

**Geotechnical Desktop
Study City of Leduc East
Telford Lake Area
Structure Plan**

Project No.: 1161106060



Prepared for:

City of Leduc

Prepared by:

Stantec Consulting Ltd.

July 7, 2017

Sign-off Sheet

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1.0 Introduction

Stantec Consulting Ltd. (Stantec) is pleased to present this report to City of Leduc pertaining to the results of a desktop study for the proposed City of Leduc East Telford Lake Structure Plan (ASP). The desktop study was prepared in compliance with the document entitled "City of Leduc Request for Proposals for East Telford Lake Area Structure Plan" dated November 22, 2016.

The purpose of the geotechnical desktop study was to:

- Assess the subsurface soil and groundwater conditions; and,
- Identify potential geotechnical concerns associated with the proposed development.

Stantec's scope of work included the following tasks:

- Carry out an aerial image or airphoto review of the proposed development area;
- Review publically available surficial and bedrock geology mapping products for the area;
- Compile and review water well information from the Alberta Water Well Information Database; and
- Review of historical geotechnical reports for the area (including adjacent quarter sections), if made available to Stantec.
- Review of Stantec's own geotechnical report database for projects in the area.

Limitations associated with this report and its content are provided in the Statement of General Conditions provided in **Appendix A**.

2.0 Site and Project Description

The East Telford Lake project covers eight adjacent quarter sections of the legal land descriptions 31-49-24-W4M and 30-49-24-W4M located within the east side of the City of Leduc, both north and south of Telford Lake. The site is bounded by Rollyview Road to the south, by Range Road 245 to the east, by 65 Avenue to the north and William F. Lede Park and cultivated farmlands to the west. At the time of the desktop study the site was being used as cultivated farmland.

A site plan showing the location of the site and the overall study area is provided on **Figure 1 (Appendix B)**. The proposed land usage is quite diverse and will likely include parks, business developments and commercial mixed use. Additionally, a series of storm water management facilities will likely be proposed across the site.

3.0 Field Exploration Program

3.1 Published Surficial Geology Maps

Based on the available literature, the surficial geology in the area is predominantly described as glacial till deposit overlying bedrock. The glacial till generally contain unsorted clay, silt, pockets of sand and gravel, cobbles and boulders. Locally, it may contain blocks of bedrock, stratified sediments, or lenses of glaciolacustrine and/or glaciofluvial sediments. Throughout much of the study area the till is between 5 to 10 m thick, however, areas of relatively thin till might also occur.

The near-surface bedrock geology is the Horseshoe Canyon Formation of Late Cretaceous age. The Horseshoe Formation consists primarily of fine- to very fine grained, feldspathic sandstone interbedded with siltstone, bentonitic mudstone, carbonaceous mudstone and laterally continuous coal seams.

3.2 Previous Reports

A review of the following information (made available to use from the City of Leduc) was undertaken for the purpose of obtaining anticipated subsurface conditions in the vicinity of the site:

- J.R. Paine & Associates Ltd., May 17, 2016. Groundwater Table Investigation Proposed Leduc Cemetery Site, Portion of NE 30-49-24-W4M, Leduc, Alberta.
- Wedler Engineering LLP, August 24, 2010. Harvest Industrial Park Area Structure Plan, Appendix E, Geotechnical Assessment Report Proposed Industrial Subdivision Portions of NE1/4 and SE ¼ 36-39-25-W4M North Telford Lake, Leduc, Alberta.
- TetraTech EBA, August 22, 2011. Phase I Environmental Site Assessment at NW 30-049—24 W4M, Leduc, Alberta.

3.3 Historical Aerial Photograph Review

Historical aerial photographs and Google Earth images were reviewed for the site spanning from 1978 and 2005 and 2002 and 2016 respectively. Aerial photographs were obtained from the "Air Photo Distribution, Alberta Sustainable Resource Development" in Edmonton. The photographs were reviewed to identify the historical change and development in the subject property.

A detailed summary of the site conditions observed from the aerial photographs is presented in the table below. A copy of the aerial photos is also provided in **Appendix C**.

Table 3-1 Summray of Aerial Photograph Review

Year	Scale	Observations
1978	1:25,000	<p>The subject property in this aerial photograph was predominantly undeveloped agricultural land. Telford Lake and Telford Creek exist in the central portion of the subject site bisecting it.</p> <p>A major natural drainage channel can be observed at the NW corner of the site. Poorly defined surface drainage features, mostly oriented to the east, are also visible.</p> <p>A number of low-lying wet areas are also observed throughout.</p> <p>Woodland areas can be seen in some areas north and south of Telford Lake and along the Telford Lake shoreline area.</p> <p>A circular feature, possibly a pond, was visible on the southeastern part of the site.</p> <p>An indistinct feature, assumed to be a residential dwelling, was visible at the southwestern side of the site.</p>
1987	1:25,000	<p>The subject property remains as undeveloped agricultural land. Telford Lake and the woodland areas are still visible in this aerial photo.</p> <p>The circular feature on the southeastern part of the site was no longer present. An indistinct feature is now visible at this location.</p> <p>Also, significant activity, consisting of land clearing was visible on the northwest corner of the quarter section to the southeast.</p> <p>The pipeline ROW is visible dissecting the site.</p> <p>Other topographical features remain the same as above.</p>
1993	1:20,000	<p>The subject property remains as undeveloped agricultural land. Land on northwest corner of the quarter section to the southeast appears to have been reclaimed to its original conditions.</p> <p>Other topographical features remain the same as above.</p>
2002	1:10,000	<p>The subject property remains as undeveloped agricultural land. A small structure, assumed to be a residential dwelling, was visible south of Telford Creek.</p> <p>Other topographical features remain the same as above.</p>
2005	1:25,000	<p>There is no change in the subject site from the previous aerial photo of 2002. The site remains agricultural undeveloped land.</p> <p>Other topographical features remain the same as above.</p>

3.4 Coal Mine Atlas Review

Based on a review of the Alberta Energy Regulator online Coal Mine Map Viewer, no coal mines were identified within the footprint of the site. Therefore, issue related to the presence of coal mines are not likely to be a concern.

4.0 Site Reconnaissance

A site visit was carried out by a Stantec geotechnical representative on April 10, 2017. The aim of the visit was to take photographs, identifying sources of geotechnical concern through visual inspection of the site and its borders. Pictures were taken to show the boundaries, roads, land topography and associated drainage patterns (Appendix D). This section presents the observations made of the site during the site visit.

The weather conditions were overcast, no wind and the temperature was 8°C. The ASP area is generally flat with slight rolling and low-lying wet areas observed throughout. Generally, the ASP area slopes to the east towards Saunders Lake, however, it is expected some local surface water to drain towards Telford Lake or Telford Creek bisecting the site.

A number of small ephemeral wetlands were identified throughout the site and are low-lying areas with similar level grading and shallow water table conditions. The short-lived nature of these wetlands indicates that they are highly dependent on climatic inputs and outputs, with precipitation, local runoff, and evapotranspiration dominating the water budgets.

The ASP area has been predominantly cleared and utilized for agricultural purposes. Areas not cultivated include woodland in the south-central portion of of the NW $\frac{1}{4}$ section of 31-49-24-W4M, the central part of section 30-49-24-W4M, the eastern-central part of the SW $\frac{1}{4}$ of section 30-49-24-W4M and the Telford Lake shoreline area.

There are currently several buildings on the site, which includes a mobile home and garage, and a couple of residential homes. In addition, there is one valve station located on the north side of the site within the NE $\frac{1}{4}$ section of 31-49-24-W4M.

5.0 Site Conditions

5.1 Surface Features

The majority of the site is currently utilized as cultivated farmland with several farmyards and low-lying areas throughout.

The site is relatively flat with an overall gentle slope towards Saunders Lake with local relief toward Telford Lake or Telford Creek.

Adjacent to the southwest side of the site is the William F. Lede Park. The surrounding areas primarily consist of cultivated farmland, with the exception of the lands to the northwest where industrial development has commenced.

5.2 Soil Conditions

Based on our review of the aforementioned geotechnical reports, available geotechnical boreholes records consists of sixteen (16) boreholes drilled offsite advanced to depths between 4.6 and 15.3 m, and six boreholes drilled onsite advanced to depths of 6.1 m (Appendix E).

Based on these borehole records, the soil profile generally consisted of topsoil over clay till underlain by bedrock comprised of clayshale and sandstone. These findings are consistent with the results from surficial geology maps.

In general the clay till was described as silty, sandy, moist to very moist, stiff to very stiff, medium plastic, greyish brown to brown, with thin sand seams and pockets throughout. The clay shale bedrock was described as silty, sandy, moist, hard, high plastic and the sandstone as silty, clayey, dense, moist, grey to light grey.

5.3 Groundwater Conditions

At the completion of drilling, groundwater was encountered at the majority of boreholes, however, no sloughing was recorded in any of them. A total of eleven (11) piezometers were installed during drilling.

Groundwater conditions were measured two weeks after completion of drilling. In general, the watertable is within 3 m below ground surface but with groundwater level readings as deep as 5.2 m below ground surface. The watertable elevations were also highly variable but seem to correlate with the lake water level and other major drainage features.

However, it should be noted that groundwater levels are expected to fluctuate seasonally and affected by site use, adjacent site use, and during or following significant precipitation events.

6.0 Geotechnical Considerations

Geotechnical concerns associated with this site relative to the proposed future development are considered typical with those associated with similar development in this area of Leduc.

6.1 Uncontrolled Fill

Detail review of the aerial photographs showed evidence of construction activities in the 1980's to the north of the southeast quarter section of Sec. 30-49-24-W4M, including some clearing of farmland and construction of structures. The structures were subsequently removed and the entire area reclaimed to its original conditions as shown in the 1993 aerial photo. The conditions and standards under which the fill was placed are unknown.

The Canadian Foundation Engineering Manual states the following regarding fill material: "An engineered fill placed under careful control may be an extremely dense material, more uniform, more rigid, and stronger than almost all natural deposits. When not placed under controlled conditions, it may be a heterogeneous mass of rubbish, debris, and loose soil of many types totally useless as a foundation material. It may, of course, also be some combination intermediate between these extremes".

The potential presence of fill with poor quality control (i.e. uncontrolled fill placement) presents a risk of settlement due to the compressibility of poorly compacted fills. Therefore, given the above noted information and previous statement, for grade supported structures that are sensitive to settlements such as slab-on-grades, etc., complete removal of the existing fill material (if encountered) is expected to be required and the grade reinstated with imported engineered fill as required depending on the final grading plan.

6.2 Historical Structural Elements

The presence of former structural elements associated with previous development was identified on site during the historical aerial photograph review. It is possible that other buried structures, or portions thereof, remain on site. Although a detailed geotechnical, or geophysical investigation may help identify additional relic structures or elements, it will be difficult to ascertain with certainty whether additional relic structures remain until such time as construction excavation proceeds. The designer and future construction contractor should be made aware of these potential unknowns.

6.3 Flowing Sands

The presence of interbedded sand pockets and increased sand content with depth in the till layer may lead to challenges during construction, especially if excavations extend below the groundwater level. Challenges such as sloughing, ground water seepage, piping or flowing sands may be encountered. Typically, these situations can be addressed by various dewatering methods. Confirming the groundwater elevation and developing a detailed soil stratigraphy for the site is recommended as part of a detailed geotechnical investigation to be completed during the detailed design stages.

