-Based Treatment	Level 2 or better with pressure distribution lateral pipe distribution lateral pipe	13.2	44.7
21TP005	Massive SCL (1.2)	1,200	Soil-Based Treatment	Level 2 or better with pressure distribution lateral pipe	13.2	44.7
21TP006	Massive CL (1.1)	1,100	Soil-Based Treatment	Level 2 or better with pressure distribution lateral pipe	13.2	44.7
21TP007	Massive CL (1.3)	1,300	Soil-Based Treatment	Level 2 or better with pressure distribution lateral pipe	13.2	44.7
21TP008	Massive CL (0.6)	600	Soil-based Treatment with Treatment Mound	Level 2 or better with pressure distribution lateral pipe	13.2	37.3
21TP009	Massive CL (0.95)	950	Soil-Based Treatment	Level 2 or better with pressure distribution lateral pipe	13.2	44.7
21TP010	Massive SICL (0.9)	900	Soil-Based Treatment	Level 2 or better with pressure distribution lateral pipe	13.2	44.7
21TP011	Massive CL&SCL (0.9)	900	Soil-Based Treatment	Level 2 or better with pressure distribution lateral pipe	13.2	44.7

Table E: Assessment Results of Site Suitability and Soil-Based Treatment System

Testpit Number	Restricting Layer/Depth (mbgs)	Separation Distance (mm)	Feasible Soil-Based Treatment System	Effluent Quality	Effluent Lading Rate (L/Day/sq. m)	Hydraulic Linear Loading Rate (L/Day/m)
21TP012	Massive SICL (0.7)	700	Soil-based Treatment with Treatment Mound	Level 2 or better with pressure distribution lateral pipe	13.2	44.7

*May increase to13.2 if level 2 or better effluent quality to be applied.

It is understood that the local municipal authority having jurisdiction will be contacted to determine what will be accepted for septic disposal field installation. Depending on the requirements of the local municipal authority, further assessment of the soil conditions at the specific locations of proposed septic systems; as well, further site evaluation to meet the requirements of Part 7 within the APSSSoP may be required. This may include, but is not limited to, the following:

- Hydrogeological site and soil evaluation for on-site sewage systems exceeding 9 m³ per day design capacity as per Section 7.1.1.3 of the APSSSoP.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Mr. Rick Aldoff, and his agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Mr. Rick Aldoff or his representatives., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on Use of this Document attached in Appendix C or Contractual Terms and Conditions executed by both parties.

6.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully Submitted,
Tetra Tech Canada Inc.

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Attachments: Figure 1: Testpit Location Plan
Appendix A: Hydrometer Results
Appendix B: Soil Observation and Soil Profile Descriptions
Appendix C: Limitation on Use of This Document

REFERENCES

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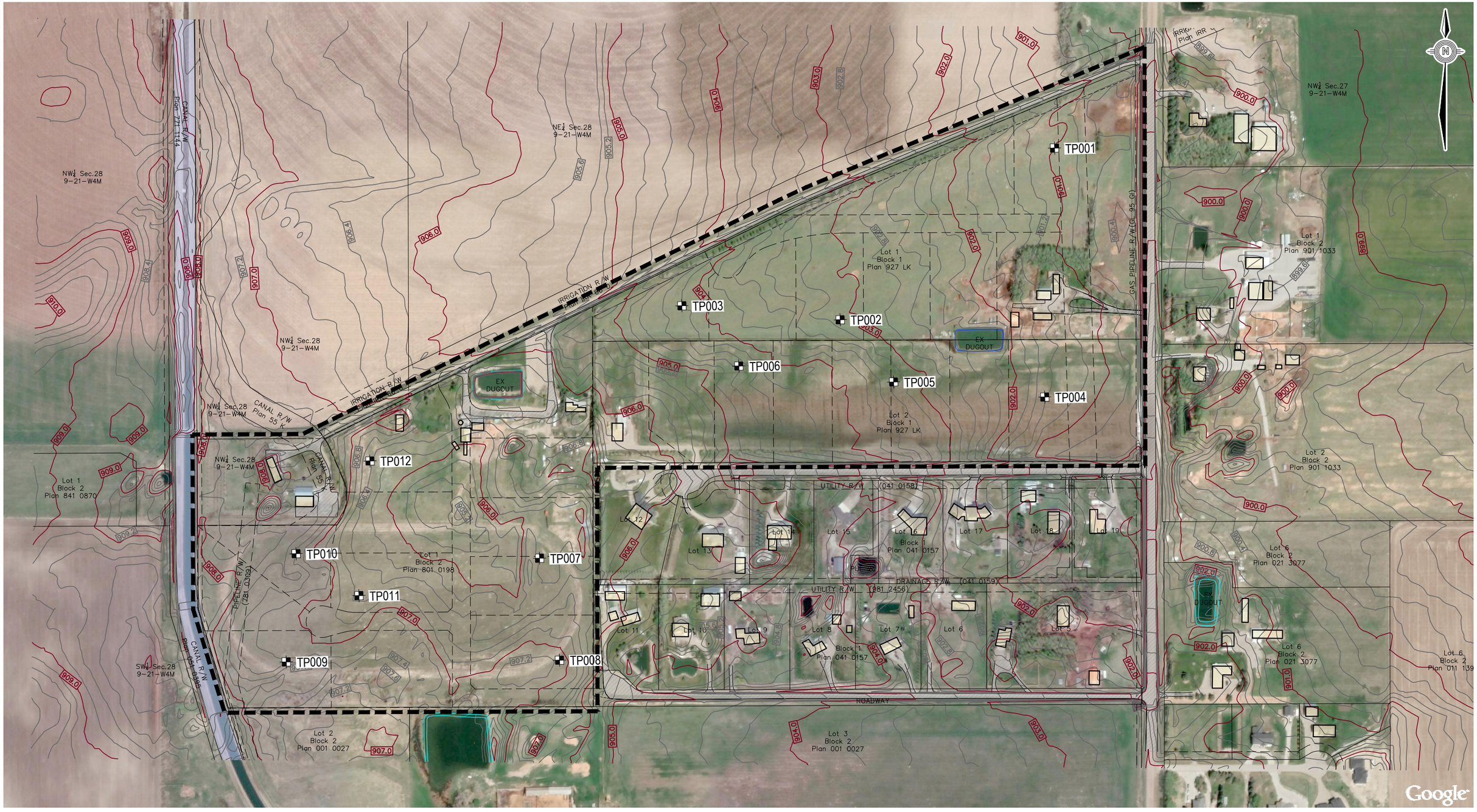
FIGURES



LEGEND

- SITE BOUNDARY
- TEST PIT LOCATION
- 1 m MAJOR CONTOUR
- 0.2 m MINOR CONTOUR

0 200m

Scale: 1:4,000 @ 11"x17"

NOTES

GOOGLE EARTH IMAGERY DATED 2021.

BASE DRAWING PROVIDED BY CLIENT, DATED JULY 15, 2021.

CLIENT

Mr. Rick Aldoff

PRELIMINARY SEPTIC FIELD FEASIBILITY ASSESSMENT - MacLAINE ACRES ASP

TEST PIT LOCATION PLAN

TETRA TECH

PROJECT NO.	DWN	CKD	REV
LGEO04408-01.003	LCH	JM	0

OFFICE	DATE
Tt Leth	October 2021

Figure 1

C:\Lethbridge\Drafting\ENG.LGEO\LGEO04408\CAD\LGEO04408-01-003 Figure 1.dwg [FIGURE 1] October 06, 2021 - 10:47:13 am (BY: HUGHES, LEANNE)

