LETHBRIDGE COUNTY
IN THE PROVINCE OF ALBERTA

BYLAW NO. 1481

A BYLAW OF LETHBRIDGE COUNTY BEING A BYLAW PURSUANT TO SECTION 633(1) OF THE MUNICIPAL GOVERNMENT ACT, REVISED STATUTES OF ALBERTA 2000, CHAPTER M.26

FOR THE ADOPTION OF AN AREA STRUCTURE PLAN

WHEREAS Meadowscape Properties Ltd. wishes to develop a Country Residential Subdivision on a portion of SW 15-9-22-W4 (LSD 4 and 5).

AND WHEREAS the County's Municipal Development Plan requires that the developers prepare an Area Structure Plan to ensure that sound development occurs within the County;

AND WHEREAS an application to re-designate the above lands from Lethbridge Urban Fringe to Grouped Country Residential has also been submitted for consideration by County Council (Bylaw 1482);

AND WHEREAS the landowner/developer has prepared the "Meadowscape Area Structure Plan" which provides a framework for subsequent subdivision and development of the area;

NOW THEREFORE BE IT RESOLVED, under the Authority and subject to the provisions of the Municipal Government Act, Revised Statutes of Alberta, 2000, Chapter M-26, as amended, the Council of Lethbridge County in the Province of Alberta duly assembled does hereby enact the following:

1. The "Meadowscape Area Structure Plan" Bylaw No.1481, attached as "Appendix A".

GIVEN first reading this 17th day of August, 2017.

Reeve

Chief Administrative Officer

GIVEN second reading this 21st day of September, 2017.

Reeve

Acting Chief Administrative Officer

GIVEN third reading this 21st day of September, 2017.

Reeve

Acting Chief Administrative Officer

MEADOWSCAPE AREA STRUCTURE PLAN

AUGUST 2017

Lethbridge County By-Law 1481

Adopted September 21, 2017

DOUGLAS J. BERGEN & ASSOCIATES LTD.
ARCHITECTURAL TECHNOLOGY

MEADOWSCAPE
AREA STRUCTURE PLAN

August 2017

Prepared for
John Davis & Henry Bakker
Lethbridge, Alberta

Prepared by
Douglas J. Bergen & Associates Ltd.
HV Consulting Ltd.
Osprey Engineering Ltd.
Tetra Tech EBA Inc.

DOUGLAS J. BERGEN & ASSOCIATES LTD.
ARCHITECTURAL TECHNOLOGY

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1 INTRODUCTION

1.1 PURPOSE OF THE PLAN

The purpose of the Meadowscape Area Structure Plan (ASP) is to set out a concept for planning and proposed guidelines for the future subdivision and development of the lands described in this document. The plan has been prepared to compliment the proposed amendment to the Lethbridge County Land Use Bylaw # 1404 to change the zoning of the subject lands from Lethbridge Urban Fringe (LUF) to Grouped Country Residential (GCR).

1.2 LOCATION AND BACKGROUND

The Meadowscape ASP area includes a portion of the SW ¼ 15-09-22 W4M (the site) and is shown on **Figure 1.0 – Location Plan** and **Figure 2.0 – Aerial Photo**. The site includes one legal parcel of land, which is identified as LINC 0027 188 819, title number 151 119 596 and includes approximately 16.2 ha (40 acres). The land is owned by John Davis and Henry Bakker. Certificates of title and legal survey are included in **Appendix A – Property Ownership.**

The site is located along the east side of Range Road 22-3, south of the Town of Coalhurst. The site offers an attractive opportunity for country residential living with views of the City of Lethbridge to the south east. Other country residential properties exist in the immediately surrounding area. The site is within a few minutes drive from the Town of Coalhurst and within a 12 minute drive from downtown Lethbridge.

The site is unique in that it is severed from north to south by a meandering irrigation canal owned and operated by the Lethbridge Northern Irrigation District (LNID). A subdivision approval was granted by the Lethbridge County Subdivision Authority (2015-0-088) on June 19, 2015, to split the 40-acre title into two titles, (west/east portions) split along the LNID canal. A condition of subdivision approval was imposed on the applicants requiring them to prepare an ASP for the land to the satisfaction of the Lethbridge County in order to address future subdivision.

1.3 APPROVAL PROCESS

This Area Structure Plan will be submitted to the Lethbridge County in support of an application to amend the Lethbridge County Land Use Bylaw. An application will be submitted for a land use amendment from Lethbridge Urban Fringe (LUF) to Grouped Country Residential (GCR). The application will be circulated in accordance with the Lethbridge County

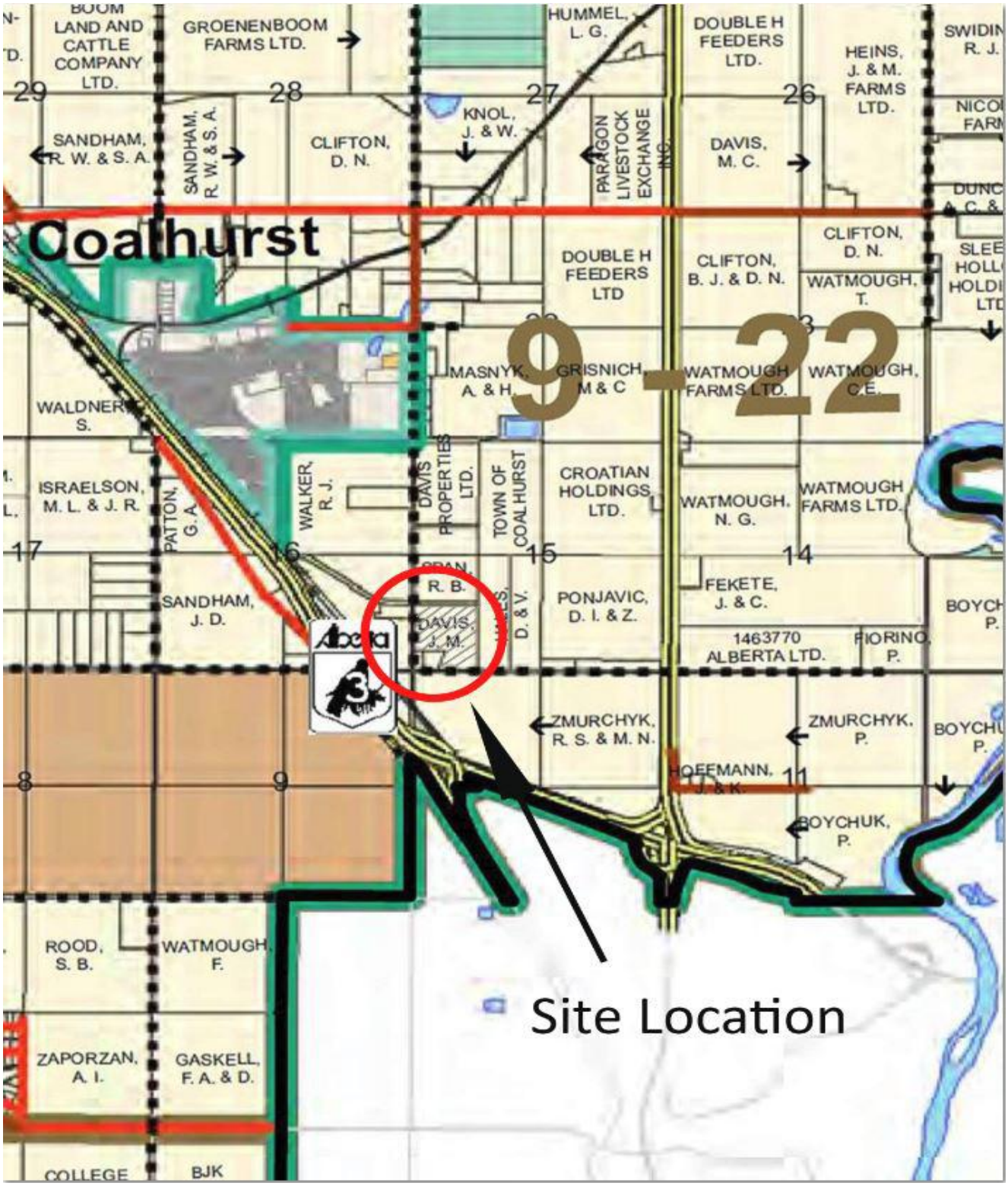


Figure 1.0 – Location Plan

Figure 2.0 – Aerial Photo

policies seeking comment from the appropriate authorities including:

1. The Oldman River Regional Services Commission
2. The Lethbridge Northern Irrigation District
3. Alberta Environment and Parks
4. Alberta Agriculture Food and Rural Development
5. The Chinook Regional Health Authority
6. The City of Lethbridge
7. Alberta Transportation
8. The Town of Coalhurst

Lethbridge County council will evaluate the comments received from the above mentioned authorities prior to rendering a decision on the application for reclassification. If the Area Structure Plan and rezoning application are approved, the applicant will have a framework from which to make application for the subdivision of the various lots. A Development Agreement will be entered into between the Lethbridge County and the applicant to ensure orderly and quality infrastructure as directed by the agreement.

1.4 LEGISLATIVE FRAMEWORK

1.4.1 The Municipal Government Act

The Municipal Government Act (MGA) is the provincial legislation which regulates municipal land use planning. This legislation sets out the requirements for two documents which this proposal is subject to: The Lethbridge County Municipal Development Plan and the Land Use Bylaw.

1.4.2 The Municipal Development Plan

The Lethbridge County Municipal Development Plan (MDP) documents broad policies relative to development and growth within the County. This planning document pays particular attention to the desire of the County to maintain a strong agricultural base.

The subject property is of a size and scale that does not allow for a viable farming operation and therefore is suitable for consideration of reclassification and further subdivision. The parcel is also compromised by the fragmentation of the LNID canal.

This Area Structure Plan is intended to provide the information required by the MDP to enable council to make an

informed decision on the application. It should be noted that the land is located within the City of Lethbridge and Lethbridge County Intermunicipal Development Plan (IDP) area and therefore this plan has been circulated to the Lethbridge Planning Department for comment. The city's Manager of Development has confirmed that this proposal complies with the intentt of the IDP relative to Policy Area 2, Sub area 3, Policy 3.4.2.22, Policy 3.4.2.23 and map 5.

The Meadowscape ASP also complies with the South Saskatchewan Regional Plan.

1.4.3 Subdivision Regulations

The MGA outlines the requirements for the creation of new parcels of land in the County. The application for subdivision of the new lots as laid out in this Area Structure Plan will be submitted to the Oldman River Regional Services Commission (ORRSC) for processing.

1.4.4 Land Use Bylaw

The Lethbridge County Land Use Bylaw No. 1404 recognizes the area of the proposed development as Lethbridge Urban Fringe (LUF). The purpose of this classification is by in large to protect land for agricultural purposes and prevent fragmentation of parcels that may be considered in future annexations of the City of Lethbridge. The proposed re-designation of the subject land is intended to be Grouped Country Residential (GCR) as defined in the Bylaw.

1.5 JUSTIFICATION

The Municipal Development Plan mandates that the maximum parcel size which is eligible for further breakdown of lots to be 20 acres. The subject land was recently approved for subdivision by virtue of the LNID irrigation canal which severs the property. This subdivision allowed for 2 parcels of land, on either side of the canal, the easterly parcel of 9.52 ha (23.5 acres) and the westerly parcel of 5.74 ha (14.2 acres). The size of these parcels as well as the location of the LNID canal renders these lands as poor quality agricultural land. (It is noted that the easterly parcel exceeds the MDP maximum by 3.5 acres; however, given the topography and the irregular shape of the parcel the owners believe it is reasonable to apply for reclassification of both east and west parcels.) The easterly parcel is not classified as good agricultural land.

This diminished value as agricultural land gives way to a higher and better use of the property as a residential

development. Small acreage parcels are a viable option for consideration. This proposed use is prevalent in the fringe area of many County communities with the Town of Coalhurst being no exception. There is increased benefit to the County should these parcels be redesignated to GCR given the land value would increase giving way for a greater tax base.

The owner believes that the proposal outlined in this ASP is in keeping with the Municipal Development Plan and therefore offers support for a reclassification application.

2 GOALS

2.1 GOALS

The principal goals of the Meadowscape Area Structure Plan are:

1. To provide the information required to support the reclassification of the land;
2. To establish a framework for the future development of the subject parcels;
3. To set out the access, servicing, and development standards that must be met in the development of the lands; and
4. To outline architectural controls and guidelines that will ensure a high-quality and attractive country residential subdivision.

3 PLAN AREA

3.1 SITE ANALYSIS

3.1.1 Site Location

The property is located 1 km south of Coalhurst on the east side of Range Road 22-3. This land is included in the urban fringe of the Town of Coalhurst and the City of Lethbridge. The overall parcel is square in shape with the exception of two previous homesteads subdivided out of the south west corner. See **Figure 3.0 – Site Survey**.

3.1.2 Existing Land Use

The land is currently zoned Lethbridge Urban Fringe (LUF) and has been used for a hay crop in recent years. Seepage from the LNID canal coupled with some low lying areas present challenges for this land to be economically viable as a farming operation. Revenues from the hay crop do not justify this property as a viable farm.

3.1.3 Topography and Site Characteristics

The portion of the property on the west side of the canal generally slopes from west to east. The ground elevation ranges from a high point of 933.48 to a low of 931.30 at the toe of the canal bank.

The easterly parcel slopes away from the canal with a high point of 931.00 to 926.41. A detailed topographic plan was produced by Mike Spencer Geometrics Ltd. and is provided in **Figure 3.0 – Site Survey**.

The soils are generally comprised of a 150 mm layer of topsoil on top of medium plastic clay and glacial till. Two geotechnical studies were conducted on the site by Tetra Tech – EBA to evaluate the property for its suitability for septic fields as well as for the placement of buildings. Both engineering documents are available in **Appendix B – Geotechnical Investigation.**

3.1.4 Environmental, Historical, and Archaeological Significance

The County provided the applicant with a copy of the "Environmentally Significant Areas in the Oldman Region, County of Lethbridge" (February 1987) document. This study provides valuable information relative to

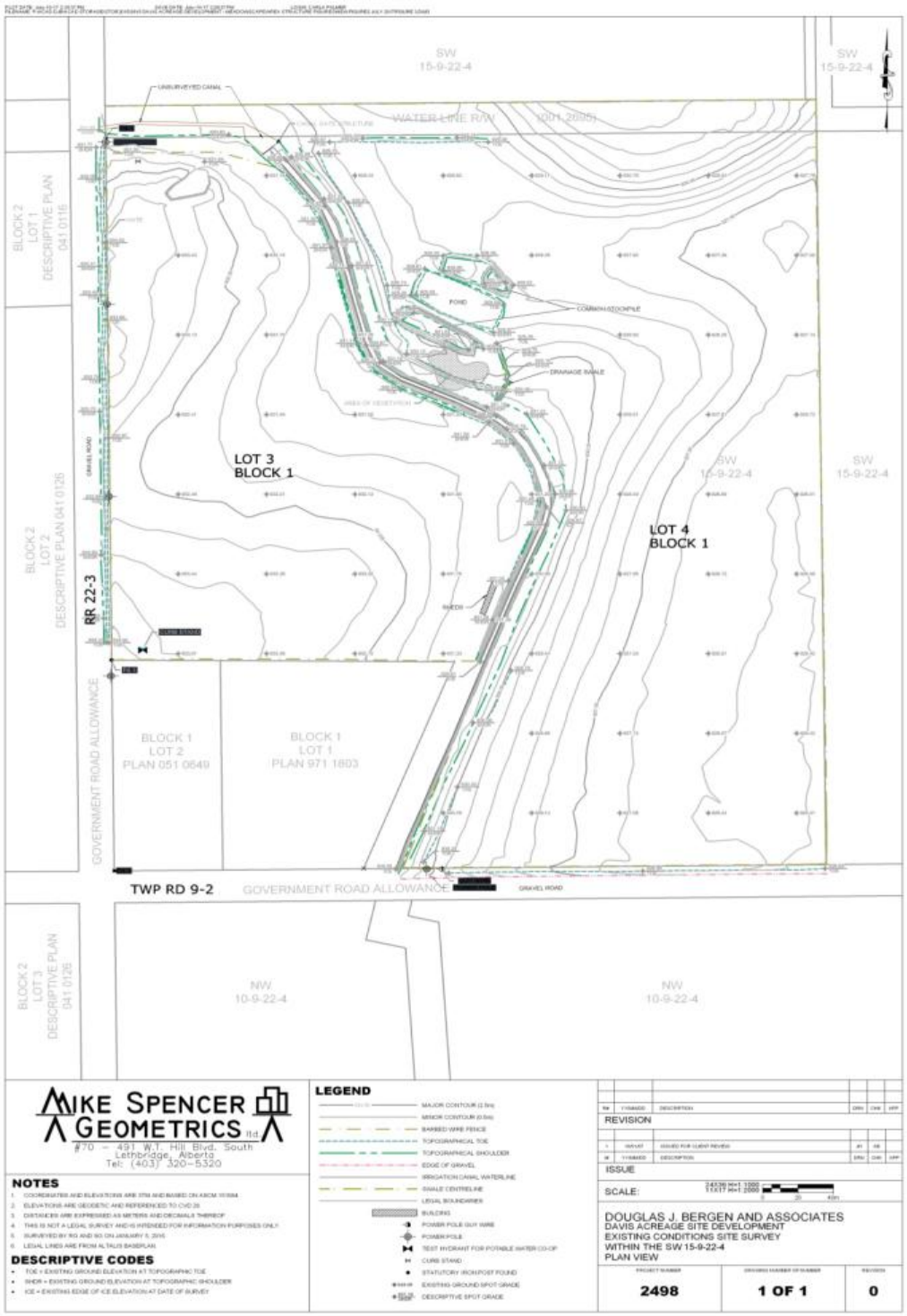


Figure 3.0 – Site Survey

environmental and archaeological significant sites in the Lethbridge County. A detailed review of the relevant figures contained in the study revealed that the subject property is outside of any of the noted sensitive area. The site has historically been used for agriculture and is located away from the edge of the river valley which comprises the most archaeologically significant area. See **Figure 4 – Environmentally Significant Areas.** There is also no evidence that the lands have been compromised by oil and gas facilities or historical undermining that would negatively impact the proposed use. Home owners will be encouraged to engage geotechnical engineers to verify that historic mining activity does not impact the specific location they have selected to construct their home.

3.1.5 Opportunities and Constraints

3.1.5.1 Opportunities

This property offers an excellent opportunity for rural residential living. It's proximity to Coalhurst offers convenience for daily necessities as well as a short bus ride for children attending schools.

The elevation of the site provides for views of the surrounding prairie landscape as well as a view corridor to the City of Lethbridge to the south east.

Range Road 22-3 was upgraded complete with a paved asphalt surface in the summer of 2016. This improvement will make this property highly desirable for country residential living. Township Road 9-2 is currently being upgraded to the same status.

The developer has secured shares on the local potable water cooperative which will provide City of Lethbridge water to every proposed site. Natural gas, electricity and telephone infrastructure is adjacent to the property which will make servicing convenient.

3.1.5.2 Constraints

The 9.52 ha (23.5 acres) lying east of the LNID irrigation canal has limited opportunity for development due to seepage from the canal. See **Figure 5.0 – LNID map.**

In discussions with senior development staff at the Lethbridge County along with management at LNID, it was recommended that the owners consider funding the installation of a pipe to house the current LNID canal facility in order to mitigate seepage. A piped conveyance system also eliminates the possibility for effluent from septic fields to migrate into the LNID irrigation water.

