Environmental Impact Assessment Report for Maple Road Crossing of Fulton Creek, Edmonton, Alberta

Prepared for:
Lehndorff Land General Partner Inc.

Prepared by:
Stantec Consulting Ltd.

May 2017
110219456

Stantec Consulting Ltd.
10160 112 Street, Edmonton AB T5K 2L6

May 8, 2017
File: 1102-19456

Attention: Brittany Davey
City of Edmonton
1200 - 10250 101 Street NW
Edmonton AB
T5J 3P4
Canada

Dear Ms. Davey,

Reference: BD17-03 Maple Road Environmental Impact Assessment for the Crossing of Fulton Creek

Thank you for your comments concerning the above referenced report dated February 28, 2017. Stantec has endeavored to provide further clarification, response or additional information regarding the comments as summarized in the attached tables.

We appreciate the feedback and look forward to further discussion and review of the EIA submission.

Regards,

STANTEC CONSULTING LTD.

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Attachments: HRIA Map
Maple Road Environmental Impact Assessment for Crossing of Fulton Creek (Submission 2)

wt \\cd1001-c200\workgroup\1102\active\110219456\report\eia\submission 2\comment_response\let_comment_response_20170512_final.docx

Reference: BD17-03 Maple Road Environmental Impact Assessment for the Crossing of Fulton Creek

Geotechnical Comments

C1.	The project also included extensive retaining walls at each end of the culvert based on a 'Sierra Slope Retention System as well as erosion control measures using a 'Scourshield' product in the creek bed. The geotechnical consultant should provide review and recommendations pertaining to theses aspects of the project, and additional supporting technical discussion should be submitted in this context.
R1.	CT & Associates Engineering Inc. has reviewed the design and provided their comment in a technical memo that has been added to Appendix D of the EIA.
C2.	Should the project be approved to proceed, the recommendations of the geotechnical consultant must be followed, together with construction phase engineering inspection to confirm appropriate adherence.
R2.	Thank you for your comment. These recommendations will be implemented during construction.

Drainage Comments

C3.	Add a separate section for the culvert in regard to the hydraulics and hydrology.
A3.	We have added additional information into our EIA on the hydraulics and hydrology of the proposed culvert. New information can be found in Section 6.1.
C4.	Our full review/acceptance for this project is subjected to review and acceptance of detailed engineering drawings.
A4.	Thank you for your comment.
C5.	The geotechnical recommendations founded under the geotechnical report must be followed.
A5.	Thank you for your comment.

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Ecology Comments

C6.	We are concerned that the proposed openness ratio is inadequate for this crossing. Research summarized in the Wildlife Passage Engineering Design Guidelines outline that the minimum openness ratio that the design should be aiming for is 0.4. Currently, the proposed closed bottom box culvert has an openness ration of 0.04 – more than 10 times less than the minimum required (more at high flow). This issue needs to be addressed either through increasing the opening area, decreasing the culverts length, or ideally a combination of both.
A6.	As discussed in our meeting on April 6, 2017, the passage was designed for the small terrestrial and amphibian ecological design groups (EDGs). The guidelines on openness quoted in the comment above are for the medium terrestrial EDG. We understand that there may have been some confusion regarding what EDGs the passage was being designed for. As discussed in our meeting, we have gone through the EIA and clarified that the passage was designed for small mammals and amphibians, and that the medium terrestrial design group is expected to cross the road at grade.
C7.	It is currently unclear how much space would be available on the sides of the channel that carries water for terrestrial mammals to traverse – particularly in the spring freshet or during an extreme rain event. Widening the culvert may assist in resolving this issue. Please outline terrestrial wildlife use of this structure.
A7.	During extreme rain events the culvert will not facilitate dry passage. However, the culvert does remain functional during regular base flows and smaller events (e.g. 1:2, 1:5 year storms).
C8.	Note that terrestrial wildlife prefers a natural substrate to walk across, indeed, open bottom culverts are preferred to closed bottom culverts.
A8.	Unfortunately, an open bottom culvert is not feasible at this location due to topographical and engineering constraints. There is not enough topographic relief in this ravine to install an open bottom culvert without elevating the roadway, and this is not possible without significant alterations to infrastructure already constructed in the area. The major drainage flows in this neighbourhood are designed to flow north down Maple Road across this creek crossing towards Fulton Marsh. If the crossing were to be elevated, these flows would need to be diverted south towards 8 Street, then back to Fulton Marsh. Portions of 8 Street are already constructed along with and housing with residents already in place. Such a re-direct of flows would require redesign and reconstruction of the existing infrastructure, which would be both costly and disruptive to the local residents. As a mitigation measure for utilizing a concrete box culvert, we are proposing to "brush" the concrete bottom. This will create a roughness that will likely trap a thin layer of

Reference: BD17-03 Maple Road Environmental Impact Assessment for the Crossing of Fulton Creek

	sediment in the bottom of the culvert, but not enough to create a maintenance concern.
C9.	Note that in other areas of the City where a smaller creek is being crossed, and with a longer than average culvert (43m) proposal, the following solutions are instituted: • reduce length (retaining walls used in some cases) • increase width • move to an open bottom arched culvert • introduction of tee-riser manholes to allow for more light in passage
A9.	The proposed culvert has been optimized as best as was able given the topography of the site. Retaining walls have been utilized to reduce the length of the culvert as much as is feasible from an engineering perspective. The width of the culvert is limited by the available space in the ravine itself. A8 above discusses the limitations regarding an open bottom arch culvert and tee-riser manholes would interfere with major flows on the roadway.
C10.	Open bottom culverts are preferred over closed bottom as they maintain the existing soil surface and associated ecological function
A10.	Please see A8 above.
C11.	In some areas, the site will require appropriately designed fencing to funnel terrestrial wildlife into the culvert.
A11.	At this location, it is intended that the medium terrestrial EDG would cross the road at grade. We are therefore not proposing the use of any fencing at this site.
C12.	Interior cover within culvert should promote use by multiple species. For example, cover requirements of smaller mammals may be met by placing stones or logs to create structural diversity (and areas for hiding). How will this be handled during an extreme flow event?
A12.	Interior cover has not been proposed within this culvert due to concerns regarding maintenance and the potential that interior structures could trap debris washed into the culvert and cause a blockage of the creek.
C13.	Road lighting treatment should be directed away from the creek (e.g. incorporate lighting with minimal spill light).
A13.	Thank you for your comment, it has been passed along to the design team for incorporation into the detailed design.

Reference: BD17-03 Maple Road Environmental Impact Assessment for the Crossing of Fulton Creek

C14.	Diversionary plantings on either side of the road to move birds and aerial mammals up and over the road.
A14.	Thank you for your comment, it has been passed along to the design team for incorporation into the detailed design.
C15.	Consider the use of signage and/or reflectors in conjunction with the development of this below grade crossing. This is particularly significant knowing that a longer than average culvert length may prevent use of this passage structure for medium mammals which could result in a greater number of at grade crossings (and increased safety concerns).
A15.	Thank you for your comment, it has been passed along to the design team for incorporation into the detailed design.
C16.	Section 1.1 indicates that this EIA was to "...develop a mitigation plan to identify key areas for avoidance or minimize disturbance..." While the report in many areas reiterates the need to minimize project impact (e.g. page 6.8: "extent of veg. clearing ...should be minimized"), nowhere in the document is it outlined how or where this will be accomplished. Please include a section that outlines the mitigation plan and include a more detailed figure (please also include lay down areas).
A16.	Mitigation measures are outlined within the subsections of each component in Section 6. Figure 1-1 has been updated to improve clarity. Report wording has also been updated in Sections 1.1 and 2.2.
C17.	Please include a project alternatives section which more fully outlines the other culverts considered and the reasons they were not better for the project. In particular, please more fully address the comment that the proposed culvert was selected "due to engineering considerations and efficacy of wildlife passage." In addition to those items, please also speak to impact on hydrology and construction footprint of each alternative.
A17.	Section 2.5 has been added to the report to address this request.
C18.	No detailed on ESC measures are included. Please include ESC measure details.
A18.	An ESC drawing has been provided by the design team and can be found in the revised Appendix A.

Reference: BD17-03 Maple Road Environmental Impact Assessment for the Crossing of Fulton Creek

C19.	Section 3.0: what regulations will apply to this project, and have conversations with the Provincial and Federal agencies been completed?
A19.	Legislation that applies to the project is outlined in Section 3.0 of the EIA; however, the only application required will be a Water Act Code of Practice Notification. The project will not be submitted to Fisheries and Oceans Canada (DFO) as the creek is not fish bearing and therefore meets the self-assessment criteria to not apply to DFO. The Crown has also waived any right to lands in 8-52-23 W4M as these were Hudson Bay Company lands and the Crown has no bed and shore rights on them.
C20.	Section 4.2.1 indicates upland and wetland land units will be classified, however, this information is not included in the EIA. Please include a map of these areas.
A20.	As described in Section 5.5, the entire Study Area was classified as Aspen Poplar Woodland Alliance. There were no other upland or wetland units to classify or map within the Study Area.
C21.	Section 4.2.1.2 : what is the area covered by the site characterization analysis? How many sites were characterized and did some include the riparian zones? Where is the information on soil moisture regimes, slope, aspect, etc.
A21.	The area covered by the site characterization is the Study Area shown of Figure 4-1. Two sites were characterized, one of which was in the riparian zone. Information on soil moisture regime, slope and aspect were not included in the EIA discussion as the discussion was kept high level and focused on the overall community and presence/absence of rare plants. The upland site (RMAPJL1501, Figure 4-1) was in a depression, with a gentle slope and no aspect. The moisture regime at that site was recorded as subhygric. The riparian site (RMAPJL1502) was taken at the toe of slope on an ENE aspect with a 2% slope. The moisture regime was subhydric to hydric.
C22.	Section 4.2.2: what assessments were completed to understand mammal use/presence of the area?
A22.	No mammal specific studies were conducted as part of this study. We have assumed that large mammals will be excluded from the site due to barriers for the neighbourhood.

Reference: BD17-03 Maple Road Environmental Impact Assessment for the Crossing of Fulton Creek

C23.	Section 5.4: is there a better reference than the "Daryl Watters 2005" that game fish are not likely to be supported at this location. This is a 12 year old personal communication reference which does not even speak to fish bearing potential in 2017 or into the future.
A23.	Further to the correspondence referenced, the Fisheries & Wildlife Management System (FWMIS) database contains three separate fisheries studies conducted on Fulton Creek and Fulton Marsh, both within the Maple Neighborhood and upstream of Anthony Henday Drive. These studies were conducted in 2011, 2012 and 2013. None of these studies recorded the presence of any fish.
C24.	Section 5.5.2: what is the distribution of weeds across the site? Are they clumped, or are they equally distributed?
A24.	Weeds were in patches of two to five square meters in size.
C25.	Section 5.7.2: please provide confirmation the original HRIA completed in 2005 included the study area. One way to achieve this would be to include the map that was submitted for the HRIA in 2005.
A25.	A copy of the 2005 HRIA map prepared by Historic Resource Management Ltd. has been attached as requested.
C26.	Section 6.1: Hydrology: • It appears the natural drainage pattern is being re-aligned through road construction. How will the proposed creek realignment alter the natural creek function, base flow and velocity? What impact will any potential changes in hydrology have on the riparian ecosystem as well as high sediment loading to the downstream of the creek. The EIA should inform the detailed information on how these issues will be considered for mitigation and restoration plan during and post construction.
A26.	As the culvert will have a smooth concrete surface, it will accelerate flows as they pass through the culvert. The design team has calculated that during a 1:5 year event the velocity will be increased by 246% (from 0.46 m/s to 1.13 m/s) and in the 1978 storm event the velocity will be increased by 332% (from 0.72 m/s to 2.39 m/s). Left unchecked these increases in flow could cause scour and result in erosion to the downstream channel. Section 6.1 of the EIA has been updated to include further discussion for this as well as mitigation measures proposed by the design team.

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C27.	Section 6.1: Hydrology: • The report should include additional information on stream hydrology to justify the practical application of best management practices and mitigation measures proposed in this report. Please consider key parameters (e.g. floodplain connectivity, Bed form diversity, Riparian Vegetation) in describing pre-and post-disturbance conditions and rationale for proposed mitigation measures.
A27.	Thank you for your comment, Section 6.1 has been updated accordingly.
C28.	Section 6.1: Hydrology: • Revegetation should consider native riparian species and planting should consider natural succession of species. What riparian species exist currently in the area and which are going to be replanted in the riparian area? Please include the landscape drawing.
A28.	Fulton Creek is a very small creek with a relatively narrow riparian area. The riparian area was dominated by beaked willow but also contained balsam poplar, red-osier dogwood, wild black currant, and wild red currant along with trace amounts of other shrubs and an assortment of forbs. A landscape drawing has been added to Appendix B. Currently the riparian area is proposed to be seeded to a wet meadow seed mix.
C29.	Section 6.2: Vegetation/landscaping: • Please include and address the following potential environmental effect, “Introduction of weeds”
A29.	Section 6.2 has been updated as requested.
C30.	Section 6.2: Vegetation/landscaping: • Please include a detailed landscaping plan so that our office can assess. Be sure to provide detail on understory planting requirements.
A30.	A landscaping drawing has been added to Appendix B.
C31.	Section 6.2: Vegetation/landscaping: • What approved seed mix is recommended for this area?
A31.	A wet meadow seed mix and a dry meadow seed mix has been proposed for this area by the design team. Please refer to the landscaping drawing that has been added to Appendix B for further detail on the seed mixes.

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C32.	Section 6.2: Vegetation/landscaping: • What methods will be used to prevent the reintroduction of weeds post-construction?
A32.	Revegetation activities will take place as soon as is practical following the construction of the crossing. Once seeded, the contractor will maintain the site and initiate appropriate weed control activities until such a time as FAC is issued for the site per City of Edmonton procedures.
C33.	Section 6.2: Vegetation/landscaping: • What is the current age of trees in this area? I ask to get an understanding of year to equivalent maturation from project disturbance.
A33.	Tree cores were not taken at this site to ascertain exact tree age numbers; however, the average age of the trees is estimated to be somewhere between 30 and 50 years of age based on field observations.
C34.	Section 6.2: Vegetation/landscaping: • The report is unclear how much vegetation will be removed. Will the whole 0.4 acre study area be cleared? How much will be replaced?
A34.	The disturbance area has been added to Figure 1-1 and is also shown on Figure 4-1. The total area being cleared is approximately 0.24 ha. The area being replanted is approximately 0.17 ha.
C35.	Section 6.2: Vegetation/landscaping: • Please show on Design Drawings where construction fencing will be placed.
A35.	Construction fencing will be placed at the boundaries of the disturbance/cleared area.
C36.	Section 6.3: Wildlife: • Please outline/show how mitigation measures outlined are addressed on the detailed design drawings
A36.	Revised design drawings have been included in the EIA with this submission. These drawings include utilization of non-rip rap ESC material in the creek bed to provide a natural substrate, they do not utilize grates, and they include planting plans with tree plantings in the boulevard and adjacent disturbed ravine.

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C37.	Section 6.3: Wildlife: • Is it being recommended that large mammal movement should be promoted at grade?
A37.	Large mammals are not expected to be present in this ravine; however, if they do attend the crossing site, they would be expected to cross at grade along with the medium terrestrial ecological design group.
C38.	Please confirm if this is full build out of this road (e.g. two lanes)
A38.	This road is designed for a final width of 4 lanes.
C39.	Please include a map of laydown areas.
A39.	These areas have been added to Figure 1-1.
C40.	Is the Figure on page 13 of Appendix C up to date? If yes, please refer to concerns expressed in 2015 about this structure for passage (see above). Is there an option of making the channel portion of the culvert deeper to accommodate dry passage at a 1:100 design event?
A40.	Yes, this figure is up to date. Unfortunately, the lack of topographic relief at this site limits the ability to provide 1:100 year dry passage within this culvert. The ravine is simply too shallow.

Transportation Comments

C41.	The Maple Road cross-section and culvert section included on page 48 of the report are consistent with the approved preliminary plan for Maple Road.
A41.	Thank you for your comment
C42.	The retaining wall details included on page 49 of the report have not yet been reviewed by our group. We will review these details with the detailed engineering drawing submission and they will also be referred to the City's structural and geotechnical groups for review.
A42.	Thank you for your comment.

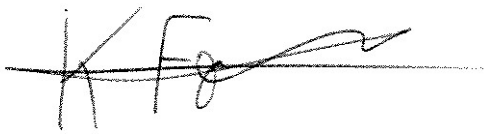
Reference: BD17-03 Maple Road Environmental Impact Assessment for the Crossing of Fulton Creek

General Comments

C43.	Hard surface access/haul routes are preferred
A43.	This will be passed along to the design team and the contractor once the project is tendered.

Sign-off Sheet

This document entitled Environmental Impact Assessment Report for Maple Road Crossing of Fulton Creek, Edmonton, Alberta was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Lehndorff Land General Partner Inc. (the "Client").



Reviewed by _____ _____

(signature) (signature)

Kurtis Fouquette, B.Sc., P.Biol.
Environmental Scientist

Elaine Little, B.Sc.
Associate, Project Manager

Stantec

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1.0 INTRODUCTION

Lehndorff Land General Partner Inc. (the Proponent) retained Stantec Consulting Ltd. (Stantec) to complete an Environmental Impact Assessment (EIA) for activities associated with the extension of Maple Road across Fulton Creek, including the installation of a box culvert (the Project). The development of residential infrastructure is necessary within the City of Edmonton to accommodate a growing population. The Project will accomplish this by allowing the Proponent to continue residential development beyond Fulton Creek as part of their approved Neighbourhood Structure Plan (NSP) for the Maple Neighbourhood (Study Area, Figure 1-1).

The Project is located within the North Saskatchewan River Valley Area Redevelopment Plan area (NSRVARP) (Bylaw No. 7188; City of Edmonton 2014a). Bylaw 7188 requires the completion of an EIA to assess the effects of the Project on the environment. This process aims to minimize effects on the environment within the North Saskatchewan River Valley and Ravine System and inform developers of environmental concerns to consider in their designs.

1.1 SCOPE

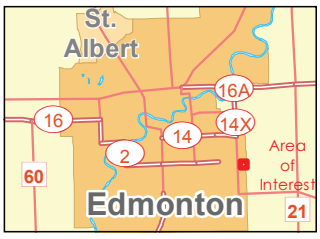
The scope of this EIA (as discussed with the City of Edmonton) is to:

- Review background information including existing reports, historical aerial photographs and to develop an understanding of the existing ecological conditions within the Study Area
- Summarize regulations and policies that will likely apply to the Project
- Describe the potential environmental effects of the Project on the biophysical environment
- Characterize anticipated residual effects remaining after mitigations are implemented
- Develop mitigation measures to address potential effects on the environment from development

1.2 STUDY AREA DESCRIPTION

The Study Area is located within a portion of SE-08-52-23 W4 in the Maple Neighbourhood of the City of Edmonton (Figure 1-1). The Study Area is currently undeveloped and part of the approved Maple NSP (City of Edmonton 2010a), surrounded by important transportation corridors including the Whitemud Drive (Highway 14) to the north, Anthony Henday Drive (Highway 216) to the east, and a Canadian National Railway line to the west.

The Study Area was selected to characterize local biophysical conditions, and discuss the effects of the Project on the environment. It covers an area of 0.57 ha and is limited to the extent of the NSRVARP boundary.



- Potential Laydown Area
- Study Area
- Area of Disturbance
- Quarter Section

0 50 100 150 200 metres

1:5,000 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 3TM 114
2. Base features: Geogratis, ©Department of Natural Resources Canada, All rights reserved.
3. Imagery: City of Edmonton Transportation, 2014

Stantec

Project Location
SE¼ 08-052-23 W4M
Edmonton, Alberta

110219456
Prepared by JC on 2015-10-28
Review by MK on 2016-12-22
Approved by KF on 2017-05-08

Client/Project
Lehndorff Land General Partner Inc.
Maple Road Fulton Creek Crossing
Environmental Impact Assessment Report

Figure No.
1-1

Title
Study Area Location

2.0 PROJECT OVERVIEW

The following sections provide a description of the Project and discusses the planned construction activities, laydown area, and erosion and sedimentation control measures.

2.1 PROJECT DESCRIPTION

In accordance with the Maple NSP (Bylaw No. 15396), the Proponent plans to extend the existing Maple Road across Fulton Creek. Maple Road will bisect a potential wildlife movement corridor along Fulton Creek upstream of Fulton Marsh. As such, the crossing structure to be deployed at Fulton Creek is designed to maintain permeability for small wildlife movement. A modified concrete box culvert has been proposed, that is sized to allow for movement of amphibians and small-sized animals. Refer to Appendix A for Project preliminary design including the drawings of the box culvert and its location.

Various types of infrastructure will be installed as part of the Project. The Project infrastructure will be described from the view of an observer looking at a cross-section of the crossing and working its way from the bottom to the top.

Deep utilities (sanitary sewer, stormwater sewer and water main) will be located approximately 2.5 to 3 m below the Fulton Creek bed. A modified concrete box culvert will sit at the creek bed height on crushed gravel substrate and weeping tile. The installation of a box culvert will serve dual purposes: to continue the conveyance of water within Fulton Creek when present, and accommodate wildlife passage under Maple Road post-construction.

The modified concrete box culvert consists of a 1.2 m high by 1.8 m wide and 50 m long concrete box structure with a notched bottom to allow “dry passage” of wildlife when normal water flows are present in the culvert. The raised area is 10 cm higher than the notch and has a 2% slope to prevent water pooling. This elevated area will also be brushed concrete, which is intended to catch a thin layer of sediment to provide a better substrate for wildlife movement yet not pose a maintenance concern. A vegetated retaining wall has also been proposed that will assist in keeping the culvert length to the shortest feasible while creating less of a visual barrier because of the vegetation.