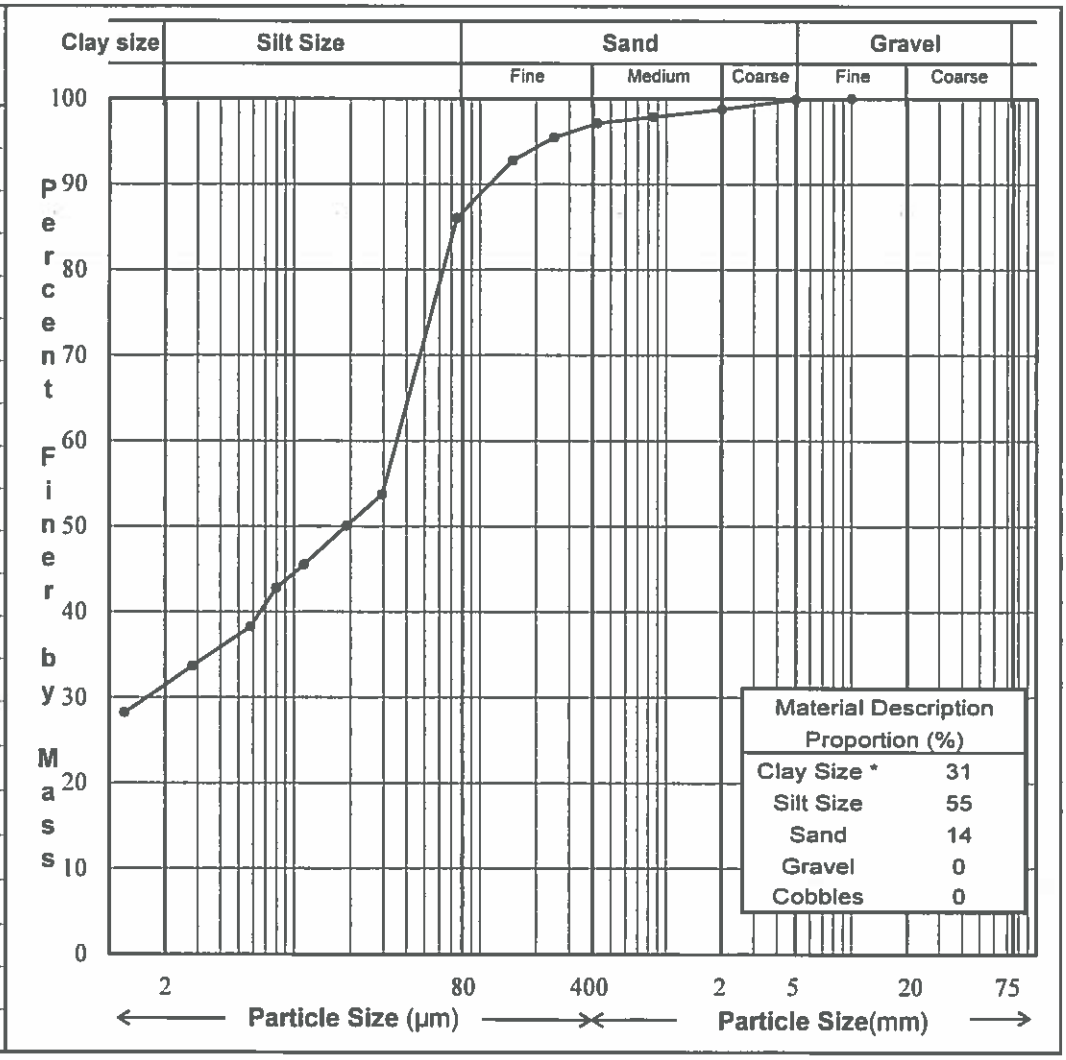
APPENDIX A
HYDROMETER RESULTS

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	1
Client:	Rick Adolf	Borehole/ TP:	21TP01
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.10 -0.25 m
Location:		Date Tested	September 21, 2021
Description **:	Silty Clay Loam (SICL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	100
5 mm	100
2 mm	99
850 µm	98
425 µm	97
250 µm	95
150 µm	92.8
75 µm	86.0
30 µm	53.7
19 µm	50.1
11 µm	45.5
8 µm	42.8
6 µm	38.2
3 µm	33.7
1 µm	28.2



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

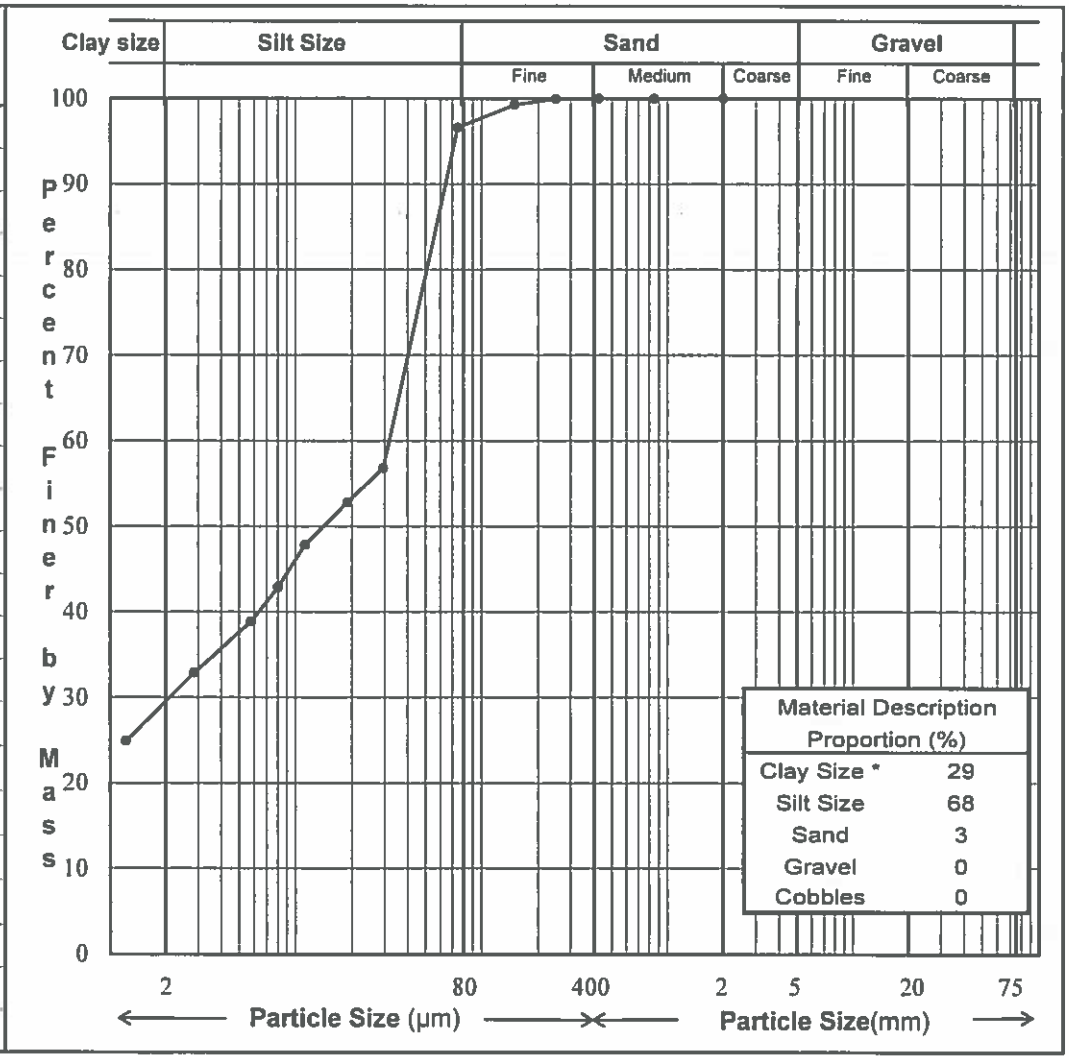
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	2
Client:	Rick Adolf	Borehole/ TP:	21TP02
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.25 - 0.83m
Location:		Date Tested	September 21, 2021
Description **:	Silty Clay Loam (SICL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	100
425 µm	100
250 µm	100
150 µm	99.2
75 µm	96.6
30 µm	56.8
19 µm	52.8
11 µm	47.8
8 µm	42.8
6 µm	38.9
3 µm	32.9
1 µm	24.9



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is behaviour based & subject to Tetra Tech description protocols.

Reviewed By: _____ P.Eng.

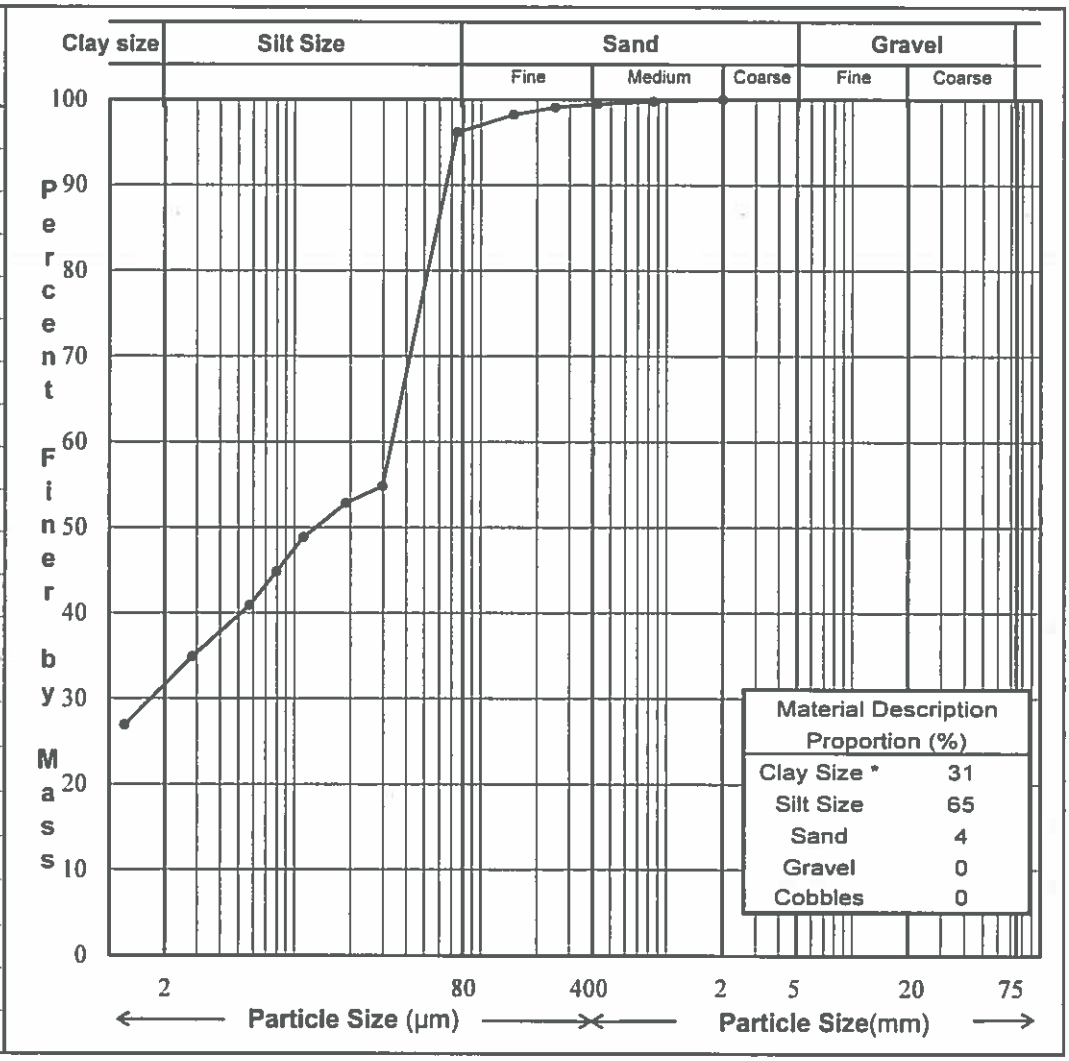
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	3
Client:	Rick Adolf	Borehole/ TP:	21TP03
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.27 - 0.9m
Location:		Date Tested	September 21, 2021
Description **:	Silty Clay Loam (SICL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	100
425 µm	99
250 µm	99
150 µm	98.2
75 µm	96.2
30 µm	54.8
19 µm	52.8
11 µm	48.8
8 µm	44.8
6 µm	40.9
3 µm	34.9
1 µm	26.9