6.4 Shallow Groundwater and Surface Water

Based on the reports obtained during the desktop study, the groundwater watertable could be as shallow as 3 m below ground surface. Having groundwater at a depth of 3.0 m or less will need to be

considered during the detailed design stage, especially if below grade structures such as a basement or parkade are considered in the new development. Furthermore, a shallow groundwater level may lead to constructability issues when dealing with open excavations for utilities and foundations.

As recommended previously, a detailed geotechnical investigation should be performed to confirm the groundwater levels at the site and how these levels will need to be addressed in the design and construction of the development.

6.5 Thick Organic and Topsoil Deposits and Soft Soils

The presence of ponded water and areas indicative of poor surface drainage were encountered. It is possible that increased thickness of topsoil and organic containing materials and soft soils may be present in areas across the site.

7.0 Geotechnical Recommendations

7.1 Feasibility Assessment

Based on the soil and groundwater conditions encountered over the site, which consists of topsoil over a medium plastic, stiff to very stiff clay till overlying bedrock comprising of clayshale and sandstone, the proposed development is considered feasible at the subject site.

Standard construction practices for site grading, utility installation, building foundations, and roadway construction are generally applicable for any future development. The following guidelines are presented as part of the feasibility assessment.

- There is surficial topsoil material present throughout the site, which will be required to be removed during construction;
- Some wetting may be required during trench backfilling at utility installation due to the dry nature of the clay till soils at depth;
- Soft, wet soils with high groundwater conditions might be present at ponded areas or other areas indicative of poor drainage which will need to be taken into account for design and construction of utilities, residential foundations, and foundation drainage systems.

Based on the preliminary nature of this study, further investigations will be required for future design stages in order to confirm the details presented herein and provide additional appropriate geotechnical design criteria as required.

7.2 Site Preparation

Site preparation for foundations, slabs-on-grade, roadway subgrades, and areas considered for the placement of engineered fill should be prepared by clearing and stripping all vegetation, topsoil, organic-rich soils, soft or loose native soil, and other deleterious materials that may be encountered at time of site preparation. The thickness of surficial organic topsoil deposits varies within the site; therefore, quantity estimates should recognize the inherent variability associated with these deposits.

If soft, disturbed, deleterious or otherwise unsuitable soils or fill materials are encountered during earthworks, these materials should be sub-excavated and replaced with suitable, engineered fill (of a similar nature to the native subgrade soils) to promote subgrade uniformity. Suitable clean fill can be reused as engineered fill.

The near-surface soils encountered are expected to be susceptible to disturbance and to have poor trafficability, particularly during periods of adverse (wet or freezing) weather conditions. Loose and disturbed material should be removed and the bearing surface should not be allowed to become wet or frozen prior to concrete placement. Care should be taken to avoid disturbance during construction as the disturbance will reduce the bearing resistance of soils and would require removal and replacement of the disturbed material.

The exposed subgrade soil should be reviewed by a qualified geotechnical engineer prior to placement of fill, foundation forms or concrete. The subgrade should be proof-rolled using a fully-loaded truck or water truck to identify weak or soft areas. Any soft/weak areas should be over-excavated, backfilled using engineered fill and compacted as per specification outlined in **Section 7.3**.

Where construction is carried out during winter conditions, the subgrade should be protected from freezing. In addition, the subgrade should be protected from wetting or drying, both before and after the placement of the granular base material and concrete. Subgrade surfaces that are allowed to dry or become wet must be scarified, moisture conditioned and re-compacted, as specified above.

7.3 Backfill selection and Compaction Requirements

Engineered fill should consist of clean mineral soil free from organics or other deleterious materials. The native clay till is considered suitable for re-use as Engineered Fill with proper moisture conditioning.

In general, drying or wetting of the site soils will be required during periods of heavy rain, hot weather, or in the event that excavated material is allowed to dry excessively prior to re-use. Alternatively, mixing of dry and wet soils to reach the OWC may be considered provided that qualified geotechnical personnel approve the mixed soil prior to use.

All fill materials should be placed in lifts having a thickness such that the compaction equipment can achieve the required density, but not exceed 150 mm. All imported fill materials should be tested and approved by a geotechnical engineer prior to delivery to the site.

7.4 Utility Trench Excavation and Backfill

Bedding materials for utilities should be specified and placed in accordance with the pipe design requirements and meet applicable City of Leduc Design and Construction Specifications. Utility trench backfill should consist of compacted engineered fill, similar to, or the same as the excavated soils. Different abutting materials within the frost zone will require a frost taper in order to minimize differential frost heaving.

It is suggested that the bedding material be placed around the service pipes with a minimum of 300 mm cover on all sides of the pipe.

Temporary surcharge loads such as excavated soils and stockpiles of materials should be kept back from the excavation crest by a minimum distance equal to the excavation depth.

Soft, wet soils with high groundwater conditions might be present at ponded areas or other areas indicative of poor drainage which will need to be taken into account for design and construction of utilities. Some drying of trench backfill materials or blending with drier soils to obtain proper compaction due to the wet nature of these subsurface soil conditions.

7.5 Site Grading and Drainage

As noted previously, the groundwater watertable could be as shallow as 3 m below ground surface with groundwater levels expected to be higher than the recorded levels due to seasonal fluctuations or at ponded areas and other areas indicative of poor drainage. The final grades across the site are not available. It is likely that for each business/commercial building and/or regional permanent drainage

systems will be required to avoid seepage into underground structures that are constructed deeper than the groundwater level.

For preliminary design, individual drainage systems should be installed surrounding and below the underground structures such as residential basements or parkades. Final layout and design of the drainage system will need to be addressed during the detailed design phases of the project.

It is anticipated that some site grading will be required in the development areas in order to level the site and to achieve subgrade design elevations. Positive drainage away from areas to be occupied by any buildings, exterior slabs, roadways and parking areas should be designed in order to reduce accumulation of surface runoff to prevent ponding and possible softening of the subgrade. Excess water should be drained or pumped from the site as quickly as possible, both during and after construction.

The final grade should provide surface drainage away from all structures. Landscaped areas should be graded to slope water away from any buildings. A minimum gradient of 2% should be used wherever possible. Roof and other drain extensions should discharge well clear of any buildings or equipment.

7.6 Foundations

Over the majority of the site, the native clay till materials encountered over the site are found to be suitable for housing development. Shallow foundations are considered to be suitable and the preferred foundation type for business/commercial developments given the anticipated relatively lightly-loaded foundations.

Shallow foundations placed on suitably-compacted engineered fill or undisturbed clay till are considered suitable for structures or buildings without significant uplift loading. For preliminary planning purposes, a factored geotechnical bearing resistance at Ultimate Limit States (ULS) of 100 kPa is recommended for the native clay tills as well as for properly constructed engineered fill. The bearing pressure at Serviceability Limit States (SLS) is dependent on footing width, shape, embedment depth, subgrade material and allowable settlement. For preliminary planning purposes, the Serviceability Limit States (SLS) bearing pressure can be assumed to be in the order of 75 kPa (assuming an allowable settlement of 25 mm and foundation width of up to 1 m).

For areas where a significant thickness of engineered fill is proposed, both deep (pile) foundations (cast-in-place concrete piles) and footings are feasible for the foundation systems.

Based on the soil and groundwater conditions presented in the reports reviewed as well as our own experience with similar soil materials, the cast-in-place piles may be designed on the following preliminary allowable skin friction values:

Table 7-1 Cast-in-Place (CIP) Preliminary Parameters

Material and Depth	Factored Shaft Resistance (kPa)	Factored Toe Resistance (kPa)
Frost Zone/Fill ¹ (0 to 2.5 m)	0	-
Clay Till	20	250
Bedrock	30	350

Notes:

- (1) Shaft resistance should be neglected in all fill soils and within the frost zone

The minimum embedment depth of cast-in-place concrete piles should be sufficient to resist the imposed loads and uplift forces due to frost heave, but not be less than 7.0 m. The minimum depth will also depend on the construction details of the pile and future fill placement.

It should be noted that based on the preliminary nature of this study (limited number of borehole and testing information), further site-specific soil investigation is required in order to confirm preliminary foundation design parameters provided in this report.

Other deep foundation systems may be feasible and could be utilized based on application such as driven steel piles, helical piles, cast-in-place concrete belled piles, etc.

7.7 Storm water management facilities (SWMF)

It is considered that any SWMF are to be placed within the surficial clay till, as such for preliminary design purposes the maximum side slopes between the high water levels (HWL) and a point 1 m below the normal water levels (NWL) must be 7H:1V including overflow areas. These side slopes should be landscaped upon construction of the SWMF to reduce erosion. A side slope of 4H:1V or flatter is recommended after the 7H:1V side slope.

The side slope in the vicinity of the NWL (horizontally, 2.1 m inside an 2.1 m outside of the NWL) must be protected from wave and ice erosion using a minimum 250 mm deep layer of well graded washed rock, with a minimum particle size of 75 mm, placed on a woven polypropylene geotextile fabric. The slope above this zone should be landscaped as soon as practical after grading to reduce erosion.

As noted previously, the groundwater watertable could be as shallow as 3 m below ground surface with groundwater levels expected to be higher than the recorded levels at ponded areas and other areas indicative of poor drainage. The final grades for the SWMFs are not available, however, having the pond extended below the groundwater table may present difficulties during construction of a clay liner. This issue may be aggravated if sand pockets or seams are found during construction.

In addition, as previously mentioned in **Section 6.1**, the potential existence of uncontrolled fill was identified which will need to be taken into account for design and construction of SWMF.

7.8 Frost considerations

7.8.1 Frost Susceptibility and Penetration Depth

Guidelines developed by Casagrande (1932) are commonly used to qualitatively assess the frost susceptibility of soils. These guidelines are based on plasticity index and the percentage of the soil finer than 0.02 mm (by weight) and have been adapted by the Canadian Foundation Engineering Manual (CFEM 2006) and the United States Army Corps of Engineers (US ACE 1984). According to these guidelines, soils are classified into four group of F1 through F4 in order of increasing frost susceptibility. According to these guidelines, the clay till at the site is classified as frost susceptible soil (F3).

CFEM (2006) provides a procedure to estimate the seasonal frost penetration depth in the surficial soil units. A mean freezing index of 1,500°C days was used for the site area. Accordingly, a design seasonal frost penetration depth is estimated to be approximately 2.5 m for the clay till. It is noted that the seasonal frost penetration depth is expected to decrease if significant snow cover, peat and/or vegetation are present at the surface. Alternatively, greater frost penetration will occur if granular fill materials are utilized.

Appropriate insulation type should be chosen based on the design loading, deformation tolerance and exposure to chemicals. Considering viscoelastic behavior the insulation products, the compressive strength of the product should be at least three times the design bearing pressure (a factor of safety of 3 against long-term creep).

7.8.2 Foundation Protection

To provide protection for shallow foundations from frost heave, these foundations should be placed at minimum depths of 2.5 m and 1.5 m below ground surface, for unheated and heated buildings, respectively. For foundations placed shallower than these depths, insulation should be considered.

7.8.3 Utility Lines

For un-insulated utility lines including water and sewer pipelines, the minimum burial depth should not be less than the seasonal frost penetration depth. For installation of un-insulated utility lines including water and sewer pipelines with soil cover less than the design seasonal frost penetration depth, insulation must be considered.

7.9 Seismic Site Class

The 2010 NBCC seismic design procedures are used for site seismic classification. These procedures are based on ground motion parameters (e.g. peak ground acceleration (PGA) and spectral acceleration, S_a values) having a 2% probability of Exceedance in 50 years; i.e., the 2,475 year return period earthquake event. Based on the subsurface conditions, it is appropriate to classify the ground conditions at the subject site as a Class D Site, in accordance with the 2010 NBCC (Table 4.1.8.4.A).