This type of culvert is consistent with other similar crossings completed within the City of Edmonton. This structure will conform to Kintsch and Cramer’s (2011) “Class 1 Small Underpass”, which includes ephemerally flooded drainage culverts. This type of culvert has the potential to provide passage for the species movement guilds expected to be present in the Study Area. This includes the following target Environmental Design Groups (EDG): Small Terrestrial. This type of structure is considered to be adequate to allow passage of small animals (Stantec 2010a; Clevenger and Huijser 2011, Stantec 2015).

There will be scourshield 4 m wide by 6 m long covered with sod and vegetation on each end of the culvert in the creek bed. There will also be vegetated retaining walls (Sierra slope retention system) on each end of the culvert.

Shallow utilities (Telus, power and gas) will be installed 0.3 to 0.5 m above the top of the box culvert. The roadway will sit 1.42 m high from the top of the box culvert and will be 11.7 m wide. An asphalt shared used pathway, safety railing and a concrete sidewalk will be found at ground level within the 37 m right of way (RoW). For more details, consult the Project design in Appendix A.

2.2 CONSTRUCTION ACTIVITIES AND TIMING

Project construction activities include the following:

- **Site preparation:** Preparation work will be required prior to the start of construction. Vegetation will be cleared and topsoil will be stripped where needed. Access roads, laydown and stock pile areas will be prepared by clearing vegetation and stripping topsoil. Interim erosion and sediment control (ESC) measures will be implemented. Figure 1-1 illustrates the total area of vegetation clearing as well as potential laydown area locations. Fulton Creek will be diverted with pumps. The road crossing will be excavated and material will be sorted and piled.
- **Road construction:** During this phase, shallow utilities (Telus, power and gas) and the Sierra slope retention system will be installed. The area will be backfilled and the road will be built. Subgrade embankment will be prepared, granular fill will be placed, the area will be graded and asphalt will be installed. The asphalt shared use path, sidewalks and safety railing will also be built at this time.
- **Utility Installation:** Two types of utilities are planned for the Project, deep and shallow utilities. Deep utilities consist of the sanitary sewer, storm water sewer and a water main. These utilities will be installed at a depth of approximately 2.5 to 3 m below the bed of Fulton Creek, below the frost line to prevent freeze damage during colder months. Shallow utilities consist of Telus cables, a gas line and power lines and will be installed 0.3 to 0.5 m above the top of the box culvert. For more details, consult the Project design in Appendix A.
- **Reclamation**: Reclamation of the Study Area will be completed during this phase. Topsoil will be replaced and the area will be re-contoured and seeded with vegetation.
- **Operation**: Once construction is completed, Maple Road will be open for vehicle use. There will also be maintenance done on the road (e.g. snow removal and re-pavement) and the crossing structure, as needed during operation of the road.

Construction of the Project is scheduled for the fall of 2018 when Fulton creek has a low flow. The construction schedule may vary depending on regulatory approvals and market conditions, but will take place during a low flow season.

2.3 LAYDOWN AREA

The laydown area(s) will be located outside the Study Area in an area already disturbed through neighbourhood construction, likely to the north of the Study Area.

2.4 EROSION AND SEDIMENTATION CONTROL MEASURES

Permanent ESC measures will include the installation of Scourshield at each end of the culvert in the Fulton Creek bed. The Scourshield is 4 m wide by 6 m long and will be covered with sod and vegetation. For more details, consult the Project design in Appendix A.

Interim ESC measures will be developed during the detailed design process.

2.5 PROJECT ALTERNATIVES

Other crossing structures considered for installation at the Fulton Creek crossing included a round concrete or galvanized steel culvert, and an open-bottomed arch culvert. These alternatives were considered but ultimately dismissed in favour of the selected modified concrete box structure due to engineering considerations and efficacy of wildlife passage. A similar box culvert structure is located at the nearby downstream crossing of Maple Road over Fulton Creek which was used as part of the City of Edmonton's submission package for their recent Emerald Award win for wildlife passage. The proposed box culvert has been modeled after this crossing.

A summary of the alternative designs considered are provided below.

2.5.1 Alternative 1: Round concrete or galvanized steel culvert

A standard round culvert was considered for the crossing. This type of culvert would have accommodated the flows in the creek but may have accelerated the flows more than the proposed design, especially during times of higher flow. This could have been mitigated through design of additional permanent ESC measures. This type of culvert would have had limited wildlife passage function as there would be no potential for dry passage any time there was flow in the creek.

2.5.2 Alternative 2: Open bottom arch culvert

An open bottom arch culvert was considered for this crossing but quickly dismissed. This type of culvert could likely have been designed to create very limited impact to the hydrology of the creek, and provide wildlife passage that incorporated the natural substrate. However, it was found that an open bottom culvert is not feasible at this location due to topographical and engineering constraints. There is not enough topographic relief in this ravine to install an open bottom culvert without elevating the roadway, and this is not possible without significant alterations to infrastructure already constructed in the area. The major drainage flows in this

neighbourhood are designed to flow north down Maple Road across this creek crossing towards Fulton Marsh. If the crossing was to be elevated, these flows would need to be diverted south towards 8 Street, then back to Fulton Marsh. Portions of 8 Street are already constructed along with housing and residents already in place. Such a re-direct of flows would require redesign and reconstruction of the existing infrastructure, which would be both costly and disruptive to the local residents.

3.0 APPLICABLE REGULATIONS

Various federal, provincial and municipal acts, regulations or bylaws may apply to the Project including those listed in the table below.

Table 3-1 Applicable Regulations

Name of Regulatory Consideration	Federal, Provincial or Municipal
Fisheries Act	Federal
Migratory Birds Convention Act, 1994	Federal
Species At Risk Act	Federal
Environmental Protection and Enhancement Act	Provincial
Historical Resources Act	Provincial
Public Lands Act	Provincial
Occupation Health and Safety Act	Provincial
Water Act	Provincial
Weed Control Act	Provincial
Wildlife Act	Provincial
City of Edmonton North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188) (City of Edmonton 2014a)	Municipal
City of Edmonton Community Standards Bylaw (Bylaw 14600) (City of Edmonton 2015a)	Municipal
The Way We Grow, Municipal Development Plan (Bylaw 15100) (City of Edmonton 2010b)	Municipal
Corporate Tree Management Policy (Policy C456A) (City of Edmonton 2010c)	Municipal
Way We Green, City of Edmonton Environmental Strategic Plan (City of Edmonton 2011)	Municipal
City of Edmonton Erosion and Sediment Control Guidelines Field Manual (City of Edmonton 2005a and b)	Municipal

4.0 METHODS

The EIA involved a review of historic aerial photographs, a background research of available information, field assessments, and an assessment of potential effects resulting from Project construction and post-construction activities within the Study Area. The following sections discuss in detail the methods used in this EIA.

4.1 DESKTOP REVIEW

The methods used for the desktop review are described in the following sections.

4.1.1 Historical Aerial Photograph Review

CT & Associates Engineering Inc. (2015) prepared a review from historical aerial photographs dating from1949 to 2011 for the Project as part of their site-specific geotechnical investigation. Their findings were reviewed, summarized, and used to provide input to the effects assessment

4.1.2 Background Research

Relevant available information pertaining to the Study Area for climate, water quality and hydrology, geology, terrain and soils, fisheries, vegetation, wildlife, and the socio-economic environment was reviewed and used to guide the field assessment and effects assessment. Information sources that were reviewed included scientific journals, previous reports, reference material and other literature, internet sites, and online databases.

4.1.3 Species Occurrence

The method used to research the occurrence of rare vegetation, fish species and wildlife species in the Study Area is described below.

4.1.3.1 Rare Vegetation Species

Scientific names for plant species follow the Integrated Taxonomic Information System (ITIS) (2015). Common names for plant species conform to the Alberta Conservation Information Management System (ACIMS) (AEP 2015a). Otherwise, regulated and listed species naming conventions used scientific and common names within these specific documents: *Species at Risk Act* (S.C. 2002, c. 29) and the Alberta *Weed Control Regulation* (Alta. Reg. 19/2010).

A search within 08-052-23 W4M was conducted through the ACIMS on June 9, 2015 for historical occurrences of rare plants and rare ecological communities. Species of conservation concern identified via the ACIMS database inquiry are summarized and referenced to the Subnational Status Rank (S Rank) and definition (AEP 2015b). Pertinent life history and habitat requirements for these species are discussed where appropriate.

4.1.3.2 Fish and Wildlife

The Fish and Wildlife Management Information System (FWMIS) (AEP 2015c) database was queried on November 6, 2015 for occurrence data of fish species within a 1 km of the centroid of SE-08-052-23 W4M. The FWMIS database was also queried for occurrence data of wildlife species of management concern within 2 km of the center of the Study Area. Stantec used the 2 km area to capture species with large home ranges that may occur in the Study Area.

4.2 FIELD PROGRAM

A field assessment was completed to collect site-specific information on vegetation and wildlife species occurring in the Study Area.

4.2.1 Vegetation: Rare Plant and Site Characterization Surveys

Vegetation within the Study Area was assessed using rare plant surveys in conjunction with site characterization surveys. The objective of the rare plant and site characterization surveys were to classify the vegetation within the Study Area according to upland and wetland land units based on existing ecological land classifications. The surveys were also conducted to identify sensitive environmental conditions as they pertain to vegetation, to allow for the development of appropriate mitigation, conservation, and management recommendations, as required.

During the vegetation assessment, information on plant species and ecological communities of management concern, if present, was collected. Species and communities of management concern include:

- Uncommon communities and or those sensitive to watershed disturbance (e.g. old growth forest, wetlands) identified from upland ecosite phase and wetland class mapping
- Rare plants and rare ecological communities
- *Noxious* and *prohibited noxious* weeds (as per the *Weed Control Act* [S.A. 2008, c. W-5.1])

4.2.1.1 Rare Plant Survey Preparation

Before field data was collected, historical rare plant and rare ecological community records from the ACIMS were searched (see Section 4.1.3.1). Additionally, a list of rare plant species that have the potential to be found in the NSR valley was compiled from *Rare Vascular Plants of Alberta* (Kershaw et al. 2001) and historical rare plant records available from ACIMS. Habitat information for each rare plant species was researched to determine which species have the highest potential of being located within the NSR valley and provide surveyors with a better understanding of the characteristics and habitats of rare plants that could be found. ACIMS tracking and watch lists were printed for reference in the field.

Vegetation and wetland land units within the Study Area were classified using a Central Parkland (Natural Regions Committee 2006) Classification system derived from the following sources:

- *A Preliminary Classification of Plant Communities in the Central Parkland Natural Subregion of Alberta* (Wheatly and Bentz 2002) for uplands
- *Stewart and Kantrud Wetland Classification System* (1971) for wetlands
- *Alberta Vegetation Inventory Standards Manual* (Alberta Environmental Protection1991) for agricultural, industrial and settled lands

4.2.1.2 Field Data Collection

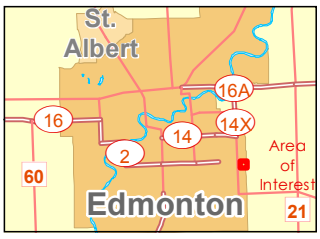
Site characterization and rare plant surveys were completed by a rare plant specialist, and were conducted simultaneously at each survey location. Surveys were conducted within the Study Area in two survey intervals to capture different flowering times of targeted species (Figure 4-1). One site characterization and rare plant survey was conducted on June 10, 2015 (spring survey) and another one on August 7, 2015 (summer survey).

Vegetation data gathered within the Study Area, during the site characterization surveys, included percent cover of characteristic tree, shrub, herbaceous, and non-vascular species. Additionally, general site information was recorded, including soil moisture regime, slope and aspect, slope position, and structural stage.

Each survey site was classified to the appropriate upland or wetland land unit using the Central Parkland Classification system. Additionally, GPS coordinates were recorded and representative site photos were taken. Notes on ecological communities or conditions, if present, that may require special consideration, were also made.

For the rare plant surveys, a meander survey within the plant community was completed. A comprehensive species list was compiled at each site until no new species were found. Specimens requiring further examination or species confirmation were collected, with the exception of plants where seed heads or flowers required for identification to species level were unavailable or where plant populations were small (i.e., no more than 1 in 50, Alberta Native Plant Council 2006).

To assess bryophytes (mosses and liverworts), all microhabitat types present at a site were examined for presence of species. Sampling of bryophytes by microhabitat is the recommended protocol of the Alberta Biodiversity Monitoring Protocol (Doubt and Belland 2000). Species that could be identified on the basis of macroscopic features, were noted. Species that required microscopic examination for correct species identification were collected. As collections are required to define almost all rare bryophyte species, determination of population size and extent is not possible.



- Spring Rare Plant Survey
- Summer Rare Plant Survey
- Study Area
- Area of Disturbance
- ATS Quarter Section Grid

0 50 100 150 200 metres

1:5,000 (at original document size of 8.5x11)

Stantec

Notes
1. Coordinate System: NAD 1983 3TM 114
2. Base features: Geogratis, ©Department of Natural Resources Canada. All rights reserved.
3. Imagery: City of Edmonton Transportation, 2014

Project Location
SE¼ 08-052-23 W4M
Edmonton, Alberta

110219456
Prepared by LF on 2015-09-16
Review by MK on 2016-12-22

Client/Project
Lehndorff Land General Partner Inc.
Maple Road Fulton Creek Crossing
Environmental Impact Assessment Report

Figure No.
4-1

Title
Rare Plant Survey Locations

4.2.1.3 Plant Identification

Collected vascular plant species were identified by a botanist while collected bryophytes were identified by a bryologist. Comprehensive species lists were then referenced to ACIMS tracking and watch lists and *SARA* (*Species at Risk Act*. S.C. 2002, c. 29) to ensure all plants considered to be rare were identified.

4.2.1.4 Weed Identification

Occurrences of species identified as *prohibited noxious* (Schedule 1) or *noxious* (Schedule 2) in the *Weed Control Regulation* were also included at each survey site. Occurrences of these species were recorded on a weed survey form taken from the *R&R / 03-4 Weeds on Industrial Development Sites – Regulations and Guidelines* (Alberta Environment 2003).

4.2.2 Wildlife

The methods used in the breeding bird and amphibian surveys during the field assessments are described below.

4.2.2.1 Breeding bird Survey

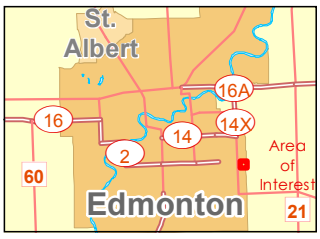
A breeding bird survey was conducted in the Study Area on June 11 and June 25, 2015 between sunrise and 10:00 a.m. during the peak breeding period for migratory songbirds (Figure 4-2). A modified fixed-radius point count sampling survey procedure (Bibby et al. 1993) was used to document bird species diversity and abundance. Surveys were preceded by two minutes of silence to minimize any disturbance caused by the arrival of observers.

Surveys consisted of two consecutive five minute periods where all birds heard vocalizing, or observed within 100 m of the point, were recorded. The two independent survey periods can be used to support an estimate of detectability, and the longer survey period is important for detecting quieter or more secretive species. Surveys were conducted twice within the breeding bird season as required by Alberta Environment and Parks (AEP) (ESRD 2013) guidelines.

Surveys were not conducted when wind speeds were above 20km/h (i.e. Beaufort 3), or during periods of strong rain as these conditions tend to decrease bird activity and hinder the ability of observers to effectively detect birds. Incidental observations of birds detected outside the 100 m point count radius during the survey were also recorded as incidentals and were included in the species list of birds observed. The species list includes all incidental observations.

4.2.2.2 Amphibian Survey

Amphibian surveys were conducted in the Study Area on May 15th and 21st, and June 3rd, 2015, at one location from 30 minutes after sunset to 2:00 AM (Figure 4-2). The amphibian survey was conducted in accordance with standard protocols (ESRD 2013). The amphibian survey consisted of a two minute period of silence to reduce disturbance effects associated with the arrival of observers, followed by a five minute listening period where all amphibian species detected were recorded. The amphibian survey was conducted at wind speeds below 20km/h (i.e., Beaufort 3) and conditions not exceeding a light rain to optimize the ability of observers to effectively hear all amphibians vocalizing. Incidental wildlife species encountered during the amphibian survey were also recorded.



Wildlife Survey Location

- Amphibian
- Bird
- Study Area
- ATS Quarter Section Grid

0 50 100 150 200 metres

1:5,000 (at original document size of 8.5x11)

Stantec

Project Location
SE¼ 08-052-23 W4M
Edmonton, Alberta

110219456
Prepared by JC on 2015-10-28
Review by MK on 2016-12-22

Client/Project
Lehndorff Land General Partner Inc.
Maple Road Fulton Creek Crossing
Environmental Impact Assessment Report

Figure No.
4-2

Title
Wildlife Survey Locations

Notes
1. Coordinate System: NAD 1983 3TM 114
2. Base features: Geogratis, ©Department of Natural Resources Canada. All rights reserved.
3. Imagery: City of Edmonton Transportation, 2014

4.3 ENVIRONMENTAL EFFECTS ASSESSMENT

The following five environmental components were considered when evaluating the effects of this project:

- Water quality and hydrology
- Vegetation
- Wildlife
- Aesthetics
- Noise

Fisheries was initially considered, but was excluded as the presence of fish is not anticipated in the Study Area. Fulton Creek is considered a Class D waterbody with several barriers to fish presence downstream of the Project. Fulton Creek's channel is also dry for much of the year. In addition, no fish occurrence in the Study Area was retrieved through the FWMIS search (Section 5.4) and previous email correspondence with local fish and wildlife technicians has revealed studies by Pisces Environmental in the connected Fulton Marsh to have not caught any fish and cast doubt on the ability of Fulton Creek to support fish (pers. Comm. Daryl Watters 2005). As such, this component was not analyzed as part of the environmental effects assessment.

Any effect on fish habitat downstream of the Project due to instream work was addressed in the effect assessment of water quality and hydrology in Section 6.1.

The effects of the Project were characterized based on the magnitude of the effect, its spatial extent, and duration of the effect (Noble 2006). Definitions of magnitude, spatial extent, and duration are provided in Table 4-1.

Specific definitions for magnitude are particular to the environmental component being considered. For example, the magnitude of a vegetation effect relates to total area of vegetation disturbance and pre-disturbance species composition, since this may have an effect on re-vegetation success, post-construction species composition of re-vegetated areas, and invasion by weedy/undesirable species. These variables are not applicable to other environmental components, therefore they are unique to each component. The definitions of magnitude provided are based upon generally accepted knowledge and professional judgment.

Table 4-1 Effect Characterization Definitions

Parameter		Definition
Magnitude	Water quality and Hydrology	**Low** - Minimal decrease in water quality in Fulton creek during/post-construction, parameters ≤7.5% higher than baseline and minimal change in the timing and magnitude of stream flow discharge ≤5% of baseline **Moderate** – Partial decrease in water quality in Fulton creek during/post-construction, parameters 7.5% - 10% higher than baseline and partial change in the timing and magnitude of stream flow discharge ≤25% of baseline **High** – Substantial decrease in water quality in Fulton creek during/post-construction, parameters ≥10% higher than baseline and total change in the timing and magnitude of stream flow discharge ≥50% of baseline
	Vegetation	**Low** – The distribution and abundance of native plant communities, rare plants, or rare ecological communities are not reduced in the Study Area beyond natural variation. **Moderate** – The distribution and abundance of native plant communities, rare plants, or rare ecological communities are reduced, but not lost, in the Study Area. **High** – The distribution and abundance of native plant communities, rare plants, or rare ecological communities are completely removed from the Study Area.
	Wildlife	**Low** – No wildlife species will be permanently forced away from the Study Area and wildlife movement corridors will not be affected. **Moderate** – Some species may be permanently forced away from the Study Area. Wildlife movement corridors will not be permanently disrupted. **High** – The Project will result in some species of management concern no longer using the Study Area on a permanent basis. Wildlife corridors will be lost.
	Aesthetics	**Low** – Minor loss or alteration to key elements/features/characteristics of view, and/or may not be uncharacteristic of the broader area. **Moderate** – Partial loss or alteration to key elements/features/characteristics of view, and/or may be somewhat uncharacteristic of the broader area. **High** – Total loss or alteration to key elements/features/characteristics of view, and/or totally uncharacteristic of the broader area.
	Noise	**Low** – minor change to perceived noise levels **Moderate** – moderate change to perceived noise levels **High** – large change to perceived noise levels and/or exceeds municipal sound level guidelines

Parameter	Definition
Spatial Extent	**Project** – effect is only measurable within the confines of the proposed Study Area **Local** – effect is measurable within 1 km of the proposed Study Area **Regional** – effect is measurable within 25 km of the proposed Study Area
Duration	**Short** – effect is measurable for 1-5 years. **Medium** – effect is measurable for 6-15 years. **Long** – effect is measurable for 16+ years.

5.0 BASELINE CONDITIONS

The following sections summarize the results of the desktop review and field assessments, and provide an understanding of the existing ecological conditions in the Study Area.

5.1 HISTORICAL AERIAL PHOTOGRAPH REVIEW

CT & Associates Engineering Inc. (2015) summarized the historical air photo review (1949 to 2011) as follows (see Appendix D of CT & Associates Engineering Inc. (2015) for historical air photos):

- "The areas immediately to the north and south of the creek have been undeveloped and vacant, grassy land, with no surface grading or other activities in the area;
- No instabilities or erosion effects are observed in the historical air photos of the drainage"

5.2 WATER QUALITY AND HYDROLOGY

The general groundwater movement in the Project vicinity is toward the northwest, in the direction of the NSR (Ceroici 1979).