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

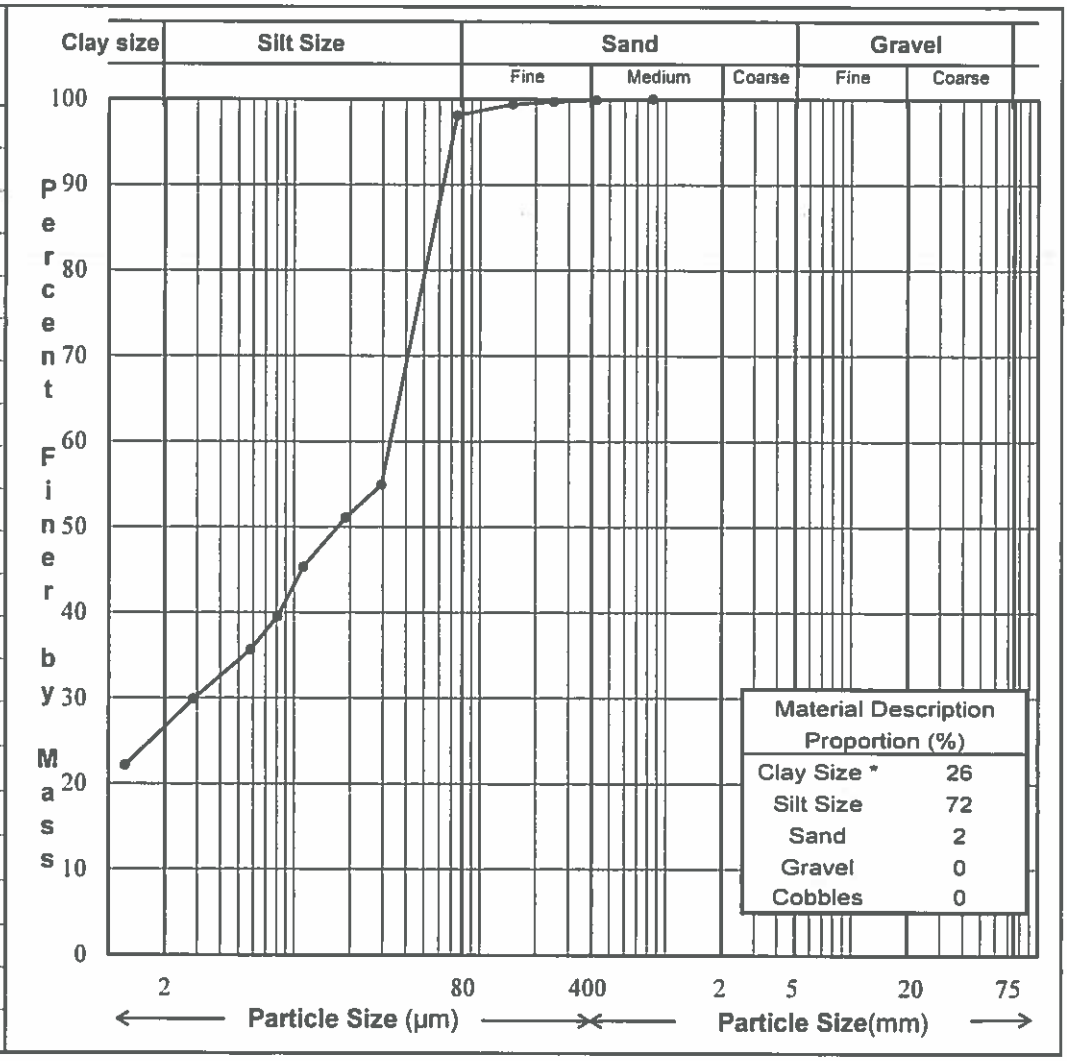
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	4
Client:	Rick Adolf	Borehole/ TP:	21TP04
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.19 - 1.30 m
Location:		Date Tested	September 21, 2021
Description **:	Silt Loam (SIL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	
850 µm	100
425 µm	100
250 µm	100
150 µm	99.4
75 µm	98.1
30 µm	54.9
19 µm	51.1
11 µm	45.3
8 µm	39.5
6 µm	35.7
3 µm	29.9
1 µm	22.2



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

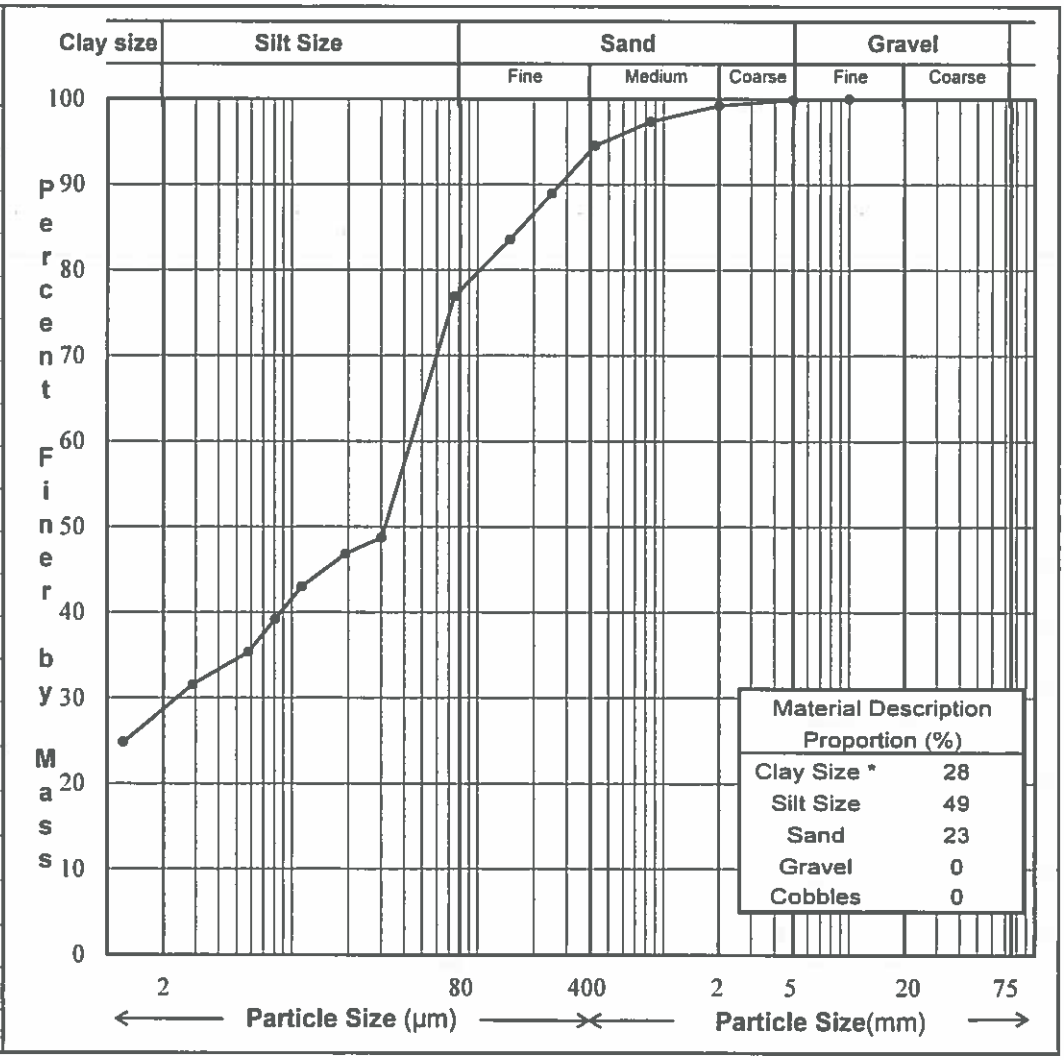
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	5
Client:	Rick Adolf	Borehole/ TP:	21TP05
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.29 - 1.2 m
Location:		Date Tested	September 22, 2021
Description **:	Clay Loam (CL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	100
5 mm	100
2 mm	99
850 µm	97
425 µm	95
250 µm	89
150 µm	83.6
75 µm	76.9
30 µm	48.7
19 µm	46.8
11 µm	43.0
8 µm	39.2
6 µm	35.4
3 µm	31.5
1 µm	24.8