8.0 Closure

This report has been prepared for the sole benefit of City of Leduc, and may not be used by any third party without the express written consent of Stantec Consulting Ltd. Any use, which a third party makes of this report, is the responsibility of such third party. Use of this report is subject to the Statement of General Conditions provided in the Appendices.

It is the responsibility of City of Leduc, who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the report
- Standard of care
- Interpretation of site conditions
- Varying or unexpected site conditions
- Planning, design or construction

We trust the above information meets with your present requirements. Should you have any questions or require further information, please contact us.

Appendix A **Statement of General Conditions**

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub- surface conditions are present upon becoming aware of such conditions.

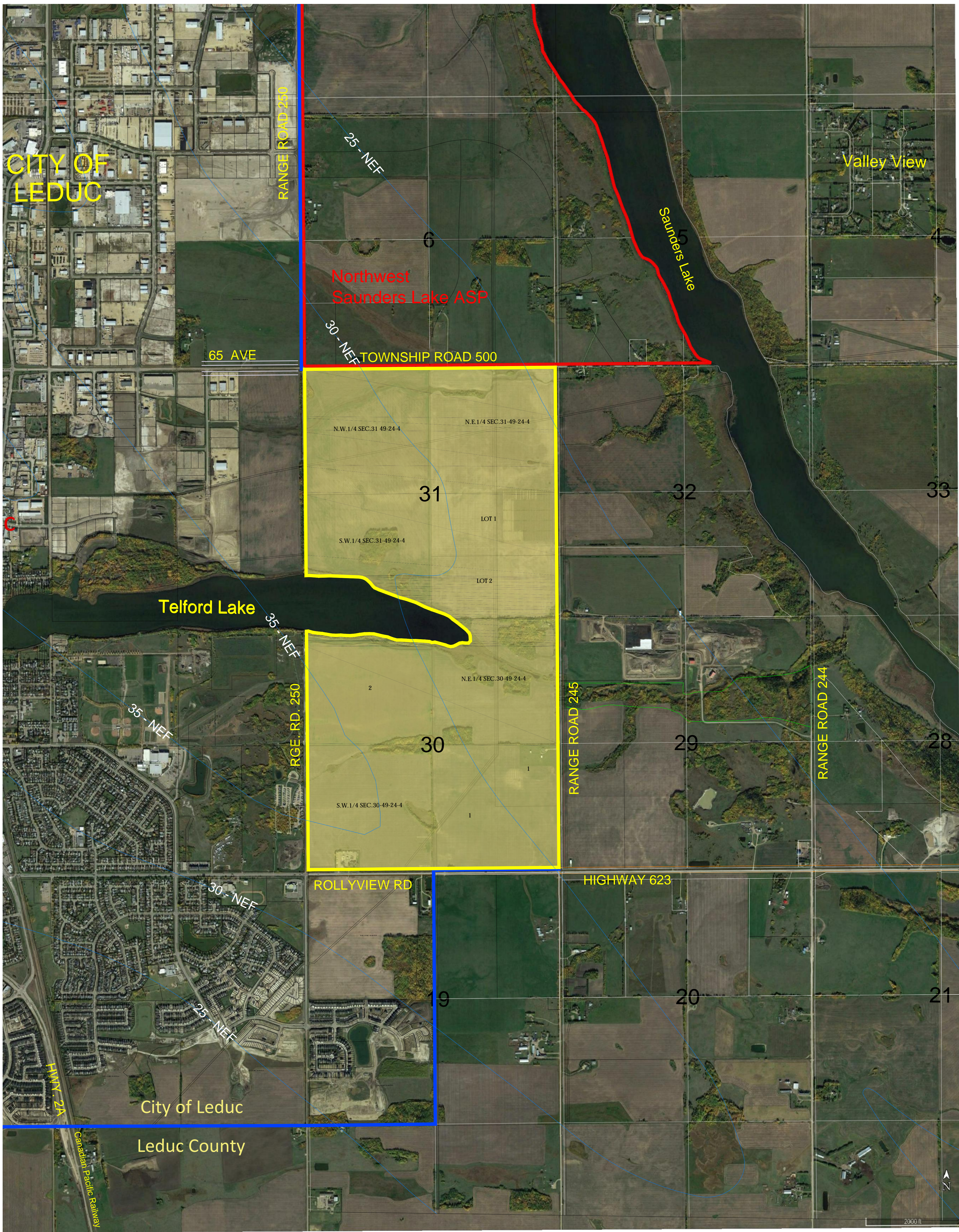
PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.



**Geotechnical Desktop Study City of Leduc
East Telford Lake Area Structure Plan**

Revision: July 7, 2017
Project No.: 1161106060

Appendix B **Site Plan**

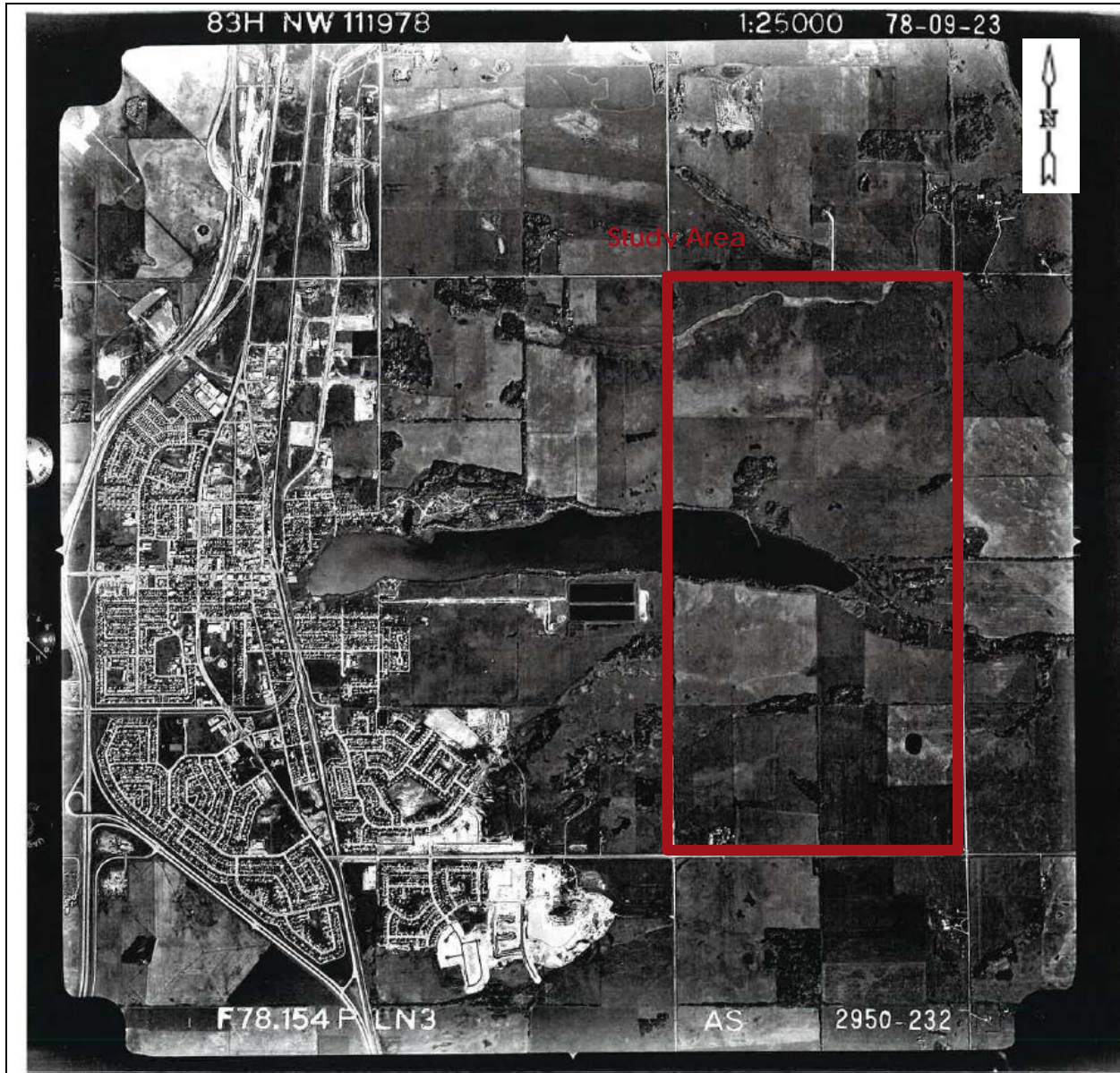



East Telford Lake Area Structure Plan Context



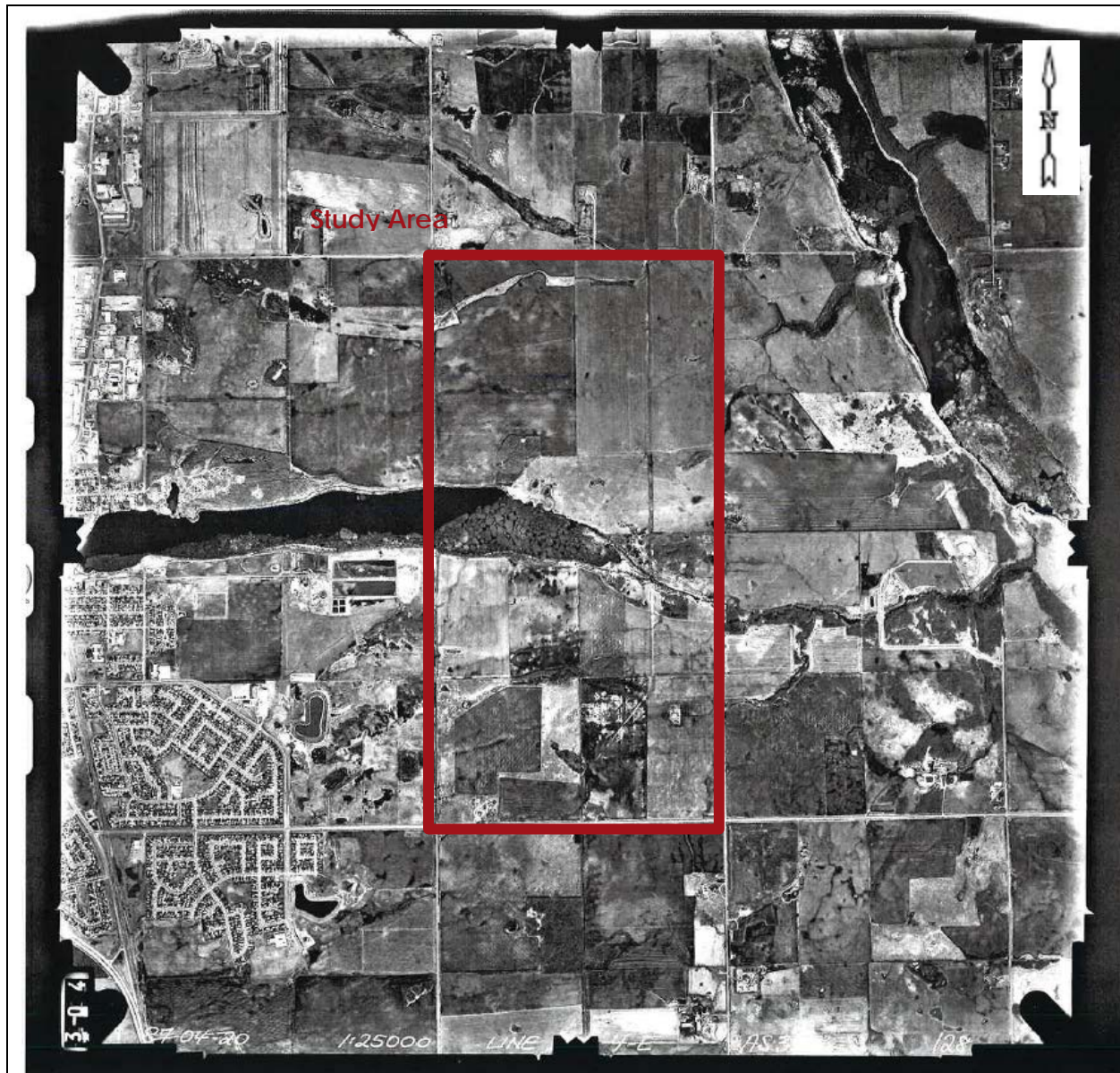
Appendix C Aerial Photos


Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
 Appendix C: Aerial Photos



			PROJECT GEOTECHNICAL DESKTOP STUDY CITY OF LEDUC EAST TELFORD LAKE AREA STRUCTURE PLAN		
CLIENT CITY OF LEDUC			TITLE SITE AIR PHOTO 1978		
DATE APRIL 28, 2017	DWN FM	CHKD MA	PROJECT No. 1161106060	DRAWING NUMBER D-1	


Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
 Appendix C: Aerial Photos



			PROJECT GEOTECHNICAL DESKTOP STUDY CITY OF LEDUC EAST TELFORD LAKE AREA STRUCTURE PLAN		
CLIENT CITY OF LEDUC			TITLE SITE AIR PHOTO 1987		
DATE	APRIL 28, 2017	DWN	FM	CHKD	MA
			PROJECT No.	DRAWING NUMBER	
			1161106060	D-2	


Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
 Appendix C: Aerial Photos



			PROJECT GEOTECHNICAL DESKTOP STUDY CITY OF LEDUC EAST TELFORD LAKE AREA STRUCTURE PLAN		
CLIENT CITY OF LEDUC			TITLE SITE AIR PHOTO 1993		
DATE	APRIL 28, 2017	DWN	FM	CHKD	MA
PROJECT No.		DRAWING NUMBER			
1161106060		D-3			


Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
 Appendix C: Aerial Photos



			PROJECT GEOTECHNICAL DESKTOP STUDY CITY OF LEDUC EAST TELFORD LAKE AREA STRUCTURE PLAN		
CLIENT CITY OF LEDUC			TITLE SITE AIR PHOTO 2002		
DATE APRIL 28, 2017	DWN FM	CHKD MA	PROJECT No. 1161106060	DRAWING NUMBER D-4	

Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
 Appendix C: Aerial Photos



			PROJECT GEOTECHNICAL DESKTOP STUDY CITY OF LEDUC EAST TELFORD LAKE AREA STRUCTURE PLAN		
CLIENT CITY OF LEDUC			TITLE SITE AIR PHOTO 2005		
DATE APRIL 28, 2017	DWN FM	CHKD MA	PROJECT No. 1161106060	DRAWING NUMBER D-5	

Appendix D **Photographs**

Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix D: Photographs



View of East Telford Lake Area showing lower wet area



View of East Telford Lake Area showing undulating topography

Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix D: Photographs



View showing existing valve station



View of East Telford Lake Area showing flat topography

Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix D: Photographs



View of East Telford Lake Area showing existing surface drainage channel



View of East Telford Lake Area showing lower wet area

Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix D: Photographs



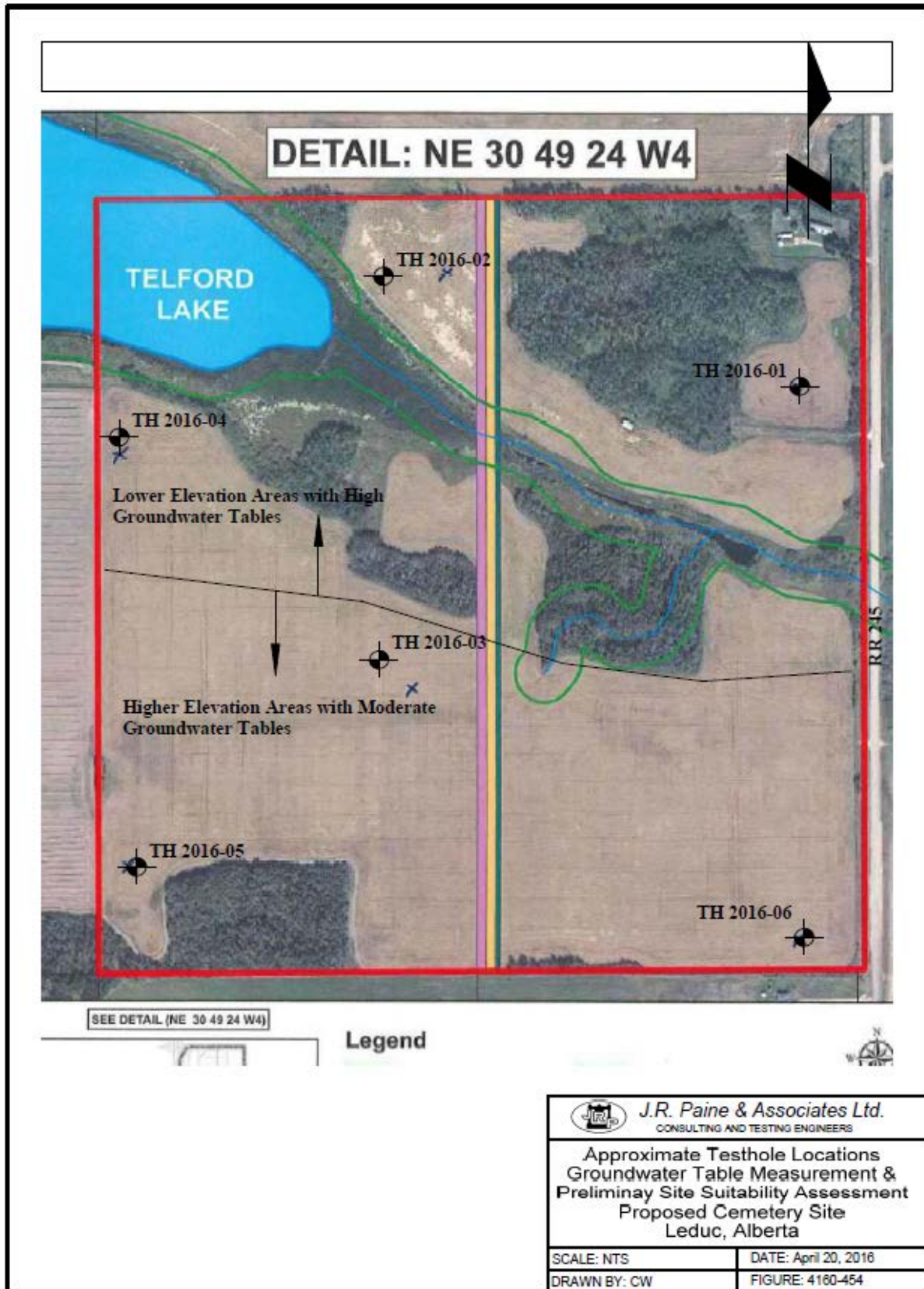
View of Telford Creek at intersection with Range Road 245



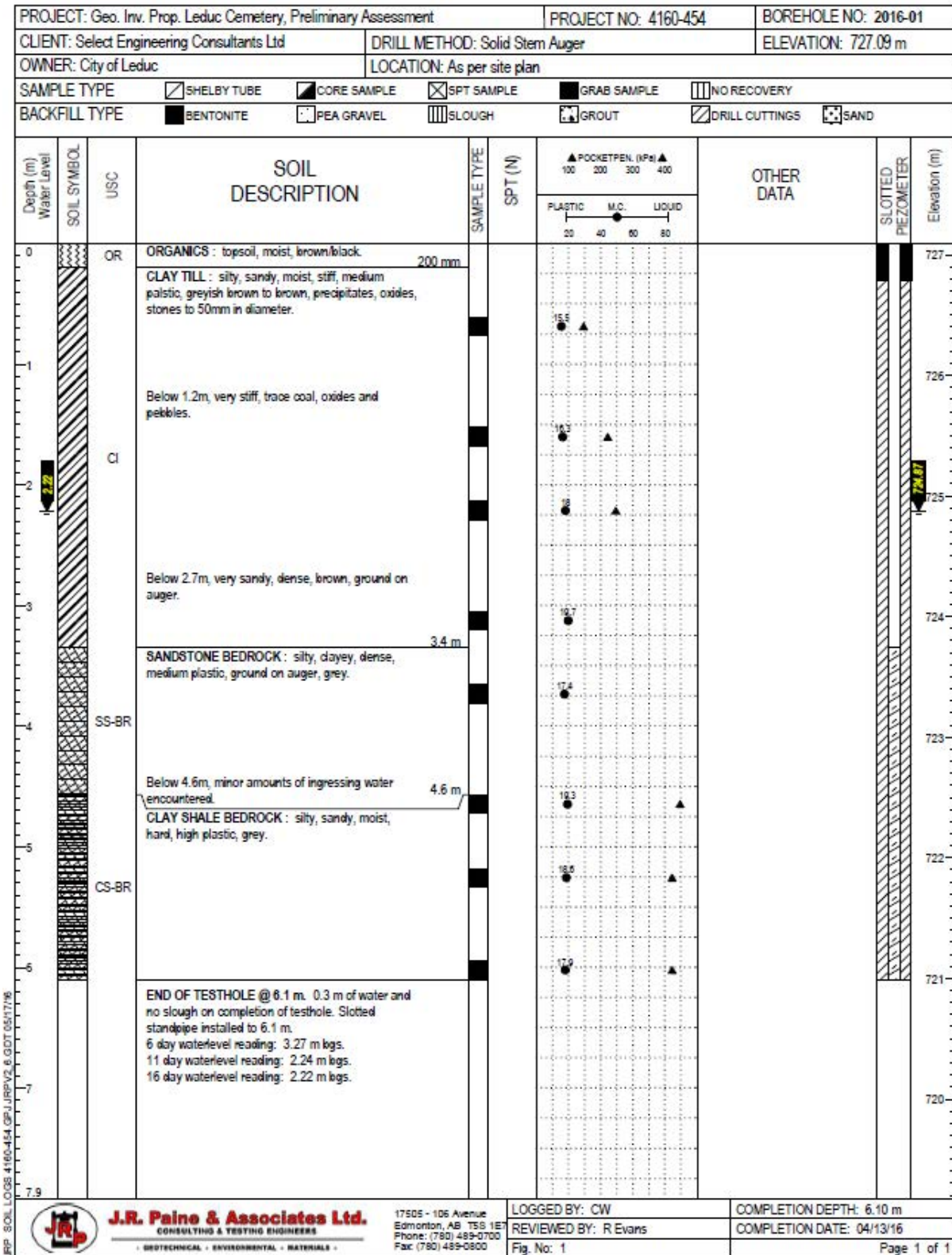
View showing existing residential housing, garage, and other small structures