In May of 2017, the owners entered into an agreement with LNID to install a pipe to convey LNID water from the north end of the site to the south end. See **Figure 5.0a – LNID Lateral Pipeline.**

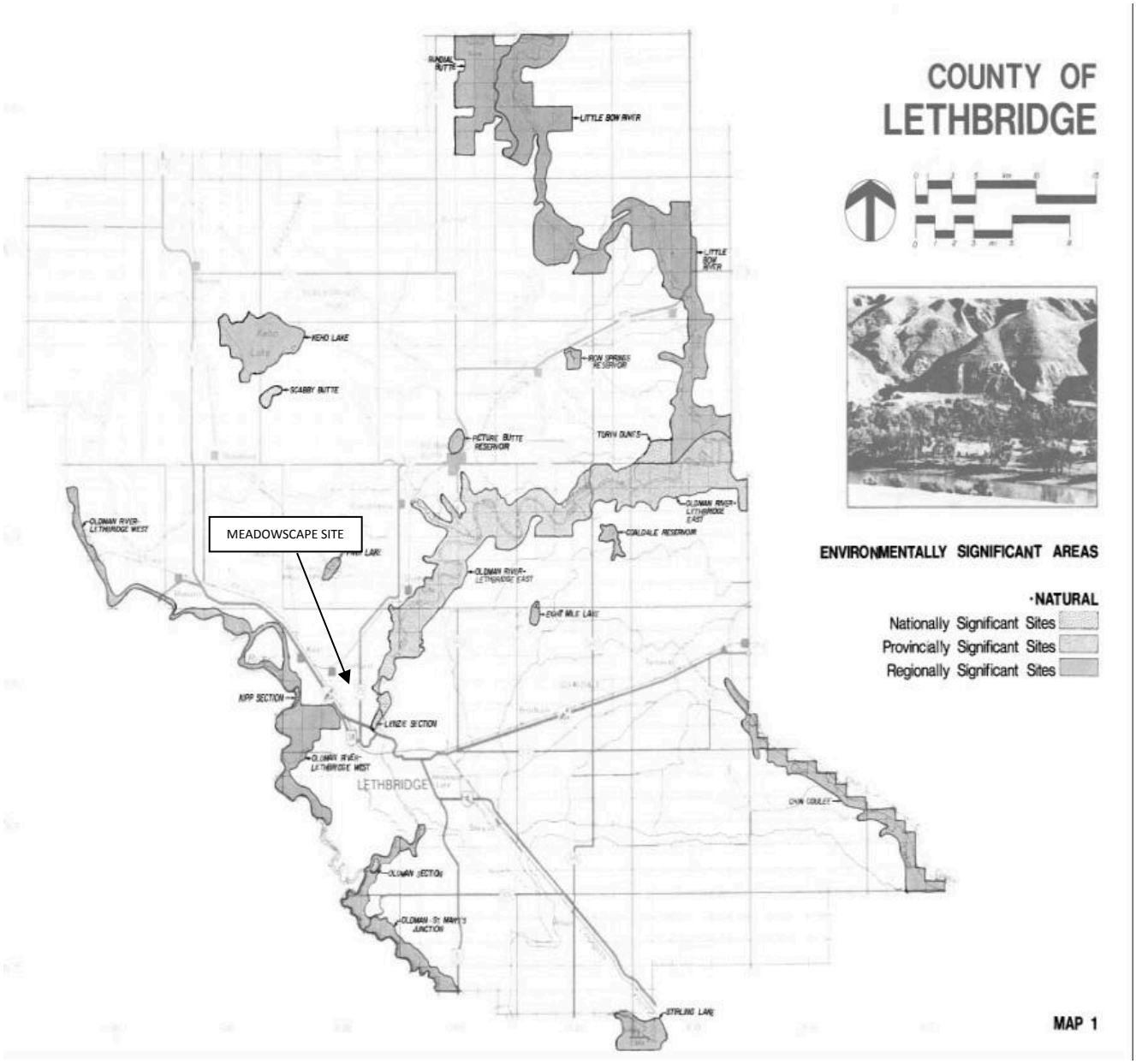


Figure 4.0 – Environmentally Significant Areas

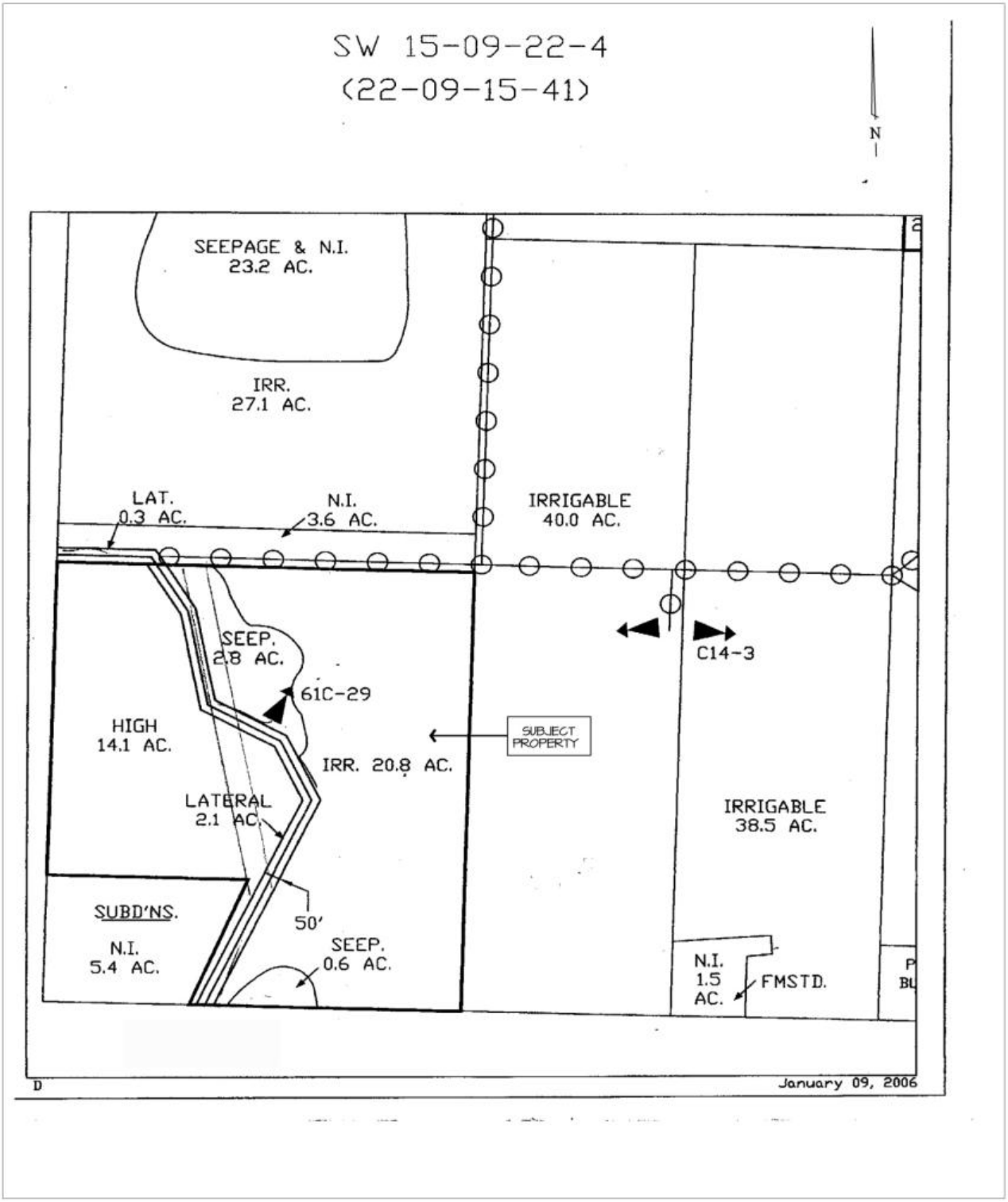


Figure 5.0 LNID Map

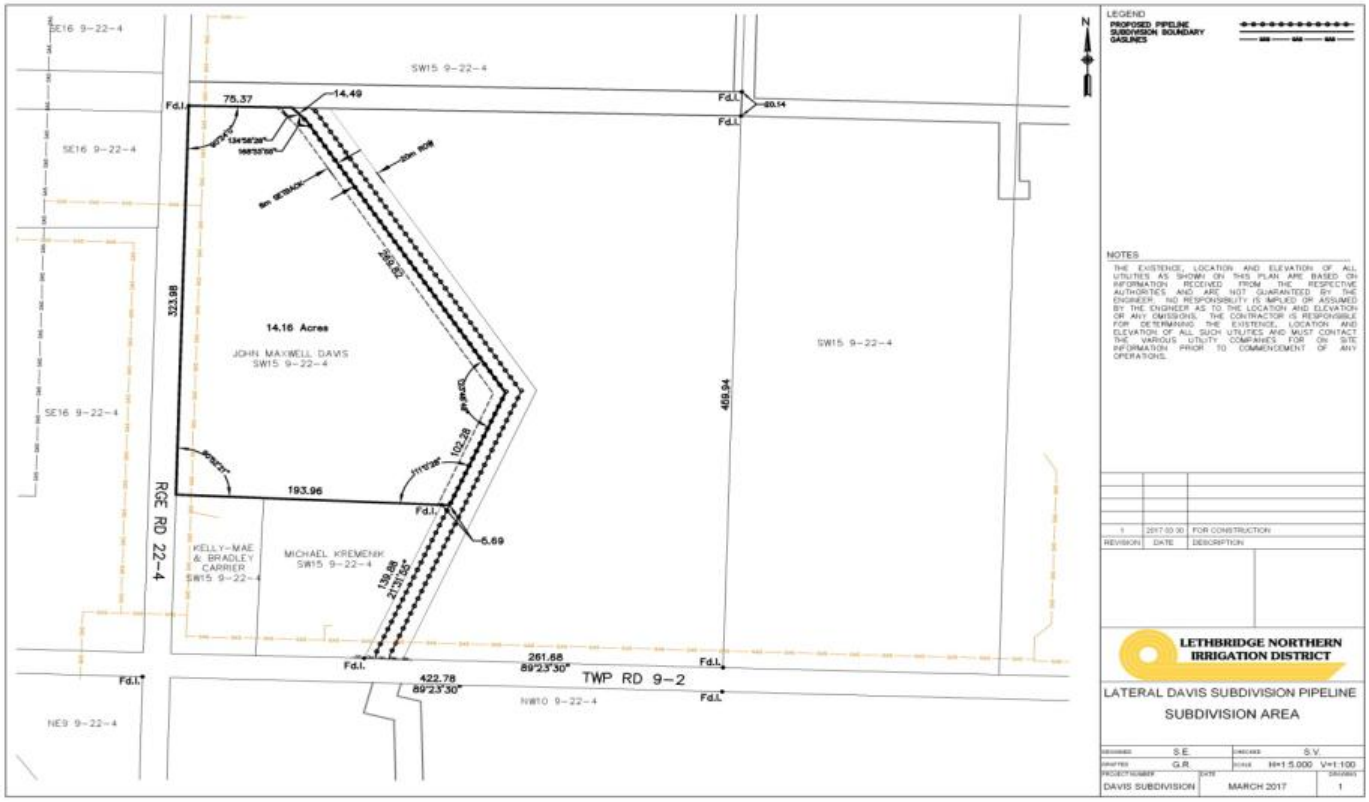


Figure 5.0a – LNID Lateral Pipeline

4 PROPOSED LAND AND DEVELOPMENT CONCEPT

4.1 DEVELOPMENT CONCEPT

The concept for the proposed lot layout is illustrated in **Figure 6.0 - Subdivision Layout**. The development proposal consists of 14 lots. The westerly portion of the property will have 6 new lots while the east side will support 8 lots and a constructed wetland facility.

The lots on the west side of the canal will be serviced via a new paved road and cul-de-sac accessed off of RR 22-3. The easterly 8 lots will be serviced by a similar road accessed from Township Road 9-2. Each proposed lot will be a minimum of 2 acres in size as required by the Lethbridge County Land Use Bylaw. A paved driveway access will be extended into each lot complete with a culvert for roadside drainage.

4.2 DEVELOPMENT AGREEMENT

As stipulated by the Land Use Bylaw, the Developer will enter into a Development Agreement with the Lethbridge County. The development agreement will outline specific conditions for development of the site. It is expected that these will include:

- Standards and requirements for municipal infrastructure that will be constructed by the Developer and turned over to the County.
- Any other improvements deemed necessary to support the development.
- Timelines for completion of Developer-led improvements.

4.3 BUILDING SETBACKS

The useable building envelope within each lot will depend on the setbacks imposed by the County Land Use Bylaw as well as the LNID and are summarized in the following table:

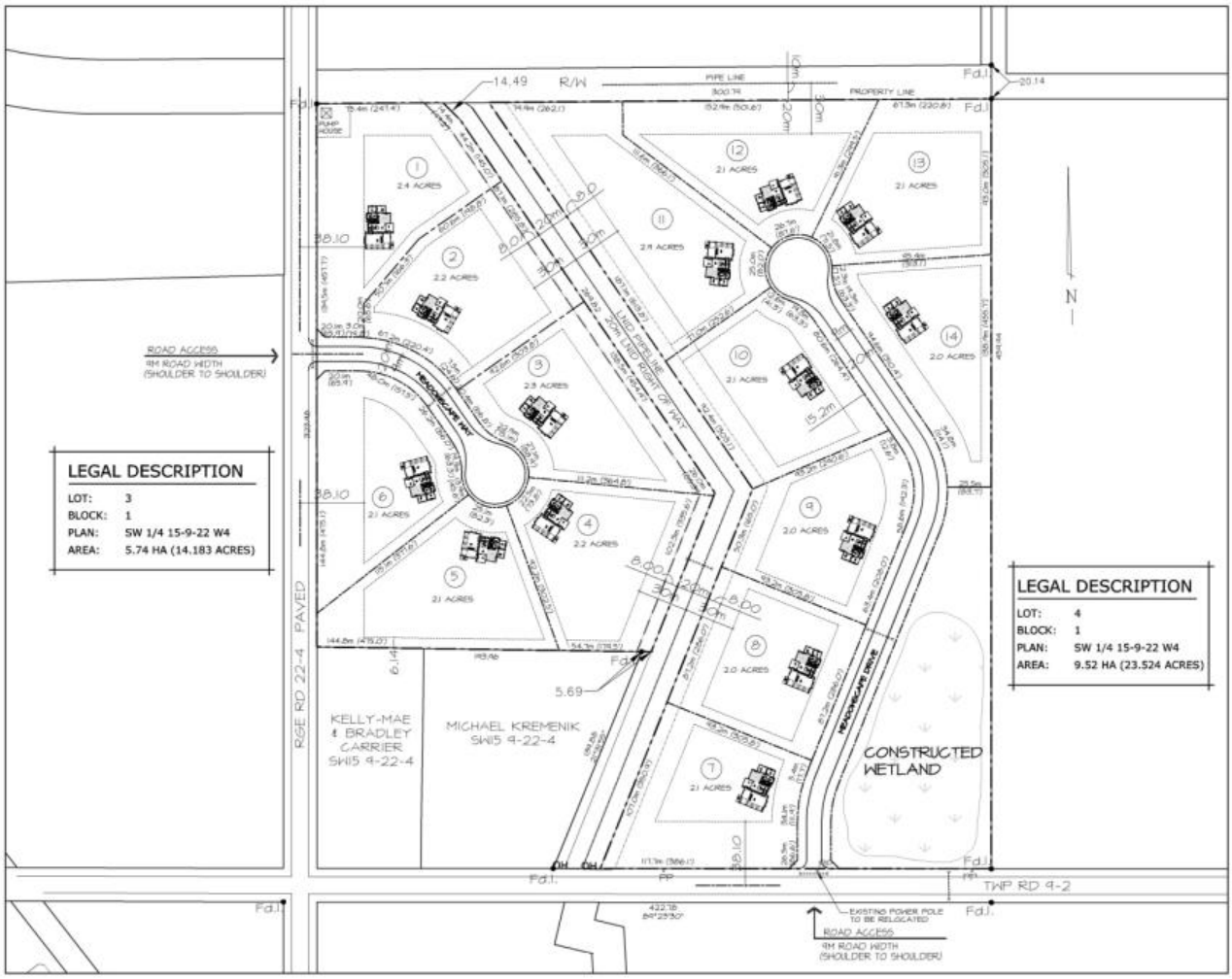


Figure 6.0 – Subdivision Layout

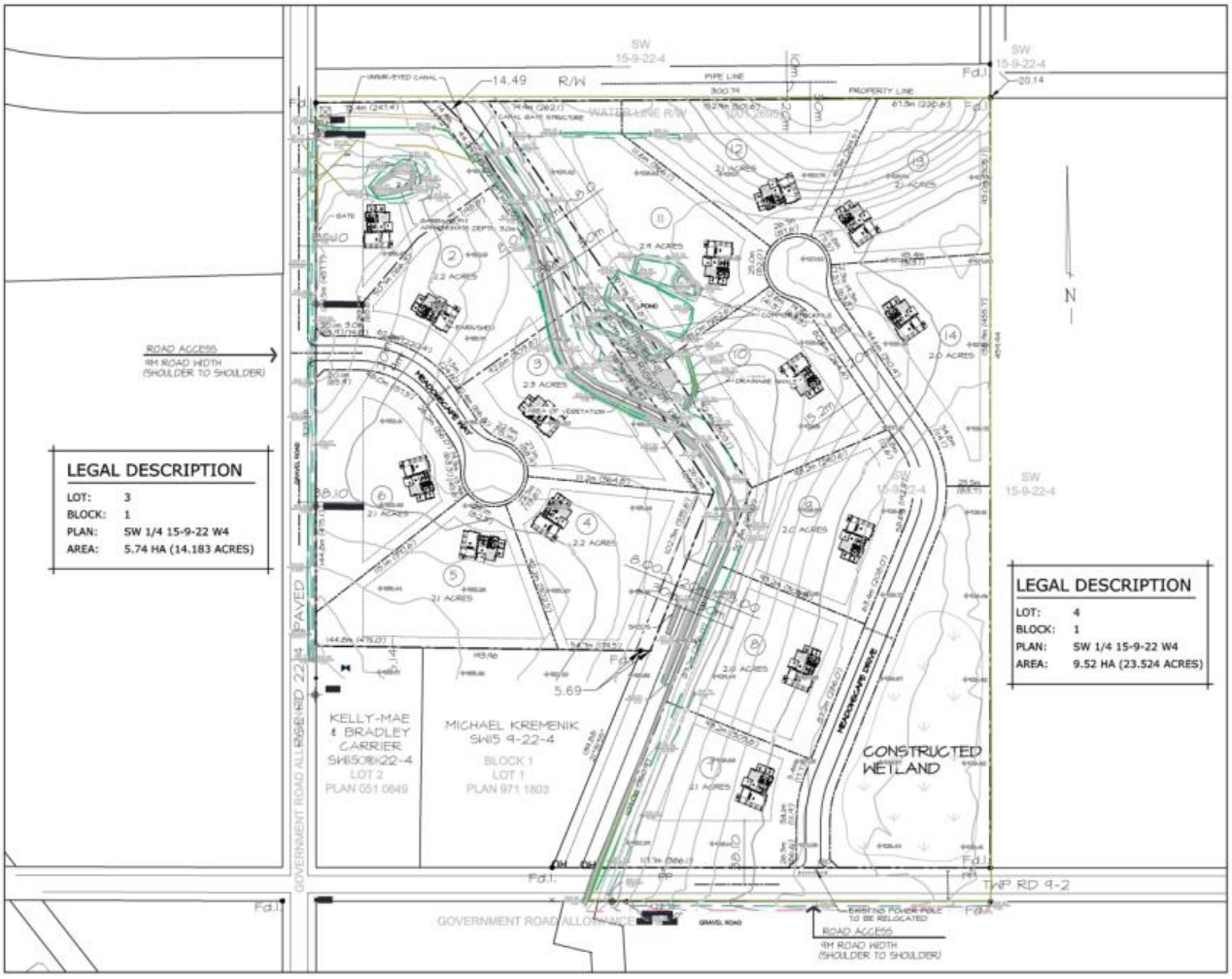


Figure 6.0 a – Subdivision Layout with Contours

Criteria	County Land Use Bylaw
Building setback from centreline of a rural road	38.1 m (125 ft)
Side yard setback	6.1 m (20 ft)
Minimum lot size	0.81 ha (2.0 acres)
Setback to LNID pipeline	30.0 m from centre line of pipe (98.4 ft)
Setback for fence from those lots banking onto LNID pipeline	8.0 m from LNID R/W boundary (26.2 ft)

Where Range Road 22-3 and Township Road 9-2 are considered rural roads, the building setbacks imposed by Schedule 6 of the Land Use Bylaw will govern the front and rear yards of the proposed lots 1, 6 and 7. The proposed front yard setback of the lots fronting the cul-de-sacs of Meadowscape Place and Meadowscape Way will be 15.2 m (50 ft). Side yard setbacks between proposed new lots as well as neighbouring adjacent parcels will be 6.1 m (20 ft). LNID has requested a building pocket setback of 30.0 m (98.4 ft) from the centre line of the new pipeline as well as an access easement of 8.0 m (26.2 ft) from the boundary of the LNID R/W. Homeowners will be required to build a fence at this location. A temporary fence will be constructed by the developer at this location to prevent any equipment from entering the LNID right of way. See **Figure 6.0 – Subdivision Layout**.