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

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PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	6
Client:	Rick Adolf	Borehole/ TP:	21TP06
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.11 - 0.21m
Location:		Date Tested	September 22, 2021
Description **:	Silty Clay Loam (SICL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	100
2 mm	100
850 µm	99
425 µm	98
250 µm	97
150 µm	93.4
75 µm	85.5
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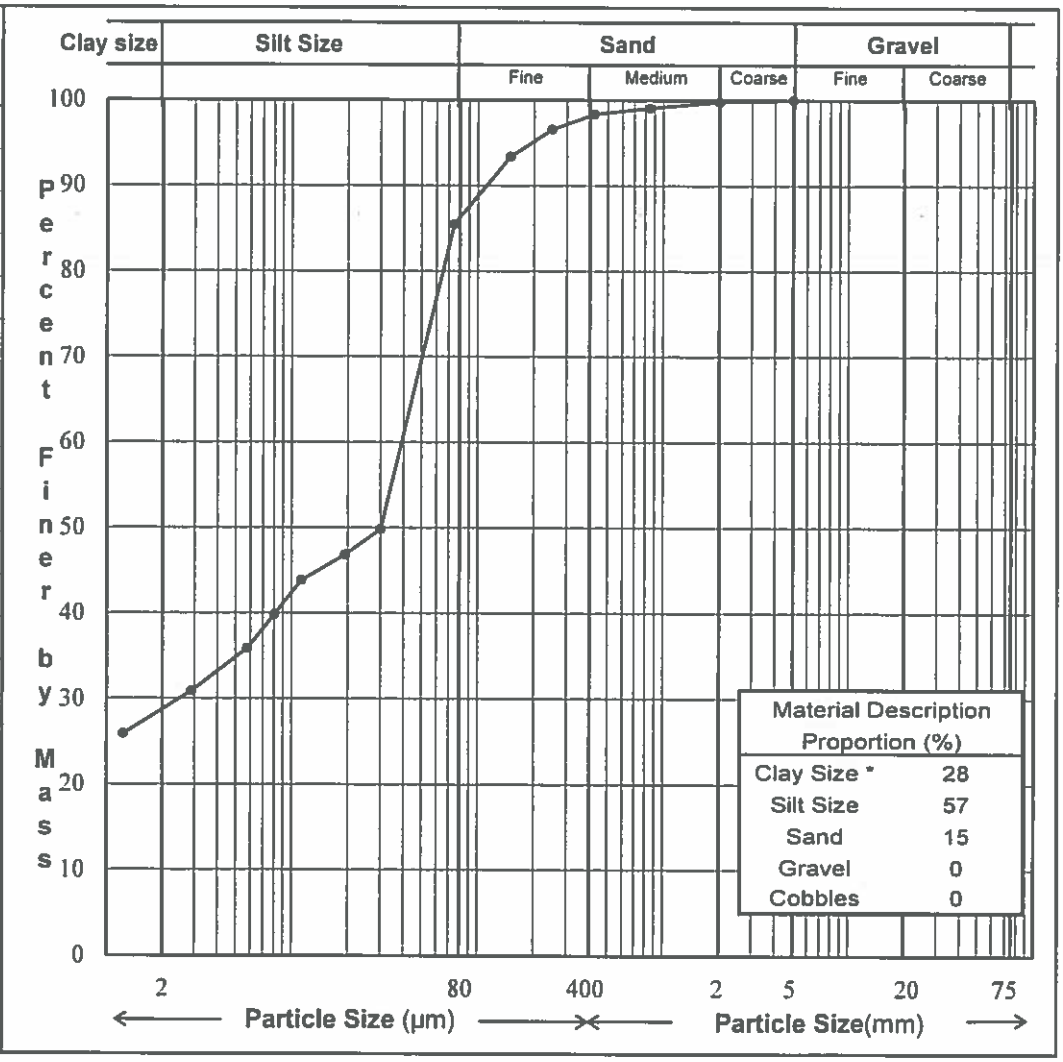
19 µm	46.8
11 µm	43.8
8 µm	39.8
6 µm	35.9
3 µm	30.9
1 µm	25.9



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

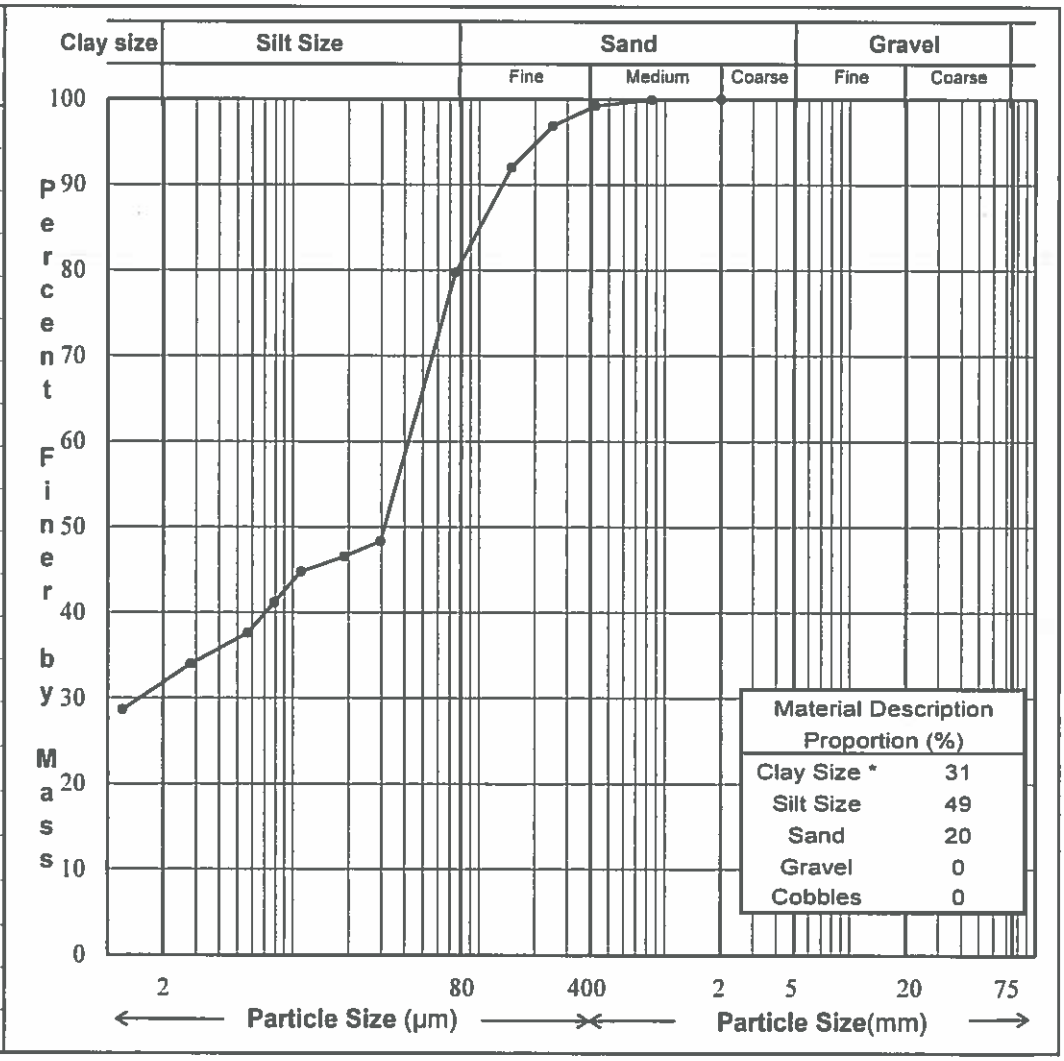
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	7
Client:	Rick Adolf	Borehole/ TP:	21TP07
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.5 - 0.7m
Location:		Date Tested	September 22, 2021
Description **:	Silty Clay Loam (SICL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	100
425 µm	99
250 µm	97
150 µm	92.0
75 µm	79.7
30 µm	48.3
19 µm	46.5
11 µm	44.7
8 µm	41.2
6 µm	37.6
3 µm	34.0
1 µm	28.6