Appendix E Borehole Logs

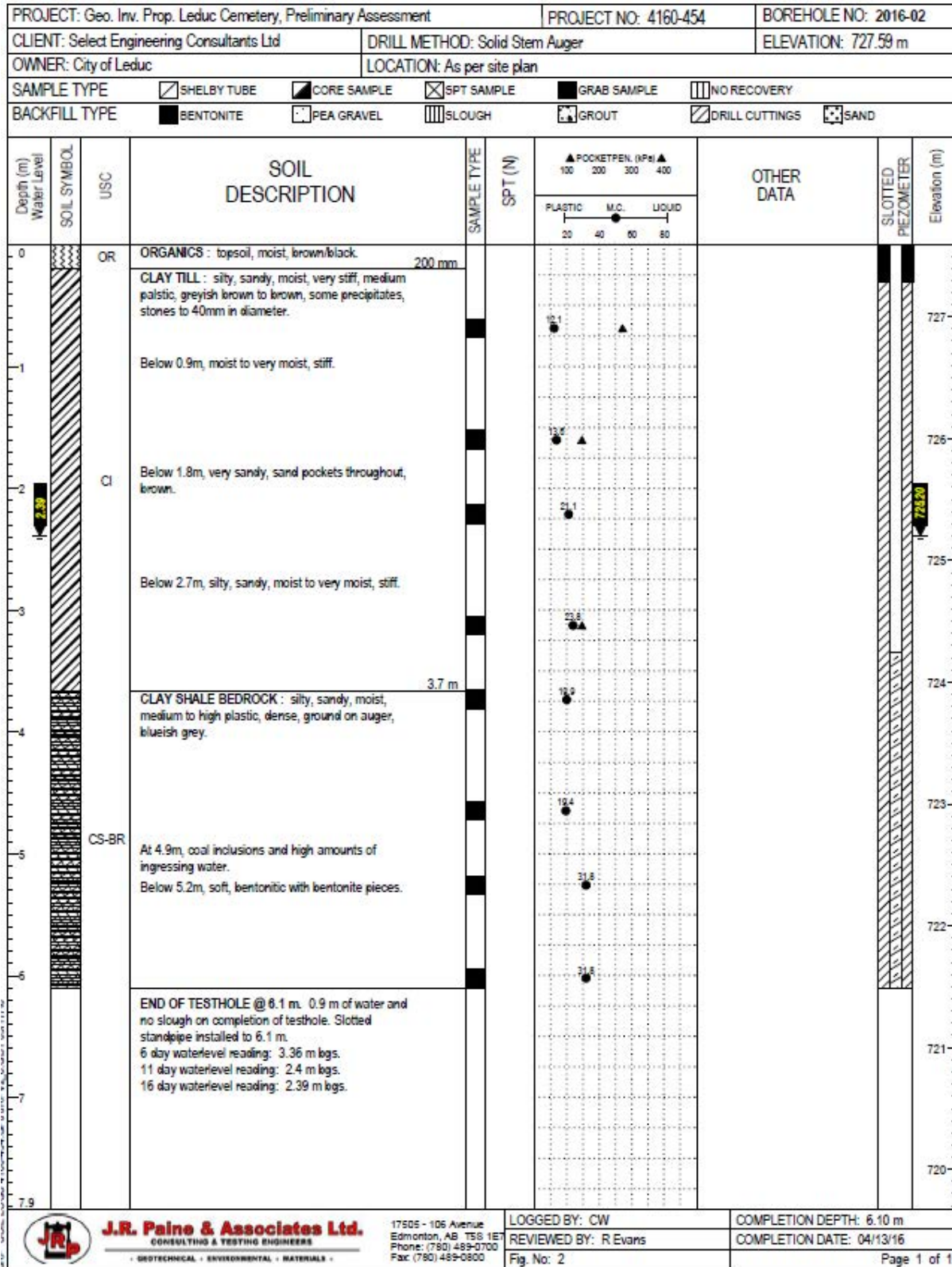
Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



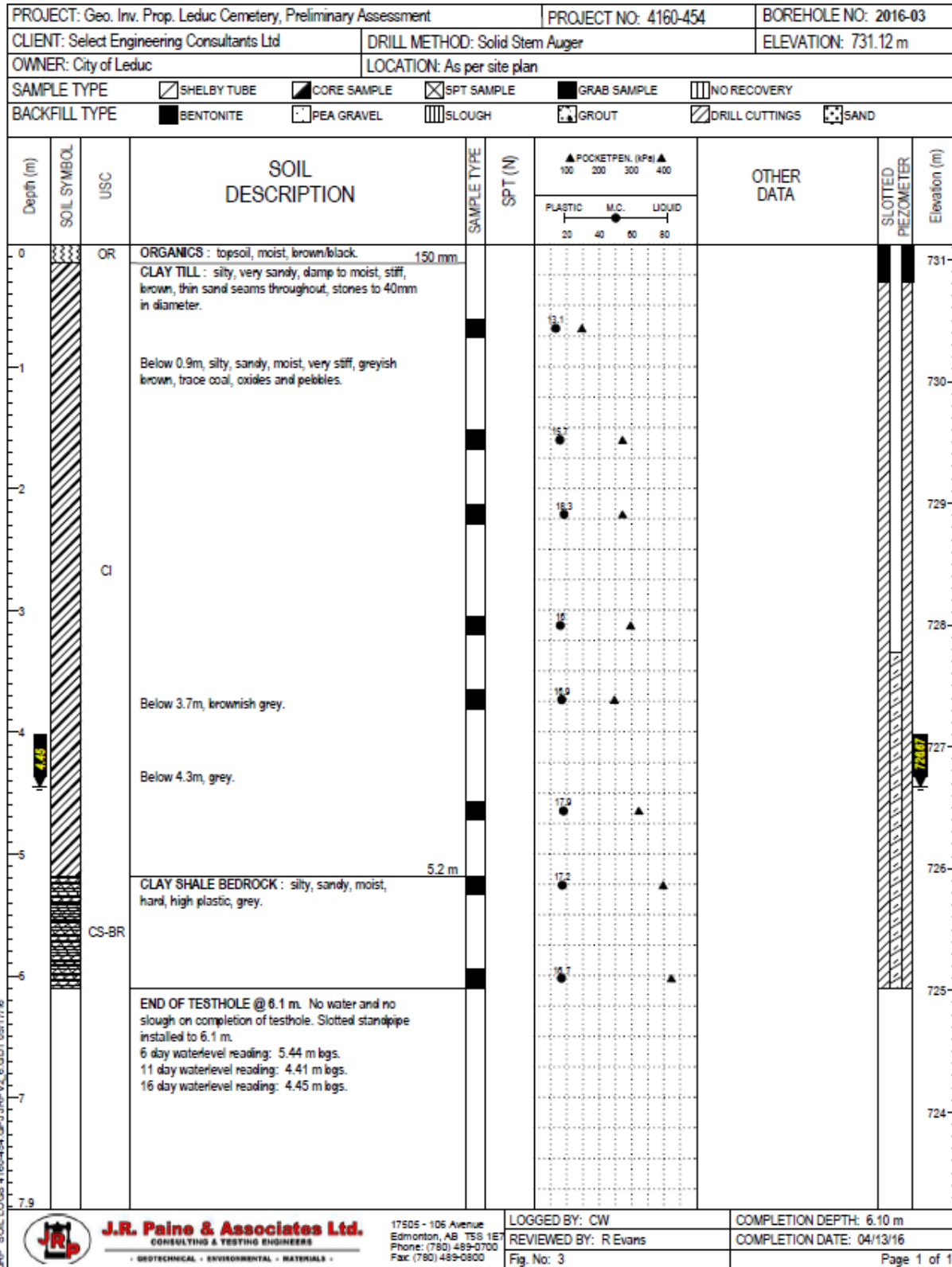
Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



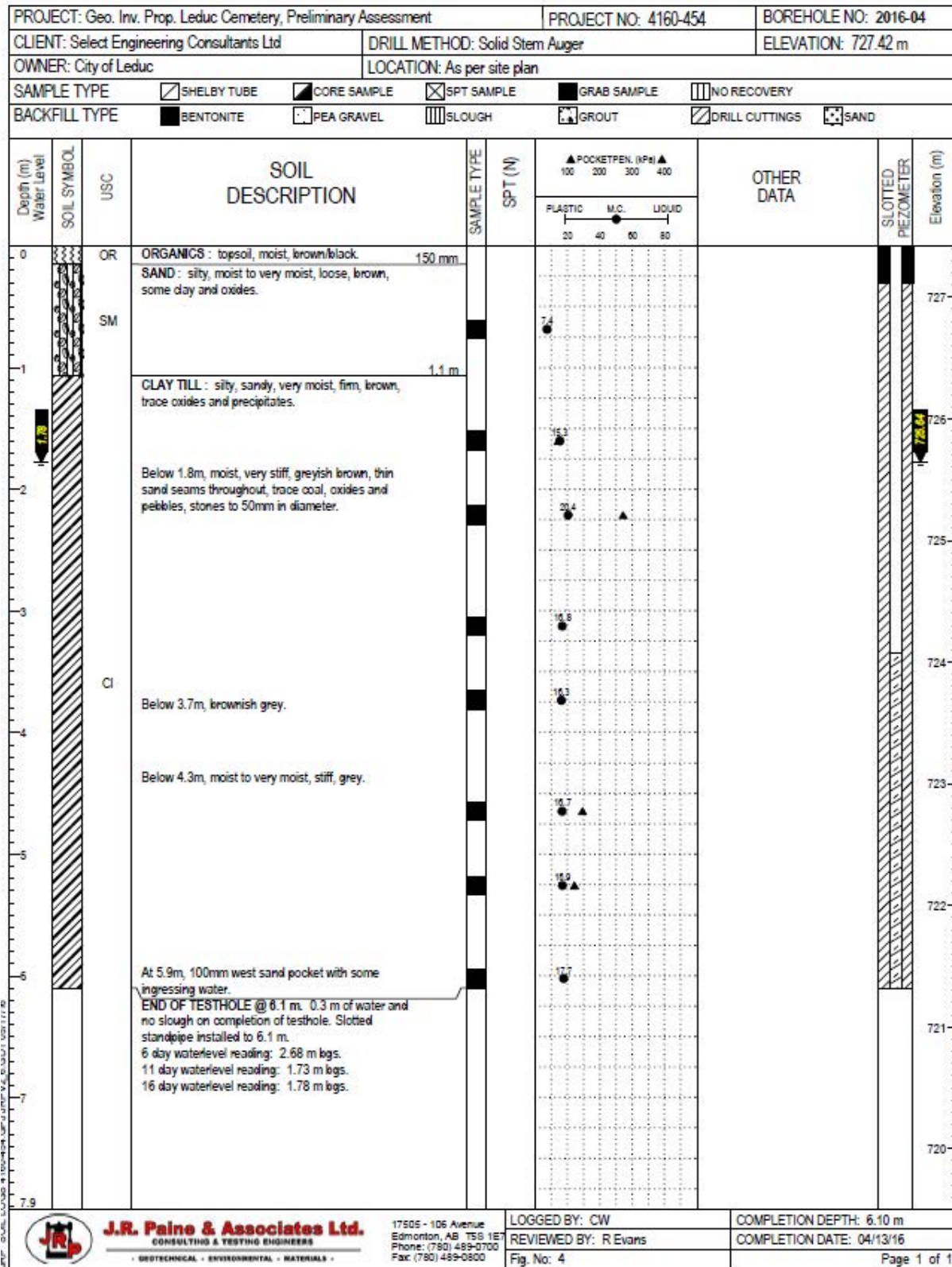
Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