Shallow utility easements will be registered against the property to protect these installations. No building development will be permitted to occur on these easements. A perimeter irrigation system is also planned for the development to allow for watering of landscaping. A pump facility will be installed at the north west corner of the property to draw water out of the LNID canal. This system will also be protected by an easement. See F**igure 7.0 – Servicing Plan**.

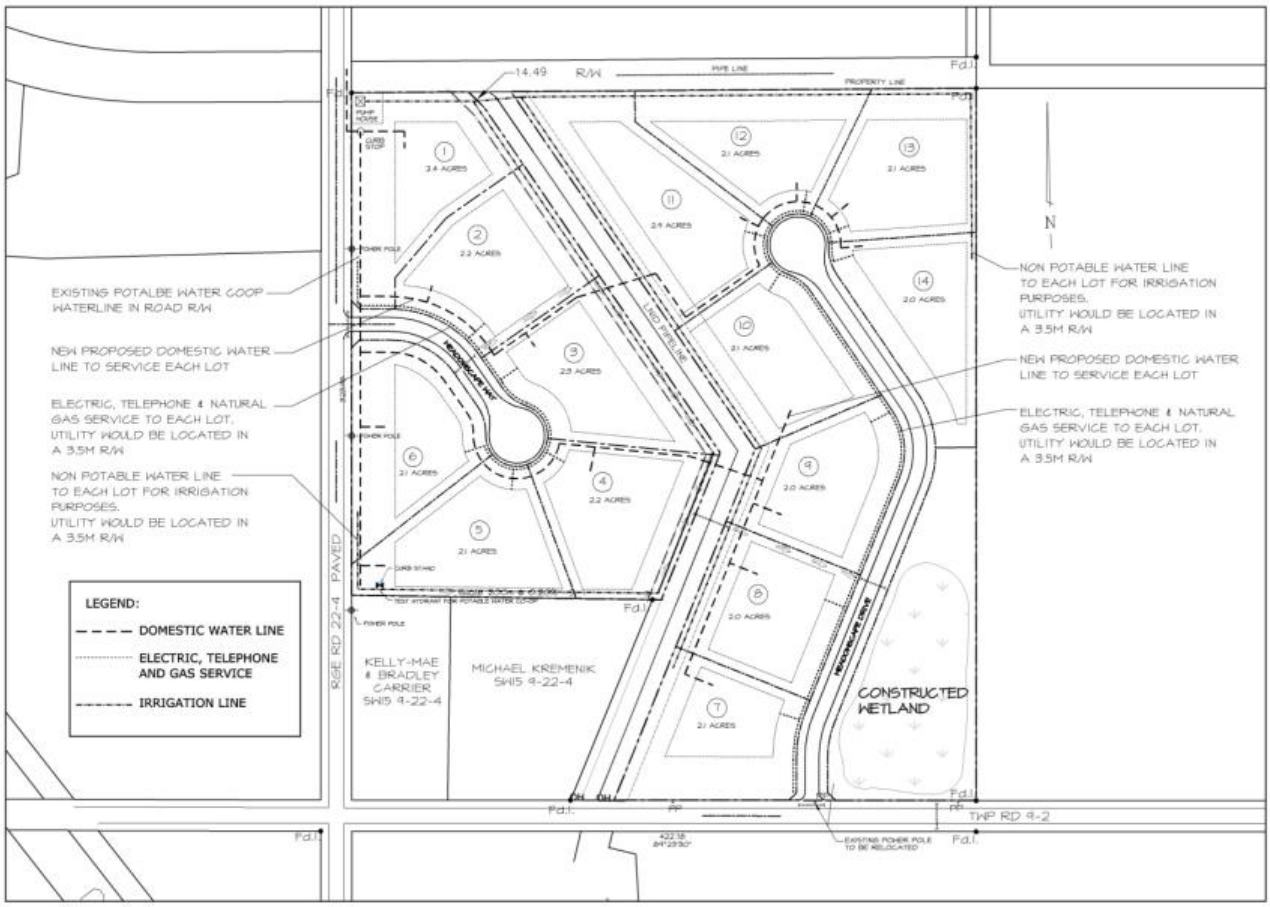


Figure 7.0 – Servicing Plan

June 15, 2017

To Whom It May Concern,

Mr. John Davis has indicted to the LNCPWC that in his subdivision application for Meadowscape Properties Ltd. In SW ¼ 15 9 22 W4M with Lethbridge County he requires assurance that the LNCPWC co-op has the means and capacity to provide water to this subdivision.

Based on the need of 14 units of water (2160 litres per day per lot) the LNCPWC can assure both Mr. Davis and Lethbridge County that our water distribution system can handle this addition volume.

The LNCPWC will not require a deposit on said water units at this time and will only request these deposits upon approval of the subdivision. In the interim the 14 units will be set aside pending that approval.

Operations Manager

Martin Nordstrom
403-380-6918

Figure 7.0a – LNCPWC Letter

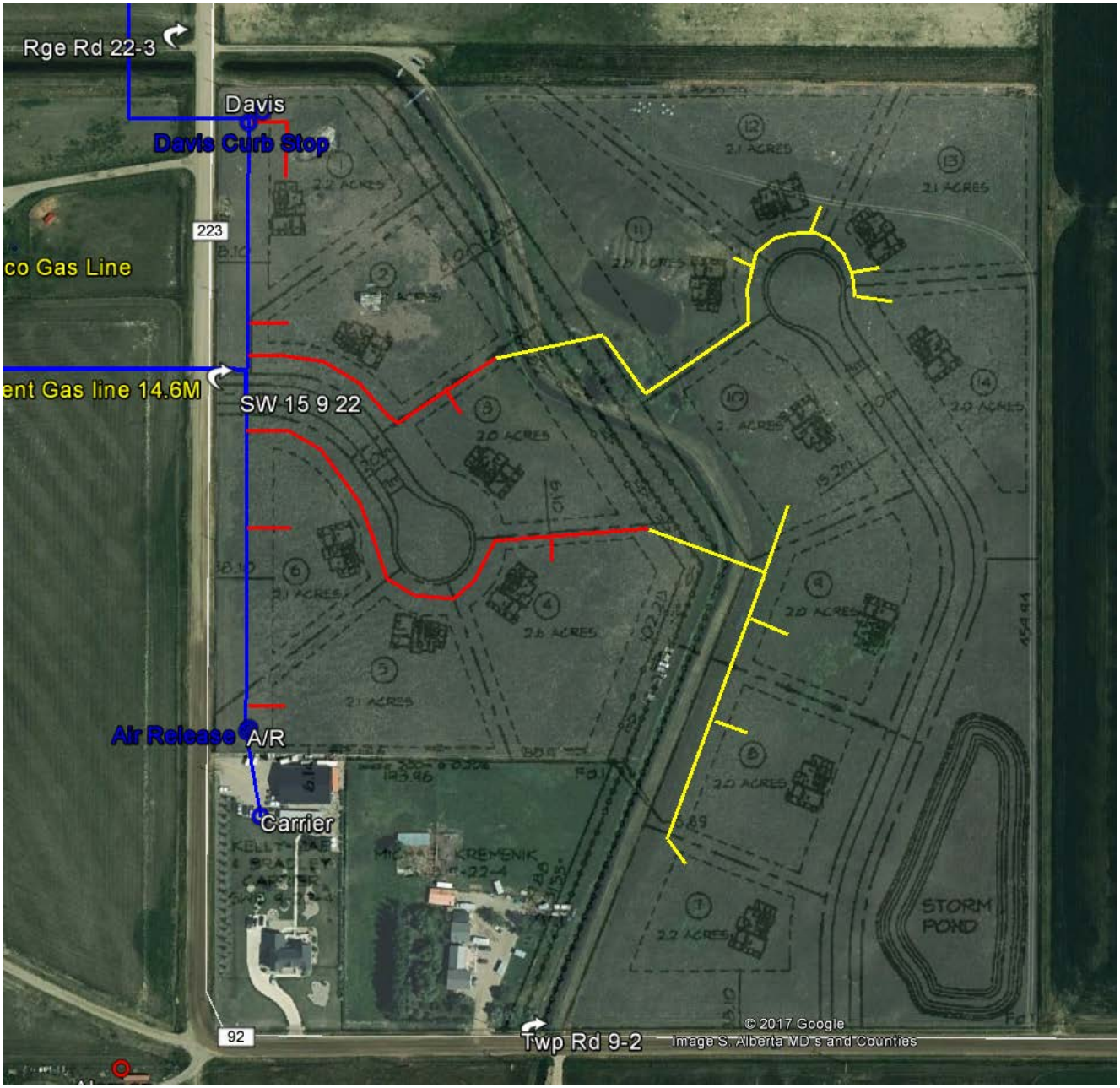


Figure 7.0b – LNCPWC Servicing Plan

4.4 ENVIRONMENTAL/MUNICIPAL/SCHOOL RESERVES

Environmental and school reserves have not been provided within the site. It is proposed that a cash dedication be provided to cover any requirement for municipal reserves of land. (This was addressed in the subdivision approval 2015-0-088).

4.5 ARCHITECTURAL CONTROLS

Architectural Controls have been drafted and will be registered against the lots by way of a caveat. The proposed controls are basic and provide a framework for guiding the lot owner in developing their site. The controls will address minimum house size, basic massing of structures, colour control, and out buildings as well as landscape standards. See **Appendix C – Draft Architectural Controls.**

The developer's designated Architectural Controls consultant will govern the controls at the onset of the building out of the sites. A Home Owners Association (HOA) will be established once the majority of the sites are occupied. The HOA will enforce the Architectural Controls once the homes are all complete.

The Architectural Controls will also address conditions applied to the development by the Land Use Bylaw, this Area Structure Plan as well as the Geotechnical Report. See **Appendix B – Geotechnical Investigation.**

4.6 DESIGN POPULATION AND DENSITY

For the purpose of this Area Structure Plan, the development population has been estimated using an assumed population of 3 persons per household (pph) and a total of 14 new lots. Therefore, the ultimate population for the development is:

14 lots x 3 pph = 42 persons

The overall population density is calculated by:

42 persons/15.26 = 2.75 persons per ha

4.7 PHASING

This development will be serviced and built out as two phases. Phase one – lots 1-6, phase two – lots 7-14. All improvements will be constructed and installed in a timely fashion should approval for this ASP be granted.

5 PROPOSED INFRASTRUCTURE

5.1 TRANSPORTATION

The developer is proposing that lots 1-6 be serviced via a new paved road with access off of RR 22-3. RR 22-3 was widened and upgraded to a paved road in the summer of 2016. A new approach for the access road will be constructed to meet Lethbridge County criteria. Lots 7-14 are proposed to be accessed by a similar cul-de-sac connected to Township Road 9-2 which is currently being upgraded to match RR 22-3. Culverts will be sized to meet County standards to ensure proper drainage along each side of the road. See **Figure 8.0 – Road Design.**

5.1.1 Traffic Generation

A traffic impact assessment has not been undertaken for the site since the low density of residential units will result in negligible traffic volumes. The roadway entrances into the subdivision have 300 metres of separation from the intersection of the Township Road 9-2 and Range Road 22-3. The detailed design plans for the intersections will be submitted to Alberta Transportation for their review should this ASP be adopted. Stop signs will be installed on the subdivision roadways.

5.1.2 School Bus Routes

Access for school buses is provided by Range Road 22-3 and Township Road 9-2. Palliser School Division will determine whether it will enter the cul-de-sacs to pick up students or if the children will walk to a common point at the entrance of the development. This assessment will take place once it is determined how many children will be resident at Meadowscape.

5.1.3 Parking

It is proposed that all parking requirements as per the Land Use Bylaw will be satisfied on the lots.

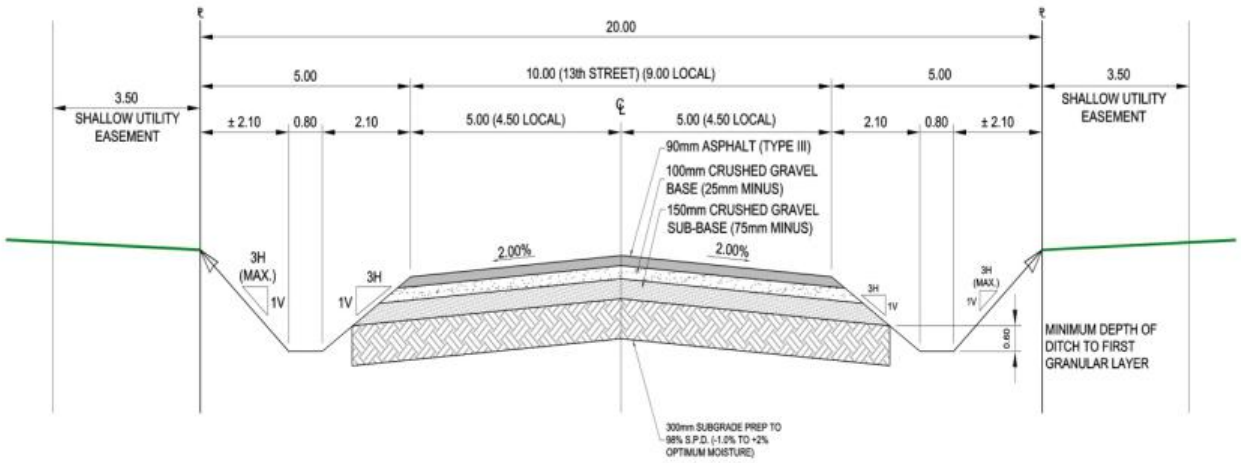
5.2 MUNICIPAL SERVICING

5.2.1 Potable Water Supply

Potable water will be supplied through the Lethbridge North County Potable Water Co-op and will be independently delivered to a cistern on each lot. The pipeline is currently constructed within the west boundary

of the lands. Each lot owner will be responsible to install a cistern complete with a pressure pump and emitter valve assembly in accordance with the Co-op's requirements. The Developer has made a deposit to the Co-op for fourteen (14) shares, which will be transferred to the lot purchasers. See **Figure 7.0a and 7.0b – Co-op Plan.**

The developer will pay to have curb stops installed to each lot as part of the Development Agreement and prior to any development on the lots.



1 TYPICAL GRADING SECTION AND PAVEMENT STRUCTURE THRU ROADWAY
SCALE NTS

ROADWAYS

90mm ASPHALT TYPE III
100mm OF 20mm MINUS CRUSHED GRAVEL BASE
150mm OF 75mm MINUS CRUSHED GRAVEL SUB-BASE
300mm SUBGRADE PREP TO 98% S.P.D. 0% TO +2% OPTIMUM MOISTURE

MINIMUM DEPTH FROM BOTTOM OF DITCH TO BOTTOM OF FIRST GRANULAR LAYER TO BE MINIMUM 0.60m

DRIVEWAYS

75mm ASPHALT TYPE III
± 150mm OF 20mm MINUS CRUSHED GRAVEL BASE
300mm SUBGRADE PREP TO 98% S.P.D. 0% TO +2.0% OPTIMUM MOISTURE

Figure 8.0 – Road Design

5.2.2 Non-Potable Water

Non-Potable water for the purposes of irrigation will be provided to each lot via a shallow water line. This line will follow the back of the lots and be protected by an easement registered in the name of the Home Owner's Association for maintenance purposes. See **Figure 7.0 – Servicing Plan.** Each lot owner will install their own pressure system and have access to the line in order to draw water for irrigation. A wet well will be installed in the north west corner of the property adjacent to the LNID canal to supply the irrigation line. The operation and winterization of this distribution system will be part of the Home Owners' Association's responsibilities. The Association will enter into a water conveyance agreement with the LNID for access to irrigation water. See letter in **Appendix D.** (It is noted that the County will not accept responsibility for operation or maintenance of the non-potable water system.)

5.2.3 Fire Protection

In the event of a fire, emergency responders would be dispatched from the most available detachments by the emergency services personnel at 911. Water for fire fighting would be transported to the site by the responding detachment.

5.2.4 Domestic Wastewater

Domestic wastewater will be managed by means of individual on-site wastewater treatment systems for each lot. The geotechnical investigation completed by Tetra Tech – EBA (attached as **Appendix B – Geotechnical Investigation**) and the report by Osprey Engineering Ltd. (attached as **Appendix E – Private Sewage Treatment System Feasibility**) confirms the feasibility of individual on-site wastewater treatment systems and provides general recommendations for their design and construction. Lot purchasers will be responsible for the installation of on-site wastewater treatment systems in accordance with the Alberta Private Sewage Systems Standard of Practice (2016).

5.2.5 Storm Water Drainage

Meadowscape sits in a 60.0 ha catchment which is generally bordered as follows:

- To the north and east by series of ridges which extend to approximately the north south quarter line of Section 15-9-22-4
- To the south by the CPR
- To the west by the LNID canal See **Figure 8.1**

The 9.0-ha area north of Township Road 9-2 and east of Range Road 22-3 is presently a tributary to the LNID canal. However, the canal from the undercrossing of Range Road 22-3 to the undercrossing of Township Road 9-2 is to be buried in a pipeline. As such, this area is included in the catchment to the east.

The catchment drains to a large low area which extends into the southeast corner of the Meadowscape parcel. This depression can overflow to the northeast above elevation 927.0 m Alberta Geodetic Datum (AGD). Runoff from this area flows northeastward toward Highway 25. At Highway 25, runoff is captured by a coulee which is located at approximately the north boundary of Section 15-9-22-4. This coulee flows east and meets the Oldman River approximately 1.6 km further east.