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

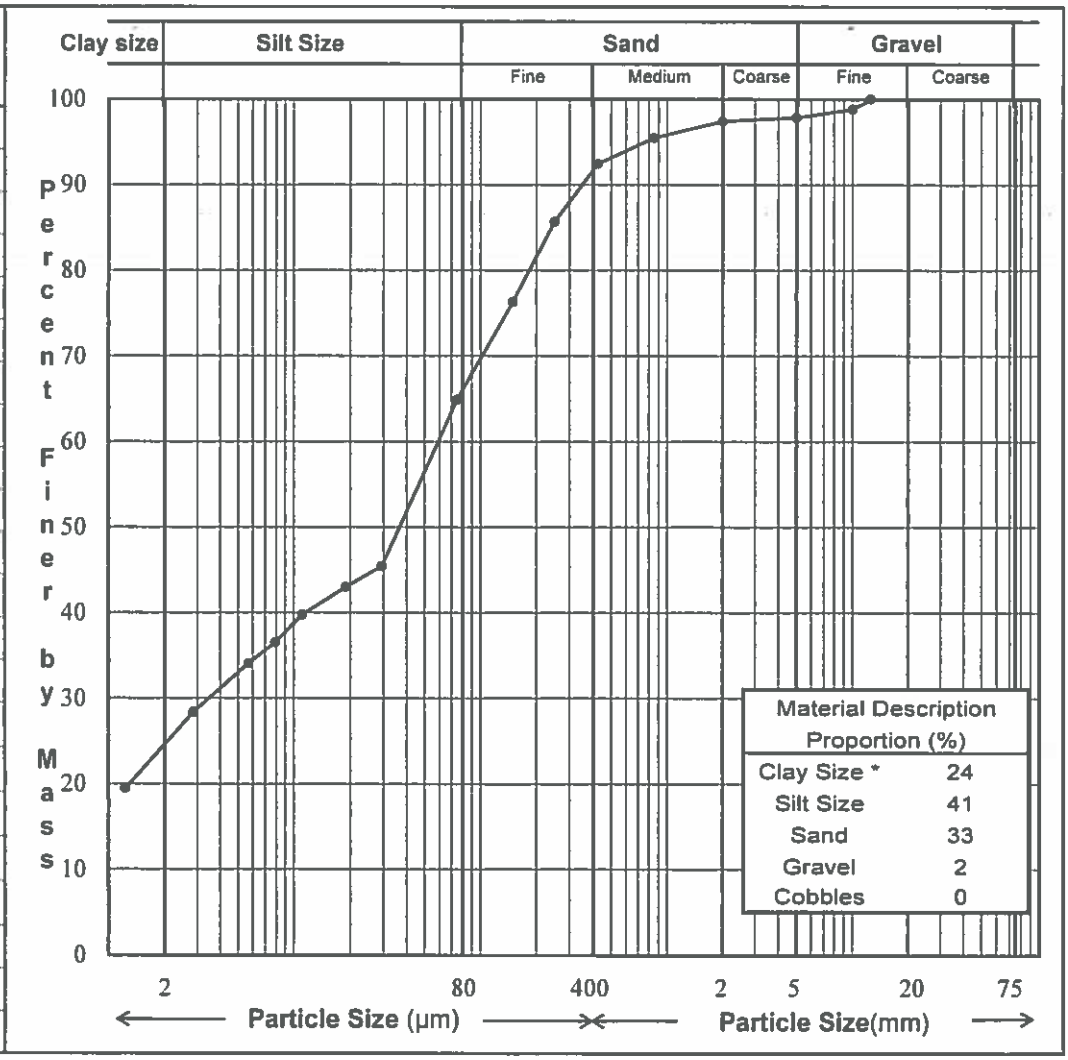
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	8
Client:	Rick Adolf	Borehole/ TP:	21TP08
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.2 - 0.6m
Location:		Date Tested	September 23, 2021
Description **:	Loam (L)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	100
10 mm	99
5 mm	98
2 mm	97
850 µm	95
425 µm	92
250 µm	86
150 µm	76.3
75 µm	64.9
30 µm	45.4
19 µm	43.0
11 µm	39.8
8 µm	36.5
6 µm	34.1
3 µm	28.4
1 µm	19.5



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

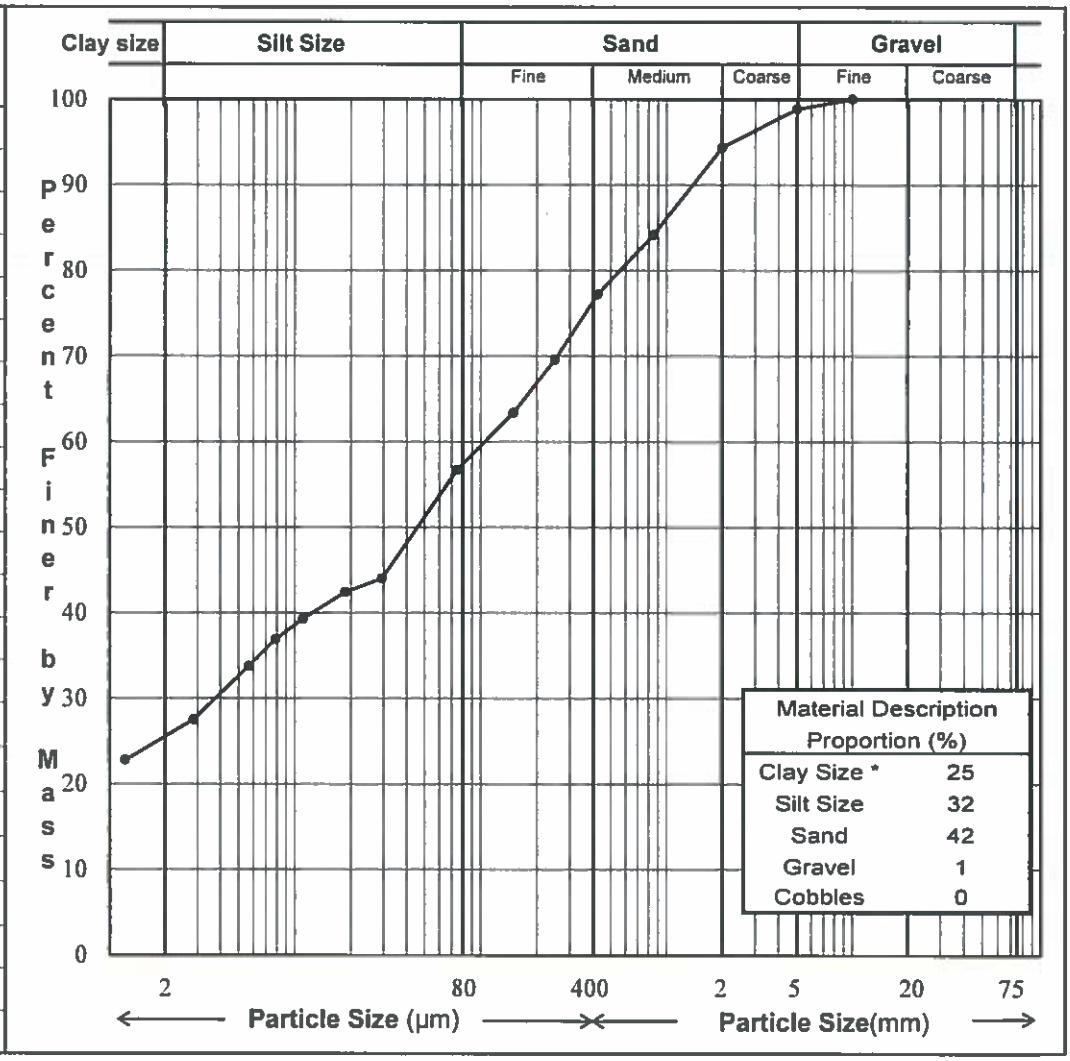
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	9
Client:	Rick Adolf	Borehole/ TP:	21TP09
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.3 - 0.95m
Location:		Date Tested	September 23, 2021
Description **:	Loam (L)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	100
5 mm	99
2 mm	94
850 µm	84
425 µm	77
250 µm	70
150 µm	63.4
75 µm	56.7
30 µm	44.0
19 µm	42.4
11 µm	39.3
8 µm	36.9
6 µm	33.8
3 µm	27.5
1 µm	22.8