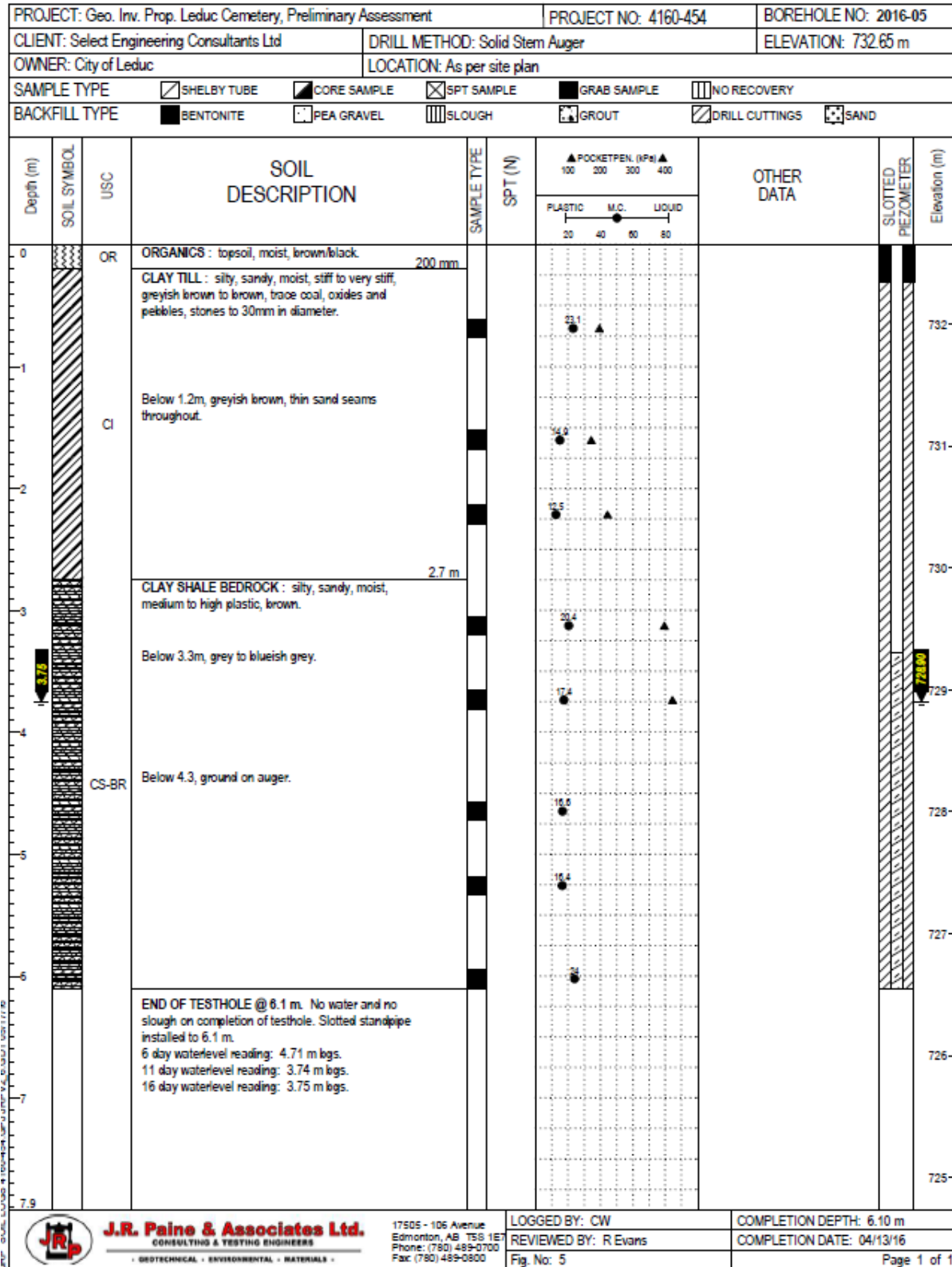
Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



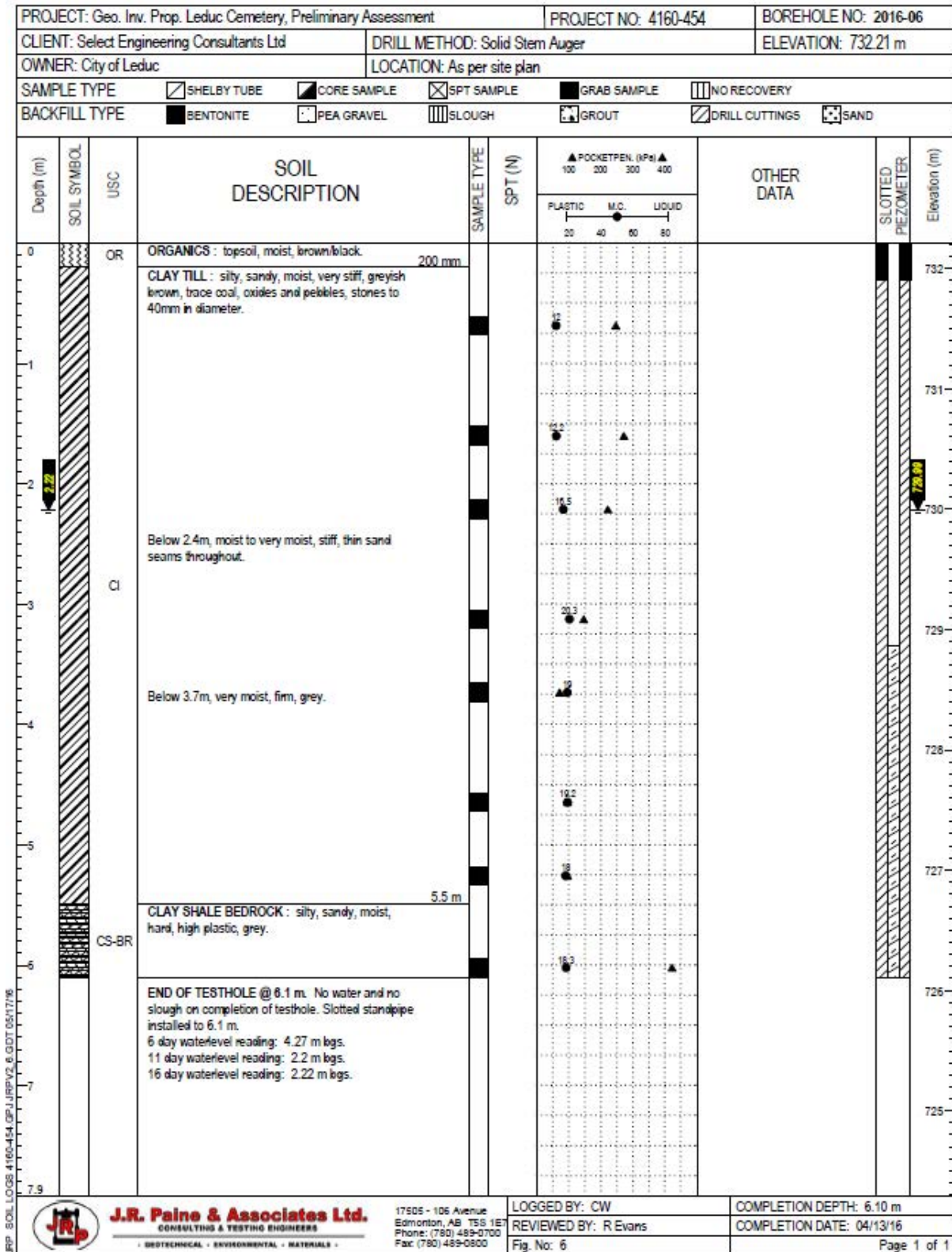
Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



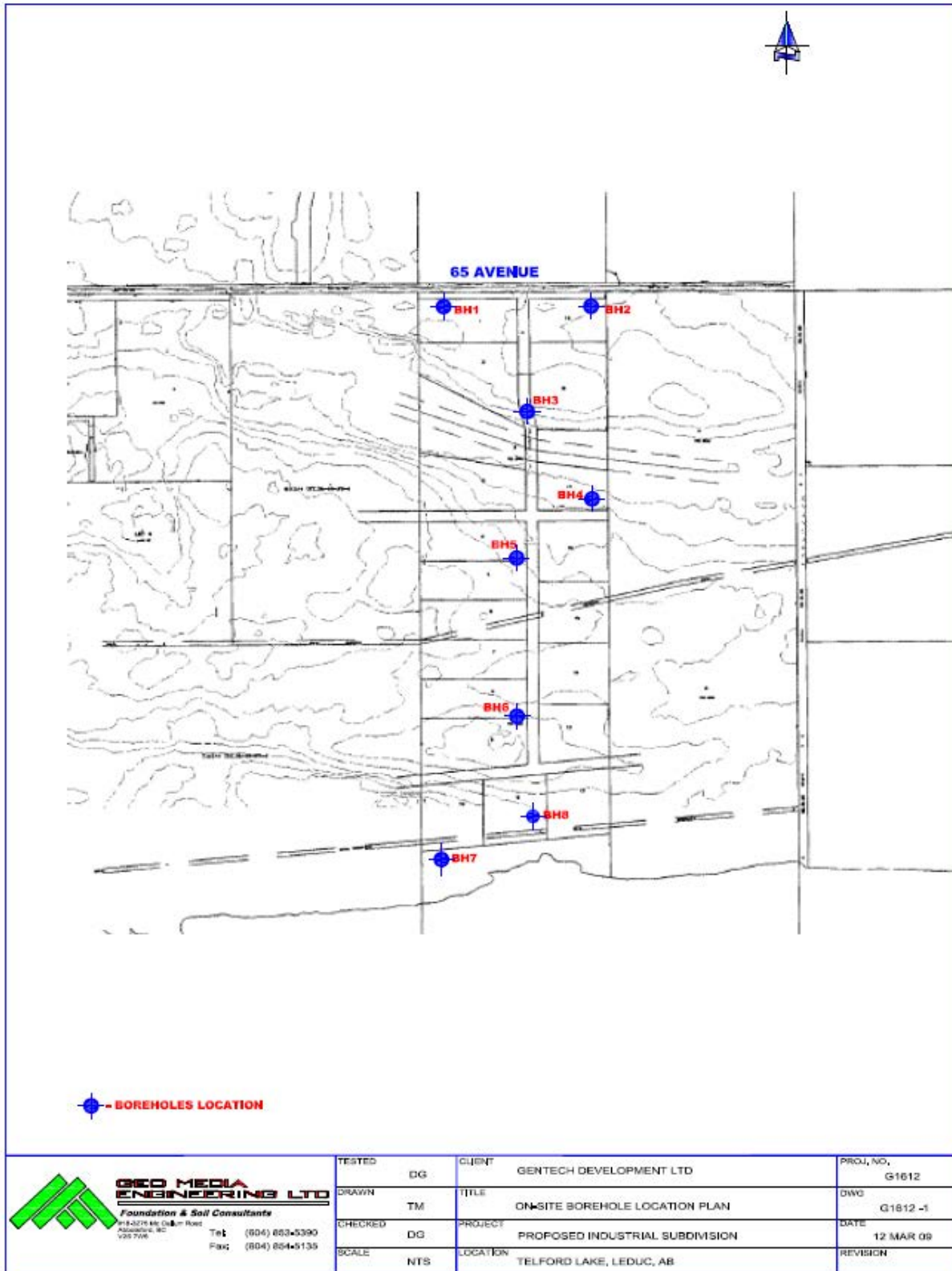
Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