Fulton Creek is part of the Mill Creek / Fulton Creek Drainage Basin. The basin is approximately 13,000 ha, with approximately 3,300 ha of this area being part of the Fulton Creek watershed. Approximately 60% of the basin lies outside the City limits in Strathcona County. The Fulton Creek watershed primarily consists of undeveloped agricultural land with some commercial and industrial developments scattered throughout. Within the City limits, a large proportion of the Fulton Creek drainage basin has been fragmented, altered, or channelized, and is presently dominated by industrial developments (Associated Engineering 1999). As a result, extensive sections of Fulton Creek have been directed into the Argyll Tunnel, a storm sewer channel, although portions of the ravine remain.

Fulton Creek enters the City from the southeast, passes through Fulton Marsh, and follows a meandering course that eventually enters the Argyll Tunnel in the Weir Industrial Park, which is located at 68 Avenue NW near 50 Street NW. The flow from Fulton Creek eventually connects with a stormwater line that carries water from the Mill Creek watershed. The combined flow from both watersheds flows through 5 km of underground pipe before entering a natural portion of the Mill Creek Ravine, west of 83 Street NW and north of Argyll Road. It then flows for approximately 1.3 km before being directed into another storm sewer pipe south of Whyte Avenue and east of 96 Street NW. The creek remains in pipe for a distance of approximately 0.6 km before discharging into the North Saskatchewan River.

During a storm event, peak flows in the Fulton Creek watershed can be delayed by up to two days as a consequence of the biophysical and topographical conditions of the watershed. In June 1997, 105 mm of rainfall accumulated in the basin, causing extensive flooding in low-lying

areas. Pre-development peak flows have been estimated for Fulton Creek using hydrological models and are predicted to be 2.99 m^3/s for a storm event (based on a 1978 event). Of this volume of water, 2.62 m^3/s is contributed by Strathcona County and 0.372 m^3/s is contributed by the area within Maple Neighbourhood (pers. comm. Trevor Singbeil 2010).

5.3 GEOLOGY, TERRAIN AND SOILS

The geology in the vicinity of the Project consists of unconsolidated deposits of glaciolacustrine material and glacial till. The glaciolacustrine deposits consist of sands, silts, and clays deposited in a preglacial lake (i.e., Glacial Lake Edmonton). The glacial till consists of unsorted and unstratified clay, silt, and sand sediments. The Edmonton Formation, which is bedrock that underlies the area, consists of fine-grained bentonitic sandstone and siltstone integrated with bentonitic silty clay sandstone (Kathol and McPherson 1975)

The Project is situated in generally flat to gently rolling terrain. The topography in the vicinity of the Project is hummocky moraines with well-defined knobs, doughnut-shaped hills, and kettles, with a relief that ranges from 5 to 20 m.

The majority of the soils in the vicinity of the Project are broadly classified as Chernozems. Chernozems typically occur in relatively well drained areas. The characteristic organic surface horizon develops from a build-up of grass and forb roots that decompose slowly, allowing the accumulation of organic matter in the soil. Soil types within the vicinity of Project are Ponoka Loam and Angus Ridge Loam. Ponoka Loam is an Eluviated Black to Orthic Black Chernozem that developed on alluvial lacustrine material. Angus Ridge Loam is an Eluviated Black Chernozem developed on glacial till. Several isolated pockets of Organic soils that developed under sedge and moss peats are located in the vicinity of the Study Area (Kathol and McPherson 1975).

The soil stratigraphy in the Project location consist of topsoil and organic soil from a depth of 0.3 to 0.8 m, followed by a till like clay soil from a depth of 0.8 to 4.1 m and a clay till from a depth of 4.1 to 13.4 m (CT & Associates Engineering Inc. 2015).

5.4 FISHERIES

Fulton Creek headwaters are currently in a shallow slough approximately 8 km east of 34 Street NW. Downstream of Fulton Marsh, Fulton Creek has been converted into a pipe sewer system (i.e., Argyll tunnel) near 68 Avenue NW. Due to habitat limitations as a result of the conversion of a significant portion of Fulton Creek into a stormwater system extending from the Argyll tunnel located near 68 Avenue NW and 50 Street NW, the potential for Fulton Creek and Fulton Marsh to support game fish is low (pers. comm. Daryl Watters 2005 as cited in Stantec 2010b).

Fulton Creek crosses through the central portion of the NSP in an east-west direction from Highway 216 in the east to Fulton Marsh, and is ephemeral within the Bylaw 7188 boundaries.

Spencer (2007) characterized Fulton Creek as a narrow, ephemeral, meandering creek located within a shallow ravine, with early spring snow melt providing the majority of the instream flow throughout that period. During the rest of the year, flow in the creek is minimal and Fulton Creek often dries up by mid- to late-summer, although isolated pools may remain.

Spencer (2007) also indicated that Fulton Creek did not support fish and was incapable of supporting fish on a continuous basis (at the Pylypow Stormwater Pond downstream of the Project). They indicated that fish presence in Fulton Creek by fish originating from the NSR was impossible as a result of the Mill Creek outfall structure (through which Fulton Creek ultimately drains), which is an impassable barrier to fish.

Stantec (2010b) reported that Alberta Environment and Alberta Sustainable Resource Development (2006) classified Fulton Creek and Fulton Marsh as Class D (i.e., non-sport fish bearing) water bodies.

5.4.1 Fisheries Species Occurrence

No occurrence of fish within the Study Area was obtained from the FWMIS database. The Project is also not located within any Aquatic Environmentally Significant Areas (AESA).

5.5 VEGETATION

Fulton Creek, in which the Project is located, has been designated as an Environmentally Sensitive Area (ESA), with local significance, within the NSR Valley and Ravine System (GEOWEST 1993). An ESA is defined as 'undisturbed or relatively undisturbed sites which, because of their natural features have value to society and ecosystems worth protecting' (GEOWEST 1993). Fulton Creek is located within the Central Parkland Natural Subregion (Central Parkland), which is located within the Parkland Natural Region (Natural Regions Committee 2006). This subregion is a large transition zone between the Boreal Forest Natural Region to the north and the Grassland Natural Region to the south. The Central Parkland is dominated by undulating till plains and hummocky uplands. Under natural conditions, native vegetation community remnants are a mosaic of aspen (*Populus tremuloides*) dominated forest stands on moist sites intermixed with prairie vegetation on drier sites. Stands of aspen dominated forest are found throughout the Central Parkland and have understories dominated by saskatoon (*Amelanchier alnifolia*), prickly rose (*Rosa acicularis*), and beaked hazelnut (*Corylus cornuta*). Stands dominated by balsam poplar (*Populus balsamifera*) occur on moist, nutrient rich sites, and often have aspen and white spruce (*Picea glauca*) intermixed within the stand (NRC 2006).

The Study Area was classified an Aspen Poplar Woodland Alliance (Wheatly and Bentz 2002), surrounded by agricultural and residential land use.

5.5.1 Rare Vegetation Species

There were no historical occurrences of rare species or plant communities within 08-052-23 W4M within the ACIMS.

A spring rare plant survey was conducted on June 10, 2015 followed by a summer rare plant survey on August 7, 2015. No rare plants were observed during these surveys.

The Study Area was classified as an Aspen Poplar Woodland Alliance (Wheatly and Bentz 2002). This upland woodland alliance has a deciduous-dominated forest canopy of both aspen and balsam poplar. This unit is characteristically found in lower slope positions along streams and riverbanks, on moderately to imperfectly drained soils, as was observed within the Study Area. The shrub layer was dominated by beaked willow (*Salix bebbiana*), prickly rose, and red-osier dogwood (*Cornus sericea*). The ground cover layer was dominated by smooth brome (*Bromus inermis*), spotted touch-me-not (*Impatiens capensis*), northern bedstraw (*Galium boreale*), bluegrass species (*Poa* spp.) and wild mint (*Mentha arvensis*). A comprehensive list of species observed during the spring and summer rare plant surveys are provided in Appendix B.

5.5.2 Weeds

Three species designated as *noxious* in the *Weed Control Regulation* were observed:

- common burdock (*Arctium minus*)
- creeping thistle (*Cirsium arvense*)
- scentless chamomile (*Tripleurospermum inodorum*)

All *noxious* species were found in low densities within the Study Area.

5.6 WILDLIFE

The following sections discuss various types of wildlife that are or may be present in the Study Area.

5.6.1 Amphibians and Reptiles

Amphibians and reptiles represent less than five percent of species that have the potential to occur in the Study Area (City of Edmonton 2008). Amphibians and reptiles that may be found within Edmonton consist of:

- wood frog (*Lithobates sylvatica*),
- boreal chorus frog (*Pseudacris maculata*),
- red-sided garter snake (*Thamnophis sirtalis parietalis*)
- tiger salamander (*Ambystoma tigrinum*)
- plains garter snake (*Thamnophis radix*)

- Canadian toad (*Anaxyrus hemiophrys*), and
- western toad (*Anaxyrus boreas*).

The latter three species are considered less common. Western toads have been recorded around Big Lake in the northwest corner of Edmonton (AMEC 2002; Stantec 2007) while Canadian toads have been recorded in the Clover Bar waste management area in early 2000 and in Terwillegar park in 2004, 2005 and 2013 (Browne 2009; Stantec 2014).

Boreal chorus frog was the only amphibian species detected during the field program. Boreal chorus frogs are not a listed or ranked species, provincially or federally.

5.6.2 Mammals

According to the City of Edmonton (2008), mammals represent approximately 20 percent of species that may occur in Edmonton. Small mammals common in the Greater Edmonton area include beaver (*Castor canadensis*), muskrat (*Ondatra zibethica*), snowshoe hare (*Lepus americanus*), Franklin's ground squirrel (*Citellus franklinii*), northern flying squirrel (*Glaucomys sabrinus*), porcupine (*Erethizon dorsatum*), red squirrel (*Tamiasciurus hudsonicus*), skunk (*Mephitis mephitis*), white-tailed jack rabbit (*Lepus townsendii*), deer mice (*Peromyscus maniculatus*), red backed vole (*Microtus microtus*), shrews (Family *Soricidae*), western jumping mice (*Zapus princeps*), house mouse (*Mus musculus*), and big brown bat (*Eptesicus fuscus*) (EPEC 1981; City of Edmonton 2008). Some larger mammals such as white-tailed deer (*Odocoileus virginianus*), mule deer *(Odocoileus hemionus*), moose (*Alces alces*), coyote (*Canis latrans*), and red fox (*Vulpes vulpes*) are also commonly observed in the NSR valley and ravine system. Other large mammals including black bear (*Ursus americanus*), Canada lynx (*Lynx canadensis*), and cougar (*Puma concolor*) may also be observed occasionally within Edmonton because the NSR valley is part of a large ecological corridor that provides connectivity across the province that may be used by these large mammals (EPEC 1981).

A White-tailed deer and signs of the species were observed incidentally during breeding bird surveys.

5.6.3 Birds

Although the total number of bird species varies in the literature, it is estimated that birds represent approximately 80 percent of wildlife species that may occur in Edmonton. According to the City of Edmonton (2008), 178 bird species occur within Edmonton, while Spencer (1976) recorded 73 bird species in four ravines in the NSR Valley and Ravine System during 1972 and 1973, and EPEC (1981) estimated that 150 bird species occur within the NSR Valley and Ravine System. However, a large number of these species are neo-tropical migrants and are only present during the breeding season. Outside of the breeding season, resident and regional migrants can be present in Edmonton (e.g. owls, waxwings, jays and crows, grouse, chickadees). Urban areas are also home to a number of non-native species of birds (e.g., consisting of

European starling [*Sturnus vulgaris*), gray partridge [*Perdrix perdrix*], house sparrow [*Passer domesticus*], ring-necked pheasant [*Phasianus colchius*], and rock pigeon [*Columbia livi*]) are considered exotic and are not native to the Study Area). The Edmonton Christmas Bird Count conducted in December 2014 confirmed the presence of 48 bird species, mostly year-round residents or species in their wintering range (National Audubon Society 2015).

Ten bird species were detected during the field program. Table 5-1 lists the species detected and the provincial and federal status ranks associated with each species. None of the species detected are species of management concern, rather most are commonly-occurring, urban-adapted species that do well in small habitat patches or in edge habitat.

Table 5-1 Birds Detected in the Study Area

Common Name	Scientific Name	AEP General Status Ranks[1]	Species at Risk Act (Schedule, Status)[2]
Chipping sparrow	*Spizella passerina*	Secure	No Schedule, No Status
Yellow warbler	*Setophaga petechia*	Secure	No Schedule, No Status
Song sparrow	*Melospiza melodia*	Secure	No Schedule, No Status
American goldfinch	*Carduelis tristis*	Secure	No Schedule, No Status
House wren	*Troglodytes aedon*	Secure	No Schedule, No Status
American crow	*Corvus brachyrhynchos*	Secure	No Schedule, No Status
Orange-crowned Warbler	*Vermivora celata*	Secure	No Schedule, No Status
Savannah sparrow	*Passerculus sandwichensis*	Secure	No Schedule, No Status
Brown-headed Cowbird	*Molothrus ater*	Secure	No Schedule, No Status
Black-capped Chickadee	*Poecile atricapillus*	Secure	No Schedule, No Status

Notes:
[1]AEP (2012)
[2]Government of Canada (2015)

5.6.4 Rare Wildlife Species

A query of the FWMIS database, yielded seven occurrence records of bird species of management concern within a 2 km radius of the Project (Table 5-2).

Table 5-1 Species of Management Concern FWMIS Records (2 km radius)

Common Name	Scientific Name	AEP General Status Ranks[1]	Species at Risk Act (Schedule, Status)[2]	Factors contributing to AEP General Status Rank[1]
American kestrel	*Falco sparverius*	Sensitive	No Schedule, No Status	Not available.
Least flycatcher	*Empidonax minimus*	Sensitive	No Schedule, No Status	Species has been declining in Alberta and surrounding jurisdictions. May be threatened by habitat changes on wintering range.
Lesser scaup	*Aythya affinis*	Sensitive	No Schedule, No Status	Surveys show a long-term decline in populations within Alberta and surrounding jurisdictions. Alteration and loss of suitable habitat may pose threats.
Northern pintail	*Anas acuta*	Sensitive	No Schedule, No Status	Widespread species with severe population declines across North America in last 40 years. Wetland habitat threatened by drought and drainage. Conservation of temporary wetlands in native habitats essential.
Sora	*Porzana carolina*	Sensitive	No Schedule, No Status	Large (>50%) declines have occurred in Alberta and all surrounding jurisdictions since 1994. Species threatened by loss of wetland habitat.
Swainson's hawk	*Buteo swainsoni*	Sensitive	No Schedule, No Status	Adult population recently subjected to mass poisoning on winter range. Dependent on healthy ground squirrel population.
Western wood-pewee	*Contopus sordidulus*	Sensitive	No Schedule, No Status	Not available.

Notes:
[1]AEP (2012)
[2]Government of Canada (2015)

Table 5-2 evaluates the likelihood of bird species of management concern to be present in the Study Area. Each species identified in the FWMIS query and its breeding habitat requirements are listed, because this is the most important life requisite. This is followed by a determination of whether the Project is likely to affect the breeding habitat for each species (i.e., is breeding habitat available in the Study Area). Species of management concern that could be affected by Project activities are least flycatcher and western wood-pewee because they may use the Project footprint for breeding activities.

Table 5-2 Species of Management Concern Occurrence Likelihood in the Study Area

Common Name	Key Habitat Requirements and life requisite	Key Habitat Available in the Study Area (yes or no)
American kestrel	Mature or old trees with woodpecker excavated cavities- breeding	No
Least flycatcher	Deciduous and mixed forests, can be locally abundant - breeding	Yes
Lesser scaup	Large seasonal or small semi-permanent wetlands with emergent vegetation-breeding	No
Northern pintail	Shallow wetlands interspersed with prairie grasslands or arctic tundra--breeding	No
Sora	Freshwater marshes with abundant emergent vegetation - breeding	No
Swainson's hawk	Scattered tree within grassland, shrubland or agricultural landscapes—breeding	No
Western wood-pewee	Woodlands and forests, especially forest edge and riparian zones-breeding	Yes
Notes: all habitat associations were derived from the Birds of North America Online website: http://bna.birds.cornell.edu/bna/		

5.7 SOCIO-ECONOMIC ENVIRONMENT

The following sections discuss the results of the socio-economic environment desktop review in the Study Area.

5.7.1 Land Use

The Project occurs within the Maple Consolidated NSP area. It is located within a mixed-use region containing urban commercial, residential and recreational areas.

This neighbourhood is surrounded with transportation infrastructure on all sides creating well-defined boundaries and limited connectivity points. Situated immediately west of the Maple neighbourhood is a railway line beyond which is the Tamarack neighbourhood, which consists primarily of residential land uses and some commercial use. Further west, across 17 Street, are the developed residential neighbourhoods of Larkspur and Wild Rose. The lands to the north of Whitemud Drive are within the proposed Maple Ridge Industrial Area Structure Plan (ASP). Land immediately north of the Maple NSP is utilized by the City of Edmonton as a snow dump and a private land owner operates a funeral home and cemetery. To the east and south of the plan area are Transportation and Utility Corridor (TUC) lands, owned by the Province. These lands are set aside for the purposes of providing land for regional transportation and utility infrastructure (e.g. Highway 216/Anthony Henday Drive, major transmission facilities, and pipelines). Beyond the TUC lands to the south is currently undeveloped farmland. Beyond the TUC lands east of Highway 216 are lands within Strathcona County which are primarily used for agricultural uses, but are designated for rural/urban transitional land uses in the Strathcona County Municipal Development Plan.

5.7.2 Archaeology and Historic Resources

The Maple NSP Consolidation (Stantec 2010b) described the results of a Historical Resources Impact Assessment, as follows

> *"In preparation of The Maple NSP, Historical Resource Management Ltd. conducted a Historical Resources Impact Assessment (HRIA) for Dundee Developments in 2005. Copies of this report were submitted and approved by Alberta Community Development Archaeology in 2005. Based on the long cultivation and agricultural history for this area, no significant historic, archaeological, paleontological resources or concerns were identified within the proponents' subject lands following a pedestrian and detailed review of relevant background materials. As a result, HRIA investigation findings and recommendations conclude suburban development will not impact any significant historical resources and that the author recommends that "the project be given clearance under the Historical Resources Act." In accordance with Section 31 of the Historical Resources Act, development proponents and/or their representatives are required to report the discovery of any archaeological, historic period or paleontological resources, which may be encountered during construction."*

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT

The following sections outline the potential effects of construction and use of the area once construction is complete, recommended mitigation measures, and evaluation of residual effects of the Project after mitigation measures have been implemented.

Five components have been assessed for effects from Project activities. Main findings of existing conditions in the Study Area are summarized in Section 5 to provide context for the assessment of effects. These components include:

- Water quality and hydrology
- Vegetation
- Wildlife
- Aesthetics
- Noise

Mitigation measures designed to reduce the degree of effects are discussed. The potential effects are characterized as described in Section 4.3 (i.e., magnitude, spatial extent, duration, likelihood of occurrence) and Project phases are described in Section 2.2. Where possible, discussions of effects as a result of the construction activities and corresponding mitigation measures have been combined for readability and to reduce redundancy within this report.

6.1 WATER QUALITY AND HYDROLOGY

The following sections discuss effects to water quality and hydrology within and surrounding the Study Area as a result of the Project.

6.1.1 Potential Effects

The potential effects of the Project on water quality and hydrology include:

- Change to water quality
- Change in site drainage (including hydraulics and hydrology)

Surface and groundwater could be encountered during the installation of the crossing structure and water quality and hydrology could be adversely affected. Potential effects will result from the site preparation and operation phases.

Change to Water Quality

Changes to water quality are regulated under federal, provincial and municipal legislations. Water quality could potentially be adversely affected by Project activities, and could affect

downstream aquatic habitats through overland surface flows, erosion and sedimentation, and instream flow. Water quality may be affected by:

- Increases in suspended sediment levels into Fulton Creek from runoff from construction activity.
- Introduction of deleterious substances from construction equipment during installation of the crossing structure and utilities in the Study Area.

Change to Site Drainage

Edmonton Municipal Bylaw 16200 requires that an approval be obtained prior to any grading or alteration of site drainage at the Project site and restricts the release of matter into watercourses or sewage systems without approvals. Site drainage changes are anticipated as a result of Project activities through overland surface flows, erosion and sedimentation, and instream flow.

The culvert will have a smooth concrete surface and will accelerate flows as they pass through the culvert. The design team has calculated that during a 1:5 year event, the velocity will be increased by 246% (from 0.46 m/s to 1.13 m/s) and in the 1978 storm event the velocity will be increased by 332% (from 0.72 m/s to 2.39 m/s). Left unchecked these increases in flow could cause scour and result in erosion to the downstream channel.

6.1.2 Proposed Mitigation Measures

The following mitigation measures have been developed for the Project and are expected to reduce potential effects on water quality and hydrology.

Change to Water Quality

- Conduct instream construction activities during periods of low or no flow.
- Minimize Project footprint in forested areas. Locate temporary laydown areas in previously disturbed areas.
- Implement and monitor all required ESC measures during site preparation, instream works, road construction, and post-construction cleanup and reclamation at the guidance of a professional in ESC, preferably a Certified Erosion and Sediment Control (CPESC) specialist.
- A Qualified Aquatic Environmental Specialist (QAES) should be retained to conduct regular sediment monitoring of instream activities to ensure that adverse effects are avoided or minimized if the construction takes place during a period where there are flows in the creek.
- If any ESC or containment measures fail and sediment laden runoff water enters Fulton Creek, the proper authorities will be notified immediately of a release. The contractor will be required to determine where the deficiencies in ESC measures occurred and to repair these deficiencies immediately.
- All disturbed areas will be re-vegetated as part of the ESC measures and final reclamation plan.

- Scourshield will be installed at either end of the culvert to prevent erosion due to changes in flow.