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

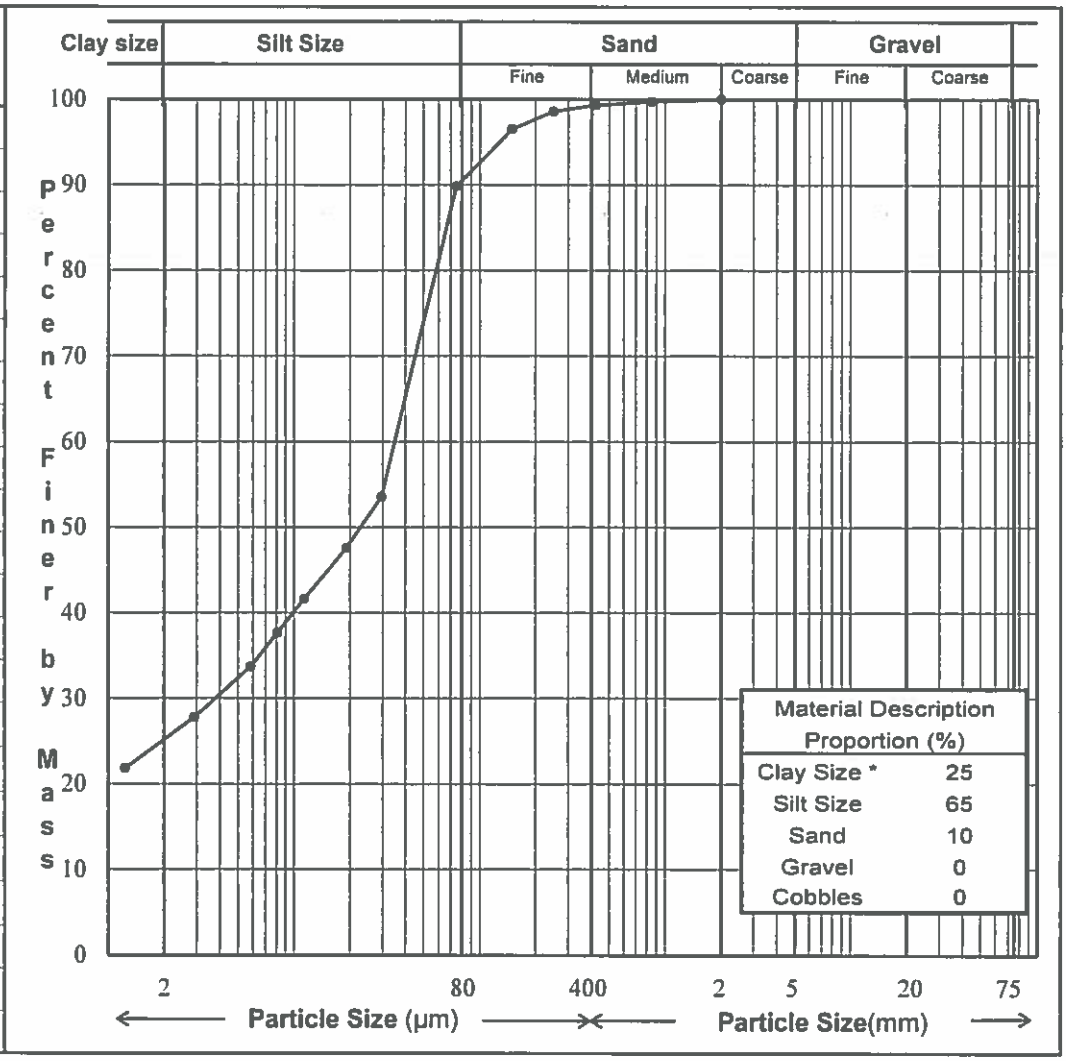
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	10
Client:	Rick Adolf	Borehole/ TP:	21TP10
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.31 - 0.90m
Location:		Date Tested	September 23, 2021
Description **:	Silt Loam (SIL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	100
425 µm	99
250 µm	99
150 µm	96.5
75 µm	89.8
30 µm	53.5
19 µm	47.6
11 µm	41.6
8 µm	37.7
6 µm	33.7
3 µm	27.8
1 µm	21.8



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

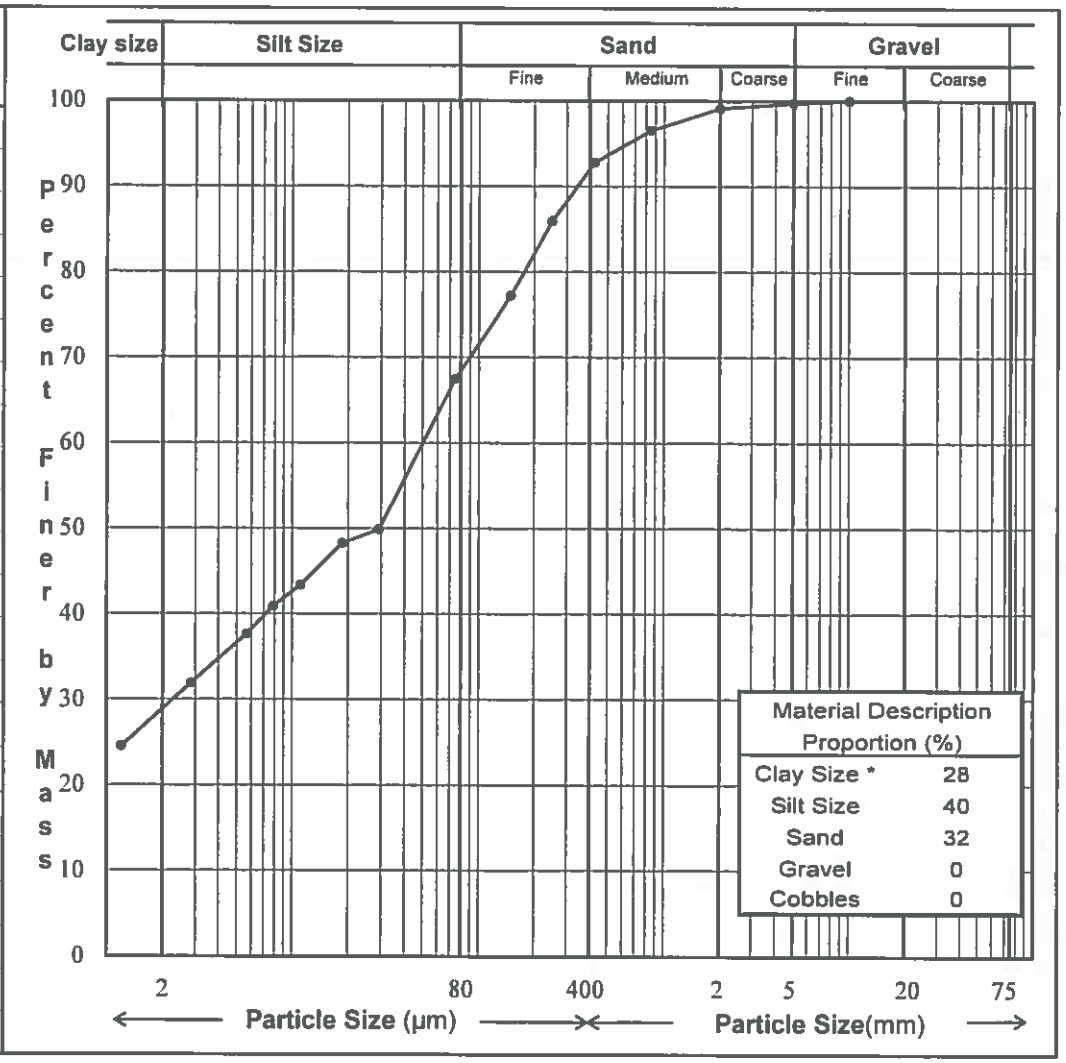
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	11
Client:	Rick Adolf	Borehole/ TP:	21TP11
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.4 - 0.9m
Location:		Date Tested	September 24, 2021
Description **:	Clay Loam (CL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	100
5 mm	100
2 mm	99
850 µm	97
425 µm	93
250 µm	86
150 µm	77.2
75 µm	67.4
29 µm	49.9
19 µm	48.3
11 µm	43.3
8 µm	40.9
6 µm	37.6
3 µm	31.9
1 µm	24.5



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

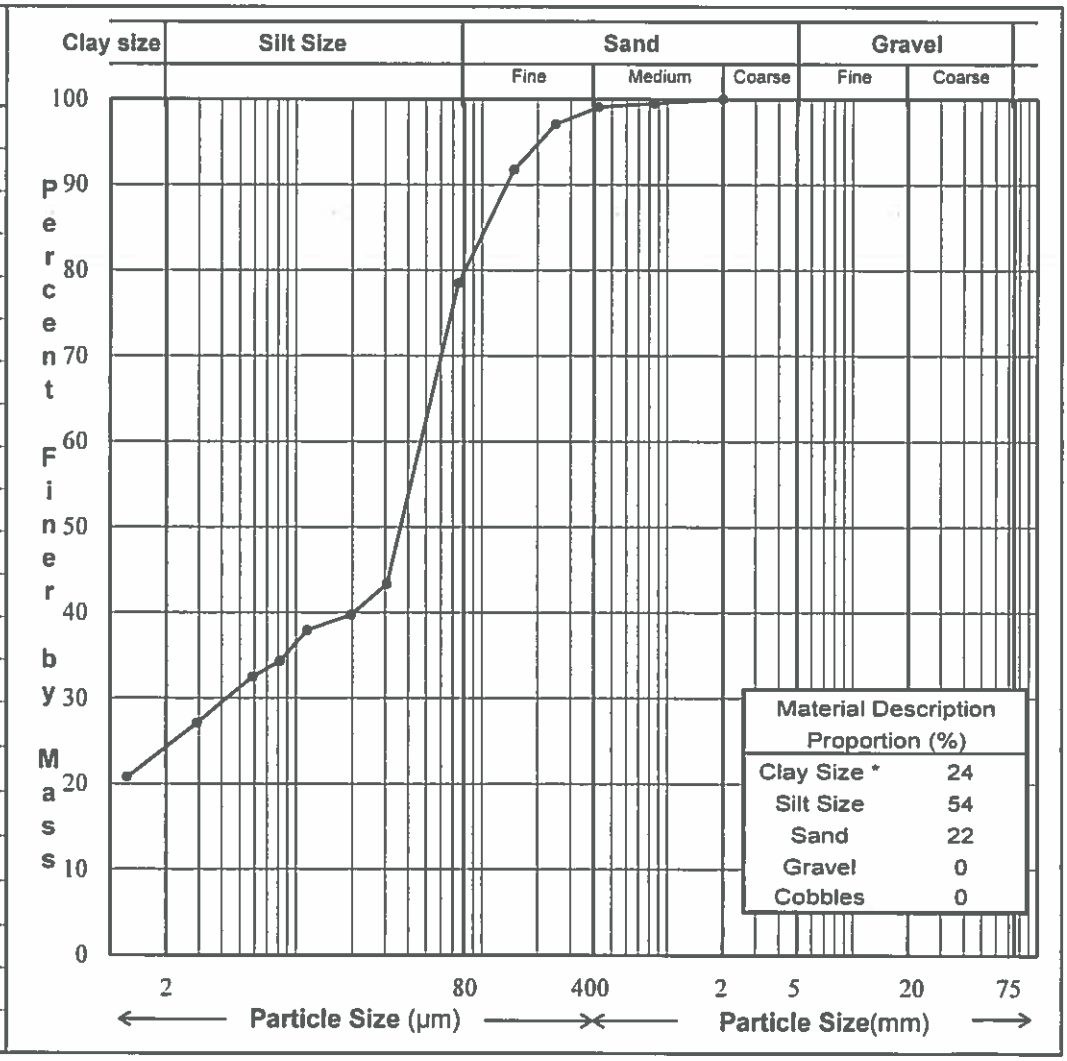
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	MacLaine Acres ASP - PSDFFA	Sample No.:	12
Client:	Rick Adolf	Borehole/ TP:	21TP12
Project No.:	704-ENG.LGEO04408-01.003	Depth:	0.45 - 0.7m
Location:		Date Tested	September 24, 2021
Description **:	Silt Loam (SIL)	Tested By:	VO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	100
425 µm	99
250 µm	97
150 µm	91.8
75 µm	78.5
31 µm	43.3
20 µm	39.7
11 µm	37.9
8 µm	34.3
6 µm	32.5
3 µm	27.1
1 µm	20.8