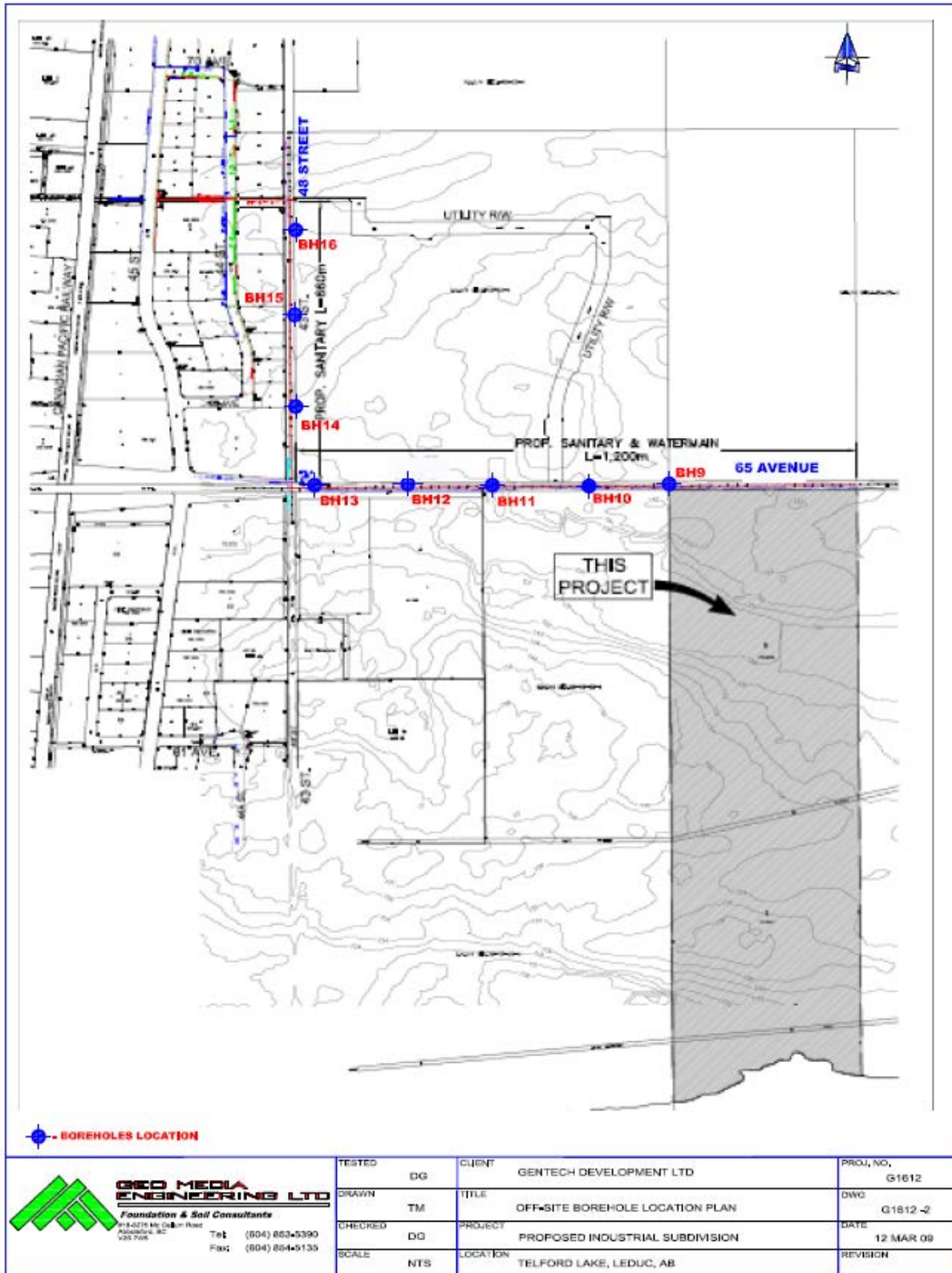
Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs



Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
 Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-01	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS		
		<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND		

Depth (m)	STANDARD PEN (N)	USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
0			TOPSOIL	TOPSOIL						0
0.5				SILT, some sand, trace clay and gravel, light brown, frozen.						0.5
1.5				- some clay and sand, trace gravel, blocky, moist.			15	MC = 18%		1.5
2.5							22	MC = 19%		2.5
3.5							13	MC = 15%		3.5
4.5				CLAY, trace sand and gravel, stiff, dark brownish grey with grey flecks, moist.			82	MC = 17%		4.5
5.5										5.5
6.5				SILT, some sand and clay, hard / very dense, low plastic, light grey, moist.						6.5
7.5										7.5
8.5							70	MC = 16%		8.5
9.5				- WATER ENCOUNTERED. - sandy.			50/ 0.07	MC = 14%		9.5
10.5										10.5
11.5				SAND, silty, trace fine gravel, very dense, light brown, moist.			50/ 150	MC = 14%		11.5
12.5				SILT, clayey, trace sand, hard, light brown, moist.						12.5
13.5				- sandy, trace clay.			50/ 0.10	MC = 17%		13.5
14.5							50/ 0.10	MC = 18%		14.5
15.5							50/ 0.09	MC = 16%		15.5
16.5				REFUSAL Monitoring Well Installed. Screen from 14.2 to 11.2 m. Solid from 11.2 m to surface. Cuttings from 14.2 m to 0.3 m. Bentonite from 0.3 m to surface. Groundwater level on February 22, 2009 = 5.2 m below surface. End of borehole at 14.2 m.						16.5
17.5										17.5
18.5										18.5

LOGGED BY: DG	COMPLETION DEPTH: 14.2 m
REVIEWED BY: RM	COMPLETION DATE: 16/2/09
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Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-02	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS		
		<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND		

Depth (m)	STANDARD PEN (N)		USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
	20	40									
0					SILT, some sand, trace clay and gravel, light brown, frozen.						0
2	20	40			- some clay, trace sand and gravel, very stiff, medium plastic, medium brown, moist.	X		20	MC = 16%		2
3	20	40			- stiff.	X			MC = 18%		
4	20	40			- light brown specks.	X					
5	20	40			- trace clay, sand and gravel, hard, low plastic, light brown, moist.	X					
6	20	40			- some sand, hard, low to non-plastic, grey, moist.	X		65	MC = 19%		
7	20	40			- sandy.	X					
6					SAND & SILT, very dense, light grey, moist.	X		50/ 0.09	MC = 16%		6
8					SILT, sandy, light plastic, hard, light grey, moist.	X		50/ 0.08	MC = 16%		8
10					- WATER ENCOUNTERED.	X		50/ 150	MC = 20%		10
12						X		50/ 0.10	MC = 19%		12
12.7					Backfilled to surface with cuttings. End of borehole at 12.7 m.						12.7

LOGGED BY: DG	COMPLETION DEPTH: 12.7 m
REVIEWED BY: RM	COMPLETION DATE: 16/2/09
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Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-03	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input checked="" type="checkbox"/> CONTINUOUS		
		<input checked="" type="checkbox"/> DRILL CUTTINGS		<input checked="" type="checkbox"/> SAND	

Depth (m)	STANDARD PEN (N)		USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
	20	40									
0					TOPSOIL SILT, some sand, trace clay and gravel, light brown, frozen.						0
2					- some clay, trace sand and gravel, very stiff, medium brown with grey specks, moist.			37			2
4					- trace clay, no gravel, blocky, low plastic, light brown to yellow brown.			63	MC = 21%		4
6					- some clay, medium plastic.			63	MC = 17%		6
8					SILT, some sand and clay, hard / very dense, low plastic, light grey, moist.			50/ 0.10	MC = 13%		8
10					- WATER ENCOUNTERED.			50/ 0.10	MC = 18%		10
12								50/ -0.04	MC = 17%		12
14					Groundwater level @ 9.1 m at completion of drilling. End of borehole at 12.7 m.				MC = 23%		14

LOGGED BY: DG	COMPLETION DEPTH: 12.7 m
REVIEWED BY: RM	COMPLETION DATE: 16/2/09
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Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-04	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> FEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input checked="" type="checkbox"/> CONTINUOUS		
		<input type="checkbox"/> DRILL CUTTINGS		<input type="checkbox"/> SAND	

Depth (m)	STANDARD PEN (N)		USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
	20	40									
0					TOPSOIL						0
0.3					SILT, some sand, trace gravel, stiff, low plastic, brown, moist. - light brown. - trace sand, no gravel.			25	MC = 19%		0.3
2.0					- blocky, light grey with rust mottle.			63	MC = 17%		2.0
4.0					SILT, trace sand, trace clay, low plastic, hard, light grey, moist. - sandy.			50/ 0.11	MC = 13%		4.0
6.0					- some clay, trace sand.			90	MC = 16%		6.0
8.0					- some sand, trace clay.			50/ 0.10	MC = 16%		8.0
10.0					- some clay, trace sand.			50/ 0.10	MC = 15%		10.0
12.0								50/ 0.11	MC = 19%		12.0
12.7					Groundwater level @ 6.7 m at completion of drilling. Monitoring Well Installed. Screen from 12.7 to 9.7 m. Solid from 9.7 m to surface. Cuttings from 12.7 to 0.3 m. Bentonite from 0.3 m to surface. Groundwater level on February 22, 2009 = 2.5 m below surface. End of borehole at 12.7 m.						12.7

LOGGED BY: DG	COMPLETION DEPTH: 12.7 m
REVIEWED BY: RM	COMPLETION DATE: 16/2/09
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Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-05			
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334			
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:			
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED	<input type="checkbox"/> A-CASING	<input checked="" type="checkbox"/> CONTINUOUS
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input checked="" type="checkbox"/> DRILL CUTTINGS	<input checked="" type="checkbox"/> SAND

Depth (m)	STANDARD PEN (N) 20 40 50 80 PLASTIC MC LIQUID 20 40 50 80	USCS SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
0			TOPSOIL						
0.5			SILT, sandy, trace gravel, frozen, light brown.						
2.0	32		- some clay, some sand, trace gravel, very stiff, light brown, moist.	X		32	Frozen. MC = 12%		2.0
3.0			- trace sand.			17	MC = 17%		3.0
4.5			- clayey, medium plastic, in-situ, increasing moisture with depth.	X		11	MC = 17%		4.5
5.5			SILT, some clay, trace to some sand, low plastic, hard, light grey, moist.			50/ 0.09	MC = 15%		5.5
6.0			- sandy, trace clay.			50/ 150	MC = 16%		6.0
7.5			- WATER ENCOUNTERED.	X		71	MC = 17%		7.5
10.0			- some clay, trace sand.			50/ 0.08	MC = 22%		10.0
12.0						50/ 0.10	MC = 18%		12.0
15.7			Groundwater @ 6.7 m at completion of drilling. End of borehole at 15.7 m.						15.7

LOGGED BY: DG	COMPLETION DEPTH: 15.7 m
REVIEWED BY: RM	COMPLETION DATE: 17/2/09
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BOREHOLE LOG GP1334.GPJ, NORTHERN GEO.GDT, 13/03/09

Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-06	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
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BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS		
		<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND		