Change to Site Drainage

- A means of reducing flow velocity should be incorporated into the detailed design of the box culvert. Measures such as a stilling pond at the discharge end or placing large boulders into the flow to create riffles should be explored. Ultimately, whatever measures are chosen, should be engineered to reduce the increase in flow velocity to a reasonable margin that is approved by Drainage Services.
- Implement and monitor all required ESC measures during site preparation, instream works, road construction, and post-construction cleanup and reclamation.

6.1.3 Residual Effects

Change to Water Quality

With the construction schedule during the period of no or low flow, the implementation and monitoring of the various ESC measures prior to and throughout the Project construction phase, there is a low likelihood of a residual effect to water quality. The magnitude of the residual effect is low, the duration would be short term (mostly limited to the construction period), and the spatial extent of the affected area would be local.

Change to Site Drainage

The box culvert has been designed to accommodate the flows of Fulton Creek during the design flood event. Permanent ESC measures must be designed to withstand the flows exiting the culvert and transition them back to the native creek channel. With the implementation of permanent ESC measures and appropriate culvert design, the residual effect of the Project as a result of site drainage is anticipated to be of low magnitude, limited to the local area, and longin duration.

6.2 VEGETATION

The following sections discuss potential effects to vegetation within the Study Area as a result of the Project.

6.2.1 Potential Effects

The potential effects of the project on vegetation include:

- Change in plant community composition and the introduction of weeds

Development of the Project has the potential to alter plant community composition resulting from edge effects such as increased light availability, decreased humidity, and introduced plant species including weeds. A small area of Aspen Poplar Woodland Alliance will be cleared (Figure 4-1). Clearing vegetation could create conditions amenable to the establishment of invasive species if not mitigated. Trees could also be damaged during construction through direct limb and trunk damage by contact with vehicles, equipment and personnel, or through compaction and crush damage to root systems. Effects to vegetation are mostly expected to occur during the site preparation and reclamation phases.

6.2.2 Proposed Mitigation Measures

The following mitigation measures have been developed for the Project and are expected to reduce potential effects on vegetation.

- Disturbed areas should be reclaimed immediately with an approved seed mix to reduce weed establishment and erosion.
- Construction fencing should be set up to mark construction area boundaries and protect trees outside the boundary from root and trunk damage.

6.2.3 Residual Effects

Change in plant community composition

The Project will result in the permanent loss of the small area of Aspen Poplar Woodland Alliance, to be cleared for the roadway (approximately 0.24 ha). According to the Maple NSP (City of Edmonton 2010a), 8.1ha of forested Fulton Creek drainage will be conserved within the Neighbourhood, protected as Environmental Reserve. Using these combined numbers, this loss represents approximately 5% of the forested Fulton Creek drainage in the neighbourhood. With the application of the above mitigation measures the proposed Project is anticipated to cause a long duration effect to vegetation of moderate magnitude at a Project extent.

6.3 WILDLIFE

The following sections discuss effects to wildlife within and surrounding the Study Area as a result of the Project.

6.3.1 Potential Effects

The potential effects of the Project on wildlife include:

- Change in mortality risk
- Change in habitat
- Change in movement

Change in mortality risk

Adverse change in mortality risk can occur through interactions with equipment or Project activities, and vehicular traffic. Site preparation (vegetation clearing and brushing) and instream work (excavation, dewatering, and utility installation) might cause wildlife mortality because occupied dens or nests might be incidentally destroyed. Wildlife species that cannot move quickly from areas being cleared are more likely to be affected, such as small mammals and herptiles. The increased mortality risk is generally limited to construction during phases where vegetation clearing is taking place. Wildlife will be less likely to utilize the area during later phases of construction after the area has been cleared. Mortality risk will has the potential to be higher during the operational phase than previously as there will be an active roadway in place where there was none before; however, there will also likely be less large and medium sized wildlife moving through the area due to the development of the surrounding neighbourhood. The open fields and woodlots currently surrounding the creek will be replaced by housing, and a berm and noise barrier fence will be installed along Anthony Henday Drive that will be a barrier to wildlife accessing the area from off site.

Change in habitat

Change in habitat can occur directly through permanent or temporary habitat loss caused by Project activities or indirectly through permanent or temporary change in habitat suitability caused by sensory disturbance (e.g., noise, visual cues, human presence). Vegetation clearing and brushing required for site preparation is expected to remove and/or alter permanently approximately 0.24 ha of forested area.

Change in movement

Change in movement can occur directly through the creation of movement barriers and indirectly through sensory disturbance. Both of these processes disrupt habitat connectivity and reduce landscape permeability. Sensory disturbance caused by Project activities during construction or by vehicle traffic after the Project completion may also result in some species avoiding the Study Area. Wildlife movement was considered during the selection of the crossing structure to be installed in the Study Area.

6.3.2 Proposed Mitigation Measures

The box culvert itself has been developed as a mitigation measure against adverse effects to wildlife movement and mortality risk. A separate wildlife passage design recommendation letter was drafted to inform the design of this crossing and has been attached in Appendix C. This document lists several mitigation measures that need to be implemented to reduce the potential effects on wildlife, including:

- Natural substrate and native vegetation should be placed at the approaches to the crossing structure. These will create a more natural appearance around the structure and, for smaller EDGs, provide security cover from predators.
- Debris grates should not be installed.
- Wildlife-friendly lighting with reduced spill and glare should be incorporated in the final design of the road. Street lighting design should avoid illuminating the entrances of the wildlife crossing structures and nearby natural features (Stantec 2010).
- Natural vegetation and tree plantings can be used to direct the flight paths of birds and bats higher over the road, above the traffic (Tremblay 2006). This measure will also maintain the aesthetics of the area and minimize the reduction in habitat created by the road right-of-way.

In addition to the mitigation measures in the design recommendation letter, the following measures are also recommended:

- If sensitive wildlife features (e.g. dens, nests) are identified in pre-construction surveys or during construction, implement best management practices including setback areas around locations as recommended by a qualified professional.
- Remove fencing around construction area when construction is complete to reduce effects to connectivity.
- Waste products should be stored in secure containers and transported to appropriate facilities during construction.
- Schedule construction activities outside wildlife sensitive periods such as the breeding bird window (April 26- August 15) and raptor breeding window (March 15 -April 25).
- If constructing during the breeding bird or raptor breeding RAP, develop and implement a Bird Nest Mitigation Plan to include pre-clearing nest surveys and guidelines for setback areas for all active nests, including specific provisions for species of management concern.
- Construction activities associated with the Project should be restricted to specific hours as per the City of Edmonton's Community Standards Bylaw. This will also reduce the length of the sensory disturbance period on a daily basis.
- Wildlife Passage Engineering Guidelines (Stantec Consulting Ltd. 2010b) were followed for the Project. Passage requirements for the Small Terrestrial, and Amphibians EDGs are addressed through installation of a modified drainage culvert.

6.3.3 Residual Effects

The residual effects on wildlife due to the Project are low to high magnitude effects. There are measurable changes to habitat, wildlife movements, and mortality risk primarily related to Project construction activities.

Change in mortality risk

Project activities are anticipated to increase the risk of wildlife mortality primarily during the construction period. Mortality risk will be reduced by implementing mitigations such as respecting timing periods for breeding migratory birds. Mortality risk during the operation phase is anticipated to result primarily from potential vehicle collisions with wildlife, but the relatively low traffic level and slow speeds on Maple Road are not anticipated to result in significant collisions with large or medium sized mammals. The crossing structure should reduce vehicle collision mortality risk for small mammals and amphibians. Increased risk of wildlife mortality is expected to occur at a low magnitude, to the spatial extent of the Project, over a long duration. Once the site has been cleared of vegetation there will be little to attract wildlife to the site, resulting in few adverse interactions causing mortality.

Change in habitat

Change in habitat is expected to occur at a moderate magnitude, to the spatial extent of the Project, over a long duration. There will be a loss of habitat in the road footprint and its associated manicured space.

Change in movement

Changes to wildlife movement are also anticipated to be of low magnitude effect for large and medium sized mammals once the Project is completed. Based on projected traffic volume, Maple Road is not expected to be a barrier to movement of medium and large mammals (Stantec 2015). Wildlife movements for these guilds are already limited by the Project's setting amongst major transportation infrastructure, and the baseline values at the site are low to begin with. Changes to wildlife movement for small mammals, and amphibians are anticipated to be low magnitude effects because the crossing structure was specifically designed to accommodate movements for these guilds. Changes to movement for birds are not anticipated. Project effects related to changes in movement are anticipated to be long in duration.

6.4 AESTETICS

The following sections discuss effects to aesthetics within and surrounding the Study Area as a result of the Project.

6.4.1 Potential Effects

The potential effects of the Project on aesthetics include:

- The quality of views in the Study Area

Given that the Maple Neighbourhood is still under construction, the decreased quality of views of the Study Area should be limited to the few residents currently living in the neighbourhood and some residents to the adjacent Tamarack Neighbourhood. Residents affected by decreased aesthetics may also be habituated because of the ongoing construction in the general area. Once constructed the crossing will provide pleasant views into the forested creek channel that would have previously been inaccessible to the walking or driving public.

6.4.2 Proposed Mitigation Measures

The following mitigation measures have been developed for the Project and are expected to reduce potential effect on aesthetics.

- The extent of vegetation clearing and construction of temporary access and laydown areas should be minimized.
- Areas of bare soil, including any soil stockpiles, should be seeded with an appropriate seed mix to reduce erosion and prevent the establishment and spread of weeds.
- Retaining walls and ESC materials should be designed and placed to blend with the existing surroundings to the greatest extent possible.
- Reclaimed vegetation should incorporate native plant species and should be focused on creating species assemblages that resemble pre-development plant communities.

6.4.3 Residual Effects

The decrease in quality of views of the Study Area is expected to occur at a moderate magnitude during construction, to a local spatial extent, over a short duration. There will be a temporary adverse effect to the aesthetics of the area but it will be limited to the construction phase of the project. Disturbed soils and vegetation will be reclaimed during the reclamation phase. There is not anticipated to be a residual to aesthetics upon completion of the project.

6.5 NOISE

The following sections discuss effects to noise within and surrounding the Study Area as a result of the Project.

6.5.1 Potential Effects

The potential effects of the Project on noise include:

- Disturbance to residents

The use of vehicles and equipment during Project construction, operations and maintenance will generate noise within the Study Area and surroundings. Increased vehicle traffic once the Project is completed will increase noise level in the Study Area. The Project noise disturbance

should be limited to residents of the Maple Neighbourhood. The Areas north, south and east of the Project are undeveloped. Change in noise level is expected to occur during all project phases.

6.5.2 Proposed Mitigation Measures

The following mitigation measures have been developed for the Project and are expected to reduce potential effect on noise levels.

- All reasonable efforts should be made to minimize noise disturbance at all times.
- All work should be limited to normal working hours in accordance with City of Edmonton Community Standards Bylaw (Bylaw 14600).

6.5.3 Residual Effects

Given that the Study Area is less than 500 m from the Anthony Henday Highway and less than 1 km from the Whitemud drive/Highway 16, local residents may be habituated to an elevated noise level caused by vehicle traffic on these busy roads. Construction crews on the project will be made to follow applicable City of Edmonton policy and bylaw regarding hours of operation and maximum noise disturbances allowed. The disturbance of residents within the Study Area and surroundings is expected to be low in magnitude during construction, to a local spatial extent, over a short duration.

7.0 PUBLIC CONSULTATION

This crossing of Fulton Creek is part of the original Maple NSP and was brought forward to the public as part of the original consultation for the NSP. The Proponent has been and continues to engage in consultation with the adjacent landowner (Ahmadiyya Movement in Islam) regarding the construction of Maple Road and the associated crossing of Fulton Creek.

8.0 LIMITATIONS AND QUALIFICATIONS

In conducting the investigation and rendering our conclusions, Stantec gives the benefit of its best judgment based on its experience and in accordance with generally accepted professional standards for this type of investigation. This report was submitted with the best information to date and on the information provided. The conclusions made within this report are a professional opinion, not a certification of the Study Area's environmental condition, and no other warranty, expressed or implied, is made. This report has been prepared for the exclusive use of Lehndorff Land General Partner for the purposes of assessing the current state of the Study Area. Any use which any third party makes of this report, or any reliance on or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any other third party as a result of decisions made or actions based on this report. Our conclusions are limited by the following:

- Vegetation and wildlife surveys were completed during the dates specified and conditions may vary outside those times.
- Field surveys to verify the presence of species listed within ACIMS and/or FWMIS databases were conducted for the Study Area on the dates specified and presence or absence of said species outside of the survey dates cannot be verified.
- Some of the information contained within this report was provided by agencies and organizations external to Stantec. While Stantec cannot guarantee the information provided by external parties, this information has been assumed to be correct.
- The information contained within this report is based on the design available at the time of report preparation. Design drawings may continue to be modified and added as the detailed design process continues, but are intended to not depart significantly from the information presented in this report. Should significant changes to the drawings be made in the future, an amendment to this report may be required.
- The investigation was limited to those parameters specifically outlined in this report.
- The Contractor will be responsible for determining the ultimate construction schedule and means of construction for the Project; however, should significant changes to construction timing and/or methodology from that presented within this report be proposed or required, it is the responsibility of the Contractor to confirm with all applicable regulatory agencies or bodies that this is acceptable. It is also the responsibility of the contractor to obtain all applicable amendments to approvals and/or permits that may have previously been obtained based on the information presented within this report.

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APPENDIX A
PROJECT DESIGN

MAPLE WAY
14.50 / 24.00

FUT MAPLE WAY
11.50 / 20.00

EX MAPLE ROAD
11.90 / 37.00

PLAN 1524011

BLOCK 6

NE 8-52-23-4

EX DRAINAGE SWALE

REGRADE EX SWALE

MATCH EX DITCH

℄ DITCH

PLAN 1224110
BLOCK 5
LOT 2ER

10.50 – 400 CSP CULVERT

INSTALL SINGLE NET PHOTODEGRADABLE STRAW BLANKETS SEE NORTH AMERICAN GREEN FOR TYP. SPECIFICATIONS OR OTHER APPROPRIATE BMP

11.80 – 400 CSP CULVERT

PLAN 8211577
LOT 1

BLOCK 5

38.70 – 400 CSP CULVERT

FULTON CREEK

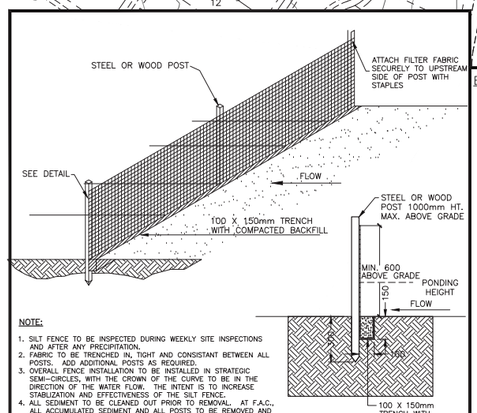
VEGETATED RETAINING WALL
SEE DETAILS S001-002
S001-003

50.0 – 1800 x 1200 BOX CULVERT
WILDLIFE PASSAGE
SEE DETAILS C200-001

VEGETATED RETAINING WALL
SEE DETAILS S001-001
S001-003

PLAN 8211577
LOT 2

13.90 / 30.00
FUT MAPLE ROAD



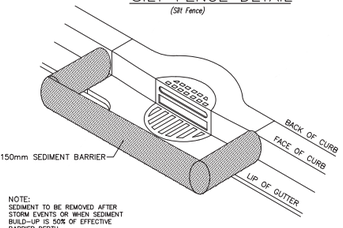
NOTE:

1. SILT FENCE TO BE INSPECTED DURING WEEKLY SITE INSPECTIONS AND AFTER ANY PRECIPITATION.
2. FABRIC TO BE TRENCHED IN, TIGHT AND CONSISTANT BETWEEN ALL POSTS. ADD ADDITIONAL POSTS AS REQUIRED.
3. OVERALL FENCE INSTALLATION TO BE INSTALLED IN STRATEGIC SEMI-CIRCLES, WITH THE CROWN OF THE CURVE TO BE IN THE DIRECTION OF THE WATER FLOW. THE INTENT IS TO INCREASE STABILIZATION AND EFFECTIVENESS OF THE SILT FENCE.
4. ALL SEDIMENT TO BE CLEANED OUT PRIOR TO REMOVAL. AT F.A.C., ALL ACCUMULATED SEDIMENT AND ALL POSTS TO BE REMOVED AND FABRIC TO BE CUT FLUSH WITH GROUND – DO NOT PULL FENCE FABRIC FROM TRENCH.
5. SEDIMENT TO BE REMOVED BEFORE ACCUMULATION REACHES 1/3 OF FENCE HEIGHT.
6. SEDIMENT TO BE REMOVED TO AN OFFSITE LOCATION.

DETAIL

SILT FENCE DETAIL

(Silt Fence)



NOTE:
SEDIMENT TO BE REMOVED AFTER STORM EVENTS OR WHEN SEDIMENT BUILD-UP IS 50% OF EFFECTIVE BARRIER DEPTH.

CATCH BASIN INLET SEDIMENT BARRIER DETAIL

(CB Sediment Barrier Detail)

EROSION AND SEDIMENT CONTROL PLAN

1. PROPOSED SITE CLEARING AND GRADING
   - LOW AREAS ARE TO BE PROTECTED FROM SPILL-OVER WITH PROPERLY INSTALLED SILT FENCE OR OTHER APPROPRIATE BMP.
   - WHERE CONCENTRATED FLOW IS ANTICIPATED, EROSION CONTROL BLANKETS, TRIANGLE SILT DIKES ("GeoRidge" FROM NILEX INC.), OR OTHER APPROPRIATE BMP WILL BE USED.
   - SURFACE DRAINAGE OR POOLS OF STORM WATER WILL BE PUMPED TO DESIGNATED DISCHARGE LOCATIONS.
   - SHOULD MUD TRACKING OCCUR, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CLEAN THE AFFECTED ROADWAYS. LEHNDORFF LAND GENERAL PARTNER INC. HAS A STREET CLEANING PROGRAM IN EFFECT AND IT IS IN ACCORDANCE WITH SECTION 48 (MATERIAL ON SIDEWALKS AND ROADWAYS) OF THE CITY OF EDMONTON'S TRAFFIC BYLAW #5590.
2. UNDERGROUND CONSTRUCTION
   - INCLUDES STORM, SANITARY SEWERS, WATERMAIN AND CREEK CROSSING.
   - DURING UNDERGROUND INSTALLATION, SILTY AND SANDY CLAY WILL BE EXPOSED. IF WET CONDITIONS ARE ENCOUNTERED, WATER IS TO BE PUMPED TO THE DESIGNATED DISCHARGE LOCATIONS PROTECTED WITH SILT FENCE. FILTER FABRIC IS TO BE WRAPPED AROUND THE END OF THE PIPE AT THE END OF EACH DAY.
   - THE CONTRACTOR WILL PUMP SURFACE RUNOFF TO DESIGNATED DISCHARGE LOCATIONS AND NOT USE THE STORM SEWER DURING CONSTRUCTION.
3. ROADWAY CONSTRUCTION
   - MANHOLE FRAMES AND COVERS, AND CATCHBASIN FRAMES AND COVERS, WILL BE LOWERED BELOW SUBGRADE TO ALLOW FOR ROADWAY SUBGRADE PREPARATION.
   - ALL RUNOFF IS MANAGED ON-SITE SIMILAR TO THE ESC FOR PROPOSED SITE CLEARING AND GRADING.
   - TRAPPED WATER WILL BE PUMPED TO THE DESIGNATED DISCHARGE LOCATIONS PROTECTED WITH SILT FENCE.
   - CONTRACTOR WILL PUMP SURFACE RUNOFF TO DESIGNATED DISCHARGE LOCATIONS AND WILL NOT USE THE STORM OR SANITARY SEWERS OR CATCHBASINS DURING OR AFTER CONSTRUCTION.
   - CATCHBASINS ARE TO BE RAISED TO GRADE WHEN CONCRETE CURB, GUTTER AND SIDEWALKS ARE IN PLACE.
   - TEMPORARY INLET SEDIMENT CONTROL BARRIERS ARE TO BE INSTALLED AT EVERY ON-SITE CATCHBASIN AND THOSE DOWNSTREAM OF THE CONSTRUCTION, AS SHOWN.
   - SHOULD MUD TRACKING OCCUR, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CLEAN THE AFFECTED ROADWAYS. LEHNDORFF LAND GENERAL PARTNERINC. HAS A STREET CLEANING PROGRAM IN EFFECT AND IT IS IN ACCORDANCE WITH SECTION 48 (MATERIAL ON SIDEWALKS AND ROADWAYS) OF THE CITY OF EDMONTON'S TRAFFIC BYLAW #5590.
4. LANDSCAPING AND SITE MAINTENANCE
   - UNTIL LANDSCAPING IS COMPLETE, THE ESC SYSTEM WILL BE MONITORED FOR MAINTENANCE AND RECORD KEEPING AFTER WEATHER EVENTS AND DURING WEEKLY SITE INSPECTIONS, DURING AND AFTER CONSTRUCTION.
   - DRAINAGE SERVICES WILL BE NOTIFIED IF ANY MAJOR CHANGES TO THE ESC PLAN ARE TO BE CONTEMPLATED.
   - SHOULD MUD TRACKING OCCUR, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CLEAN THE AFFECTED ROADWAYS. LEHNDORFF LAND GENERAL PARTNERINC. HAS A STREET CLEANING PROGRAM IN EFFECT AND IT IS IN ACCORDANCE WITH SECTION 48 (MATERIAL ON SIDEWALKS AND ROADWAYS) OF THE CITY OF EDMONTON'S TRAFFIC BYLAW #5590.