Storm drainage for Meadowscape will generally consist of surface conveyances: swales, road ditches and culverts. Due to the proposed LNID pipeline (which will follow the alignment of the existing canal), surface drainage will be directed through undercrossings consisting of catch basins and short lengths of culvert. This means of conveyance will be to the satisfaction of the County. (LNID has requested an underdrain as opposed to a surface swale.) To address the anticipated increase in rate and volume due to the development of Meadowscape, the low area in the southeast corner will be enhanced to include a constructed wetland.

Osprey Engineering Inc. has performed a preliminary analysis of the drainage in and around Meadowscape using the Environmental Protection Agency – Storm Water Management Model (EPA-SWMM) computer model. The following briefly describes what was assumed:

- Drainage areas as shown on **Figure 8.2**
- Predevelopment imperviousness based on air photos
- Post development imperviousness assumes 1000 m^2 of hard surface per lot and paved roads as shown on the plans
- Soils in the area were assumed to be silty clay loam

- Water ponds in the southeast corner of Meadowscape and immediately east, spilling toward the north above elevation 927.0 m AGD. At spill this ponding covers approximately 17.3 ha and is a maximum of 0.5 m deep. This area is estimated to retain more than 55,000 m^3 [44.5 acre-feet] of runoff at spill
- Rainfall modeled were:
    - City of Lethbridge, 100-year, 24-hour design storm
    - Environment Canada hourly rainfall for Lethbridge County Airport for 1960-1995
    - Lethbridge Research Station hourly rainfall for April 2005 to October 2005

Figure 8.1 – Drainage Basin

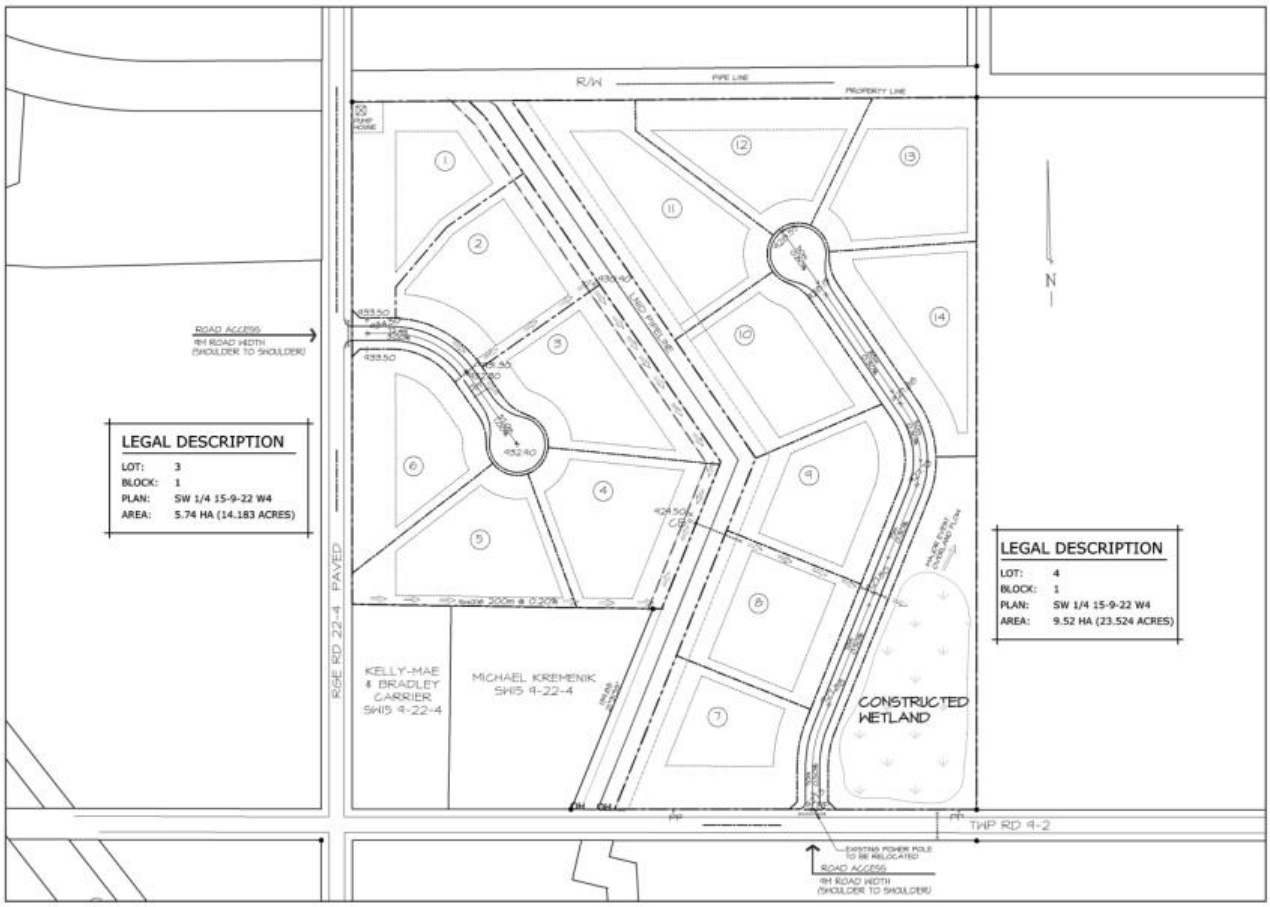


Figure 8.2 – Stormwater Management

Based on this, the following was ascertained:

- That runoff collecting in the depression does not overflow to the north in the events modeled
- For the existing (predevelopment) case:
    - That the ponded depth reaches a maximum depth of 0.32 m (water surface elevation 926.82) in September 2005. Total runoff for April to October 2005 was 55,300 m^3 or 92 mm
    - The 100-year design storm reaches a maximum depth of 0.31 m (water surface elevation 926.81). Total runoff was 25,900 m^3 or 43 mm
    - The peak depth reached for 1960-1995 was 0.40 m (water surface elevation 926.90). This was attained in 1978 during which annual runoff was 58,640 m^3 or 98 mm. Average annual runoff over 36 years of record was 10,600 m^3 or 18 mm
- For the post-development case:
    - That the ponded depth reaches a maximum depth of 0.33 m (water surface elevation 926.83) in September 2005. Total runoff for 2005 was 57,900 m^3 or 97 mm
    - The 100-year design storm reaches a maximum depth of 0.33 m (water surface elevation 926.83). Total runoff was 26,900 m^3 or 45 mm
    - The peak depth reached for 1960-1995 was 0.40 m (water surface elevation 926.90). This was attained in 1978 during which annual runoff was 59,970 m^3 or 100 mm. Average annual runoff over 36 years of record was 11,300 m^3 or 19 mm

Given the above, the most important storm drainage constraint is to ensure homes are situated on lots such that they are not prone to flooding. To accomplish this, the following recommendations will apply:

- All building foundation elevations at ground shall be greater than 927.9 m Alberta Geodetic Datum (AGD) (0.9 m above the overland spill elevation of the adjacent land)
- Ground where private sewage components are located shall be at elevation greater than 927.9 m AGD (0.9 m above the overland spill elevation of the adjacent land)

As the pond area is located in an area subject to runoff from adjacent land (i.e. near the low point of the large depression) and where no outflow is noted, controlling to a peak outflow is not possible. Moreover, the development does not have a large impact on the peak water levels attained in the depression (less than 0.02 m or ¾ inch). As such, the pond is proposed to hold the largest difference between predevelopment and post-development runoff noted in the modeling. This is 2,600 m^3 for 2005. This water will be used to allow for a steady water level in the constructed wetland proposed in the southeast corner of the site.

Water quality enhancement will be provided by the onsite vegetated ditches and by the constructed wetland. The wetland will also provide additional habitat birds and other species.

5.2.6 Sewage Treatment and Dispersal

No municipal or communal wastewater system is available or proposed to collect and treat wastewater from the Meadowscape area. As such, Private Sewage Treatment Systems (PSTS) are proposed for each lot. Preliminary soil investigation was completed by TetraTech EBA in February, 2016. Based on this soil assessment, Osprey Engineering Inc. provided additional analysis to estimate the type and size of the soil based treatment components for the lots west of the existing canal. Based on this analysis, the following general conclusions were made:

- PSTS consistent with the Alberta Private Sewage Systems Standard of Practice (Safety Codes Council 2015) are possible on each of the proposed lots
- Soil profiles found place limitations on system size and type of system
- All systems must have secondary treatment of wastewater using an appropriate packaged treatment plant due to fine textured soil and/or lack of vertical separation to restricting soil horizons. See **Appendix E**

Proposed lots to the east of the canal are assumed to have similar soil profiles and will be subject to similar limitations as those noted above. At subdivision stage, a similar study to what was completed for the west lots will be performed to confirm lot suitability and to provide guidance on system sizing and allowable soil loading rates.

5.3 PUBLIC UTILITIES

5.3.1 Electricity

Existing one-wire, single phase overhead power lines operated by Fortis Alberta are present along the south side of Range Road 22-3 and the north side of Township Road 9-2. See **Figure 9.0 - Existing FORTIS Facilities**. Preliminary discussions with Fortis have suggested that their infrastructure can support the proposed development and that they are receptive to the development proposal. Service would be provided to each lot by means of the addition of a pole-mounted transformer and underground secondary wires. Details for the lot services will be confirmed following approval of the Area Structure Plan.

5.3.2 Gas

ATCO Gas has advised that there is an existing distribution line along the east side of Range Road 22-3 and the north side of Township Road 9-2. See **Figure 10.0 – ATCO Infrastructure**. Preliminary discussions with ATCO have confirmed that their infrastructure can support the development. Details regarding the extension of natural gas distribution infrastructure will be confirmed following approval of the Area Structure Plan.

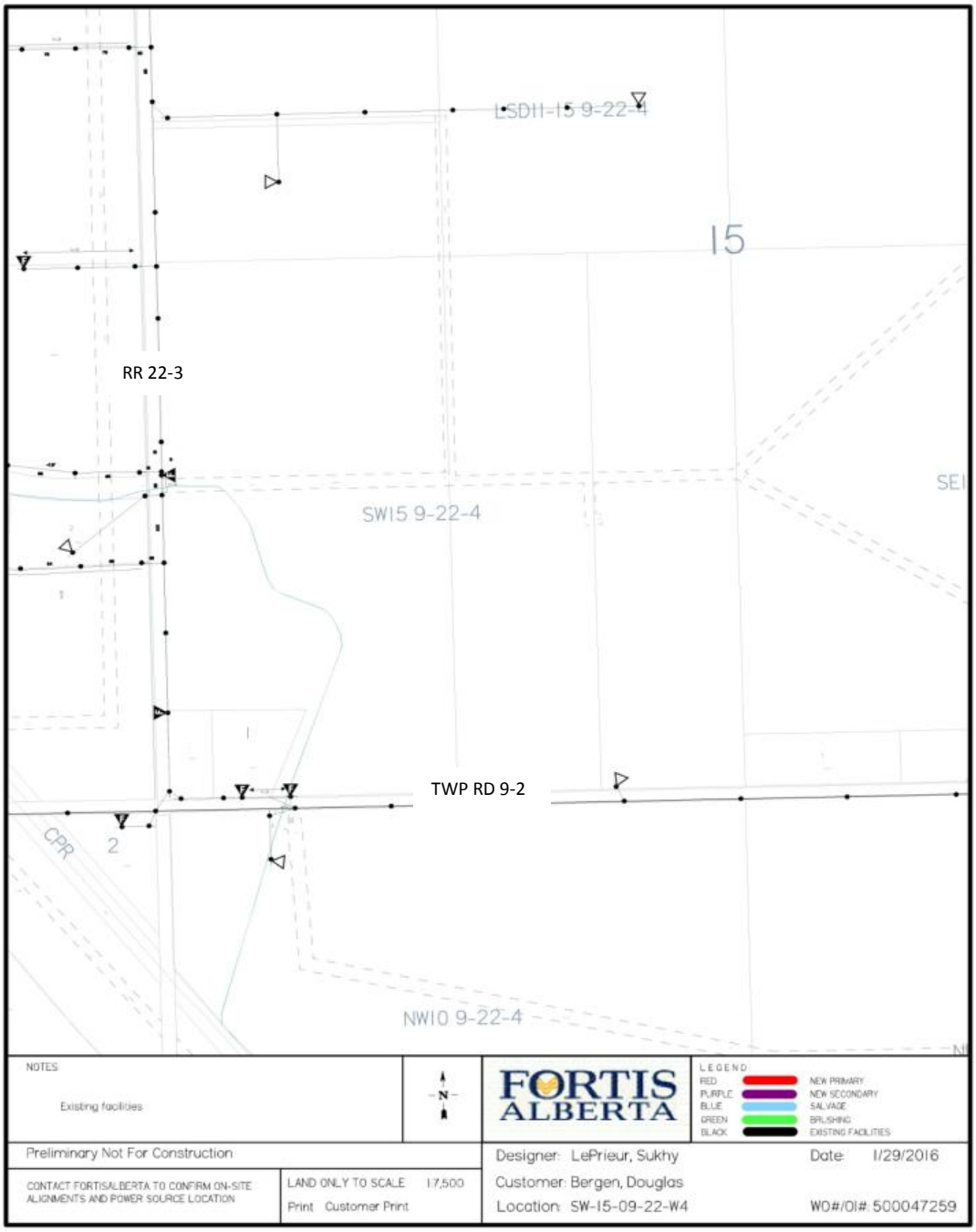


Figure 9.0 – Existing FORTIS Facilities

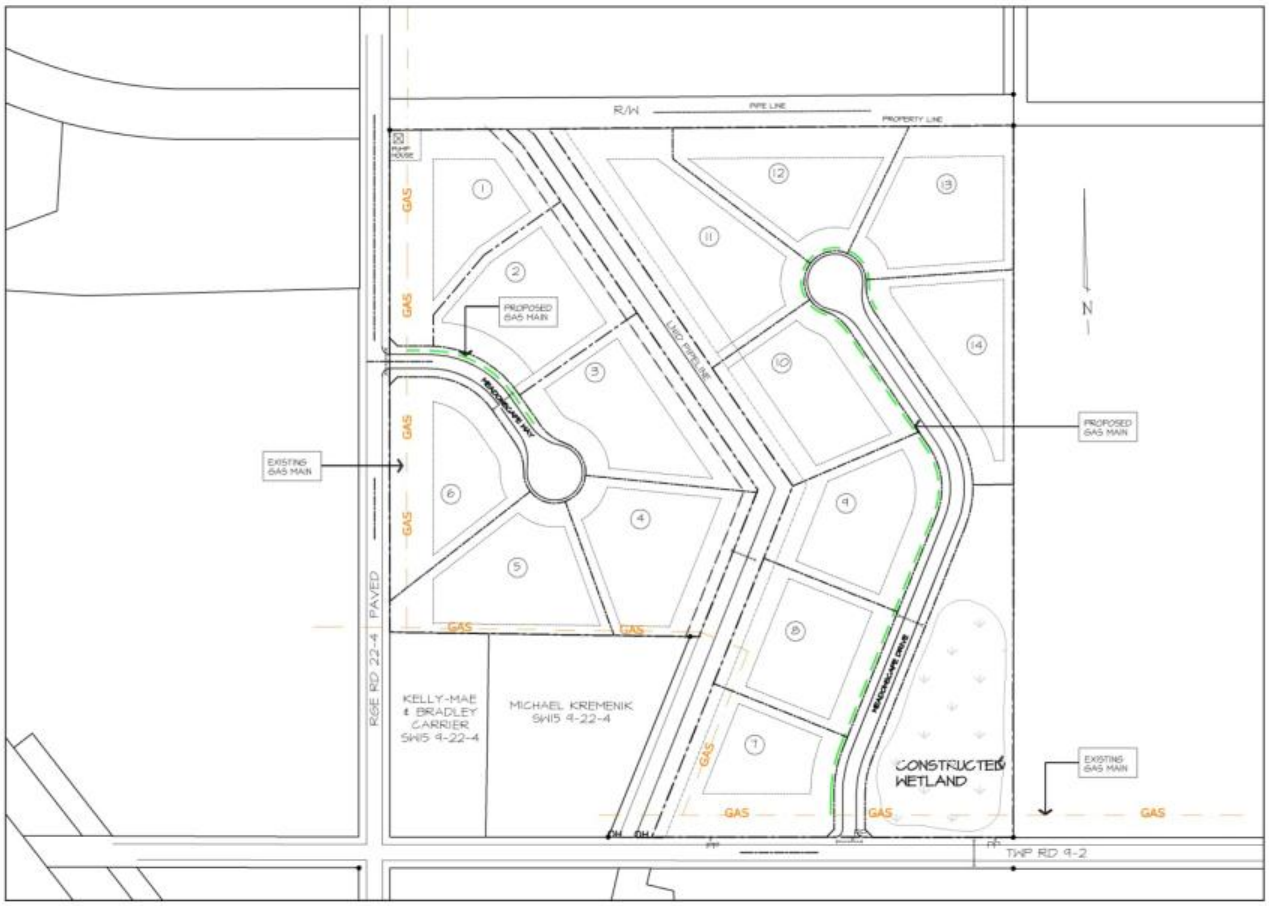


Figure 10.0 – ATCO Infrastructure

5.3.3 Telecommunication

Telus has advised that they have existing infrastructure along Range Road 22-3. Preliminary discussions with Telus have suggested that their existing facilities can support the proposed development. Details for extension of their infrastructure will be confirmed following approval of the Area Structure Plan.

Shaw Cable has advised that they do not have existing infrastructure in the area immediately surrounding the site. Shaw has provided a preliminary estimate of the cost to extend their infrastructure to the site which is prohibitive. Shaw cable will therefore not be provided to the development.

Wireless communications services are also available in the area.

5.4 PROTECTIVE SERVICES

Emergency and protective services in the area of the Development are provided by the Lethbridge County Emergency Services Department in partnership with the City of Lethbridge Emergency Dispatch Centre and emergency services agencies within the County through emergency services agreements. The development will be served by the provincial 911 system.

5.4.1 Fire

Response to fire emergencies would be dispatched by the City of Lethbridge Emergency Dispatch Centre through the 911 system. The site is located within the Coalhurst Rural Emergency Service Zone (ESZ) of the County and therefore the Coalhurst Fire Department will respond to emergency calls.

5.4.2 Police

Police service in the area of the development is provided by the Royal Canadian Mounted Police (RCMP) from the Lethbridge Detachment. Response to emergencies would be dispatched through the 911 system.

5.4.3 Ambulance

Emergency medical transport services in the area of the development are operated by Alberta Health services and would be dispatched through the 911 system. Ambulance services base stations are located in the City of Lethbridge, Picture Butte and Coaldale.

5.5 OTHER SERVICES

5.5.1 Solid Waste

Lot owners will be responsible for solid waste collection. The Lethbridge County operates solid waste transfer stations located in Picture Butte and Nobleford. Lot owners also have the option to transport waste to the Lethbridge Regional Landfill. Alternatively, lot owners may contract with a private waste collection company for solid waste removal and disposal.

5.5.2 Mail Service

Application will be made to Canada Post for postal service to the new lots following approval of the Area Structure Plan.

6 CONCLUSION

This Area Structure Plan has been prepared and submitted to support the reclassification of the subject lands from Lethbridge Urban Fringe (LUF) to Grouped Country Residential (GCR) by way of an application for amendment of the Lethbridge County Land Use Bylaw. The proposed amendment would be supported by the formal adoption of this ASP by County Council. The proponents believe this proposal establishes the highest and best use of the property as 14 residential lots since a productive farming operation is not viable on the property.

This document has been drafted and assembled in consultation with local authorities as well as experts in the area of civil and geotechnical engineering. The ASP outlines the result of considerable consultation with the many stakeholders and we trust provides the Lethbridge County with the information required to consider a request for reclassification of the lands.