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is based off the Canadian System of Soils Classification.

Reviewed By: _____ P.Eng.

TETRA TECH

APPENDIX B
SOIL OBSERVATION AND SOIL PROFILE DESCRIPTIONS

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP01	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
NE 1/4	28	009	21	W4	Lot 1; Block 1; Plan 927	Pasture – healthy, thick veg.

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Imperfect	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk (Fill)	0-0.10	Clay Loam		10YR 3/2	No	Weak	Medium	Granular	Friable	Moist	0
Bmk (Fill)	0.10-0.25	Silty Clay Loam	Hyd.	10YR 3/3	Faint Mottle	Moderate	Medium	Blocky	Friable / Firm	Moist	0
Cca	0.25-0.83	Silty Clay Loam		2.5Y 5/2	Faint Mottle	Moderate	Medium	Subangular Blocky	Firm / Friable	Very Moist	0
Ck_1	0.83-2.4	Clay Loam		2.5Y 3/2	Faint Mottle	Structureless	Medium	Massive	Friable / Soft	Very Moist to Wet	2-5
Ck_2	2.4-3.0	Silty Clay Loam		2.5Y 3/3	Faint Mottle	Structureless	Medium	Massive	Friable / Soft	Very Moist to Wet	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
1.36 mbgs	Saturated soil observed at approximately 0.83 m.	Free water entering test pit at 1.2 m	Soil texture / grade / structure

Comments:

Faint mottling noted in B and C horizon, increased soil moisture at 0.25 m with free water entering test pit at 1.2 m (saturated soil). A and B horizons are replaced as traces of red shale observed in horizons, however, structure observed. Thick, lush vegetation in pasture and area appears to have been irrigated. 1 inch standpipe installed to 3.0 in test pit.

Dugout approximately 175 m to the southwest of the test pit.

Residence approximately 100 m to the south of test pit.

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP02	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
NE 1/4	28	009	21	W4	Lot 1; Block 1; Plan 927	Pasture – healthy, thick veg.

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Imperfect	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk (Fill)	0-0.11	Clay Loam		10YR 1/1	Faint Mottle	Moderate	Fine	Granular	Friable	Moist	0
Bmk (Fill)	0.11-0.25	Clay Loam		10YR 2/1	Faint Mottle	Weak	Fine	Blocky	Friable / Firm	Moist	0
Cca	0.25-0.83	Silty Clay Loam	Hyd.	2.5Y 4/3	No	Weak	Fine	Granular	Friable	Very Moist	0
Ck_1	0.83-2.4	Sandy Clay Loam		2.5Y 3/3	No	Structureless	Fine	Massive	Friable / Soft	Wet	0-2
Ck_2	2.4-3.0	Clay Loam		2.5Y 3/3	Faint Mottle	Structureless	Fine	Massive	Friable / Soft	Wet	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
0.77 mbgs	Saturated soil observed at approximately 0.85 m.	Free water entering test pit at 1.2 m	Soil texture / grade / structure

Comments:

Faint mottling noted in A, B, and Ck horizon, increased soil moisture at 0.25 m with free water entering test pit at approximately 1.2 m (saturated soil). A and B horizons are replaced as traces of red shale observed in horizons, however, structure observed. Thick, lush vegetation in pasture and area appears to have been irrigated. 1 inch standpipe installed to 3.0 in test pit

Dugout approximately 80 m to the southeast of the test pit.

Residences approximately 150 m to the east and 190 m to the south, respectively, of test pit.

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP03	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
NE 1/4	28	009	21	W4	Lot 1; Block 1; Plan 927	Pasture – healthy, thick veg.

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Imperfect	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk (Fill)	0-0.27	Clay Loam		10YR 3/3	No	Moderate	Medium	Granular	Friable	Moist	0
Cca_1	0.27-0.9	Silty Clay Loam	Hyd.	2.5Y 4/3	No	Weak	Fine	Granular	Friable	Very Moist	0
Cca_2	0.9-2.3	Sandy Clay Loam		2.5Y 5/2	No	Weak	Fine	Single-Grained	Friable	Wet	0
Ck_1	2.3-3.0	Clay Loam		2.5Y 3/2	Faint Mottle	Structureless	Medium	Massive	Friable	Wet	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
0.69 mbgs	Saturated soil observed at approximately 0.9 m.	Free water entering test pit at 1.2 m	Soil texture / grade / structure

Comments:

Faint mottling noted in Ck horizon, increased soil moisture at 0.27 m with free water entering test pit at approximately 1.2 m (saturated soil). No distinct B horizon, A horizon is replaced as traces of red shale observed. Thick, lush vegetation in pasture and area appears to have been irrigated. 1 inch standpipe installed to 3.0 in test pit

Dugout approximately 175 m to the southwest of the test pit.

Residences approximately 125 m to the south of test pit.

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP04	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
NE 1/4	28	009	21	W4	Lot 2; Block 1; Plan 927	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk	0-0.10	Clay Loam		10YR 3/2	No	Weak	Fine	Granular	Friable	Dry to Damp	0
Bmk	0.1- 0.19	Clay Loam		10YR 4/3	No	Moderate	Fine to Medium	Blocky	Friable / Firm	Damp to Moist	0
Cca	0.19-1.3	Silty Loam	Hyd.	2.5Y 4/3	Faint Mottling	Weak	Fine	Subangular Blocky	Firm	Moist	0
Ck_1	1.3-1.8	Clay Loam		2.5Y 3/3	No	Structureless	Medium	Massive	Soft to Firm	Moist to Very Moist	2-5
Ck_2	1.8-3.0	Sandy Clay Loam		2.5Y 4/3	No	Structureless	Fine to Medium	Massive	Soft to Firm	Moist to Very Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
1.62 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Faint mottling noted in Cca horizon, increased soil moisture at 1.3 m. No evidence of free water upon completion.

Dugout approximately 70 m to the northeast of the test pit. 1 inch standpipe installed to 3.0 m.

Residences approximately 100 m to the north and south of test pit.

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP05	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
NE 1/4	28	009	21	W4	Lot 2; Block 1; Plan 927	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk	0-0.17	Clay Loam		10YR 3/3	No	Weak	Medium	Granular	Friable	Dry	0
Bmk	0.17-0.29	Clay Loam		10YR 4/3	No	Moderate	Medium	Blocky	Friable / Firm	Dry	0
Cca	0.29-1.2	Clay Loam	Hyd.	2.5Y 3/2	No	Weak	Fine	Granular	Friable	Moist	0
Ck_1	1.2-2.4	Sandy Clay Loam		2.5Y 3/2	Faint Mottle	Structureless	Medium	Massive	Friable / Firm	Moist to Very Moist	2-5
Ck_2	2.4-3.0	Silty Clay Loam		2.5Y 3/3	No	Structureless	Medium	Massive	Friable / Soft	Moist to Very Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
2.17 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Faint mottling noted in Ck horizon, increased soil moisture at 0.29 m. No evidence of free water upon completion.

Dugouts approximately 75 m to the northeast and south of the test pit. 1 inch standpipe installed to 3.0 m.

Residences approximately 125 m to 150 m to the south and northeast, respectively, of test pit.