DRAINAGE SERVICES WILL BE NOTIFIED IF THE SEDIMENT CONTROL PLAN CHANGES. REFER TO THE EROSION AND SEDIMENT CONTROL REPORT FOR MAPLE STAGE 7, PREPARED BY INVISTEC CONSULTING LTD., DATED 28/02/2017.

LEGEND:

- SPILL DIRECTION
- DIRECTION OF MAJOR DRAINAGE
- SILT FENCE
- CATCHBASIN SEDIMENT BARRIER
- DEVELOPMENT BOUNDARY
- LIMIT OF CONSTRUCTION
- STRAW WATTLE
- EROSION BLANKET

NOTES:

REVISION:

		BY	APPD	DATE
ISSUE:				
01	ISSUED FOR FIRST SUBMISSION	RR	KL	28/02/2017
		BY	APPD	DATE

PROJECT MANAGER: VINCENT LIU

CLIENT:
LEHNDORFF LAND GENERAL PARTNER INC.

PROJECT:
MAPLE ROAD
MAPLE WAY TO SOUTH OF FULTON CREEK

DRAWING TITLE:
EROSION AND SEDIMENT CONTROL

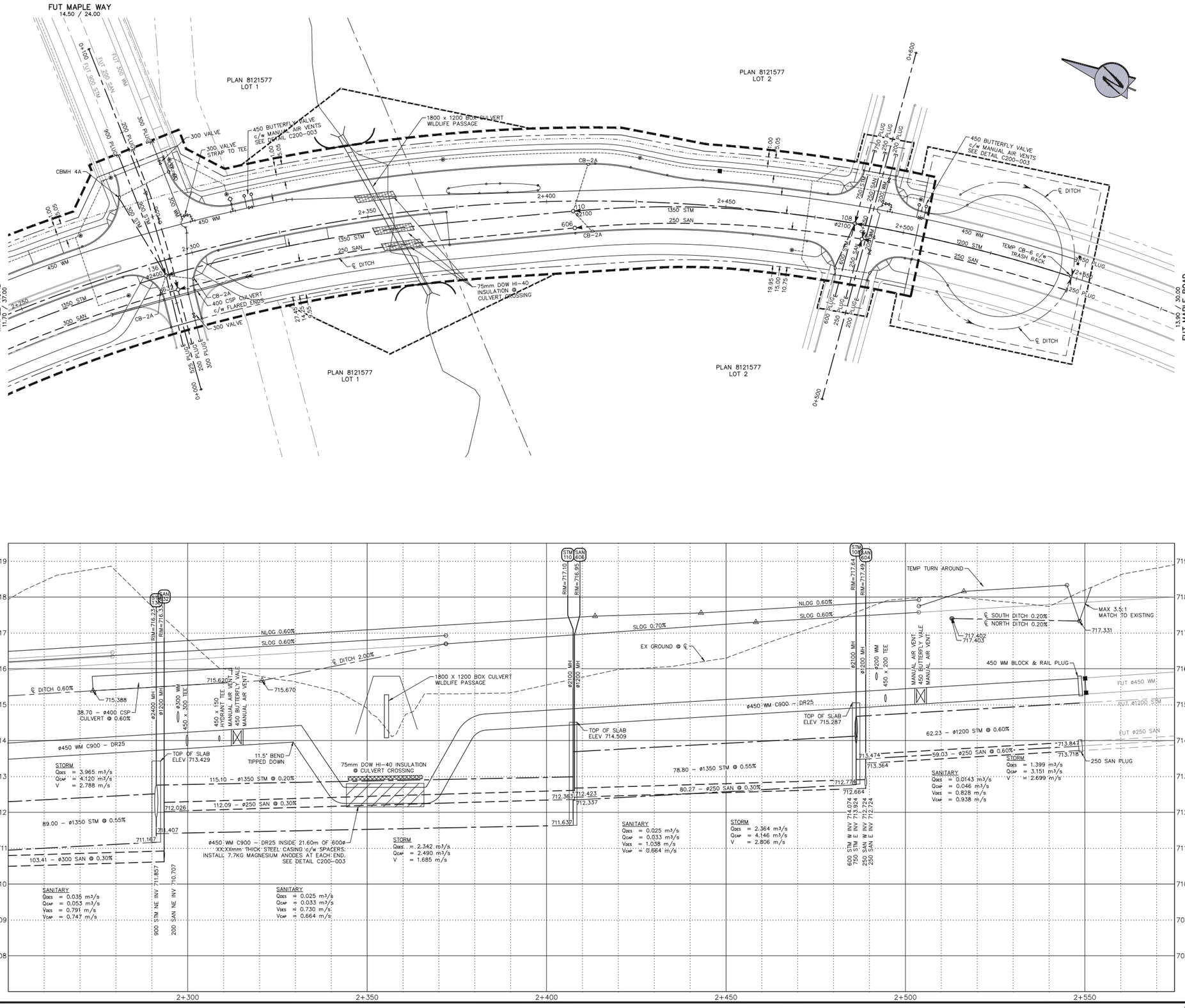
PROJECT NO: 2016-036

SCALE: 1:1000 (0 10 20 30 40 50)

DRAWING NO. C015-001

PERMIT / SEAL

Invistec Consulting Ltd.
10235 – 101 Street, 4th Floor
Edmonton Alberta, T5J 3G1
(780) 984 – 1816
www.invistec.ca



LEGEND:

- DEVELOPMENT BOUNDARY
- LIMIT OF CONSTRUCTION
- SANITARY SEWER, MANHOLE AND PLUG
- STORM SEWER, MANHOLE, PLUG AND CATCH BASIN
- WATERMAIN, FLUSH POINT, PLUG, HYDRANT, VALVE, REDUCER
- EXISTING SANITARY SEWER, MANHOLE AND PLUG
- EXISTING STORM SEWER, MANHOLE, PLUG AND CATCH BASIN
- EXISTING WATERMAIN, FLUSH POINT, PLUG, HYDRANT, VALVE, REDUCER
- LIGHT POLE
- SWITCHING CUBICLE
- TRANSFORMER
- LIGHTING CONTROL BOX

NOTES:

1. WATERMAINS 150mm TO 300mm ARE AWWA C-900 DR-18 PVC PIPE WITH CLASS "B" BEDDING UNLESS OTHERWISE NOTED.
2. WATERMAINS 350mm AND LARGER ARE AWWA C-905 DR-25 PVC PIPE WITH CLASS "B" BEDDING UNLESS OTHERWISE NOTED.
3. APPLY APPROVED PVC WATER PIPE JOINT LUBRICANT FOR POTABLE WATER, ACCORDING TO MANUFACTURER'S RECOMMENDED APPLICATION PROCEDURES.
4. CB LEADS MUST BE A MINIMUM OF 3.0m FROM VALVE CASING.
5. ALL MATERIALS AND CONSTRUCTION TO BE AS PER THE CITY OF EDMONTON DESIGN AND CONSTRUCTION STANDARDS.
6. SANITARY SEWER PIPE SHALL BE TYPE PSM PVC SDR35 CONFORMING TO ASTM D3034, INSTALLED ACCORDING TO ASTM D2321. ALL EMBEDMENT MATERIALS SHALL BE TYPE 2, COMPACTED TO TOP OF EMBEDMENT TO 95% STANDARD PROCTOR DENSITY UNLESS OTHERWISE NOTED.
7. STORM SEWER PIPE ALTERNATIVES:
   A) CONCRETE PIPE:
   ALL CONCRETE PIPE TO BE SULPHATE RESISTANT WITH RUBBER GASKET CONFINED O-RING.
   300mm – 525mm ASTM C14-CLIII, UNLESS OTHERWISE NOTED.
   600mm – 1800mm ASTM C76-CLIII, UNLESS OTHERWISE NOTED.
   B) PVC PIPE:
   200mm – 525mm ASTM D3034 SDR35
   600mm – 1200mm ASTM F-679 SDR35
   PROFILE (RIBBED) CONFORMING TO CSA B182.4
8. ALL CB LEADS ARE 250mm SDR35 PVC WITH MIN. SLOPE OF 1.00% UNLESS OTHERWISE NOTED.
9. CATCHBASINS WITH A F-51, F-51G OR DK-7 FRAME AND COVER ARE 900ø. ALL OTHER CATCHBASINS ARE 600ø.
10. TIE INTO EXISTING TO THE SATISFACTION OF THE CITY OF EDMONTON.
11. OVERSIZED MANHOLE DETAIL ON DRAWING C200-XXX-DETAILS.

REVISION:

		BY	APPD	DATE

ISSUE:

		BY	APPD	DATE
01	ISSUED FOR FIRST SUBMISSION	RR	KL	28/02/2017

PROJECT MANAGER: VINCENT LIU

CLIENT:
LEHNDORFF LAND GENERAL PARTNER INC.

PROJECT:
MAPLE ROAD
MAPLE WAY TO SOUTH OF FULTON CREEK

DRAWING TITLE:
MAPLE ROAD
STA 2+250 – STA 2+575
UTILITIES PLAN

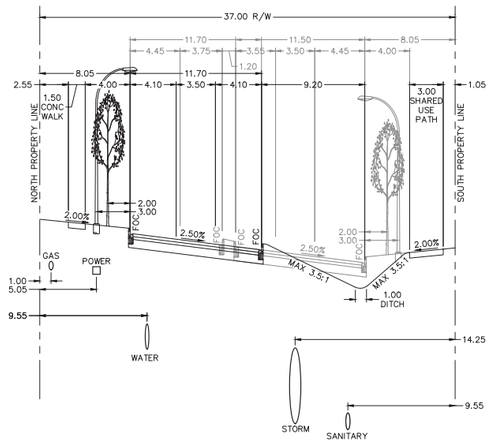
PROJECT NO: 2016-036

SCALE:
HORZ 1 : 500 (0 5 10 15 20 25)
VERT 1 : 50 (0 0.5 1 1.5 2 2.5)

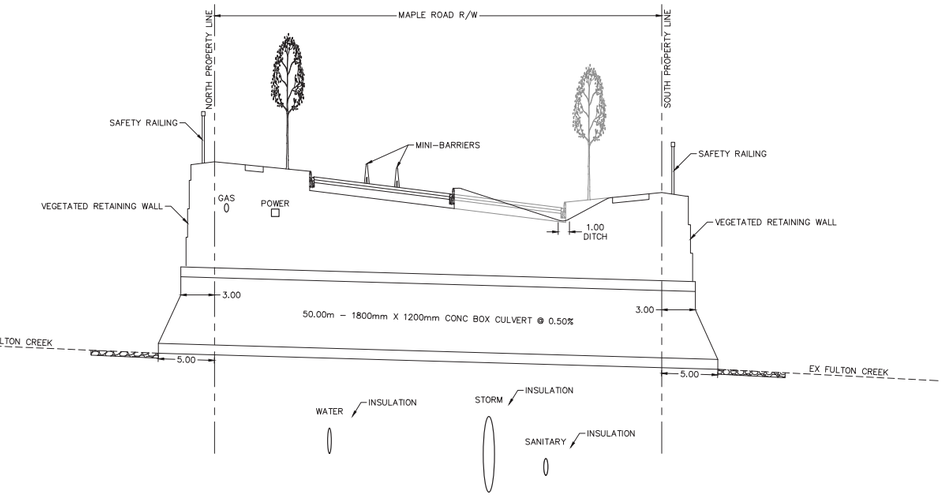
DRAWING NO. C105-002

PERMIT / SEAL

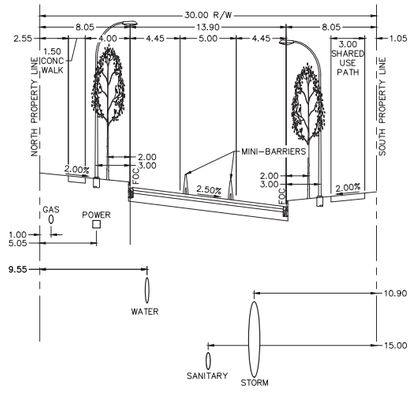
Invistec Consulting Ltd.
10235 – 101 Street, 4th Floor
Edmonton Alberta, T5J 3G1
(780) 984 – 1816
www.invistec.ca



SECTION A–A
STATION 2+225
HORIZONTAL SCALE: 1:250
VERTICAL SCALE: 1:50



FULTON CREEK WILDLIFE CROSSING
SECTION B–B
STATION 2+354.85
HORIZONTAL SCALE: 1:250
VERTICAL SCALE: 1:50



SECTION C–C
STATION 2+465
HORIZONTAL SCALE: 1:250
VERTICAL SCALE: 1:50

LEGEND:

NOTES:

REVISION:

		BY	APPD	DATE

ISSUE:

		BY	APPD	DATE
01	ISSUED FOR FIRST SUBMISSION	RR	KL	28/02/2017

PROJECT MANAGER: VINCENT LIU

CLIENT:
LEHNDORFF LAND GENERAL PARTNER INC.

PROJECT:
MAPLE ROAD
MAPLE WAY TO SOUTH OF FULTON CREEK

DRAWING TITLE:
SECTIONS

PROJECT NO: 2016–036

SCALE:

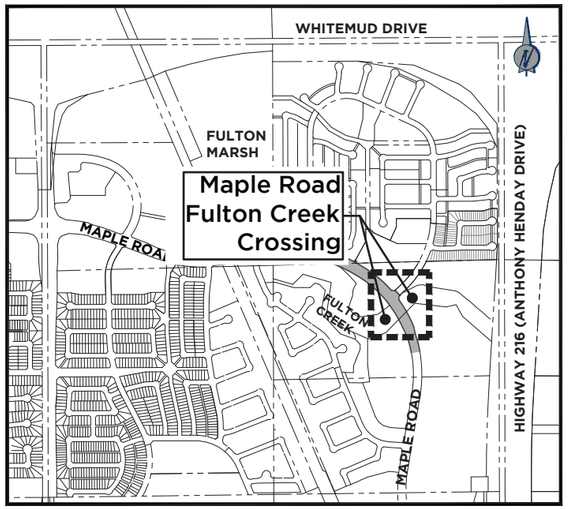
DRAWING NO.
C200–001

PERMIT / SEAL

PERMIT TO PRACTICE
INVISTEC CONSULTING LTD.
Signature
Date
PERMIT NUMBER: P 11404
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL ENGINEER ALBERTA
KEN LIU

Invistec Consulting Ltd.
10235 – 101 Street, 4th Floor
Edmonton Alberta, T5J 3G1
(780) 984 – 1816
www.invistec.ca



KEY PLAN - SCALE N.T.S

NOTES

ALL SEEDING ON 150MM CLASS **B** TOPSOIL

PLANTING NOTES:

1. CONTRACTOR TO CALL FIRST CALL AT 1-800-242-3447 TO HAVE EXISTING UTILITIES LOCATED PRIOR TO START OF ANY CONSTRUCTION.
2. CONTRACTOR TO ENSURE THAT ALL NECESSARY ARRANGEMENTS ARE MADE WITH THE PIPELINE COMPANIES CONCERNING THE MOVEMENT OF MATERIALS AND EQUIPMENT NEAR ANY PIPELINE RIGHT OF WAYS/
3. CONTRACTOR IS RESPONSIBLE FOR THE HOARDING OF ALL TREE WITHIN OR ADJACENT TO CONSTRUCTION AREAS.
4. CONTRACTOR IS RESPONSIBLE FOR HAULING OF ALL EXCESS MATERIALS OFF THE SITE
5. CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO LANDSCAPED AREAS AND MUST MAKE ALL NECESSARY RESTORATIONS AND REPAIRS
6. CONTRACTOR TO VERIFY ALL DIMENSIONS AND REPORT ANY DISCREPANCIES TO THE LANDSCAPE ARCHITECT
7. LAYOUT TO BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO CONSTRUCTION STARTING
8. ALL MEASUREMENTS IN METERS UNLESS OTHERWISE NOTED.
9. ALL PLANT MATERIAL TO BE NURSERY GROWN STOCK AND SHALL MEET OR EXCEED THE SPEC'S OF THE CDN NURSERY TRADES ASSOC. FOR SIZE, HT. SPREAD, GRADING QUALITY AND METHOD OF CULTIVATION
10. NO SUBSTITUTIONS OF MATERIALS, PRODUCTS OR QUANTITIES WITHOUT PRIOR CONSENT OF LANDSCAPE ARCHITECT.
11. ALL PLANT MATERIAL AND WORKMANSHIP TO CONFORM TO THE REQUIREMENTS OF THE CITY OF EDMONTON DESIGN AND CONSTRUCTION STANDARDS IN ITS MOST RECENT EDITION.
12. AREAS TO RECEIVE SOD TO HAVE TOPSOIL TO A DEPTH OF 100MM, AREAS TO RECEIVE SEED TO HAVE TOPSOIL TO A DEPTH OF 150MM, AREAS FOR PLANTING BEDS TO A DEPTH OF 450MM
13. 100MM WOOD CHIP MULCH ON ALL PLANTING BEDS
14. INSTALL TURF REINFORCEMENT MAT FOR ALL SEED MIX **A** AREAS AND SEED MIX **B** AREAS WITH SLOPES > 10:1 OR WITHIN 10M OF CREEK.

SEED MIXTURE A

CERTIFIED CANADA NO. 1 MIXTURE, FREE OF DISEASE, WEED SEEDS OR FOREIGN MATTER, MINIMUM GERMINATION OF 75%, MINIMUM PURITY OF 97% AND CONFORMING TO THE MIXES BELOW OR APPROVED ALTERNATIVES. ALL SEED MUST BE FROM A RECOGNIZED SEED FIRM, MEETING THE REQUIREMENTS FOR THE SEEDS ACT FOR CANADA NO. 1 SEED. SEED SHALL BE CERTIFIED NO. 1 GRADE.A GERMINATION TEST AND/OR WEED SEED ANALYSIS MAY BE REQUESTED AND ALL LAWN SEED MUST COMPLY WITH FEDERAL AND PROVINCIAL SEED LAWS.

NON-MAINTAINED NATURALIZATION LANDSCAPING - WET MEADOW SEED MIX
10% AWNED WHEATGRASS (AGROPYRON TRACHYCAULUM VAR. UNILATERALE);
10% WESTERN WHEATGRASS (AGROPYRON SMITHII);
10% SLOUGHGRASS (BECKMANNIA SYZIGACHNE);
20% TUFTED HAIR GRASS (DESCHAMPSIA CAESPITOSA);
15% GIANT WILD RYE (ELYMUS PIPERI SYN. CINEREUS);
30% FOWL BLUEGRASS (POA PALUSTRIS);
5% ANNUAL RYEGRASS (LOLIUM MULTIFLORUM).

SEED MIX A AREA 994 m²

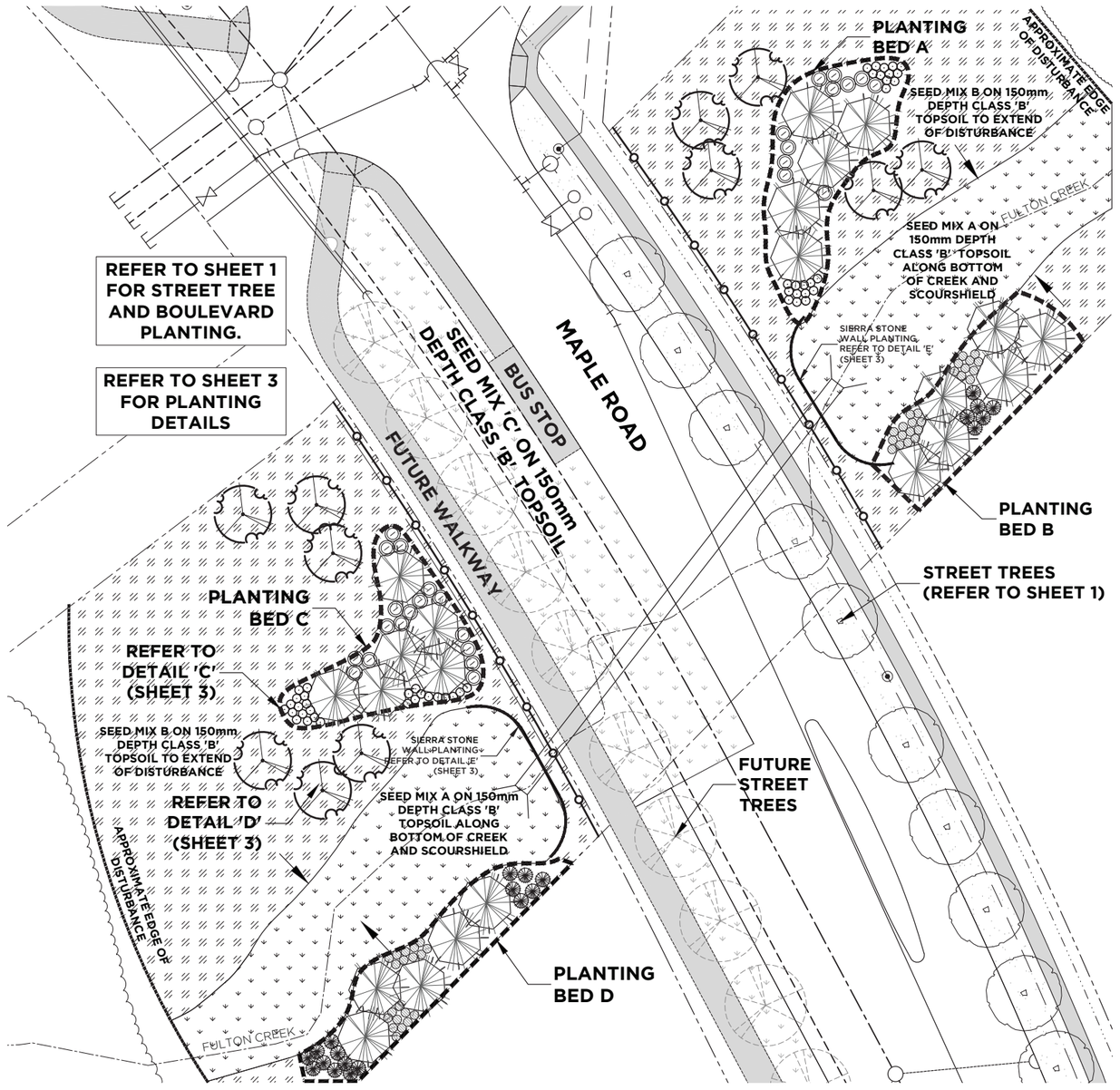
SEED MIXTURE B

CERTIFIED CANADA NO. 1 MIXTURE, FREE OF DISEASE, WEED SEEDS OR FOREIGN MATTER, MINIMUM GERMINATION OF 75%, MINIMUM PURITY OF 97% AND CONFORMING TO THE MIXES BELOW OR APPROVED ALTERNATIVES. ALL SEED MUST BE FROM A RECOGNIZED SEED FIRM, MEETING THE REQUIREMENTS FOR THE SEEDS ACT FOR CANADA NO. 1 SEED. SEED SHALL BE CERTIFIED NO. 1 GRADE.A GERMINATION TEST AND/OR WEED SEED ANALYSIS MAY BE REQUESTED AND ALL LAWN SEED MUST COMPLY WITH FEDERAL AND PROVINCIAL SEED LAWS.