APPENDIX A

Property Ownership

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0027 188 879	4;22;9;15;;4,5	151 119 596

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 22 TOWNSHIP 9
SECTION 15
FIRSTLY:
LEGAL SUBDIVISION 4
CONTAINING 16.2 HECTARES (40 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES (ACRES) MORE OR LESS
SUBDIVISION	9711803	2.20 5.44

EXCEPTING THEREOUT ALL MINES AND MINERALS AND
THE RIGHT TO WORK THE SAME
SECONDLY:
THE SOUTH 190 FEET OF LEGAL SUBDIVISION 5
CONTAINING 2.33 HECTARES (5.76 ACRES) MORE OR LESS
EXCEPTING THEREOUT ALL MINES AND MINERALS
AND THE RIGHT TO WORK THE SAME

ESTATE: FEE SIMPLE

MUNICIPALITY: LETHBRIDGE COUNTY

REFERENCE NUMBER: 971 282 639 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
151 119 596	12/05/2015	TRANSFER OF LAND	$550,000	$550,000

OWNERS

JOHN MAXWELL DAVIS
OF 60 HERITAGE POINT WEST
LETHBRIDGE
ALBERTA T1K 7B7

(CONTINUED)

ENCUMBRANCES, LIENS & INTERESTS

PAGE 2
151 119 596

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
7217DP .	08/05/1933	RESTRICTIVE COVENANT "LSD 5"
5903EK .	31/05/1933	CAVEAT RE : EASEMENT CAVEATOR - BOARD OF TRUSTEES OF THE LETHBRIDGE NORTHERN IRRIGATION DISTRICT "LSD 5"
8420DP .	23/05/1935	RESTRICTIVE COVENANT "LSD 4"
7570EM .	13/06/1935	CAVEAT RE : EASEMENT CAVEATOR - THE BOARD OF TRUSTEES OF THE LETHBRIDGE NORTHERN IRRIGATION DISTRICT "LSD 4"
741 091 031	27/09/1974	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE LETHBRIDGE NORTHERN IRRIGATION DISTRICT
151 218 993	26/08/2015	UTILITY RIGHT OF WAY GRANTEE - LETHBRIDGE NORTH COUNTY POTABLE WATER CO-OP LTD.
151 239 582	16/09/2015	UTILITY RIGHT OF WAY GRANTEE - ATCO GAS AND PIPELINES LTD.

TOTAL INSTRUMENTS: 007

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 3 DAY OF JUNE, 2016 AT 10:43 A.M.

ORDER NUMBER: 30790817

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

(CONTINUED)

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APPENDIX B

Geotechnical Investigation

TETRA TECH EBA

Geotechnical Evaluation
Meadowscapes Country Residential Subdivision
Coalhurst, Alberta

PRESENTED TO
Caliber Landscaping Ltd.

JUNE 2016
ISSUED FOR USE
FILE: ENG.LGEO03039-01

CONSULTING ENGINEERS & SCIENTISTS · www.eba.ca

Tetra Tech EBA Inc.
442 - 10 Street N.
Lethbridge, AB T1H 2C7 CANADA
Tel 403.329.9009 Fax 403.328.8817

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Caliber Landscaping Ltd., and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) 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 Caliber Landscaping Ltd., 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 report is subject to the terms and conditions stated in the Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

This report presents the results of a geotechnical evaluation conducted by Tetra Tech EBA Inc. (Tetra Tech EBA) for the proposed Meadowscapes Subdivision project to be located in Coalhurst, Alberta. The legal description of site address is SW1/4 15-9-22 W4.

The scope of work for this evaluation was outlined in a proposal issued to Mr. Henry Bakker, of Caliber Landscaping Ltd. (Caliber), on December 3, 2015. The objective of this work was to determine the general subsurface conditions in the area of the proposed development and to develop recommendations for the geotechnical aspects of design and construction for the project.

A preliminary septic disposal field feasibility assessment has been conducted by Tetra Tech EBA for this development and was issued under separated cover on February 18, 2016.

Authorization to proceed with the evaluation was provided by Mr. Bakker through a signed Services Agreement on December 24, 2015.

2.0 PROJECT DETAILS AND SCOPE OF WORK

Based on the information provided by Caliber, it is understood that two lots (Lot 3 and Lot 4, Block 1) within the Meadowscapes Country Residential Subdivision are planned to be subdivided into residential parcels. Lot 3 is approximately 5.74 ha., is located on the west half of the quarter section and will be subdivided into six residential parcels as indicated in Figure 1. Lot 4 is on the east half of the quarter section and delineated by the Lethbridge Norther Irrigation District (LNID) canal, and is approximately 9.52 ha. Lot 4 has no definitive development plans at this time and its development feasibility will be determined upon this evaluation results.

The scope of work comprised the completion of fieldwork including drilling of eight (8) geotechnical boreholes, a laboratory program to assist in classification of the subsurface soils, and a report providing the following design and construction recommendations:

- Recommended design parameters for shallow foundations and below-grade structures.
- Recommendations for design and installation of slabs-on-grade.
- Recommendations for volumetric changes of soil due to changes in moisture content and/or frost.
- Recommendations for special considerations if fill is encountered.
- Classification of site for seismic design purposes according to Table 4.1.8.4A of the Alberta Building Code 2014.
- Recommendations for subgrade preparation, backfill materials, and compaction.
- Recommendations for site grading.
- Recommended construction provisions for control of groundwater.
- Recommendations for concrete type in contact with soils.
- Recommendations for pavements.

3.0 GEOTECHNICAL FIELD AND LABORATORY WORK

The fieldwork for this evaluation was carried out on May 3, 2016 using a truck-mounted drill rig contracted from Chilako Drilling Services Ltd. of Coaldale, Alberta. The rig was equipped with 150 mm diameter solid stem continuous flight augers. Tetra Tech EBA's field representative was Mr. Stuart Smith.

Eight (8) boreholes (referenced as 16BH001 through 16BH008) were drilled across the site to depths of 6.6 m below the ground surface. The approximate borehole locations are shown on Figure 1.

From the boreholes, disturbed grab samples were obtained at approximate 600 mm intervals. In addition, Standard Penetration Tests (SPT) were generally performed at depth 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 PVC standpipes were installed in the boreholes to monitor groundwater levels. Auger cuttings were backfilled around the standpipes and they were sealed at ground surface with bentonite chips.

The boreholes were laid out with locations measured by Tetra Tech EBA. The geodetic ground elevations at the borehole locations were interpreted from the contour data provided by Douglas J. Bergen & Associated Ltd. and are shown on the borehole logs.

Classification tests, including natural moisture content, Atterberg Limits, and soluble sulphate content were performed in a 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.

4.0 SITE AND SUBSURFACE CONDITIONS

4.1 Site Description

The proposed development is located at the northwest corner of the intersection of Range Road 223 and Township Road 92. The property is bounded by farmlands to the north and east and two developed residential lots occupy the southwest corner of the quarter section. The site was vegetated with grass at the time of field drilling.

A LNID tributary canal runs from south to north through the site separating the proposed Lot 3 and Lot 4. Lot 3 is on the west side of the canal, gently sloping (approximately less than 2%) northeastward to the canal. A garbage pit and a barn shed were located on the north end of Lot 3.

Lot 4 is on the east side of the canal, with most areas lower than the berm elevation of the canal. The topography of Lot 4 is generally sloping towards the east except for the northeast area which is a local high spot with slope towards the south and west. A pond and an earth stockpile were noted in the north central part of the quarter section north of 16BH004. The area around the stockpile and the canal and drainage swale are relatively low with ponded water and dense vegetation.

In accordance with the contour data, the pond has an interior toe elevation of approximately 928.59 m which is 1.0 m lower than the interior toe elevations of the canal. It is likely that the pond is being recharged by leakage from the canal.

4.2 Subsurface Conditions

It should be noted that geological conditions are innately variable. At the time of preparation of this report, information on subsurface stratigraphy was available only at discrete borehole locations. In order to develop recommendations from this information, it is necessary to make some assumptions concerning conditions other than at borehole locations. Adequate field reviews should be provided during construction to check that these assumptions are reasonable.

The general subsurface stratigraphy for the property comprised surficial topsoil (less than 300 mm thick) overlying native clay and clay till. The following sections provide a summary of the stratigraphic units encountered at the specific borehole locations. A more detailed description is provided on the borehole logs provided in Appendix B.

4.2.1 Clay

Underlying the topsoil, clay was encountered at the borehole locations, extending to depths of between 1.8 m and the maximum termination depth of 6.6 m. The clay was generally described as silty, trace sand to sandy, damp to wet, firm to very stiff, low to high plastic, and brown. The clay encounter below 1.5 m in 16BH007 was wet and soft. Moisture contents of clay samples widely ranged between 11% and 16% in most boreholes within Lot 3 (16BH001, 16BH003, 16BH005, and the upper portion of 16BH002) and between 22% and 28% in boreholes within Lot 4 (16BH006, 16BH007, and 16BH008) and the areas adjacent to the canal (16BH004 and the lower portion of 16BH002). Atterberg Limits testing (two tests) indicated Plastic Limits ranging between 12% and 16%; and Liquid Limits between 39% and 61%; indicative of medium to high plasticity.

SPT "N" values ranged between 2 and 24 blows per 300 mm of penetration, indicative of variable consistency ranging between firm and very stiff.

4.2.2 Clay Till

Beneath the clay, glacial clay till was encountered and extended to borehole termination depth. The clay till was described as silty, some sand, trace gravel (occasional some gravel), moist to very moist, firm to very stiff, medium plastic, and brown with coal and oxide specks. Occasional silt and sand pockets, and high plastic clay inclusions were also encountered within the clay till. Moisture contents of clay till samples ranged between 11% and 23%. Atterberg Limits testing indicated a Plastic Limit of 14% and a Liquid Limit of 43%, indicative of medium plasticity.

SPT "N" values ranged between 7 and 20 blows per 300 mm of penetration, indicative of firm to very stiff consistency.

4.3 Groundwater Conditions

At the time of drilling, no seepage or sloughing was encountered at the borehole locations. The groundwater levels were measured on May 9, 2016.

Table A: Groundwater Monitoring Data – May 9,2016

Borehole Number	Depth of Standpipe (m)	Geodetic Borehole Elevation of Ground Surface (m)	Depth to Groundwater (m)	Relative Elevation of Groundwater (m)
16BH001	6.6	933.90	Dry	-
16BH002	6.6	932.50	Dry	-
16BH003	6.6	932.60	Dry	-

Table A: Groundwater Monitoring Data – May 9,2016

Borehole Number	Depth of Standpipe (m)	Geodetic Borehole Elevation of Ground Surface (m)	Depth to Groundwater (m)	Relative Elevation of Groundwater (m)
16BH004	6.6	931.20	4.60	926.60
16BH005	6.6	932.70	Dry	-
16BH006	6.6	926.70	1.93	924.77
16BH007	6.6	927.30	2.08	925.22
16BH008	6.6	927.70	5.91	921.79

The local groundwater levels represent perched groundwater within sand or silt lenses within the clay and clay till deposits. Perched groundwater normally fluctuates seasonally and in response to climatic conditions. Further comments regarding groundwater issues are provided in subsequent sections.

Based on the borehole locations and the groundwater and soil moisture conditions, it was noted that most areas of Lot 3 were higher than the canal in elevations and generally in dry conditions. The areas adjacent to the canal and most areas of Lot 4 lower than the canal elevations have relatively shallow groundwater tables and high moisture conditions, which appears to be caused by leakage migration from the canal due to the proximity and low elevations.

5.0 GEOTECHNICAL RECOMMENDATIONS

5.1 General

Specific recommendations that apply to this project are provided for general site development and lot grading, trench excavation and backfill, backfill materials and compaction, roadway subgrade preparation, shallow foundations, grade-supported floor slabs, below-grade construction, and concrete types.

Subgrade preparation is required in all lots as well as all paved areas. This includes stripping of topsoil and unsuitable soils (if encountered), scarification, moisture conditioning, and compaction. Wet and soft soils should be expected in some areas during the site grading (e.g., low areas with ponded water along the canal, the existing pond, and the area adjacent to 16BH007) and should be removed to foundation influence depths if residential structures are to be constructed in these areas.

The on-site clay soils are considered suitable for site grading purposes. The soils appear to be variable in moisture conditions, and as such, moisture conditioning may be required to achieve the compaction standards recommended. Proof-rolling within roadways to detect soft areas is also recommended.

Shallow foundations (strip and spread footings) are generally expected for the residential structures. Footings should be placed in accordance with frost protection requirements for this area, and must rest on native soils only.

Investigation with insufficient boreholes drilled in Lot 4 was only for providing preliminary soil information and assessing the feasibility of the proposed subdivision development on this lot. Detailed geotechnical investigation should be conducted when the future development plan is determined. Recommendations for shallow foundations in this report is not applicable for the development of Lot 4.

Deep foundations, including bored cast-in-place concrete piles and helical piles, are considered technically feasible but not preferred to shallow foundations due to the cost. Recommendation of deep foundations are beyond the scope of work for this report.

Slabs-on-grade for this project should consider the precautions recommended, including the subgrade preparation measures intended to improve slab performance.

All foundation recommendations presented in this report are based on the assumption that an adequate level of monitoring 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:

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

All such monitoring should be carried out by suitably qualified persons, independent of the contractor. 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.

5.2 Lot Grading and Site Development

The lot grading should be designed and carried out to the current City of Lethbridge Design Standards, or equivalent.

Following organic topsoil stripping, all lots should be graded for drainage at a minimum gradient of 2.0%. The existing site soils, comprising clay and clay till are suitable for use as landscape fill materials or for use as general engineered fill materials for lot grading, provided they are acceptably moisture conditioned. The moisture content of the site soils generally appear to be variable with respect to the anticipated optimum moisture content (OMC) for these soils in most areas. Moisture conditioning will likely be required at the site for proper compaction. Although soil moisture variability should be expected, the earthwork contractor should assess the requirements and should consider such factors as weather and construction procedures.

General engineered cohesive fill materials for lot grading should be moisture conditioned to within a range of 0% to +2% of the OMC prior to compaction, and compacted to a minimum of 98% of Standard Proctor Density (SPD). Granular materials placed as "general engineered fill" should be compacted at slightly below (0% to +2%) the OMC.

Lot 3 is generally higher than the canal elevations with no large amount of site grading work to be expected in this area. It was noted that wet and weak soil conditions at shallow depths were encountered in 16BH004 and may be expected in other low areas close to the canal. It is recommended that residences not be located in the areas adjacent to the canal to avoid problematic development issues related to the weak soil conditions.

Due to the low elevations and contribution of the leakage from the canal over many decades, development of Lot 4 is considered problematic. Wet and weak soil conditions and shallow groundwater should be expected in most areas of Lot 4. A large amount of site grading work including removal of weak soils and replacement with general engineered fill may be expected in residential development areas. Imported fill materials may be needed to infill some low areas for site grading purpose. Fill materials due to site grading or weak soil conditions, if encountered at footing depths, may bring construction and serviceability issues to the residential development. Such factors should be considered for the site development and may affect the economically feasibility of the proposed development of Lot 4.

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

5.3 Excavations

Excavations should be carried out in accordance with Alberta Occupational Health and Safety Regulations. For this project it is understood that no underground utilities, including water lines, stormwater pipelines, and sewage pipelines, are to be installed. The majority of the excavations are likely associated with basement house excavation and are assumed to be less than 3.0 m below existing ground surface. 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 in damp to very moist moisture conditions are generally anticipated to be encountered within 3.0 m below grade during excavation. The soil conditions generally vary depending on proximity to the canal and elevation of the land relative to the canal. Soft to firm clay soils should be expected in Lot 4 and low areas adjacent to the canal, and firm to stiff clay soils should be expected in most areas of Lot 3. Short-term excavations (open for less than one month) within firm to stiff clay soils 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). In areas where soft to firm clay soils are encountered, a cutslope of 1.5H:1.0V or flatter should be considered.

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.

5.4 Backfill Materials

The existing site soils, comprising clay and clay till soils are considered suitable for use as 'landscape fill' and as 'general engineered fill' and 'select engineered fill' materials, as defined in Appendix C. All soils containing organic or deleterious materials should be stockpiled separately and are not suitable for use as general engineered fill.

It is noted that moisture conditioning will be required due to the variable moisture conditions of the subgrade soils encountered during the evaluation. In general, Lot 3 has relatively dry subgrade moisture conditions, where soil wetting is to be expected except in proximity to the canal. Lot 4 has relatively wet soil moisture conditions and soil drying would be expected. However, the earthwork 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.

5.5 Pavement Structures

5.5.1 Subgrade Preparation

Within all roadway areas, following stripping of topsoil, the exposed subgrade should be proof-rolled to assess the subgrade characteristics. Following the proof-roll, a minimum subgrade preparation depth of 300 mm is recommended in all areas in order to improve subgrade uniformity. Where softer soils are encountered, subgrade preparation up to 600 mm may be necessary. Subgrade preparation includes scarification, moisture conditioning to between OMC and +2% of OMC, and uniform compaction to a minimum of 98% of SPD.

Backfill to raise the subgrade level should be general engineered fill materials, as defined in Appendix C, moisture conditioned and compacted as noted previously. The subgrade should be prepared and graded to allow drainage into drainage ditches or catchbasins if available. Proof-rolling of the prepared surface is recommended to identify localized soft areas and for an indication of overall subgrade support characteristics.

It is imperative that positive surface drainage be provided to prevent ponding of water within the roadway 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.

5.6 Gravel Pavement

The following minimum gravel pavement structure using the above subgrade preparation procedures is recommended. Both gravel materials should be compacted to 100% of SPD.

- 100 mm of crushed gravel or base gravel (25 mm minus) over
- 200 mm of pit run gravel or sub-base gravel over prepared clay subgrade

It is imperative that positive surface drainage of gravel pavement be established to prevent ponding of water. Recommended minimum grades of 2% should be used in gravel surfaced areas. Surrounding landscaping should be such that runoff water is prevented from ponding beside gravelled areas.

5.6.1 Recommended Pavement Structures

The pavement structures presented below are not based on detailed design, and do not take into consideration site-specific traffic loading conditions; as such data was not available at the time of report preparation. The pavement structures are provided as a general guideline, and are not intended to have a specific design life, and are based on the assumption that good subgrade support can be achieved. In the absence of good traffic loading data, Tetra Tech EBA recommends the use of the following "Local" pavement structure taken from the City of Lethbridge 2014 Design Standards, for use in lightly loaded areas:

- Type III Asphalt Surfacing = 75 mm
- Granular Base Course = 200 mm
- Subgrade Preparation = 300 mm

The recommended pavement layer thicknesses generally refer to average values and recognize typical construction variability. As-constructed layer thicknesses should satisfy the thickness tolerances identified in the City of Lethbridge 2014 Design Standards (or equivalent) for granular materials and asphalt concrete.

5.7 Foundation Design

5.7.1 Limit States Design

The design parameters provided in the following sections may be utilized 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)

The following soil resistance factors (Table B) must be incorporated into the foundation design. These factors are considered to be in accordance with the 2006 Canadian Foundation Engineering Manual (CFEM), as well as the Alberta Building Code 2014.

Table B: Soil Resistance Factors – Shallow Foundations

Item	Soil Resistance Factor
Bearing resistance	0.5
Passive resistance	0.5
Horizontal resistance (sliding)	0.8

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. The lower of the factored ULS resistance or the unfactored SLS resistance should be used as the working capacity for foundation design purposes

5.7.2 Shallow Foundations

It is noted that recommendations in this section only apply to development in Lot 3. 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.