Depth (m)	STANDARD PEN (N)		USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
	20	40									
0					TOPSOIL						0
0.3					SILT, sandy, trace gravel, stiff, crumbly, frozen.						0.3
2.0					- very stiff, moist.	X		18	MC = 16%		2.0
3.5					- some sand to sandy, trace clay, hard, light brown.	X		54	MC = 20%		3.5
4.5					- sandy.			50/ 0.10	MC = 16%		4.5
5.5					- some clay, trace sand, low plastic.	X		59	MC = 16%		5.5
7.5					SILT, some clay, trace sand, low plastic, hard, moist.			50/ 0.08	MC = 15%		7.5
7.5					- WATER ENCOUNTERED, trace sand.						7.5
8.0					- some sand to sandy.			50/ 150	MC = 17%		8.0
10.0					- some clay.						10.0
12.0								50/ 0.10	MC = 16%		12.0
12.7					Monitoring Well Installed. Screen from 12.7 to 9.7 m. Solid from 9.7 m to surface. Cuttings from 12.7 to 0.3 m. Bentonite from 0.3 m to surface. Groundwater level on February 22, 2009 = 4.1 m below surface. End of borehole at 12.7 m.						12.7

LOGGED BY: DG	COMPLETION DEPTH: 12.7 m
REVIEWED BY: RM	COMPLETION DATE: 17/2/09
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Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-07	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS		
		<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND		

Depth (m)	STANDARD PEN (N)		USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
	20	40									
0					TOPSOIL SILT, some sand and clay, frozen, light brown.						0
2					- trace sand, very stiff, grey specks, moist.				MC = 12%		2
4					- small carbon inclusions.	X		11	MC = 16%		4
6					- greyish-brown.	X		11	MC = 16%		6
8					- very stiff.	X		17	MC = 14%		8
10					- trace sand and clay, hard, low to non-plastic.	X		26	MC = 15%		10
12					- some clay to clayey, trace sand, stiff.	X		13	MC = 17%		12
14					SAND with fine gravels, silty, very dense, light brown, moist.	X		92/ 150.1	MC = 20%		14
16					SILT, some sand, trace clay and gravel, very dense, light grey.			50/ 0.05	MC = 21%		16
18					Groundwater @ 3.0 m at completion of drilling. Monitoring Well Installed. Screen from 15.7 m to 12.7 m. Solid from 12.7 m to surface. Cuttings from 15.7 m to 0.3 m. Bentonite from 0.3 m to surface. Groundwater level on February 22, 2009 = 2.1 m below surface. End of borehole at 15.7 m.						18

LOGGED BY: DG	COMPLETION DEPTH: 15.7 m
REVIEWED BY: RM	COMPLETION DATE: 17/2/09
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Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-08	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input checked="" type="checkbox"/> CONTINUOUS		
		<input checked="" type="checkbox"/> DRILL CUTTINGS		<input checked="" type="checkbox"/> SAND	

Depth (m)	STANDARD PEN (N)		USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
	20	40									
0					TOPSOIL						0
0.3					SILT, some sand, trace gravel, frozen, light brown.						0.3
2.0					- SPT refusal, drilled out.				MC = 11%		2.0
2.0					SILT & SAND, trace fine gravel, very dense, low to non-plastic, yellowish-brown, moist.						2.0
3.5								94	MC = 15%		3.5
5.0					SILT, some sand, hard, low plastic, light brown, damp.			50/150	MC = 14%		5.0
5.0					- sandy.						5.0
6.0								50/0.09	MC = 14%		6.0
7.5					SILT, some sand, trace clay, hard, light grey, moist.			50/0.10	MC = 16%		7.5
9.0								50/0.09	MC = 16%		9.0
9.0					- some sand to sandy.						9.0
12.0								50/0.08	MC = 17%		12.0
15.2					Groundwater @ 9.8 m at completion of drilling. Monitoring Well Installed. Screen from 15.7 m to 12.7 m. Solid from 12.7 m to surface. Cuttings from 15.7 m to 0.3 m. Bentonite from 0.3 m to surface. Groundwater level on February 22, 2009 = 4.9 m below surface. End of borehole at 15.2 m.						15.2

LOGGED BY: DG	COMPLETION DEPTH: 15.2 m
REVIEWED BY: RM	COMPLETION DATE: 17/2/09
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Geotechnical Desktop Study City of Leduc East Telford Lake Area Structure Plan
Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-09						
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334						
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:						
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED					
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT					
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS							
		<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND							
Depth (m)			USCS SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)	
				ASPHALT (80 mm thickness).						
				SILT, trace clay, sand, and gravel, hard, light brown, frozen. - trace to some clay.				MC = 18%		2
				- very stiff.				MC = 17%		
				SILT, some clay, trace sand and gravel, very stiff, medium brown, moist.				MC = 24%		4
				- light brown.						
				- sandy, trace clay.						
				Borehole dry upon completion. Backfilled to surface with cuttings. End of borehole at 6.1 m.				MC = 16%		6
										8
										10
										12
										14
										16
										18
LOGGED BY: DG						COMPLETION DEPTH: 6.1 m				
REVIEWED BY: RM						COMPLETION DATE: 18/2/09				
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BOREHOLE LOG GP1334.GPJ, NORTHERN GEO.GDT, 13/2/09

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Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-10	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS		
		<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND		

Depth (m)	STANDARD PEN (N)		USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
	20	40									
					ASPHALT (80 mm thickness).						
					GRAVEL.						
					SILT, trace organics, trace sand and clay, hard, dark brown, frozen.				MC = 14%		
					SAND, fine gravels, trace silt, compact, light brown, damp.						
2											2
					SILT, some sand, trace clay, firm to soft, light brown.				MC = 20%		
					- thin sand seam.						
					- firm.						
					Groundwater level @ 3.0 m at completion of drilling.				MC = 24%		
					End of borehole at 4.6 m.						
4											4
6											6
8											8
10											10
12											12
14											14
16											16
18											18

LOGGED BY: DG	COMPLETION DEPTH: 4.6 m
REVIEWED BY: RM	COMPLETION DATE: 18/2/09
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Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-11	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS	<input checked="" type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND
Depth (m)			USCS SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE
					INSTRUMENTATION DATA
					Depth (m)
				ASPHALT (80 mm thickness).	
				FILL, sand and gravel, trace to some silt, compact, medium brown, frozen.	
				SILT, trace organics, trace sand and clay, dark brown, frozen.	MC = 25%
				SILT, some clay, trace sand and gravel, very stiff, light brown, moist.	
				- some clay and clayey.	MC = 22%
				Borehole dry upon completion.	MC = 17%
				Backfilled with cuttings to surface.	
				End of borehole at 4.6 m.	
				LOGGED BY: DG	COMPLETION DEPTH: 4.6 m
				REVIEWED BY: RM	COMPLETION DATE: 18/2/09
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Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-12	
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334	
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:	
SAMPLE TYPE		<input type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED
BACKFILL TYPE		<input type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS	<input checked="" type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	STANDARD PEN (N)	USCS SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
			ASPHALT (90 mm thickness).						
			GRAVEL.						
			SILT, trace sand and clay, dark brown, frozen.						
			SILT, trace gravel, sand and clay, light brown, frozen.						
2			- some clay to clayey, very stiff, medium brown.				MC = 13%		2
4			- mottled light / dark brown.				MC = 15%		4
6			SILT, some sand and clay, hard / very dense, low plastic, light grey, moist.				MC = 18%		6
			Borehole dry upon completion. Backfilled with cuttings to surface. End of borehole at 4.6 m.						

LOGGED BY: DG		COMPLETION DEPTH: 4.6 m
REVIEWED BY: RM		COMPLETION DATE: 18/2/09
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Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-13							
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334							
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:							
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED						
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT						
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS								
		<input checked="" type="checkbox"/> DRILL CUTTINGS	<input checked="" type="checkbox"/> SAND								
Depth (m)	STANDARD PEN (N)		USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
	20	40									
	PLASTIC		MC	LIQUID							
	20	40	60	80							
0					ASPHALT (60 mm thickness).						
0					GRAVEL.						
0					SILT, trace sand, clay and organics, dark brown, frozen.						
0					SILT, some clay, trace sand, light brown, frozen.						
2	25				- very stiff, moist.				MC = 13%		2
3	35				- medium brown.				MC = 15%		3
4	45				- wet.						4
5	55				SILT, some sand and clay, hard / very dense, low plastic, light grey, moist.				MC = 18%		5
5					- sandy, hard.						5
6					Groundwater @ 4.0 m below surface at completion of drilling.						6
6					End of borehole at 4.6 m.						6
8											8
10											10
12											12
14											14
16											16
18											18
LOGGED BY: DG							COMPLETION DEPTH: 4.6 m				
REVIEWED BY: RM							COMPLETION DATE: 18/2/09				
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 Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-14							
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334							
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:							
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED						
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT						
		<input type="checkbox"/> A-CASING	<input checked="" type="checkbox"/> CONTINUOUS		<input checked="" type="checkbox"/> DRILL CUTTINGS						
				<input checked="" type="checkbox"/> SAND							
Depth (m)			USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
					ROAD MULCH.						
					SILT FILL, some gravel, trace clay, light brown, frozen.						
					SILT, some clay, trace sand and gravel, light brown, frozen.						
					- very stiff, medium brown.				MC = 24%		
					SILT, sandy, trace clay, very stiff, light brown, moist.				MC = 20%		
					SILT, some sand to sandy, trace clay, very stiff to hard, light grey, moist.				MC = 18%		
					Borehole dry upon completion. Backfilled to surface with cuttings. End of borehole at 4.6 m.						
								LOGGED BY: DG		COMPLETION DEPTH: 4.6 m	
								REVIEWED BY: RM		COMPLETION DATE: 18/2/09	
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Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-15							
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334							
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:							
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED						
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT						
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS								
		<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND								
Depth (m)			USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
					ROAD MULCH.						
					SILT FILL, trace clay and gravel, light brown, frozen.						
					SILT, trace clay and gravel, light brown, frozen.				MC = 16%		
					- some clay, trace sand, very stiff, medium brown, moist.						
					- clayey, trace sand, stiff, light brown.				MC = 25%		
					- some clay, trace sand, very stiff, medium brown.						
					- stiff.				MC = 24%		
					Borehole dry upon completion.						
					Backfilled to surface with cuttings.						
					End of borehole at 4.6 m.						
						LOGGED BY: DG		COMPLETION DEPTH: 4.6 m			
						REVIEWED BY: RM		COMPLETION DATE: 18/2/09			
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Appendix E: Borehole Logs

Gentech Developments Ltd.		Proposed Industrial Subdivision		BOREHOLE NO: BH-16						
SPT Drilling		North Telford Lake, Leduc, Alberta		PROJECT NO: GP1334						
150mm Solid Stem Auger		See borehole location plan.		ELEVATION:						
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> DISTURBED					
BACKFILL TYPE		<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT					
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CONTINUOUS	<input checked="" type="checkbox"/> DRILL CUTTINGS	<input checked="" type="checkbox"/> SAND					
Depth (m)			USCS SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	INSTRUMENTATION DATA	Depth (m)
				ROAD MULCH.						
				SILT, some clay, trace sand and gravel, light brown, frozen.						
				- very stiff, moist.				MC = 16%		
				- stiff.				MC = 17%		
				- trace to some sand, very stiff.						
				SILT, some sand, trace clay, hard / very dense, low plastic, light grey, moist.				MC = 23%		
				Borehole dry upon completion. Backfilled with cuttings to surface. End of borehole at 4.6 m.				MC = 16%		
					LOGGED BY: DG		COMPLETION DEPTH: 4.6 m			
					REVIEWED BY: RM		COMPLETION DATE: 18/2/09			
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