NON-MAINTAINED NATURALIZATION LANDSCAPING - DRY MEADOW SEED MIX

20% JUNEGRASS (KOELERIA MACRANTHA);
20% ROUGH FESCUE (FESTUCA CAMPESTRIS);
10% GREEN NEEDLEGRASS (STIPA VIRIDULA);
15% STREAMBANK WHEATGRASS (AGROPYRON RIPARIUM);
20% NORTHERN WHEATGRASS (AGROPYRON DASYSTACHYUM);
10% SHEEPS FESCUE (FESTUCA OVINA);
5% ANNUAL RYEGRASS (LOLIUM MULTIFLORUM).

SEED MIX B AREA 2,168 m²



PLANT LIST

TREES	33				
SYMBOL	**QTY**	**COMMON NAME**	**BOTANICAL NAME**	**SIZE**	**REMARKS**
	11	Trembling Aspen	Populus tremuloides	50 mm cal.	B&B
	22	White Spruce	Picea glauca	2000 mm Ht.	B&B
SHRUBS	**144**				
SYMBOL	**QTY**	**COMMON NAME**	**BOTANICAL NAME**	**SIZE**	**REMARKS**
	22	Highbush Cranberry	Viburnum trilobum	2 gal	Container
	28	Saskatoon	Amelanchier alnifolia	2 gal	Container
	50	Wild Rose	Rosa acicularis	2 gal	Container
	44	Red Osier Dogwood	Cornus stolonifera	2 gal	Container

PLANTING BED A - 199.34 m²
5 White Spruce, 11 Saskatoon, 24 Wild Rose

PLANTING BED B - 180.9 m²
24 Red Osier Dogwood, 6 Highbush Cranberry, 6 White Spruce.

PLANTING BED C - 180.2 m²
6 White Spruce, 17 Saskatoon, 26 Wild Rose

PLANTING BED D - 174 m²
5 White Spruce, 16 Highbush Cranberry, 20 Red Osier Dogwood

Tree Setbacks from Utilities and Property Lines

1. Distance from Light Standards/ Power Hardware 3.5m
2. Distance from Fire Hydrants 3.5m
3. Distance from Stop Signs 3.5m
4. Distance from Yield Signs 3.5m
5. Distance from Transit Zones 3.5m*
6. Distance from Other Signs 2.0m
7. Distance from Private Property on Walkway R.O.W. 1.0m
8. Distance from Private Property on Open Parkland 3.0m
9. Distance from Private Property on Boulevards 1.0m
10. Distance from Shallow Underground Utilities 1.0m
11. Distance from Gas or Oil R.O.W. Contact Utility
12. Distance from Deep Underground Utilities 1.5m
13. Distance from Sanitary and Storm Sewers 1.8m
14. Distance to Sanitary and Storm Sewers and Manholes 2.0m
15. Distance from Water Mains 2.5m

*Ensure trees do not create sightline obstructions for vehicles approaching transit zones.

Note: Distances from overhead power utilities shall be as per the requirements established by the Utility Authority.

Landscape Contractor To Call 'alberta First Call At 1-800-242-3447 To Have All Existing Site Utilities Located Prior To Construction And Plant No Closer Than The Following Dimensions From The Services.

Landscape Contractor Is Responsible For Damages And Liabilities Incurred By Damages To Site Utilities.

Permit/Seal

The Alberta Association of Landscape Architects
Penny Dunford

BALANCE landscape architecture inc.

DATE: March 13, 2017

SCALE: 1 : 250 (0, 2,5, 5, 7,5, 10, 12,5)

ALL DIMENSIONS IN METERS UNLESS OTHERWISE SPECIFIED

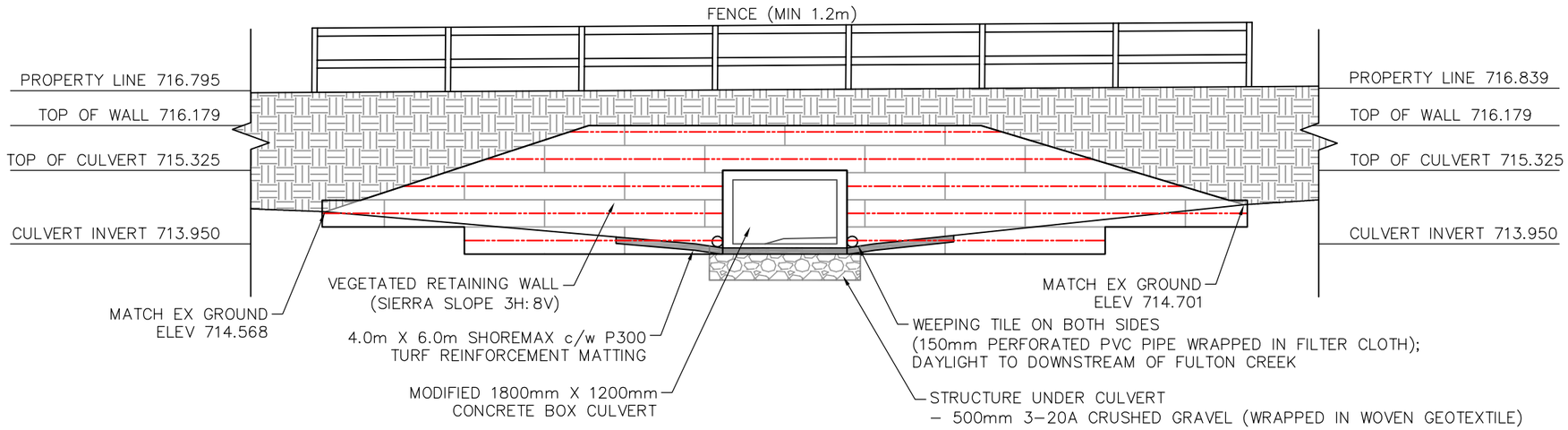
PROJECT NAME:
MAPLE ROAD
N.E. 1/4 SEC. 8-52-23-4

CLIENT NAME:
LEHNDORFF LAND GENERAL PARTNER INC.

DRAWING NAME:
MAPLE ROAD CROSSING - FULTON CREEK PLANTING PLAN

PROJECT NUMBER:	2016-036		
DRAWN:	FE	CHECKED:	PD/ RE
DESIGNED:	PD	APPROVED:	PD
SHEET NO.	02	REV.	00

Invistec Consulting Ltd.
10235 - 101 Street, 4th Floor
Edmonton , Alberta
T5J 3G1, Canada
Ph: (780) 984 - 1816



FULTON CREEK WILDLIFE CROSSING
SOUTH ELEVATION

HORIZONTAL SCALE: 1:100
VERTICAL SCALE: 1:100

LEGEND

TENSAR UNIAXIAL GEOGRID

UNIAXIAL GEOGRID TERMINATION OR EMBEDMENT LENGTH CHANGE

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar International Corporation
2500 Northwinds Pkwy, Suite 500
Alpharetta, Georgia 30009
(770) 344-2154

Nilex Civil Environmental Group
9304 39 Avenue
Edmonton, AB T6E 6L8
(780) 463-9535

Unearthing better results.

Issue/Revisions

A	2017-02-07	ISSUED FOR INFORMATION	-

Project Number
PB-17-01-003

Date Drawn
FEBRUARY 7, 2017

Scale
1:100

Designed By
-

Drawn By
DT

Checked By
-

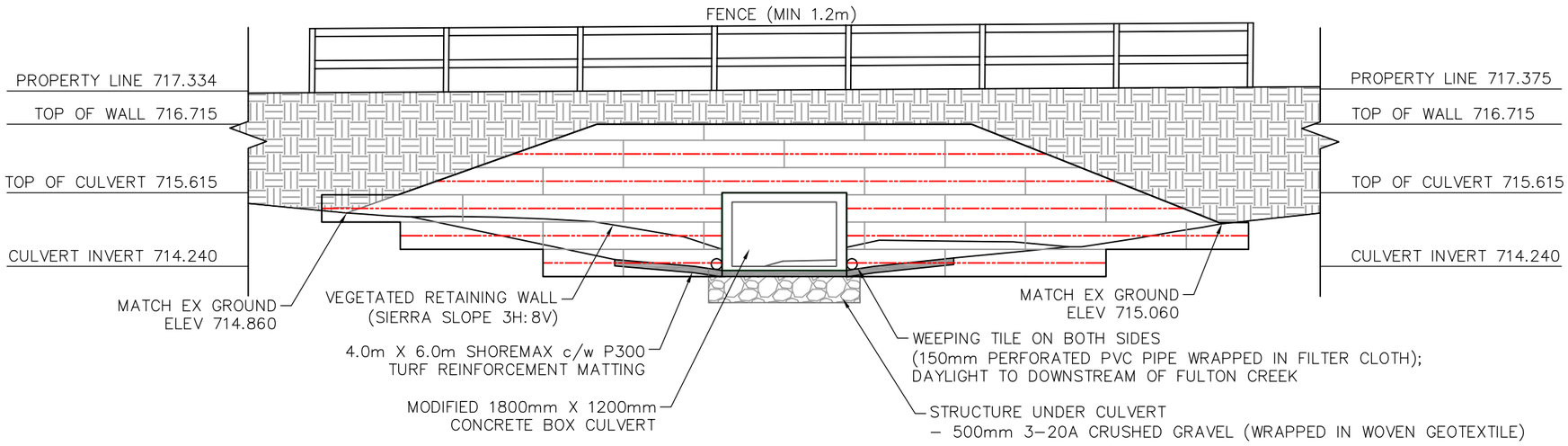
Project
FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title
SOUTH ELEVATION VIEW

Drawing Number
PB-17-01-003-004

A
Rev.

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER



FULTON CREEK WILDLIFE CROSSING
NORTH ELEVATION

HORIZONTAL SCALE: 1:100
VERTICAL SCALE: 1:100

LEGEND

TENSAR UNIAXIAL GEOGRID

UNIAXIAL GEOGRID TERMINATION OR EMBEDMENT LENGTH CHANGE

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar International Corporation
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Unearthing better results.

Issue/Revisions

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Project Number
PB-17-01-003

Date Drawn
FEBRUARY 7, 2017

Scale
1:100

Designed By
-

Drawn By
DT

Checked By
-

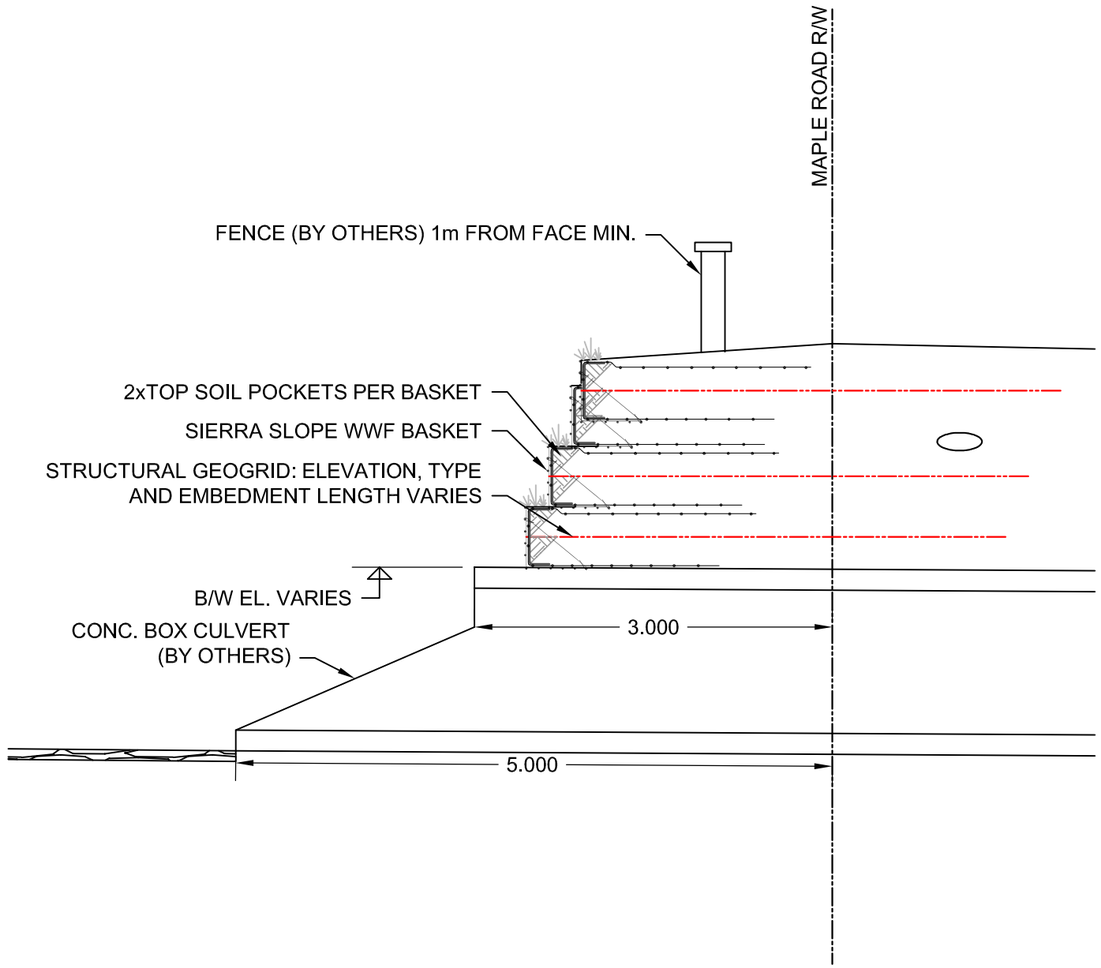
Project
FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title
NORTH ELEVATION VIEW

Drawing Number
PB-17-01-003-005

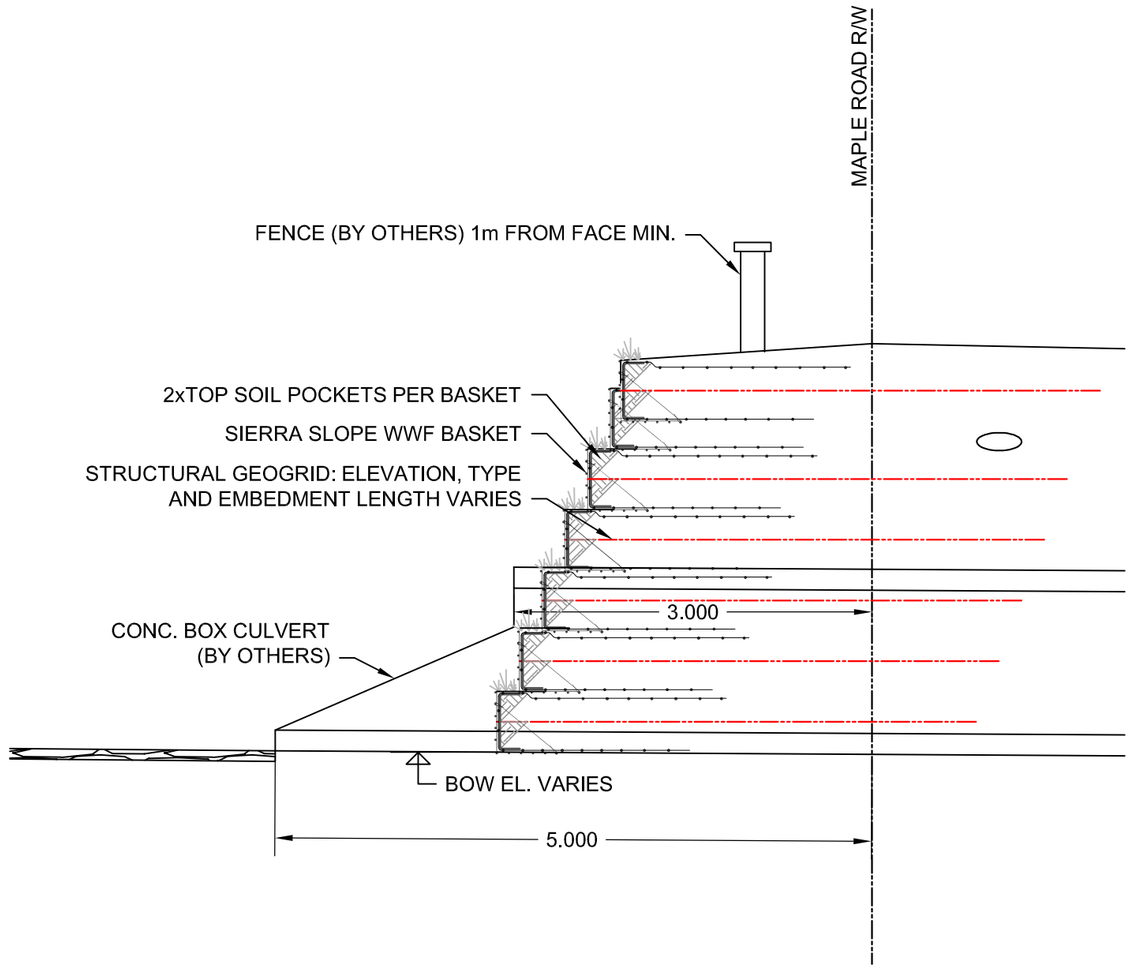
A
Rev.

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER.



CROSS SECTION OVER THE CULVERT

SCALE: 1:50



CROSS SECTION BESIDE THE CULVERT

SCALE: 1:50

LEGEND

TENSAR UNIAXIAL GEOGRID

UNIAXIAL GEOGRID TERMINATION OR EMBEDMENT LENGTH CHANGE

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar International Corporation
2500 Northwinds Pkwy, Suite 500
Alpharetta, Georgia 30009
(770) 344-2154

Nilex Civil Environmental Group
9304 39 Avenue
Edmonton, AB T6E 6L8
(780) 463-9535

Unearthing better results.

Issue/Revisions

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Project Number	PB-17-01-003
Date Drawn	FEBRUARY 7, 2017
Scale	1:100
Designed By	-
Drawn By	DT
Checked By	-

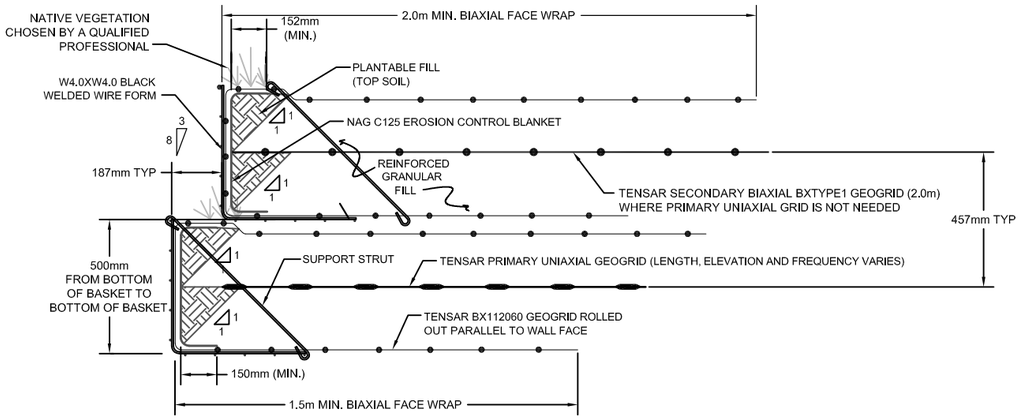
Project
FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title
TYPICAL CROSS SECTIONS

Drawing Number
PB-17-01-003-006

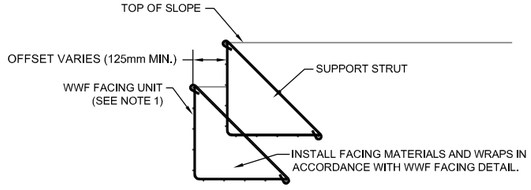
Rev. ---

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER



SIERRA SLOPE WELDED WIRE STEPPED FACE DETAIL

NOT TO SCALE

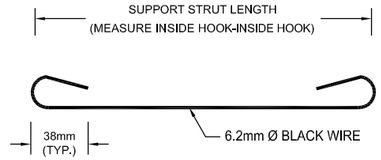


NOTES:

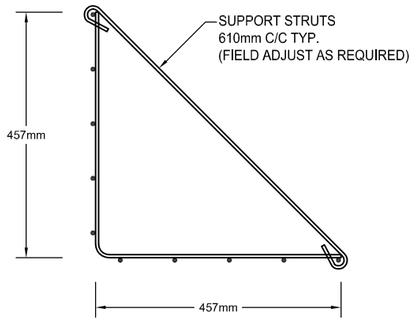
1. SEE WELDED WIRE FORM (WWF) FACING DETAIL FOR FACING MATERIALS AND DIMENSIONS.
2. SET TOPMOST WWF FACING UNIT INSIDE WWF FACING UNIT BELOW TO FOLLOW GRADE.
3. HORIZONTAL WIRES OF TOPMOST WWF FACING UNIT MAY BE CUT TO ALLOW INSTALLATION OVER STRUTS OF WWF FACING UNIT BELOW.
4. USE AT TOP OF SLOPE AND TOP OF CULVERT WHERE REQUIRED.