Where footings bear on native soils, the ultimate static bearing pressure may be taken as 250 kPa, subject to other recommendations in this report. The ultimate static bearing pressure is based on correlation between SPT "N" values. Factoring should be considered as noted in the previous section. Footing dimensions should be in accordance with the minimum requirements of the Alberta Building Code 2014.

As discussed in Section 5.2, due to the migration of leakage from the canal, wet and weak soil conditions and shallow groundwater should be expected at footing elevations in areas adjacent to the canal, which may bring construction difficulties and serviceability issues to the residential development. It is recommended that the residences be placed as close as possible to the front of the lot for this site to avoid or reduce the adverse impact by the leakage from the canal.

A weeping tile system is recommended for all residential foundations in order to aid in maintaining a consistent moisture profile. The weeping tile should consist of a perforated pipe surrounded by free draining granular material, wrapped in filter cloth. The pipe should have a consistent slope leading to a sump.

Bearing certification by a geotechnical engineer is recommended to ensure that the shallow foundations are placed on competent native soils. If weak soils are 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 native materials.

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.

Further recommendations regarding shallow foundations are given in Appendix C.

5.7.3 Frost Protection

For protection against frost action, perimeter footings in heated structures should be extended to such depths as to provide a minimum soil cover of 1.4 m. Isolated or exterior footings in unheated structures should have a minimum soil cover of 2.1 m unless provided with equivalent insulation.

Pipes buried with less than 2.1 m 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.

5.7.4 Seismic Design

The site classification recommended for Seismic Site Response is Classification D, as noted in Table 4.1.8.4.a of the Alberta Building Code 2014.

5.8 Floor Slab Systems

5.8.1 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, or if weathering is evident, 300 mm subgrade preparation is required. The minimum compaction in each case 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 replacement of the required general engineered fill). Should the exposed surface become saturated or disturbed, it should be reworked to achieve the above standards.

If the subgrade is properly prepared as noted above, floor slab movements should be limited to less than approximately 25 mm. Slabs-on-grade should be separated from bearing members to allow some differential movement. If this range of differential movement is unacceptable, the owner should consider a structurally supported floor.

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

5.8.2 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 structurally supported floor slab systems 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 structurally supported ground 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 soils.

5.8.3 Basement Floor Slabs

Slabs-on-grade construction for basements is considered feasible providing certain precautions are undertaken. All excavations should be carried out remotely using a smooth-mouth bucket or Grade-All at final grade in order to minimize disturbance of the base. Basement floor slabs should be supported by a minimum of 150 mm compacted, clean, free-draining granular material.

If partitions are constructed in the basement, provision must be made so that, if the basement floor slab heaves, the partitions do not raise the main floor. A minimum allowance of 25 mm should be left between the top plates of basement partitions and the floor above them to accommodate heaving of the floor slab.

5.9 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, and hydrostatic pressures will not be a factor in design. An acceptable weeping tile system should consist of a perforated weeping tile wrapped in a geosock or geotextile fabric, in turn surrounded with a minimum of 150 mm thick blanket of washed rock (maximum size 20 mm). 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.

5.10 Building Site Grading

Drainage of surface water away from buildings should be maintained during construction. The finished grade of proposed building sites should be designed so that surface water is drained away from buildings by the shortest route. All drains should discharge well clear of buildings. If there is a roof discharge from a building, 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 buildings. Landscaped surfaces adjacent to the walls of buildings should be graded to slope away from the building at a gradient of at least 5% within 2 m of the buildings' perimeter. General landscaped areas should have grades of no less than 2% to minimize ponding.

5.11 Concrete Types

Based on laboratory testing conducted on two samples collected from the boreholes as well as Tetra Tech EBA's experience on local soils, the properties of concrete for foundations in contact with soil or groundwater should meet the requirements of the Canadian Standards Association (CSA) A23.1-14, Class S-2 exposure [i.e., 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 have 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 MSb and/or Type HSb cements.

It is noted that the exposure classification of the concrete (i.e., Class S-2) typically governs. This stipulates the level of protection of the concrete, including the amount of cover to protect the reinforcing steel from corrosion.

6.0 DESIGN AND CONSTRUCTION GUIDELINES

General design and construction guidelines are provided in Appendix C, under the following supplemental headings:

- Shallow Foundations
- 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 EBA Inc.

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/tlp

PERMIT TO PRACTICE
TETRA TECH EBA INC.
Signature _____
Date JUNE 9, 2016
PERMIT NUMBER: P245
The Association of Professional Engineers and Geoscientists of Alberta

FIGURES

Figure 1 Borehole Location Plan

APPENDIX A
GEOTECHNICAL REPORT - GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA's Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

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

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods 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 EBA 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.

5.0 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.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of testholes and/or soil/rock exposures. Stratigraphy is known only at the locations of the testhole or exposure. Actual geology and stratigraphy between testholes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA 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 investigation and review may be necessary.

7.0 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.

8.0 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.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and 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 are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as 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.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. 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.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses 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 assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

Tetra Tech EBA 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.

14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the 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.

TETRA TECH

Tt_Borehole Terms_General.cdr

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION
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
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	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
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
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
			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

LABORATORY CLASSIFICATION CRITERIA

Classification on basis of percentage of fines

GW, GP, SW, SP
GM, GC, SM, SC
Borderline Classification requiring use of dual symbols

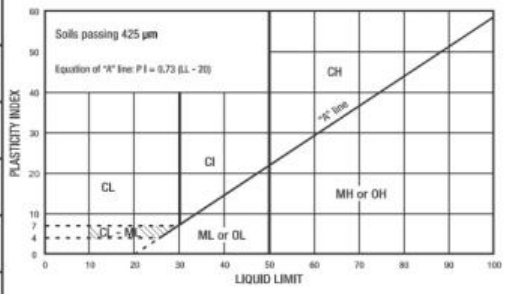
$C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$	Greater than 4 Between 1 and 3	
Not meeting both criteria for GW		
Atterberg limits plot below "A" line or plasticity index less than 4		Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
Atterberg limits plot above "A" line or plasticity index greater than 7		

Less than 5% Pass 75 mµsieve
More than 12% Pass 75 mµsieve
5% to 12% Pass 75 µm sieve

$C_u = D_{60}/D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$	Greater than 6 Between 1 and 3	
Not meeting both criteria for SW		
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
Atterberg limits plot above "A" line or plasticity index greater than 7		

For classification of fine-grained soils and fine fraction of coarse-grained 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

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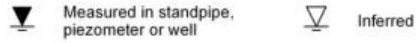
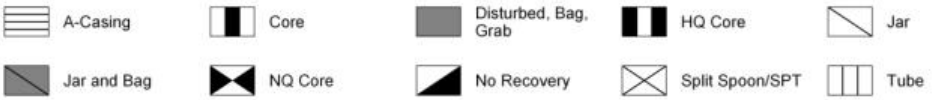
BOREHOLE KEYSHEET

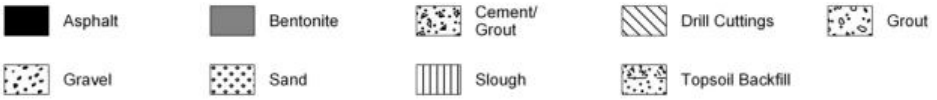
Water Level Measurement



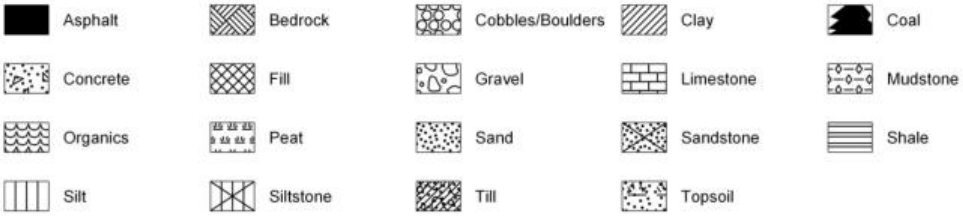
Sample Types



Backfill Materials

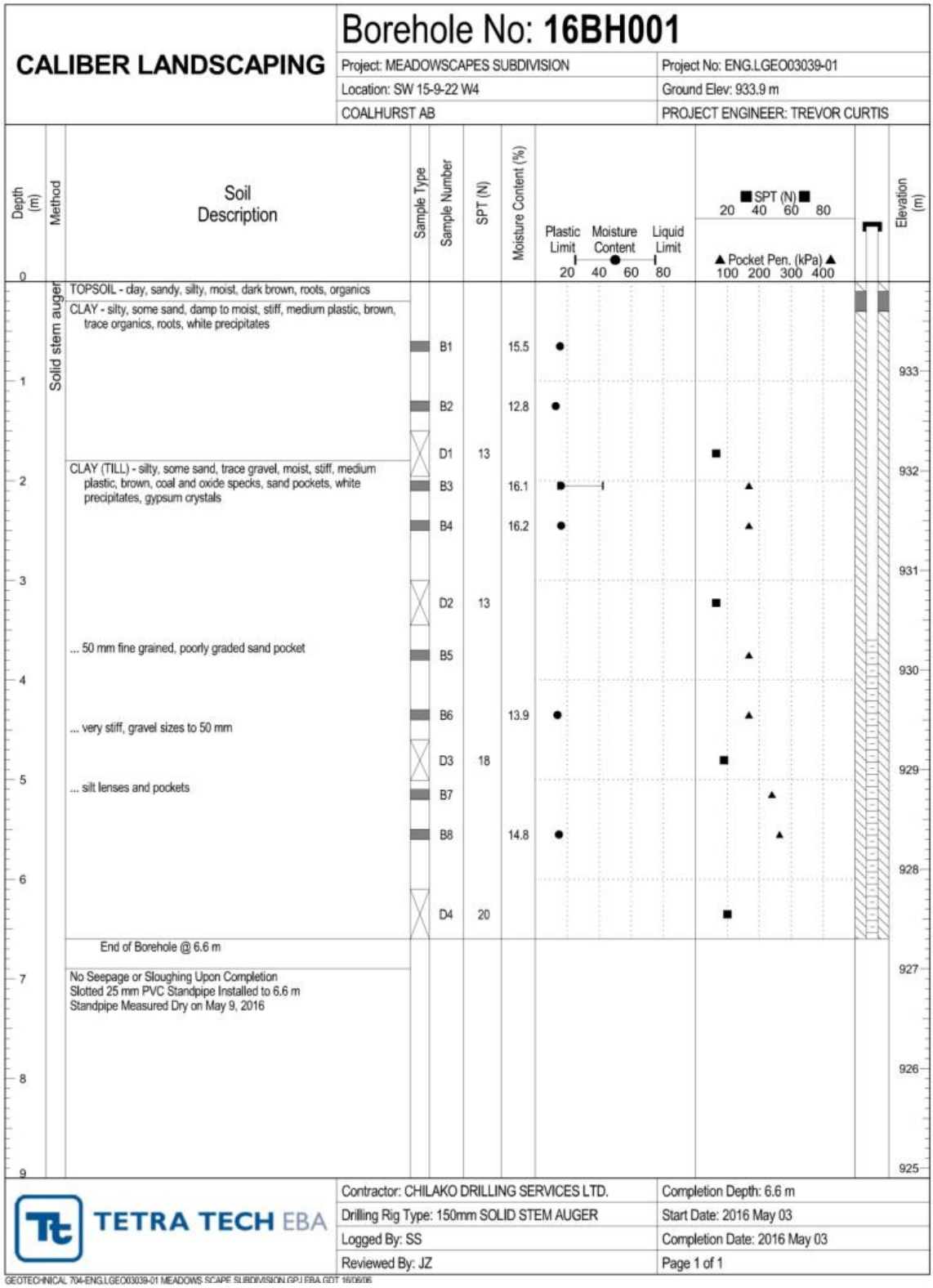


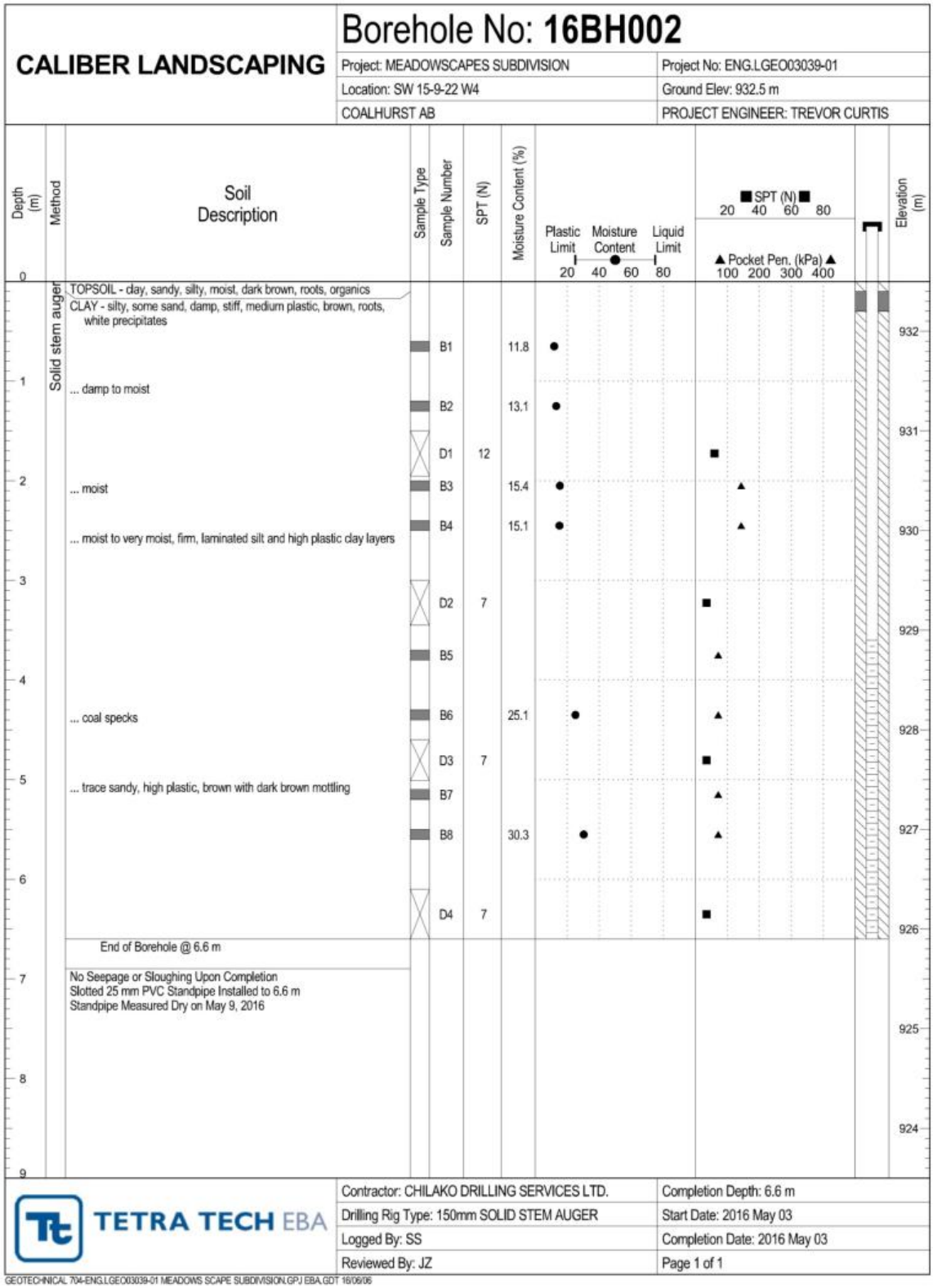
Lithology - Graphical Legend[1]



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 EBA


CALIBER LANDSCAPING
Borehole No: 16BH001
Project: MEADOWSCAPES SUBDIVISION
Project No: ENG.LGEO03039-01
Location: SW 15-9-22 W4
Ground Elev: 933.9 m
COALHURST AB
PROJECT ENGINEER: TREVOR CURTIS
Depth (m)
Method
Soil Description
Sample Type
Sample Number
SPT (N)
Moisture Content (%)
Plastic Limit
Moisture Content
Liquid Limit
SPT (N)
Pocket Pen. (kPa)
Elevation (m)
TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics
CLAY - silty, some sand, damp to moist, stiff, medium plastic, brown, trace organics, roots, white precipitates
CLAY (TILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide specks, sand pockets, white precipitates, gypsum crystals
... 50 mm fine grained, poorly graded sand pocket
... very stiff, gravel sizes to 50 mm
... silt lenses and pockets
End of Borehole @ 6.6 m
No Seepage or Sloughing Upon Completion
Slotted 25 mm PVC Standpipe Installed to 6.6 m
Standpipe Measured Dry on May 9, 2016
Solid stem auger
B1 15.5
B2 12.8
D1 13
B3 16.1
B4 16.2
D2 13
B5
B6 13.9
D3 18
B7
B8 14.8
D4 20
933
932
931
930
929
928
927
926
925
TETRA TECH EBA
Contractor: CHILAKO DRILLING SERVICES LTD.
Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER
Start Date: 2016 May 03
Logged By: SS
Completion Date: 2016 May 03
Reviewed By: JZ
Page 1 of 1
GEOTECHNICAL 704-ENG.LGEO03039-01 MEADOWS SCAPE SUBDIVISION.GPJ EBA.GDT 16/09/06