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP06	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
NE 1/4	28	009	21	W4	Lot 2; Block 1; Plan 927	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk	0-0.11	Clay Loam		10YR 2/2	No	Weak	Fine	Granular	Friable	Dry	0
Bmk	0.11-0.21	Silty Clay Loam		10YR 4/3	No	Weak	Fine to Medium	Granular	Friable	Dry	0
Cca	0.21-1.1	Silty Clay Loam	Hyd.	2.5Y 4/2	No	Moderate	Fine to Medium	Subangular Blocky	Firm / Friable	Moist	0
Ck	1.1-3.0	Clay Loam		2.5Y 4/2	No	Structureless	Coarse	Massive	Firm / Friable	Moist to Very Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
2.12 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Increased soil moisture at 0.21 m. No evidence of free water upon completion. 1 inch standpipe installed to 3.0 m.
Dugouts approximately 250 m to the east and west of the test pit.
Residences approximately 130 m to the west and 160 m to the south, respectively, of test pit.

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP07	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
SE 1/4	28	009	21	W4	Lot 1; Block 2; Plan 801 0198	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk (Fill)	0-0.08	Clay Loam		10YR 3/2	No	Weak	Fine	Granular	Friable	Dry	0
Fill	0.08-0.31	Clay Loam		10YR 4/2	No	Moderate	Medium	Blocky	Friable / Firm to Hard	Dry	0-2
Ahkb	0.31-0.5	Clay Loam		10YR 2/1	Faint Mottling	Moderate	Medium	Blocky	Friable / Firm to Hard	Dry	0
Bmkb	0.5-0.7	Silty Clay Loam	Hyd.	10YR 2/2	Faint Mottling	Moderate	Medium	Blocky	Friable / Firm to Hard	Dry	0
Cca_1	0.7-1.3	Clay Loam to Silty Clay Loam		2.5Y 4/2	Faint Mottling	Weak	Fine	Subangular Blocky	Firm	Moist	0
Cca_2	1.3-1.6	Clay Loam		2.5Y 3/2	No	Structureless	Fine to Medium	Massive	Friable / Firm	Moist	0
Ck	1.6-3.0	Clay Loam to Sandy Clay Loam		2.5Y 4/3	No	Structureless	Medium	Massive	Friable / Firm	Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
Dry to 3.0 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Faint mottling noted in buried A and B horizons, and in Cca horizon. Increased soil moisture at 0.7 m. No evidence of free water upon completion. 1 inch standpipe installed to 3.0 m

Dugouts approximately 175 m to the north and south of the test pit. Residences approximately 100 m to the east of test pit.

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP08	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
SE 1/4	28	009	21	W4	Lot 1; Block 2; Plan 801 0198	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk	0-0.07	Clay Loam		10YR 3/2	No	Weak	Fine	Granular	Friable	Dry	0
Bmk	0.07-0.2	Clay Loam		10YR 3/1	No	Moderate	Coarse	Blocky	Firm	Dry	0
Cca1	0.2-0.6	Loam	Hyd.	2.5Y 5/3	No	Moderate	Fine	Subangular Blocky	Firm	Damp to Moist	0
Cca2	0.6-1.2	Clay Loam		2.5Y 5/2	No	Structureless	Fine	Massive	Friable / Firm	Moist	0
Ck	1.2-3.0	Clay Loam		2.5Y 4/2	No	Structureless	Medium	Massive	Friable / Firm	Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
Dry to 3.0 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Increased soil moisture at 0.6 m. No evidence of free water upon completion. 1 inch standpipe installed to 3.0 m

Dugout approximately 80 m to the southwest of the test pit.

Residence approximately 80 m to the northeast of test pit.

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP09	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
SW 1/4	28	009	21	W4	Lot 1; Block 2; Plan 801 0198	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Apk	0-0.09	Clay Loam		10YR 2/2	Faint Mottle	Moderate	Medium	Granular	Friable	Dry to Damp	0
Bmk	0.09-0.3	Clay Loam		10YR 3/2	Faint Mottle	Weak	Medium	Blocky	Firm	Dry to Damp	0
Cca	0.3-0.95	Loam	Hyd.	2.5Y 4/3	Faint Mottle	Moderate	Medium	Subangular Blocky	Firm	Moist	0
Ck_1	0.95-2.3	Clay Loam		2.5Y 4/2	No	Structureless	Fine	Massive	Friable / Firm	Moist	2-5
Ck_2	2.3-3.0	Clay Loam		2.5Y 3/3	No	Structureless	Fine	Massive	Friable	Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
Dry to 3.0 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Faint mottling noted in A, B and Cca horizon. Increased soil moisture at 0.95 m. No evidence of free water upon completion. Dugout approximately 160 m to the southeast of the test pit. Irrigation canal approximately 65 m to the west of test pit. Residence approximately 200 m to the north of test pit. 1 inch standpipe installed to 3.0 m

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP10	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
SW 1/4	28	009	21	W4	Lot 1; Block 2; Plan 801 0198	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Ahk	0-0.09	Clay Loam		10YR 3/2	No	Weak	Fine	Granular	Friable	Dry	0
Bmk	0.09-0.31	Clay Loam		10YR 4/3	No	Moderate	Coarse	Blocky	Firm to Hard	Dry	0
Cca_1	0.31-0.9	Silty Loam	Hyd.	2.5Y 4/2	No	Moderate	Coarse	Subangular Blocky	Firm to Hard	Damp to Moist	0
Cca_2	0.9-2.3	Silty Clay Loam		2.5Y 4/3	No	Structureless	Fine	Massive	Friable	Moist	0
Ck	2.3-3.0	Clay Loam		2.5Y 3/2	Faint Mottle	Structureless	Medium	Massive	Friable	Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
Dry to 3.0 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Faint mottling noted in Ck horizon. Increased soil moisture at 0.9 m. No evidence of free water upon completion.
Dugout approximately 230 m to the southeast of the test pit. Irrigation canal approximately 115 m to the west of test pit.
Residence approximately 50 m to the north of test pit. 1 inch standpipe installed to 3.0 m

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP11	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
SW 1/4	28	009	21	W4	Lot 1; Block 2; Plan 801 0198	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Ahk	0-0.13	Clay Loam		10YR 3/2	No	Weak	Fine	Granular	Friable	Dry	0
Bmk	0.13-0.4	Clay Loam		10YR 4/3	Faint Mottling	Moderate	Coarse	Blocky	Firm	Dry	0
Cca1	0.4-0.9	Clay Loam	Hyd.	2.5Y 3/2	Faint Mottling	Moderate	Coarse	Subangular Blocky	Firm	Damp to Moist	0
Cca2	0.9-1.2	Clay Loam to Sandy Clay Loam		2.5Y 3/3	No	Structureless	Fine to Medium	Massive	Friable	Moist	0
Ck	1.2-3.0	Clay Loam to Sandy Clay Loam		2.5Y 3/3	No	Structureless	Fine to Medium	Massive	Friable / Firm	Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
Dry to 3.0 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Faint mottling noted in B and C horizon. Increased soil moisture at 0.6 m. No evidence of free water upon completion.
Dugout approximately 175 m to the southeast of the test pit. Irrigation canal approximately 130 m to the west.
Residence approximately 100 m to the north of test pit. 1 inch standpipe installed to 3.0 m

Site Observations and Soil Profile

Job ID	Testpit Identification	Date	Weather Condition
ENG.LGEO04408-01.003	21TP12	September 9, 2021	Clear, Sunny, Warm

Site Information:

LSD/1/4	Sec.	Twp.	Rg.	Mer.	Proposed Lot Number	Vegetation
NW 1/4	28	009	21	W4	Lot 1; Block 2; Plan 801 0198	Pasture – shortgrass, dry

Depth of Laboratory Samples:				
Soil Subgroup	**Parent Material**	**Drainage**	**Slope Position and Slope %**	**Site Topography**
Ca DBC	Till	Well Drained	1-2 % East	Level

Profile Description

Horizon	Depth (mbgs)	Texture	Lab/HT	Colour	Gleying/ Mottling?	Structure			Consistence	Moisture	% Coarse Fragments
						Grade	Class	Kind			
Ahk	0-0.16	Clay Loam		10YR 3/2	No	Weak	Fine	Granular	Friable	Dry	0
Bmk	0.16-0.45	Clay Loam		10YR 3/1	No	Moderate	Coarse	Blocky	Firm to Hard	Dry	0
Cca1	0.45-0.7	Silty Loam	Hyd.	2.5Y 3/3	No	Moderate	Coarse	Subangular Blocky	Firm to Hard	Dry	0
Cca2	0.7-1.0	Silty Clay Loam		2.5Y 4/3	No	Structureless	Fine	Massive	Friable	Moist	0
Ck	1.0-3.0	Clay Loam to Silty Clay Loam		2.5Y 4/2	Faint Mottling	Structureless	Medium	Massive	Friable / Firm	Moist	2-5

Depth to Groundwater	Restricting Soil Layer Characteristic	Depth to Highly Permeable Layer Limiting Design	Key Soil Characteristics Applied to System Design Effluent Loading
Dry to 3.0 mbgs	N/A	N/A	Soil texture / grade / structure

Comments:

Faint mottling noted in Ck horizon. Increased soil moisture at 0.7 m. No evidence of free water upon completion.
Dugout approximately 130 m to the northeast of the test pit. Irrigation canal approximately 190 m to the west of test pit.
Residence approximately 50 m to the southwest of test pit. 1 inch standpipe installed to 3.0 m.

APPENDIX C
LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

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