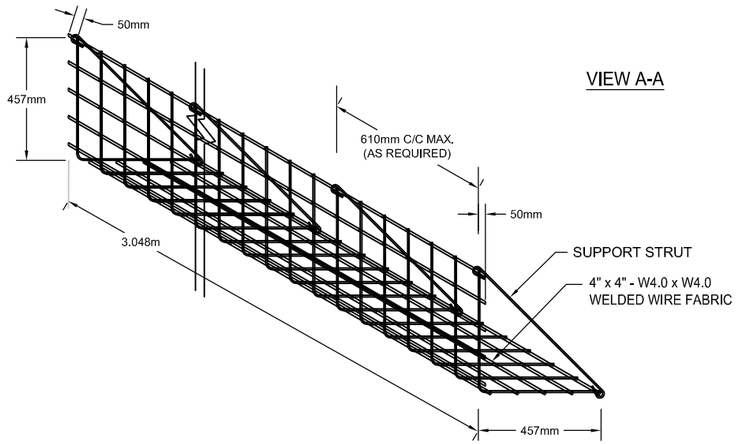
SIERRA SLOPE NESTING DETAIL

NOT TO SCALE



SUPPORT STRUT

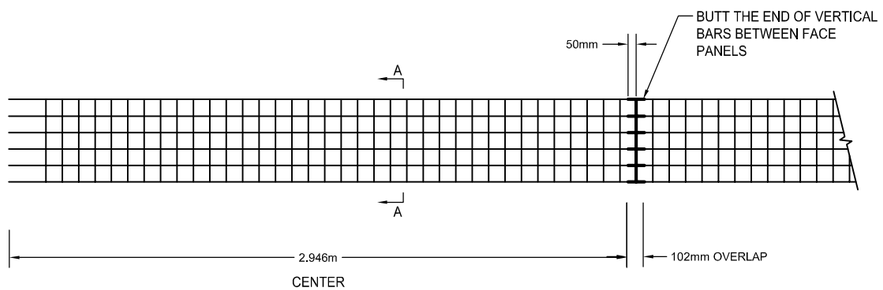




VIEW A-A

NOTES:

1. FACING TO CONSIST OF PREFABRICATED WWF 4" x 4" - W4.0 x W4.0 FORMS.
2. ALL FORMS AND STRUTS WILL BE FABRICATED WITH BLACK WIRE.
3. OVERALL LENGTH OF WIRE FORMS IS 10'-0". EFFECTIVE CONSTRUCTED WIDTH IS 9'-8" WITH 4" OVER LAPPING AT ENDS.



WELDED WIRE FORM FACING UNIT

NOT TO SCALE

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar International Corporation
2500 NorthwInds Pkwy, Suite 500
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Unearthing better results.

Issue/Revisions

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Project Number	PB-17-01-003
Date Drawn	FEBRUARY 7, 2017
Scale	NTS
Designed By	-
Drawn By	DT
Checked By	-

Project
FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title
TYPICAL DETAILS

Drawing Number
PB-17-01-003-007

Rev. ---

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER

APPENDIX B
VEGETATION SPECIES LIST

Comprehensive Vegetation Species List

Scientific Name	Common Name	Plant Form
Achillea millefolium	common yarrow	Forb
Actaea rubra	red and white baneberry	Forb
Agrimonia striata	agrimony	Forb
Anemone canadensis	Canada anemone	Forb
Apocynum androsaemifolium	spreading dogbane	Forb
Arctium minus	common burdock	Forb
Cicuta bulbifera	bulb-bearing water-hemlock	Forb
Circaea alpina	small enchanter's nightshade	Forb
Cirsium arvense	creeping thistle	Forb
Epilobium palustre	marsh willowherb	Forb
Equisetum arvense	common horsetail	Forb
Equisetum pratense	meadow horsetail	Forb
Fragaria virginiana	wild strawberry	Forb
Galium boreale	northern bedstraw	Forb
Galium triflorum	sweet-scented bedstraw	Forb
Geum aleppicum	yellow avens	Forb
Heracleum sphondylium ssp. *montanum*	cow parsnip	Forb
Hieracium spp.	hawkweed species	Forb
Impatiens capensis	spotted touch-me-not	Forb
Lathyrus ochroleucus	cream-colored vetchling	Forb
Lysimachia ciliata	fringed loosestrife	Forb
Lysimachia thyrsiflora	tufted loosestrife	Forb
Maianthemum canadense	wild lily-of-the-valley	Forb
Maianthemum stellatum	star-flowered Solomon's-seal	Forb
Mentha arvensis	wild mint	Forb
Mertensia paniculata	tall lungwort	Forb
Moehringia lateriflora	blunt-leaved sandwort	Forb
Monotropa uniflora	Indian-pipe	Forb
Petasites frigidus var. *palmatus*	palmate-leaved coltsfoot	Forb
Prosartes trachycarpa	fairybells	Forb
Rorippa islandica	northern marsh yellowcress	Forb
Rubus pubescens	dewberry	Forb
Sanicula marilandica	snakeroot	Forb
Solidago canadensis	Canada goldenrod	Forb
Stellaria longifolia	long-leaved chickweed	Forb
Symphyotrichum ciliolatum	Lindley's aster	Forb
Taraxacum officinale	common dandelion	Forb

Scientific Name	Common Name	Plant Form
Thalictrum venulosum	veiny meadow rue	Forb
Tripleurospermum inodorum	scentless chamomile	Forb
Urtica dioica	common nettle	Forb
Vicia americana	wild vetch	Forb
Viola canadensis	western Canada violet	Forb
Viola renifolia	kidney-leaved violet	Forb
Bromus inermis	smooth brome	Graminoid
Carex aquatilis	water sedge	Graminoid
Carex atherodes	awned sedge	Graminoid
Carex deweyana	Dewey's sedge	Graminoid
Carex vaginata	sheathed sedge	Graminoid
Glyceria striata	fowl manna grass	Graminoid
Poa spp.	bluegrass species	Graminoid
Poa palustris	fowl bluegrass	Graminoid
Poa pratensis	Kentucky bluegrass	Graminoid
Amelanchier alnifolia	saskatoon	Shrub
Cornus sericea	red-osier dogwood	Shrub
Lonicera dioica	twining honeysuckle	Shrub
Lonicera involucrata	bracted honeysuckle	Shrub
Prunus virginiana	choke cherry	Shrub
Ribes americanum	wild black currant	Shrub
Ribes hudsonianum	northern black currant	Shrub
Ribes oxyacanthoides	northern gooseberry	Shrub
Ribes triste	wild red currant	Shrub
Rosa acicularis	prickly rose	Shrub
Rubus idaeus	wild red raspberry	Shrub
Salix bebbiana	beaked willow	Shrub
Symphoricarpos albus	snowberry	Shrub
Viburnum edule	low-bush cranberry	Shrub
Acer negundo	Manitoba maple	Tree
Betula papyrifera	white birch	Tree
Populus balsamifera	balsam poplar	Tree
Populus tremuloides	aspen	Tree
Sorbus scopulina	western mountain-ash	Tree

APPENDIX C
WILDLIFE PASSAGE DESIGN RECOMMENDATION LETTER

Stantec Consulting Ltd.
11-2042 Mills Road, Sidney BC V8L 5X4

December 22, 2015
File: 1102-19456

Attention: Lehndorff Land General Partner Inc.

Dear Sir/Madam,

Reference: Wildlife Passage Design Recommendations - Maple Road Fulton Creek Crossing

1.0 BACKGROUND

Stantec Consulting Ltd. (Stantec) was retained by Lehndorff Land General Partner Inc. (the Client) to provide environmental consulting services and recommendations for wildlife passage as part of the design of the Maple Road – Fulton Creek Crossing (the Project). The site is located southwest of the intersection of Whitemud Drive and Highway 216 (Figure 1).

As part of the Maple residential neighbourhood development, Maple Road is currently being designed as a 3-lane urban roadway (Figure 2). Maple Road will bisect a potential wildlife movement corridor along Fulton Creek (which has intermittent flows) upstream of Fulton Marsh. Movement of wildlife along the Fulton Creek drainage is anticipated. Wildlife passage will be considered as part of the road design to maintain permeability for wildlife movements within the future residential development.

In an effort to minimize the impacts on wildlife movement from transportation infrastructure, the City of Edmonton commissioned the development of the Wildlife Passage Engineering Design Guidelines (WPEDG) (City of Edmonton 2010). The objective of these guidelines is to reduce human-wildlife conflict through improved awareness, safety, and collision reduction while also aiding in the maintenance of habitat connectivity and reduced genetic isolation. Wildlife passage recommendations in this report are based on these guidelines.

2.0 OBJECTIVE

Stantec understands that the City of Edmonton has requested specific details pertaining to wildlife passage associated with the Project at the preliminary design stage to allow for planning and incorporation of the ecological features into the ultimate design. The objective of this report is to provide wildlife passage structure recommendations to mitigate the potential adverse effects to wildlife movements resulting from Maple Road development at Fulton Creek.

3.0 WILDLIFE USE

Identification of wildlife present or likely to occur in the Project area was based on a field assessment in the vicinity of Fulton Marsh in May 2010 (Stantec 2010) and wildlife field surveys in the Project area in May and June 2015.

Reference: Wildlife Passage Design Recommendations - Maple Road Fulton Creek Crossing

The field assessment in the vicinity of Fulton Marsh in May 2010 detected nine waterfowl species, one shorebird species, six songbird species and the boreal chorus frog (*Pseudacris maculata*)(Stantec 2010). More recent wildlife field surveys in the Project area were undertaken in May and June of 2015. Boreal chorus frog was detected in Fulton Creek on May 15, May 21 and June 3, 2015. Breeding bird point counts on June 11 and June 25, 2015 also detected the following species:

- chipping sparrow (*Spizella passerina*)
- yellow warbler (*Dendroica petechia*)
- song sparrow (*Melospiza melodia*)
- American goldfinch (*Carduelis tristis*)
- house wren (*Troglodytes aedon*)
- American crow (*Corvus brachyrhynchos*)
- orange-crowned warbler (*Vermivora celata*)
- savannah sparrow (*Passerculus sandwichensis*)
- brown-headed cowbird (*Molothrus ater*)
- black-capped chickadee (*Poecile atricapillus*)

Small mammals expected in the Project area include deer mouse (Peromyscus maniculatus), southern red-back vole (*Myodes gapperi*), meadow vole (*Microtus pennsylvanicus*), shrews (Family Soricidae), and western jumping mouse (Zapus princeps)(Stantec 2010). As well, there is an historical record (FWMIS search) of the long-tailed weasel (*Mustela frenata*) documented in the general vicinity of the Project area (Stantec 2010). This species is classified as May Be at Risk in the General Status of Alberta Wild Species (see http://aep.alberta.ca/fish-wildlife/wild-species/mammals/weasels-related/small-weasels.aspx). Large- and medium-sized mammals (e.g., white-tailed deer, coyote) are also expected to occur in the Project area but site-specific information on their distribution or abundance was not available.

The wildlife species known or likely to occur in the area were then assigned to Ecological Design Groups (EDGs). EDGs are groupings of species that share characteristics that should be taken into account in wildlife passage planning and design. There are 11 EDGs: Large Terrestrial, Medium Terrestrial, Small Terrestrial, Amphibians, Aerial Mammals, Aquatic Species, Scavenger Birds, Birds of Prey, Water Birds, Ground Dwelling Birds, and Other Birds (City of Edmonton 2010).

Consistent with the WPEDG (City of Edmonton 2010), the EDGs identified for the Project area were then assessed to identify appropriate measures to mitigate adverse effects of Maple Road development at Fulton Creek.

4.0 ECOLOGICAL DESIGN GROUPS

Target EDGs for this Project area include Small Terrestrial wildlife, Amphibians, Aerial Mammals (bats), and the five bird EDGs. These EDGs are likely to use habitats associated with Fulton Creek, Fulton Marsh, and adjacent upland areas. Amphibians were selected as an EDG because of their presence in the Project area. It is anticipated that amphibians will use Fulton Creek as a breeding location and travel terrestrially to meet other life requisites.

The anticipated total long-term daily traffic volume on Maple Road at Fulton Creek is 12,285 vehicles/day (Figure 3; Bunt & Associates 2009), consistent with a "collector" road in the City of Edmonton (Ng et al. 2008). Peak hour morning traffic volumes on Maple Road are 30% of that anticipated on 17 Street (1102/3656; Table 1; Figure 4). Similarly, peak hour afternoon traffic volumes on Maple Road are 24% of that predicted for 17 Street (1061/4373; Table 1; Figure 5). The expected signed speed limit on Maple Road is 50 or 60 kilometres per hour.

Given the relatively low anticipated traffic volumes (Table 1) and signed speed limit, Maple Road is not anticipated to be a barrier to movement for Large Terrestrial and Medium Terrestrial EDGs. An analysis of wildlife-vehicle collisions in Edmonton has confirmed the strong relationship between traffic volume, vehicle speeds, and the rate of animal-vehicle collisions (Ng et al. 2008). Wildlife-vehicle collisions are also not anticipated to an issue, given the relatively low traffic volumes and vehicle speeds anticipated on Maple Road. For these reasons, a purpose-built wildlife crossing structure is not considered to be necessary at this location for wildlife species in the Terrestrial and Medium Terrestrial EDGs.

Table 1 Predicted Peak Hour Long-term Traffic Volumes: Maple Road at Fulton Creek and 17 Street[1]

Location	Time of Day	Northbound (vehicles/hr)	Southbound (vehicles/hr)	Total (vehicles/hr)	Source
Maple Road at Fulton Creek (aka 4 Street)	AM	787	315	1102	Figure 4
Maple Road at Fulton Creek (aka 4 Street)	PM	394	667	1061	Figure 5
17 Street – north of intersection with 38 Avenue (Maple Road)	AM	2996	660	3656	Figure 4
17 Street – north of intersection with 38 Avenue (Maple Road)	PM	1498	2875	4373	Figure 5

1 – after Bunt & Associates 2009 (Figures 4 and 5)

Aquatic species (i.e., fish) are not anticipated to require passage at this location because there will be no flows in the channel for the majority of the year.

Passage requirements for Small Terrestrial and Amphibians EDGs are addressed in Section 5.0. Passage requirements for the Aerial Mammals, Scavenger Birds, Birds of Prey, Ground Dwelling Birds, Water Birds and Other Birds EDGs are addressed above-grade in Section 6.0.

5.0 WILDLIFE PASSAGE DESIGN RECOMMENDATIONS

Based on the WPEDG and the EDGs identified for the Project area, a below-grade crossing will be required to accommodate the target Small Terrestrial and Amphibian EDGs.

Installation of a modified 51 m long 1.8m x 1.2m concrete box culvert is proposed in order to provide wildlife passage opportunities for the target EDGs (Figure 2 and Figure 6). The current design includes a vegetated retaining wall that has reduced the overall length of the structure by 10.5 m from the previous design. The modified box culvert also includes a 1 m wide dry pathway adjacent to the flow channel (Figure 6). The dry pathway is designed to provide passage for the Small Terrestrial EDG and the flow channel is designed to provide passage for the Amphibian EDG.

Stormwater modeling indicates that the 1 m dry pathway will be available for wildlife use for the majority of the year when there are no flows or minor flows through the culvert. However, during spring snowmelt (1:100 year event) and storms (1:5 year event) water heights are expected that would cover the dry pathway (Figure 7). These infrequent stormwater events are not expected to compromise the overall effectiveness of the modified box culvert to provide passage to the Small Terrestrial EDG.

This modified box culvert conforms to Kintsch and Cramer's (2011) "Class 1 Small Underpass", which includes ephemerally flooded drainage culverts. According to their system, this type of culvert has the potential to provide passage for the species movement guilds that include the target EDGs at this site, Small Terrestrial, and Amphibians. This type of structure is considered to be adequate to allow passage of small animals (City of Edmonton 2010; Clevenger and Huijser 2011; Phillips et al. 2012).

5.1 DETAILED DESIGN RECOMMENDATIONS

The recommended wildlife passage design for Maple Road is a below-grade crossing structure for the Small Terrestrial and Amphibians EDGs. As this Project is at the preliminary design stage, specific recommendations pertaining to wildlife passage measures and other general mitigation measures are provided below but will likely need to be refined at the detailed design stage.

- Natural substrate and native vegetation should be present at the approaches to the crossing structure. These will create a more natural appearance around the structure and, for smaller EDGs, provide security cover from predators.

- Scour Shield will be used at the entrances of the modified box culvert that will prevent or minimize erosion while facilitating wildlife passage.

- Debris grates should not be installed.

- Small animal and amphibian drift fencing should be installed to direct animals toward the culvert entrances and prevent access to the road.

- Wildlife-friendly lighting with reduced spill and glare should be incorporated in the final design of the road. Street lighting design should avoid illuminating the entrances of the wildlife crossing structures and nearby natural features (Stantec 2010).

6.0 RECOMMENDATIONS FOR REDUCING BIRD AND BAT VEHICLE COLLISION RISK

For the avian and Aerial Mammals (i.e., bat) EDGs, it is recommended that diversionary methods be incorporated to direct the flight of the birds and bats up and over the road as these species rarely use below grade crossing structures. The following above-grade mitigation measure is recommended to reduce the risk of collisions between vehicles and the Aerial Mammals, Scavenger Birds, Birds of Prey, Water Birds and Other Birds EDGs as they fly over Maple Road:

- Natural vegetation and tree plantings can be used to direct the flight paths of birds and bats higher over the road, above the traffic (Tremblay 2006). This measure will also maintain the aesthetics of the area and minimize the reduction in habitat created by the road right-of-way.

Reference: Wildlife Passage Design Recommendations - Maple Road Fulton Creek Crossing

7.0 CLOSURE

This document entitled *Wildlife Passage Design Recommendations - Maple Road Fulton Creek Crossing* was prepared by Stantec Consulting Ltd. for the account of Lehndorff Land General Partner Inc. The material in it reflects Stantec's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Stantec has endeavored to incorporate the principles of the WPEDG (City of Edmonton 2010) into the Maple Road wildlife passage design and the constraints associated with the physical site characteristics and available materials. We trust that this information is sufficient to support the submission of the preliminary design and understand further refinement will be required as design progresses.

Regards,

STANTEC CONSULTING LTD.

Bill Harper, M.Sc., R.P.Bio.
Senior Wildlife Biologist
Phone: (250) 655-5394
Bill.Harper@stantec.com

Attachments:

Figure 1. Location of the Study Area and Proposed Wildlife Crossing

Figure 2. Preliminary design of the modified 1800mm x 1200mm box culvert -Maple Road at Fulton Creek

Figure 3. Long-term traffic predictions – Daily Two-Way Traffic Volumes (Bunt & Associates 2009)

Figure 4. Long-term traffic predictions – AM peak hour (Bunt & Associates 2009)

Figure 5. Long-term traffic predictions – PM peak hour (Bunt & Associates 2009)

Figure 6. Modified 1800mm x 1200mm box culvert detail (from Figure 2)

Figure 7. Estimated Water Heights in the Modified Box Culvert Under Different Predicted Storm Events

8.0 REFERENCES

City of Edmonton. 2010. Wildlife passage engineering design guidelines. Report prepared by Stantec Consulting Ltd. for the Office of Natural Areas, City of Edmonton, AB. 249 pp.

Clevenger, A.P. and M.P. Huijser. 2011. Wildlife crossing structure handbook: Design and evaluation in North America. Report FHWA-CFL/TD-11-003 by the Western Transportation Institute, Bozeman, MT for the U.S. Federal Highway Administration, Central Federal Lands Highway Division, Lakewood, CO. 224 pp.

Kintsch, J. and P.C. Cramer. 2011. Permeability of existing structures for terrestrial wildlife: A passage assessment system. Research Report No. WA-RD 777.1. Washington State Department of Transportation, Olympia, WA. 188 pp.

Ng, J.W,C. Nielson, and C.C. St. Clair. 2008. Landscape and traffic factors influencing deer–vehicle collisions in an urban environment. Human–Wildlife Interactions 2(1): 34-47.

Phillips, J., R. Phillips, N. Srinivasan, D. Aso, W. Lao and P. Cornely. 2012. Safe passage for Coyote Valley: a wildlife linkage for the Highway 101 corridor. Kirsch Center for Environmental Studies, De Anza College, Cupertino, CA. 35pp.

Stantec Consulting Ltd. 2010. Maple Neighborhood Environmental Impact Screening Assessment. Report Prepared for Planning and Development, City of Edmonton, Edmonton, AB. 105 pp.

Tremblay, M. 2006. Assessing functional landscape connectivity for songbirds in an urban environment. *In,* C. L. Irwin, P. Garrett, and K. P. McDermott (Ed.), Proceedings of the 2005 International Conference on Ecology and Transportation (pp. 563-564). Raleigh, North Carolina: Centre for Transportation and the Environment, North Carolina State University.