CALIBER LANDSCAPING
Borehole No: 16BH002
Project: MEADOWSCAPES SUBDIVISION
Project No: ENG.LGEO03039-01
Location: SW 15-9-22 W4
Ground Elev: 932.5 m
COALHURST AB
PROJECT ENGINEER: TREVOR CURTIS
Depth (m)
Method
Soil Description
Sample Type
Sample Number
SPT (N)
Moisture Content (%)
Plastic Limit
Moisture Content
Liquid Limit
SPT (N)
Pocket Pen. (kPa)
Elevation (m)
TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics
CLAY - silty, some sand, damp, stiff, medium plastic, brown, roots, white precipitates
Solid stem auger
... damp to moist
... moist
... moist to very moist, firm, laminated silt and high plastic clay layers
... coal specks
... trace sandy, high plastic, brown with dark brown mottling
B1 11.8
B2 13.1
D1 12
B3 15.4
B4 15.1
D2 7
B5
B6 25.1
D3 7
B7
B8 30.3
D4 7
End of Borehole @ 6.6 m
No Seepage or Sloughing Upon Completion
Slotted 25 mm PVC Standpipe Installed to 6.6 m
Standpipe Measured Dry on May 9, 2016
TETRA TECH EBA
Contractor: CHILAKO DRILLING SERVICES LTD.
Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER
Start Date: 2016 May 03
Logged By: SS
Completion Date: 2016 May 03
Reviewed By: JZ
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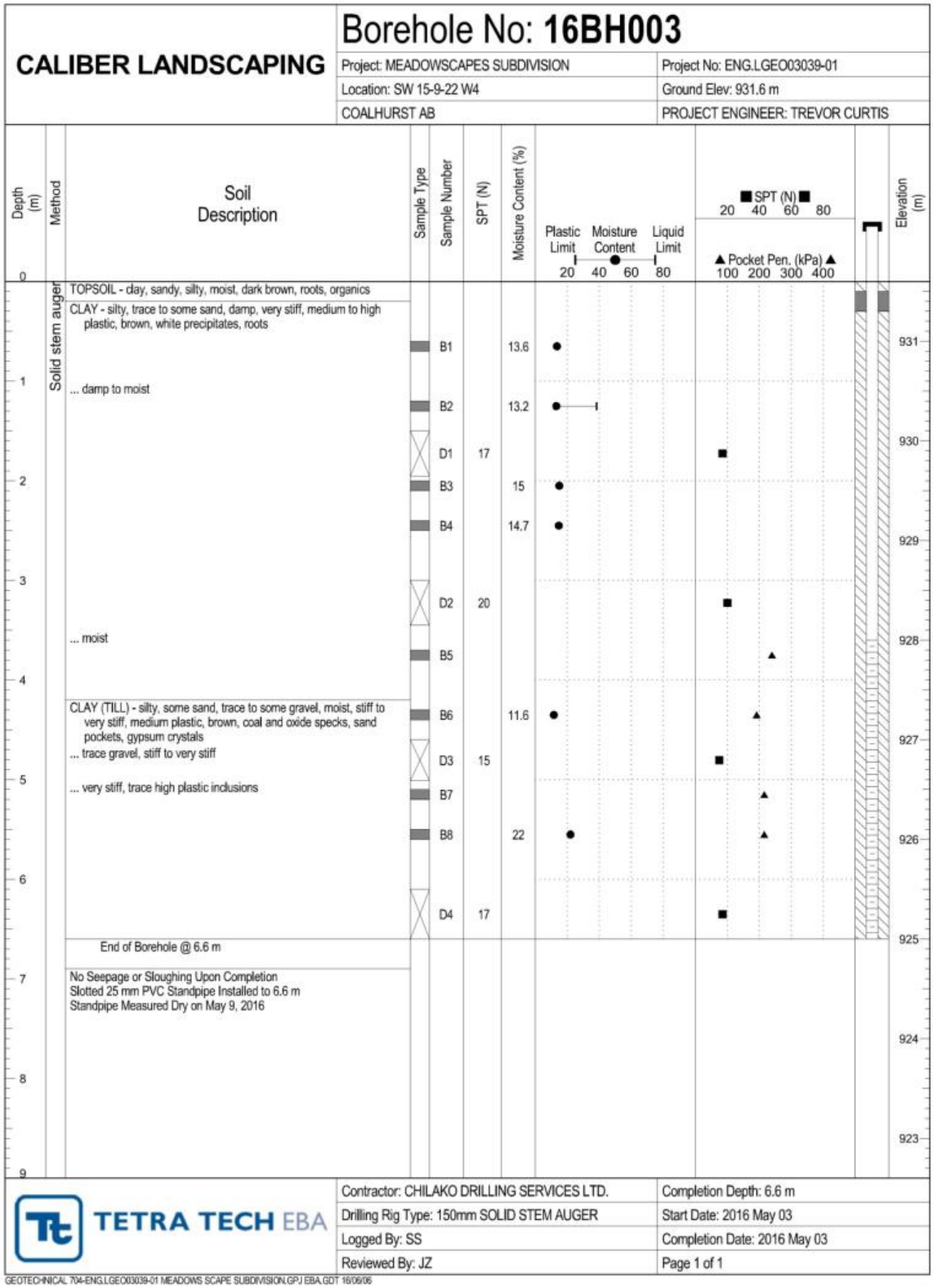
GEOTECHNICAL 704-ENG.LGEO03039-01 MEADOWS SCAPE SUBDIVISION.GPJ EBA.GDT 16/09/06


CALIBER LANDSCAPING
Borehole No: 16BH003
Project: MEADOWSCAPES SUBDIVISION
Project No: ENG.LGEO03039-01
Location: SW 15-9-22 W4
Ground Elev: 931.6 m
COALHURST AB
PROJECT ENGINEER: TREVOR CURTIS
Depth (m)
Method
Soil Description
Sample Type
Sample Number
SPT (N)
Moisture Content (%)
Plastic Limit
Moisture Content
Liquid Limit
SPT (N)
Pocket Pen. (kPa)
Elevation (m)
TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics
Solid stem auger
CLAY - silty, trace to some sand, damp, very stiff, medium to high plastic, brown, white precipitates, roots
... damp to moist
... moist
CLAY (TILL) - silty, some sand, trace to some gravel, moist, stiff to very stiff, medium plastic, brown, coal and oxide specks, sand pockets, gypsum crystals
... trace gravel, stiff to very stiff
... very stiff, trace high plastic inclusions
End of Borehole @ 6.6 m
No Seepage or Sloughing Upon Completion
Slotted 25 mm PVC Standpipe Installed to 6.6 m
Standpipe Measured Dry on May 9, 2016
B1 13.6
B2 13.2
D1 17
B3 15
B4 14.7
D2 20
B5
B6 11.6
D3 15
B7
B8 22
D4 17
931
930
929
928
927
926
925
924
923
TETRA TECH EBA
Contractor: CHILAKO DRILLING SERVICES LTD.
Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER
Start Date: 2016 May 03
Logged By: SS
Completion Date: 2016 May 03
Reviewed By: JZ
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CALIBER LANDSCAPING
Borehole No: 16BH004
Project: MEADOWSCAPES SUBDIVISION
Project No: ENG.LGEO03039-01
Location: SW 15-9-22 W4
Ground Elev: 931.2 m
COALHURST AB
PROJECT ENGINEER: TREVOR CURTIS
Depth (m)
Method
Soil Description
Sample Type
Sample Number
SPT (N)
Moisture Content (%)
Plastic Limit
Moisture Content
Liquid Limit
SPT (N)
Pocket Pen. (kPa)
Elevation (m)
Solid stem auger
TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics
CLAY - silty, some sand, moist, firm, medium plastic, brown with dark brown, trace roots, organics, trace silt pockets
... very moist, soft to firm
B1 25.6
B2 25.9
D1 4
... some sand to sandy, very moist to wet, low to medium plastic, silt and sand lenses
B3 23.9
B4 24.5
...sandy, firm to stiff, low plastic, brown
D2 9
B5
... 150 mm gravel pocket, sandy, silty, trace clay, sub angular, well graded, sizes to 25 mm
B6 22.6
CLAY (TILL) - silty, some sand, trace gravel, moist to very moist, stiff, medium plastic, brown, coal and oxidee specks, silt and sand pockets
D3 14
5/9/2016
... moist, stiff to very stiff
B7
B8 17.4
D4 16
End of Borehole @ 6.6 m
No Seepage or Sloughing Upon Completion
Slotted 25 mm PVC Standpipe Installed to 6.6 m
Indicated Water Level Measured on May 9, 2016.
TETRA TECH EBA
Contractor: CHILAKO DRILLING SERVICES LTD.
Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER
Start Date: 2016 May 03
Logged By: SS
Completion Date: 2016 May 03
Reviewed By: JZ
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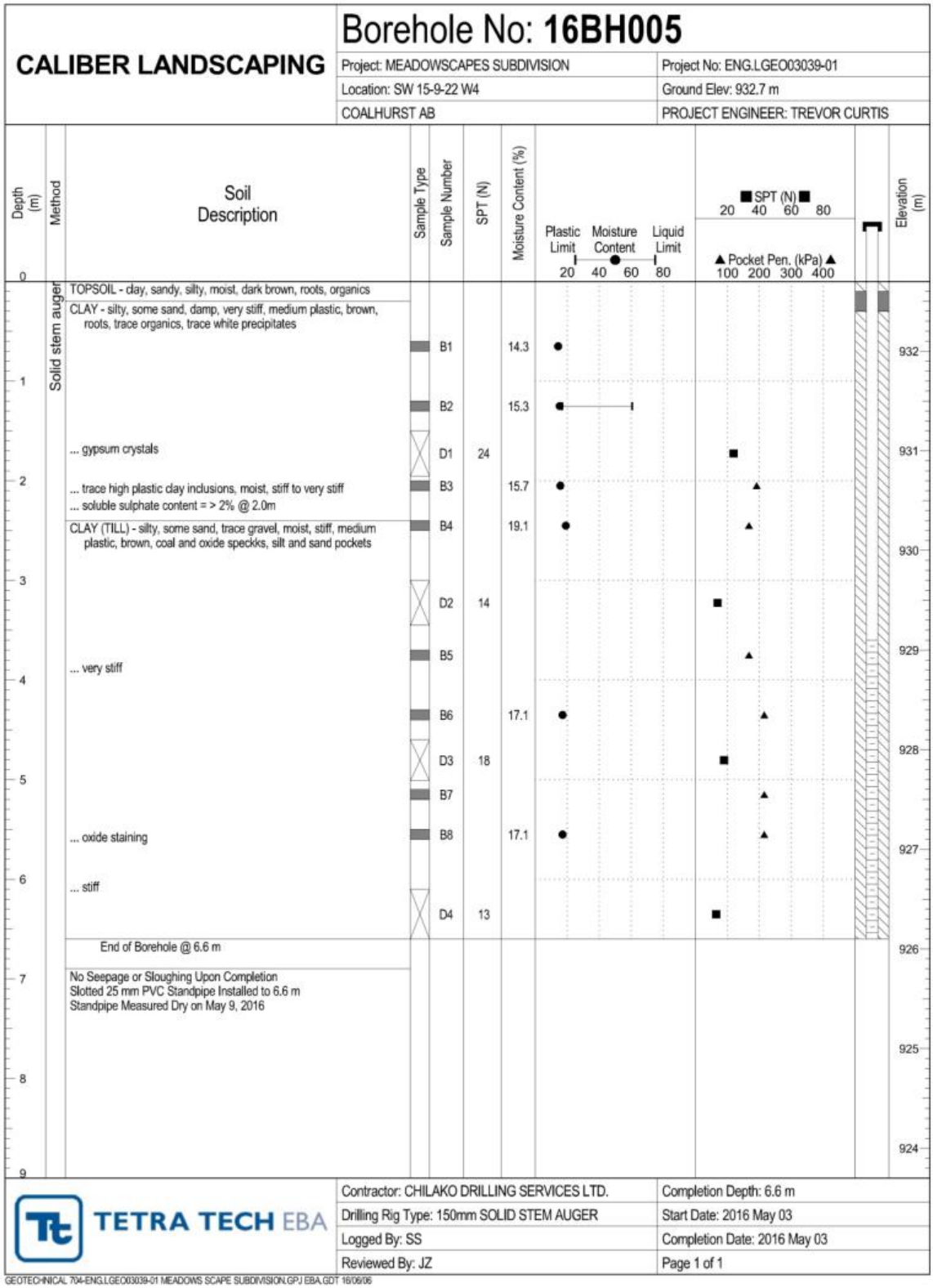
GEOTECHNICAL 704-ENG.LGEO03039-01 MEADOWS SCAPE SUBDIVISION.GPJ EBA.GDT 16/09/06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Borehole No: 16BH005
Project: MEADOWSCAPES SUBDIVISION
Project No: ENG.LGEO03039-01
Location: SW 15-9-22 W4
Ground Elev: 932.7 m
COALHURST AB
PROJECT ENGINEER: TREVOR CURTIS
Depth (m)
Method
Soil Description
Sample Type
Sample Number
SPT (N)
Moisture Content (%)
Plastic Limit
Moisture Content
Liquid Limit
SPT (N)
Pocket Pen. (kPa)
Elevation (m)
TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics
Solid stem auger
CLAY - silty, some sand, damp, very stiff, medium plastic, brown, roots, trace organics, trace white precipitates
B1 14.3
B2 15.3
... gypsum crystals
D1 24
... trace high plastic clay inclusions, moist, stiff to very stiff
... soluble sulphate content = > 2% @ 2.0m
B3 15.7
CLAY (TILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide speckks, silt and sand pockets
B4 19.1
D2 14
B5
... very stiff
B6 17.1
D3 18
B7
... oxide staining
B8 17.1
... stiff
D4 13
End of Borehole @ 6.6 m
No Seepage or Sloughing Upon Completion
Slotted 25 mm PVC Standpipe Installed to 6.6 m
Standpipe Measured Dry on May 9, 2016
TETRA TECH EBA
Contractor: CHILAKO DRILLING SERVICES LTD.
Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER
Start Date: 2016 May 03
Logged By: SS
Completion Date: 2016 May 03
Reviewed By: JZ
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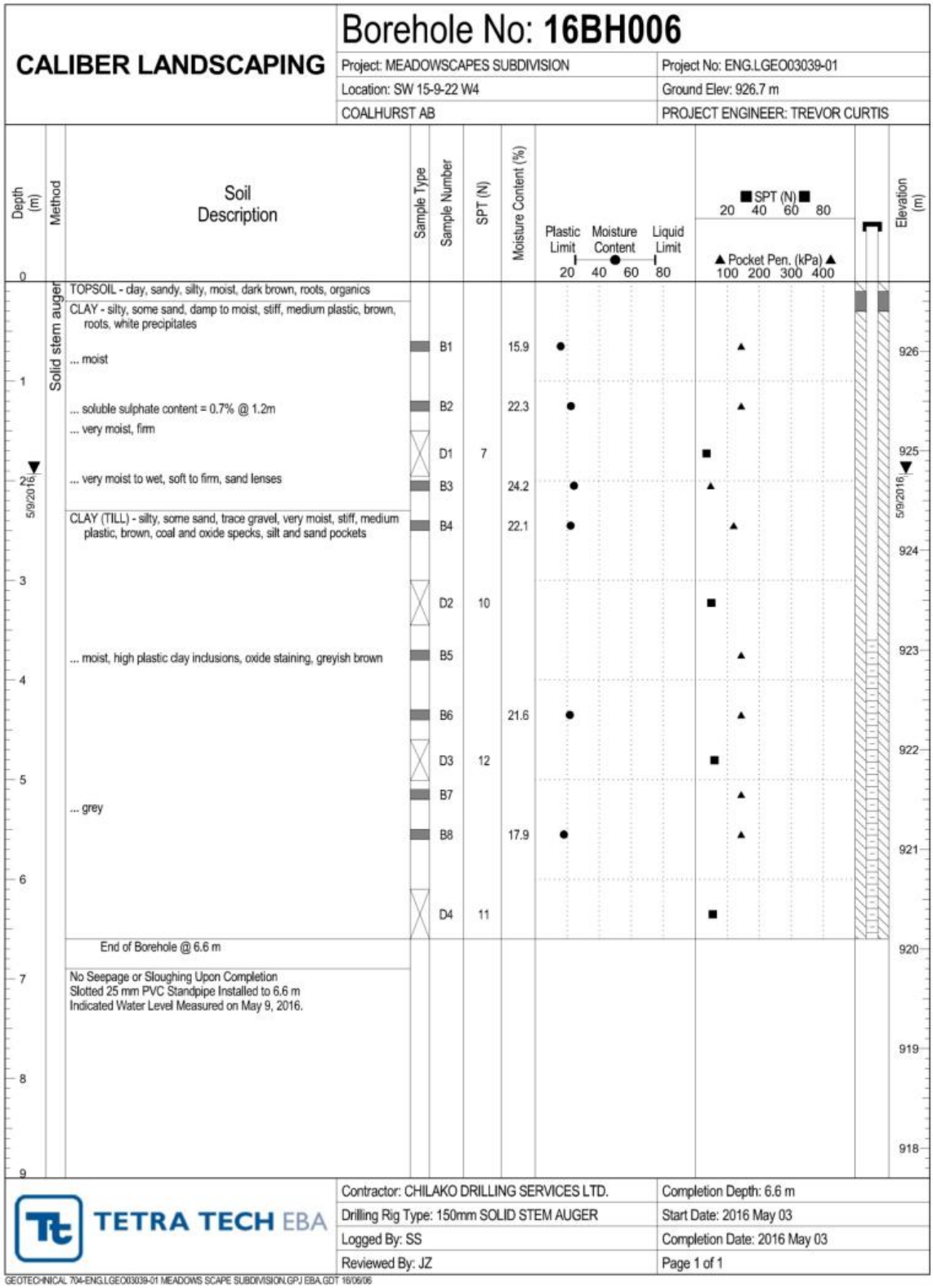
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Borehole No: 16BH006
Project: MEADOWSCAPES SUBDIVISION
Project No: ENG.LGEO03039-01
Location: SW 15-9-22 W4
Ground Elev: 926.7 m
COALHURST AB
PROJECT ENGINEER: TREVOR CURTIS
Depth (m)
Method
Soil Description
Sample Type
Sample Number
SPT (N)
Moisture Content (%)
Plastic Limit
Moisture Content
Liquid Limit
SPT (N)
Pocket Pen. (kPa)
Elevation (m)
TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics
CLAY - silty, some sand, damp to moist, stiff, medium plastic, brown, roots, white precipitates
... moist
... soluble sulphate content = 0.7% @ 1.2m
... very moist, firm
... very moist to wet, soft to firm, sand lenses
CLAY (TILL) - silty, some sand, trace gravel, very moist, stiff, medium plastic, brown, coal and oxide specks, silt and sand pockets
... moist, high plastic clay inclusions, oxide staining, greyish brown
... grey
End of Borehole @ 6.6 m
No Seepage or Sloughing Upon Completion
Slotted 25 mm PVC Standpipe Installed to 6.6 m
Indicated Water Level Measured on May 9, 2016.
5/9/2016
TETRA TECH EBA
Contractor: CHILAKO DRILLING SERVICES LTD.
Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER
Start Date: 2016 May 03
Logged By: SS
Completion Date: 2016 May 03
Reviewed By: JZ
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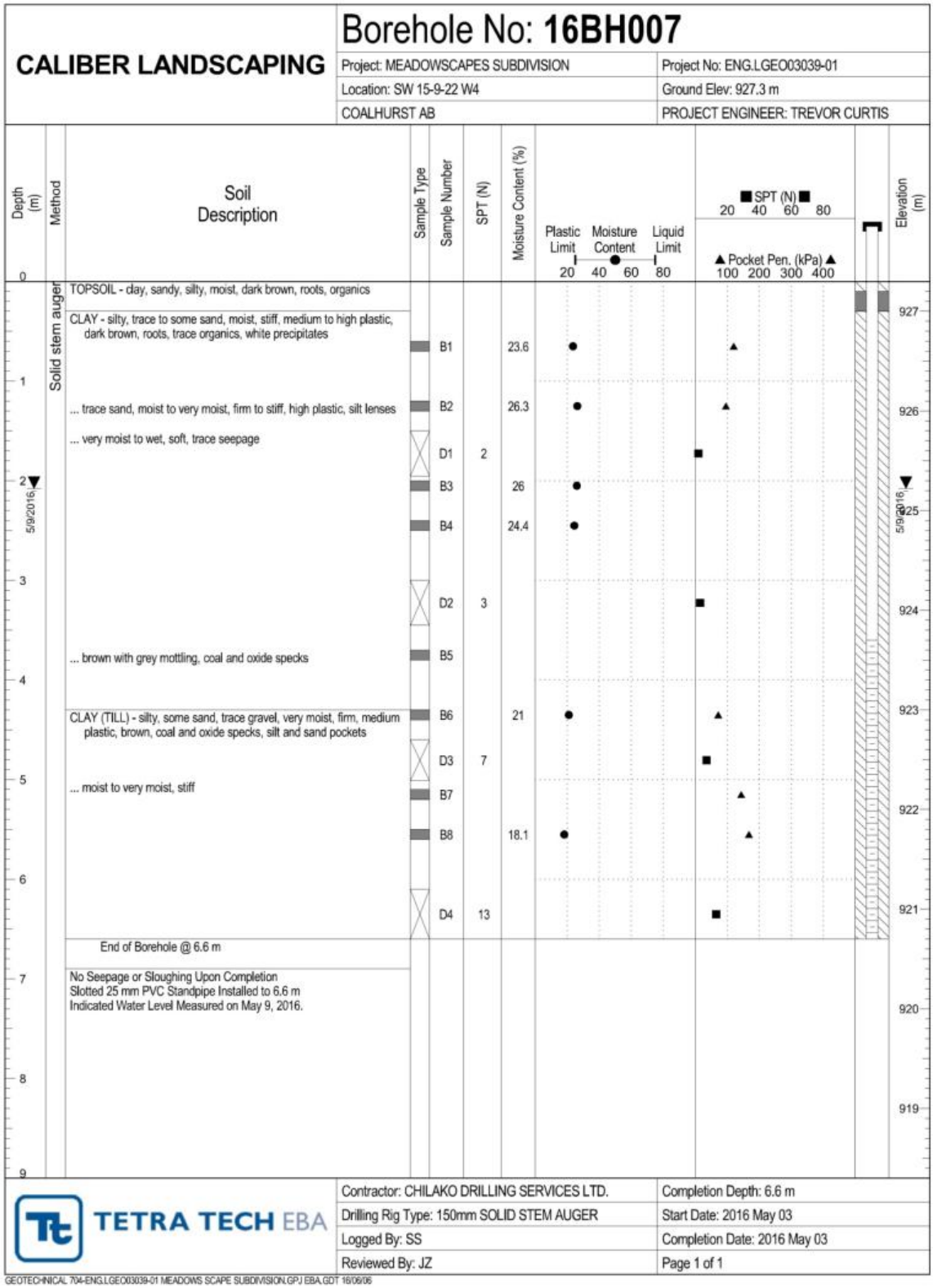
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Borehole No: 16BH007
Project: MEADOWSCAPES SUBDIVISION
Project No: ENG.LGEO03039-01
Location: SW 15-9-22 W4
Ground Elev: 927.3 m
COALHURST AB
PROJECT ENGINEER: TREVOR CURTIS
Depth (m)
Method
Soil Description
Sample Type
Sample Number
SPT (N)
Moisture Content (%)
Plastic Limit
Moisture Content
Liquid Limit
SPT (N)
Pocket Pen. (kPa)
Elevation (m)
Solid stem auger
TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics
CLAY - silty, trace to some sand, moist, stiff, medium to high plastic, dark brown, roots, trace organics, white precipitates
B1 23.6
... trace sand, moist to very moist, firm to stiff, high plastic, silt lenses
B2 26.3
... very moist to wet, soft, trace seepage
D1 2
B3 26
B4 24.4
5/9/2016
D2 3
... brown with grey mottling, coal and oxide specks
B5
CLAY (TILL) - silty, some sand, trace gravel, very moist, firm, medium plastic, brown, coal and oxide specks, silt and sand pockets
B6 21
D3 7
... moist to very moist, stiff
B7
B8 18.1
D4 13
End of Borehole @ 6.6 m
No Seepage or Sloughing Upon Completion
Slotted 25 mm PVC Standpipe Installed to 6.6 m
Indicated Water Level Measured on May 9, 2016.
TETRA TECH EBA
Contractor: CHILAKO DRILLING SERVICES LTD.
Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER
Start Date: 2016 May 03
Logged By: SS
Completion Date: 2016 May 03
Reviewed By: JZ
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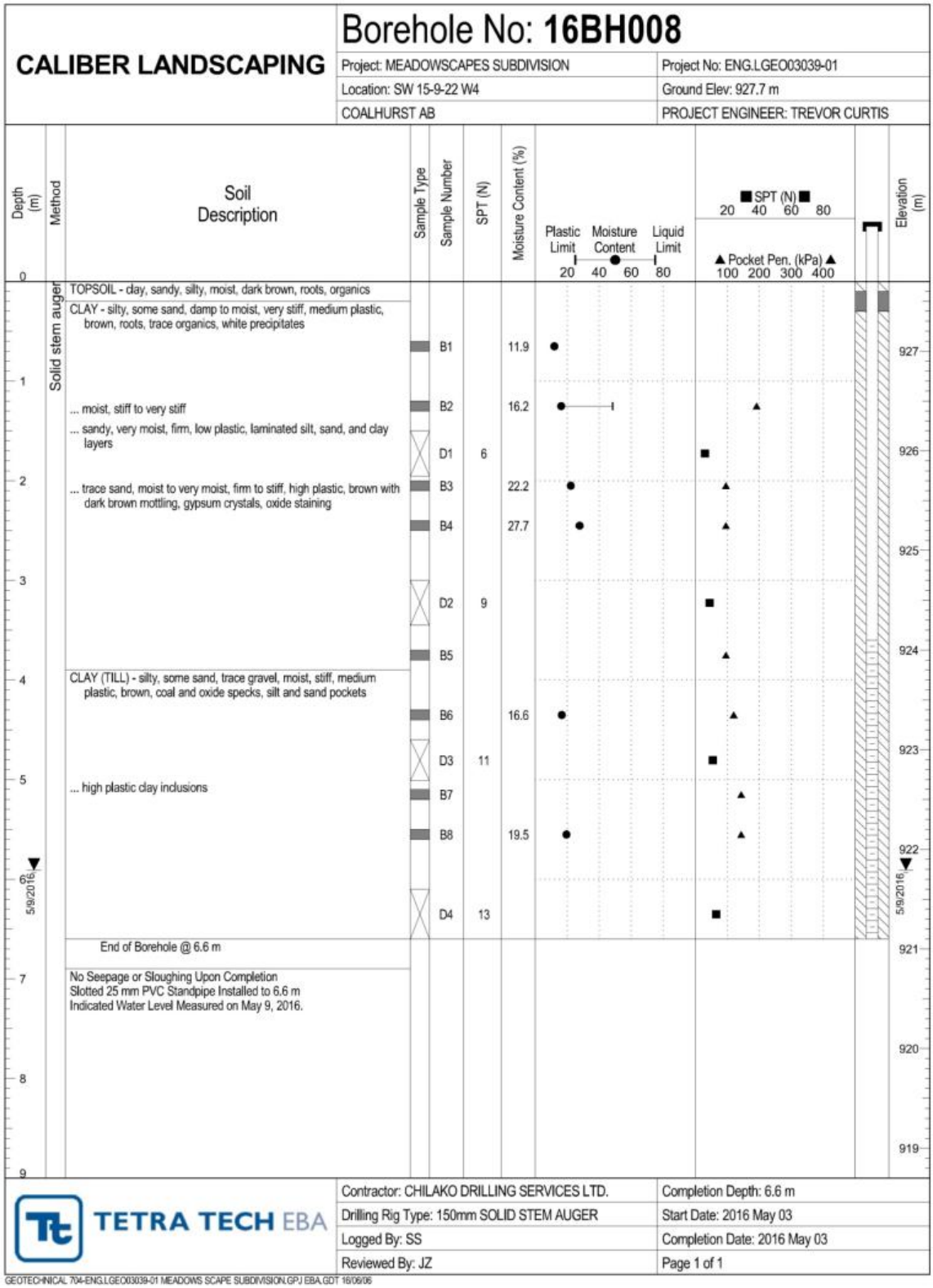
CALIBER LANDSCAPING
Borehole No: 16BH008
Project: MEADOWSCAPES SUBDIVISION
Project No: ENG.LGEO03039-01
Location: SW 15-9-22 W4
Ground Elev: 927.7 m
COALHURST AB
PROJECT ENGINEER: TREVOR CURTIS
Depth (m)
Method
Soil Description
Sample Type
Sample Number
SPT (N)
Moisture Content (%)
Plastic Limit
Moisture Content
Liquid Limit
SPT (N)
Pocket Pen. (kPa)
Elevation (m)
TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics
CLAY - silty, some sand, damp to moist, very stiff, medium plastic, brown, roots, trace organics, white precipitates
B1 11.9
... moist, stiff to very stiff
B2 16.2
... sandy, very moist, firm, low plastic, laminated silt, sand, and clay layers
D1 6
... trace sand, moist to very moist, firm to stiff, high plastic, brown with dark brown mottling, gypsum crystals, oxide staining
B3 22.2
B4 27.7
D2 9
B5
CLAY (TILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide specks, silt and sand pockets
B6 16.6
D3 11
... high plastic clay inclusions
B7
B8 19.5
D4 13
5/9/2016
End of Borehole @ 6.6 m
No Seepage or Sloughing Upon Completion
Slotted 25 mm PVC Standpipe Installed to 6.6 m
Indicated Water Level Measured on May 9, 2016.
TETRA TECH EBA
Contractor: CHILAKO DRILLING SERVICES LTD.
Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER
Start Date: 2016 May 03
Logged By: SS
Completion Date: 2016 May 03
Reviewed By: JZ
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APPENDIX C

RECOMMENDED GENERAL 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.

CONSTRUCTION GUIDELINE

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 EBA 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 EBA 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 EBA 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 C

Draft Architectural Controls

ARCHITECTURAL CONTROLS

BUILDING STYLE
Meadowscape is seeking to embrace a rural architectural style. Craftsman, Cottage and French Country are all acceptable.
All accessory buildings must match the residence.

ROOF PITCH/COLOUR
8/12 and greater roof pitches are encouraged. 6/12 is the minimum roof pitch.
Dark shingles are preferred for this development.

BUILDING SIZE
Bungalows must be a minimum of 1,500 sq ft. Two storeys or storey and a half must have a foot print of 1,000 sq ft minimum.

These areas exclude garages, verandas and deck areas.

ELEVATION
The residence must be set into the ground such that there are no more than 4 stairs to the front door or veranda.

EXTERIOR FINISHES
Cement board siding, stucco, brick, stone (cultured or real) are all acceptable finishes. Vinyl siding is prohibited. A colour board of all exterior finishes must be submitted to the Architectural Controls Consultant for approval.

DRIVEWAYS
Paved driveways of asphalt or concrete are preferred.

LANDSCAPING
Large areas of non-vegetated surface must be avoided (ie, large gravel areas). Extensive tree planting with shrub beds and lawn (or pasture grass) is important to the overall aesthetic of the development.

Site plans showing landscaping must be submitted to the Architectural Controls Consultant for approval.

FENCING
Yards need not be fenced (with the exception of the required rear lot fence on lots backing onto the LNID Right of Way). If fencing is proposed, it must be cedar board, black chain link or rail type fencing.

APPENDIX D

LNID Letters

LETHBRIDGE NORTHERN
IRRIGATION DISTRICT

2821 – 18 Avenue North
Lethbridge, AB T1H 6T5
www.lnid.ca

Phone: (403) 327-3302
Fax: (403) 320-2457
Email: lnid@telus.net

August 12, 2016

Douglas J Bergen
Box 1667
Coaldale, AB T1M 1N3

Dear Sir:

RE: WATER CONVEYANCE AGREEMENT – TYPE 3
MEADOWSCAPES ACREAGE DEVELOPMENT - SW 15-09-22-4

The Lethbridge Northern Irrigation District (LNID) is willing to supply water to the Meadowscapes Acreage Development in SW 15-09-22-4.

The estimated water requirement is about 18 acre feet. A one-time capital contribution for access to the District's water licence will be due and payable at the time of signing of the agreement. The current water licence access fee rate is $1,100/acre-foot of water and is subject to change annually on April 1st.

The Meadowlake Acreage Development will be invoiced for the agreement annually. The current rate is $400, plus GST, for the first three (3) acre-feet and then $25/acre-foot over three (3) acre-feet.

Yours truly

Alan Harrold
General Manager
AH/gb
c: Lawrence McCune, District Accountant
Maritza Suarez, Accountant

LETHBRIDGE NORTHERN
IRRIGATION DISTRICT

2821 – 18 Avenue North
Lethbridge, AB T1H 6T5
www.lnid.ca

Phone: (403) 327-3302
Fax: (403) 320-2457
Email: lnid@telus.net

March 20, 2017

Henry Bakker
Caliber Landscaping & Irrigation
PO Box 380
COALHURST, AB T0L 0V0

Dear Sir:

RE: LETTER OF COMMITMENT: LATERAL 61C
MEADOWSCAPE DEVELOPMENT: PT. SW 15-9-22-4
BETWEEN THE "DAVIS GROUP". (hereinafter called "the DEVELOPER")
and the
LETHBRIDGE NORTHERN IRRIGATION DISTRICT
(hereinafter called "the LNID")

In regards to the LNID letter dated March 14, 2017 sent to Henry Bakker, this letter is to confirm the Developer's commitment to the project in Pt. SW 15-9-22-4. The Developer agrees to be legally bound by the following terms and conditions:

1. The Lateral 61C canal running through Pt. SW 15-9-22-4 will be abandoned by the LNID. The LNID will replace the canal with a buried pipeline, some of which will be relocated from the existing canal right-of-way.

2. The LNID shall accept responsibility for the following work:
   a. Supply and installation of approximately 500m of 54" ID RSC160 HDPE pipe;
   b. Supply and installation of two (2) 54" pipe elbows;
   c. Supply and installation of a pipeline inlet structure;
   d. Surveying the area, staking of the route and determining the depth of cut for the LNID pipeline;
   e. Design and drafting of a pipeline design which shows the location and elevation of the pipeline. The pipeline design will be similar to Douglas J. Bergen & Associates Ltd. Drawing 1 of 2 showing pipeline Option A. The LNID will attempt to complete the preliminary design by March 31, 2017;
   f. Locating Utilities for the LNID pipeline, securing crossing agreements if required;
   g. Collecting survey data during construction and producing As-Built drawings of the LNID's pipeline;
   h. Registering the pipeline right-of-way;
   i. Operation and maintenance of the LNID's pipeline;
   j. Granting access to Lot 1 from the LNID's right-of-way (Plan 001 2695);

k. Providing the Developer with physical access to water for domestic purposes prior to the start of the pipeline. This cost shall be wholly born by the Developer;
l. Prepare *Land Transfer* documents and provide legal survey for portions of the pipeline being relocated, with registration of these documents at Land Titles Office.

3. The Developer shall accept responsibility for the following work:
   a. Respect the pipeline right-of-way and development setbacks which shall be established by the LNID Board of Directors;
   b. Prohibit access to the pipeline right-of-way through the use of fences or other similar physical barriers on both sides of the pipeline right-of-way;
   c. Backfilling abandoned Lateral 61C canal in areas outside of the pipeline right-of-way;
   d. Seeding the pipeline right-of-way with a grass blend similar to the existing native grass;
   e. Provide the LNID with a $40,000 non-refundable deposit by April 7, 2017;
   f. Payment of the remaining $170,000 (includes GST) by October 31, 2017;
   g. Providing the LNID a Fee-Simple Right-of-Way for the District's pipeline in Pt. SW 15-9-22-4. The transfers of land between the Developer and the LNID will be completed at the rate of $1 per acre;
   h. Supply and installation of a guardrail and locking gate along the Lot 1 access described in item 2.j;
   i. Allow access to the LNID and/or their contractors for construction during the irrigation off-season, which is projected to be from November 2017 to April 2018.

If you are in agreement with the terms and conditions specified by the LNID Board of Directors, contained within Clauses 1 – 3 of this letter, please sign both copies of this letter and return one (1) copy to the LNID office by March 31, 2017 acknowledging and accepting these terms.

Yours truly,

Alan Harrold
General Manager
AH/jcp
c: Board
Stephen Van Essen, District Engineer
Lawrence McCune, District Accountant
Maritza Suarez, Accountant

ACKNOWLEDGED & ACCEPTED

Caliber Landscaping & Irrigation

Witness

April 6, 2017
Date

APPENDIX E

Private Sewage Treatment System Feasibility

OSPREY ENGINEERING INC.
BOX 1367 · BLACK DIAMOND, ALBERTA · T0L 0H0 CANADA
TEL: 403.933.2226 · FAX: 403.933.2230 · EMAIL: ospreyeng@gmail.com

16 June 2016 Our File: 160288

Douglas J. Bergen & Associates Ltd.
Box 1667
Coaldale, AB T1M 1N3

Attention: Douglas Bergen, CET

RE: Meadowscapes Country Residential Subdivision (SW15-9-22-4)
Lethbridge County east of Coalhurst
Feasibility of Private Sewage Treatment Systems

Dear Mr. Bergen,

As requested, I completed a review of the assessments provided by Tetra Tech EBA in regards to the soil conditions at the above-noted site:

- Rigaux, M. 2016, *Preliminary Soil Assessment Meadow Scapes Proposed Subdivision Lethbridge County, Alberta*, Letter, to: H. Bakker, dated: 18 February 2016
- Zhao, J. 2016, *Geotechnical Evaluation Meadowscapes Country Residential Subdivision Coalhurst, Alberta*, Tetra Tech EBA, Lethbridge, AB

The site is located east of Range Road 223 and north of Township Road 92 in Lethbridge County – immediately east of the Town of Coalhurst corporate limits.
On 19 January 2016, EBA conducted a field soil assessment at the site. Soil profiles consistent with guidelines prescribed by Alberta Municipal Affairs and consistent with the *Alberta Private Sewage Systems Standard of Practice* (Safety Codes Council 2015) were developed based on observations of excavated test pits. Soil samples from each pit were analyzed for soil texture (Rigaux 2016). Additional geotechnical work was completed 3 May 2016 and included analyses and recommendations relating to structural stability, groundwater monitoring, road design and site grading (Zhao 2016).

Based on the above, I have the following observations:

- Soil profiles from all holes allow dispersal of effluent on site subject to limitations on system size and type of system
- All systems must have secondary treatment of wastewater using an appropriate packaged treatment plant due to fine textured soil and/or lack of vertical separation to restricting soil horizons
- Treatment fields are not permitted on 4 of 6 lots due to the presence of restricting layers at depths less than 36". On these lots treatment mounds incorporating sand layers of the thicknesses noted in Table 1 are required
- Recommended hydraulic loading rates for each site are as noted in Table 1
- As the proposed dwellings are unlikely to generate peak daily wastewater flows (assessed as per Safety Codes Council 2015) in excess of 5.7 m^3 [1250 gal], the individual systems can be designed by a person holding a valid Private Sewage Systems Certificate of Competency as issued by Alberta Municipal Affairs, Plumbing and Gas

Table 1 – Recommended Soil Loading Rates and PSTS Sizing

Property	Test pit	Soil conditions, loading rates	Approximate soil component sizing
Lot 1	16TP01	Clay, Restricting @ 17". HLR = 0.2 gal/ft^2 LLR= 2.1 gal/ft	Mound: need 19" sand layer, 240 ft long, 2500 ft^2 basal area
Lot 2	16TP02	Clay, >>48" to restricting HLR = 0.2 gal/ft^2 LLR n/a	Field: 12 laterals, 4 × 3 232 ft × 21 ft
Lot 3	16TP03	Silt loam, Restricting @ 19" HLR = 0.63 gal/ft^2 LLR = 3.2 gal/ft	Mound: need 17" sand layer, 156 ft long, 790 ft^2 basal area
Lot 4	16TP04	Clay, Restricting @ 55" HLR = 0.2 gal/ft^2 LLR = 2.6 gal/ft	Field: 12 laterals, 4 × 3 232 ft × 21 ft
Lot 5	16TP05	Silt loam, Restricting @ 20" HLR = 0.18 gal/ft^2 LLR = 3.0 gal/ft	Mound: need 16" sand layer, 167 ft long, 2778 ft^2 basal area
Lot 6	16TP06	Loam, Restricting @ 12" HLR = 0.63 gal/ft^2 LLR = 3.8 gal/ft	Mound: need 24" sand layer, 132 ft long, 794 ft^2 basal area

I have no further concerns regarding the operation of private sewage systems serving potential dwellings provided they are:

- constructed and operated consistent with relevant safety codes,
- not located in areas where concentrated overland runoff or ponding is expected

I trust the above provides the information required. If you have any questions, please contact me.

Yours truly,
OSPREY ENGINEERING INC.
Association of Professional Engineers and Geoscientists of Alberta Permit to Practice No. P10743

Michael A. Kitchen, P.Eng.
President

MAK/
cc: File