Reference: Wildlife Passage Design Recommendations - Maple Road Fulton Creek Crossing

Figure 1. Location of the Study Area and Proposed Wildlife Crossing

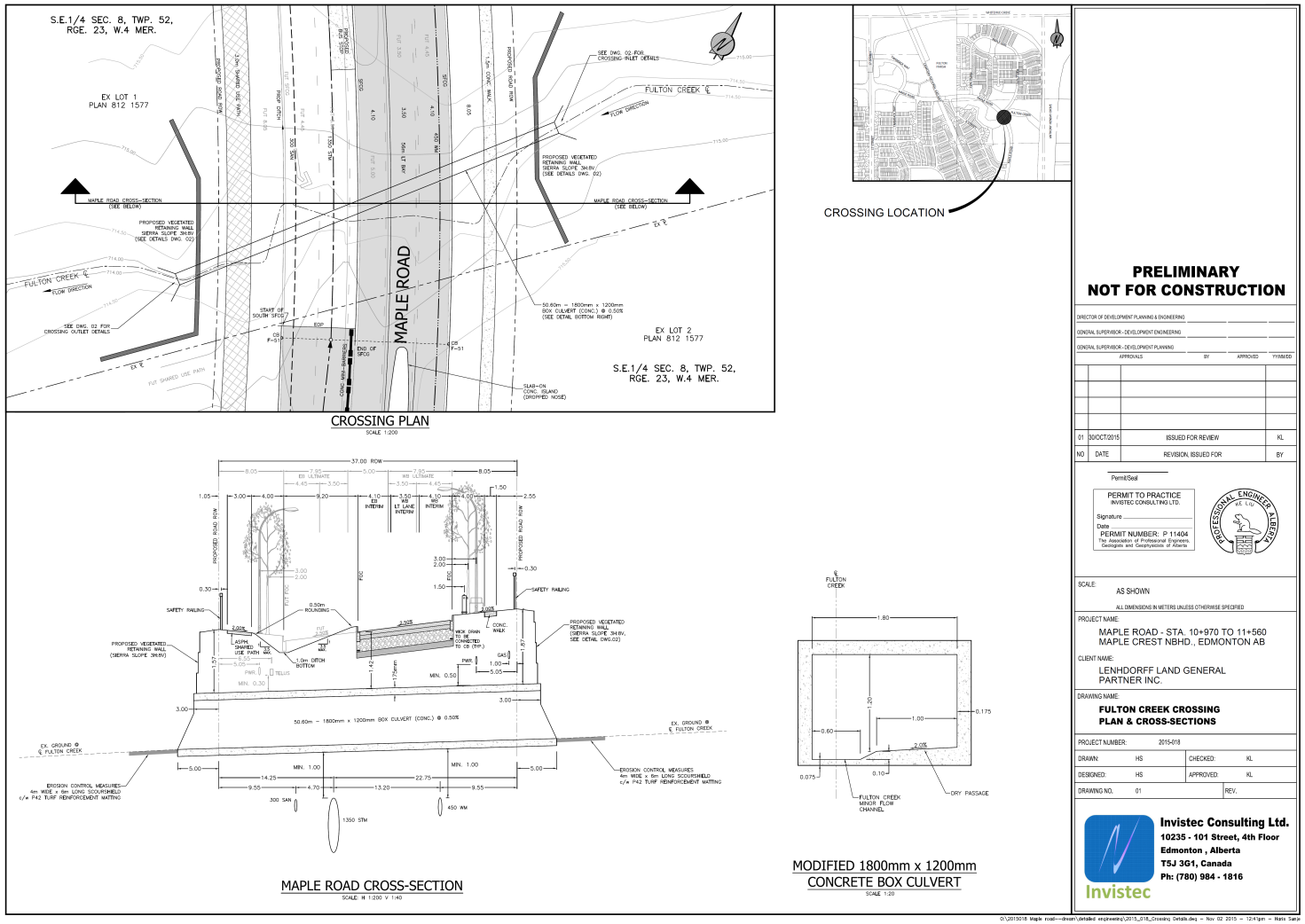


Figure 2.Preliminary design of the modified 1800mm x 1200mm box culvert -Maple Road at Fulton Creek

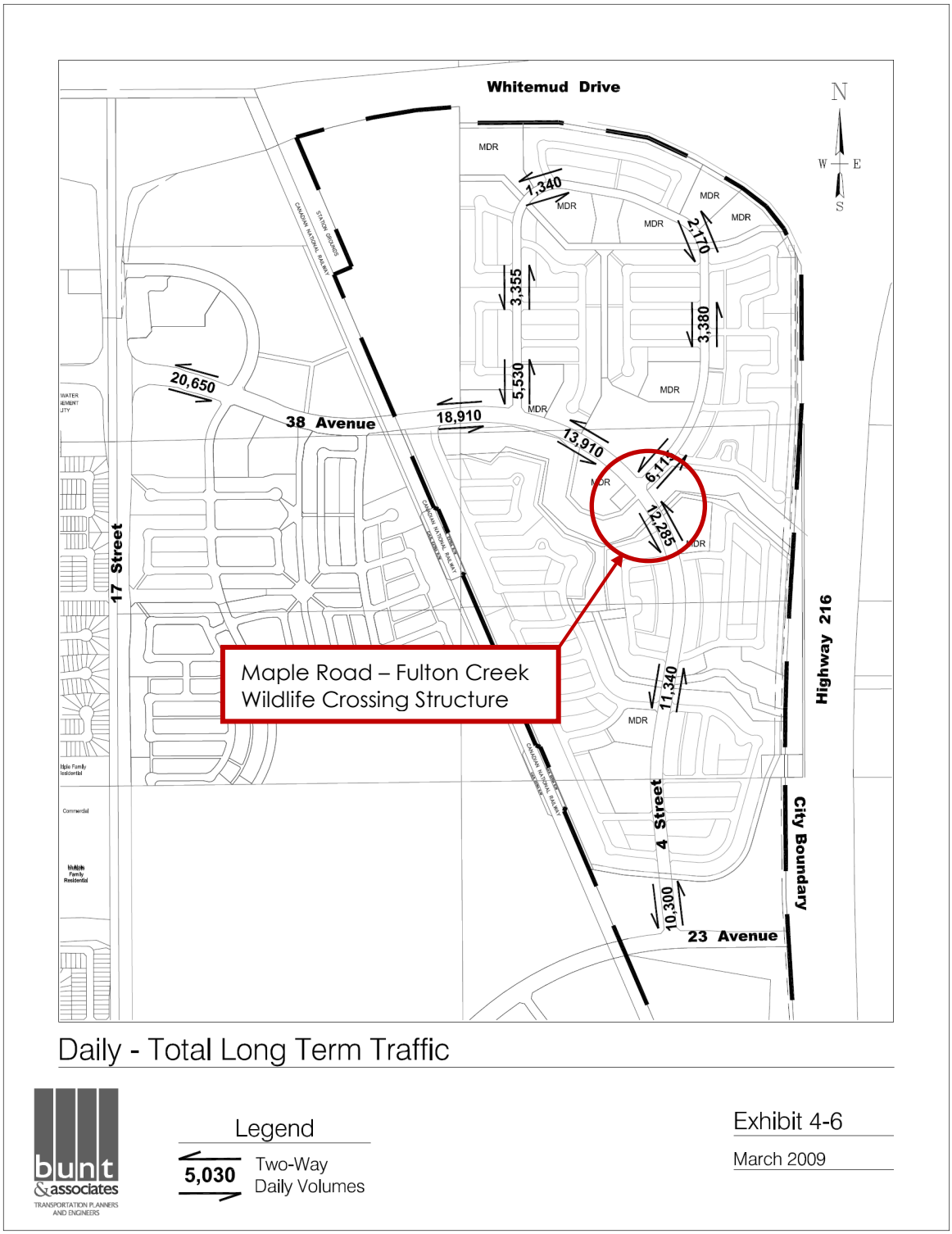


Figure 3. Long-term traffic predictions – Daily Two-Way Traffic Volumes (Bunt & Associates 2009).

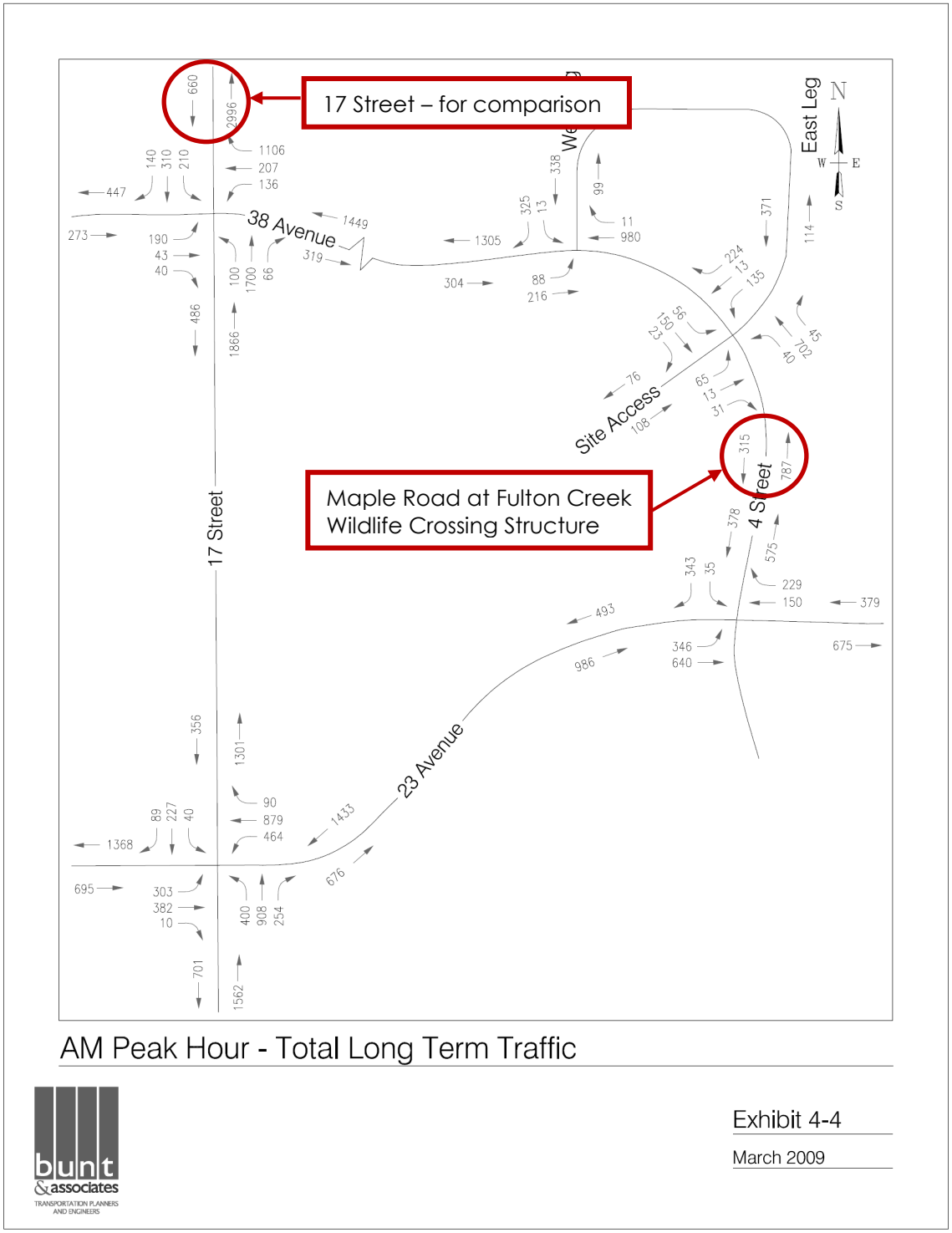


Figure 4. Long-term traffic predictions – AM peak hour (Bunt & Associates 2009).

Reference: Wildlife Passage Design Recommendations - Maple Road Fulton Creek Crossing

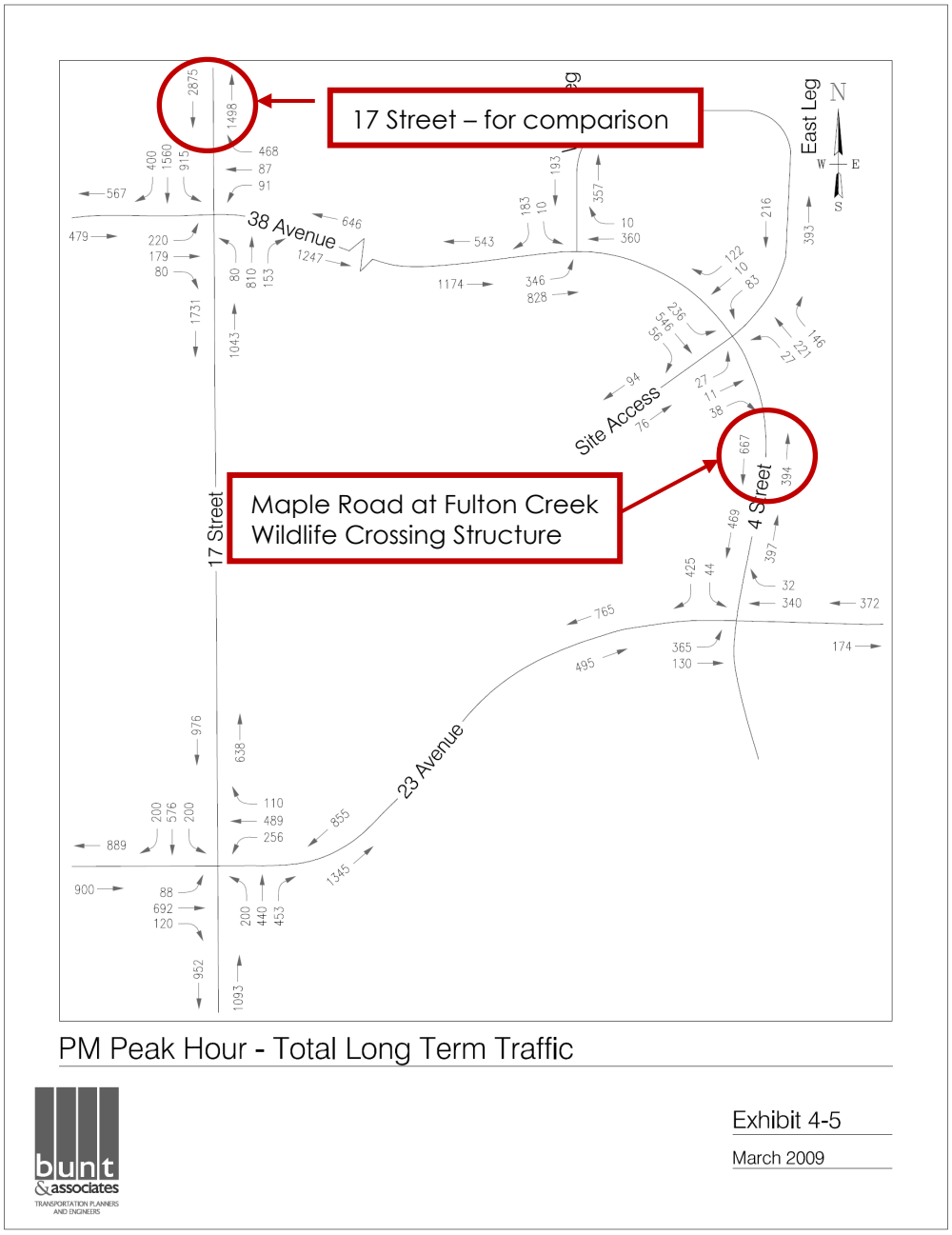
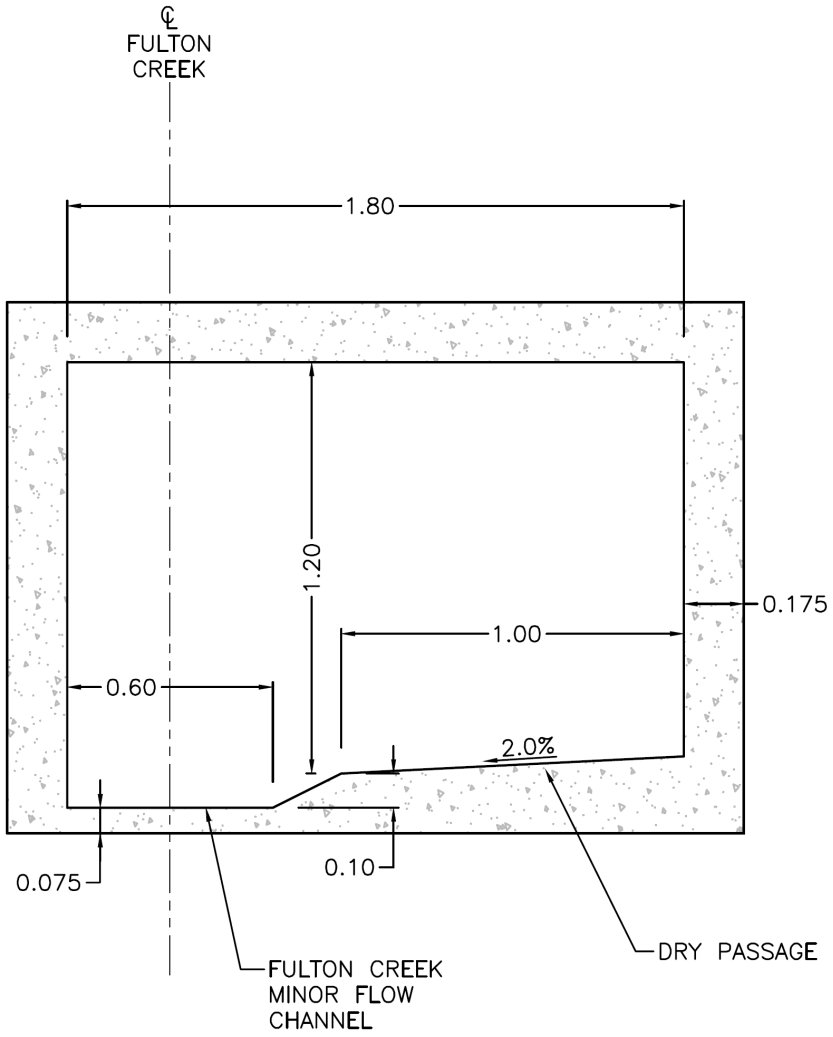
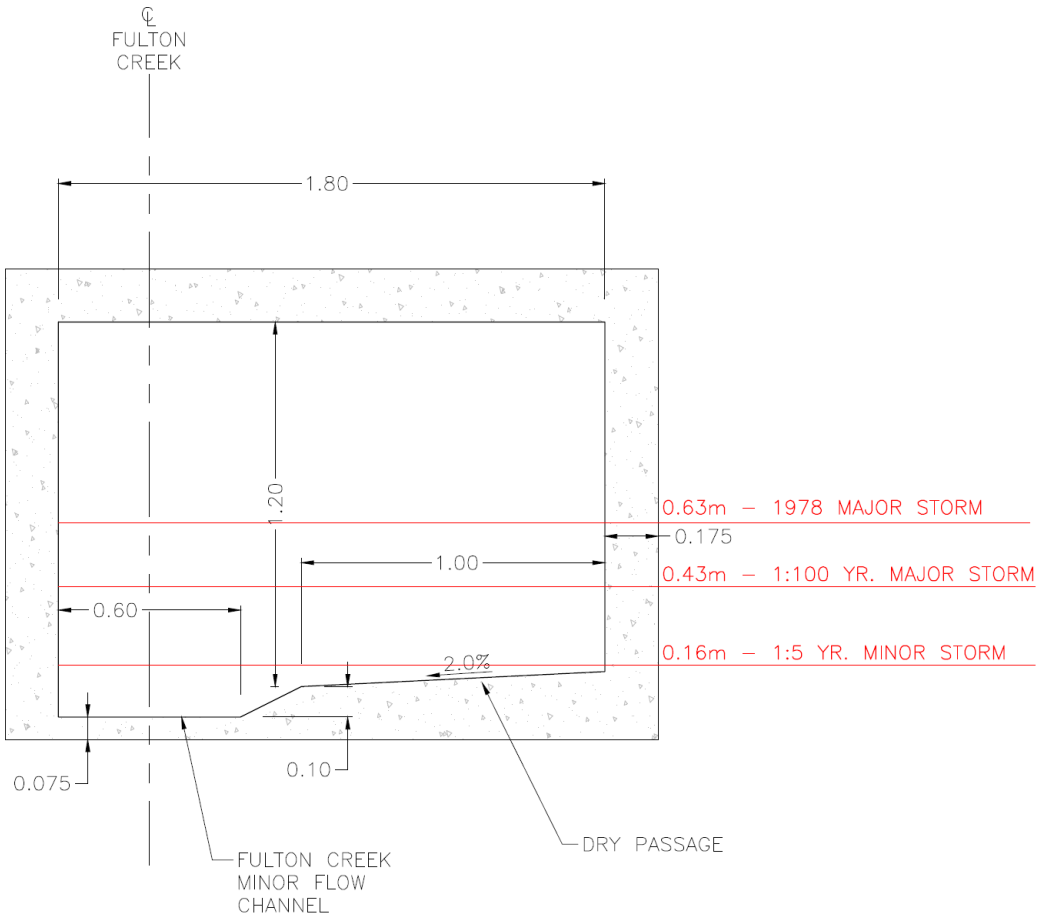


Figure 5. Long-term traffic predictions – PM peak hour (Bunt & Associates 2009).



MODIFIED 1800mm x 1200mm
CONCRETE BOX CULVERT
SCALE 1:20

Figure 6. Modified 1800mm x 1200mm box culvert detail (from Figure 2).



NOTE:
THIS IS PRELIMINARY SECTION AND IS SUBJECT TO CHANGE. FINAL DESIGN TO BE PROVIDED AT DETAILED DESIGN STAGE ALONG WITH ENVIRONMENTAL IMPACT ASSESSMENT.

MODIFIED 1800mm x 1200mm
CONCRETE BOX CULVERT

SCALE 1:100

Figure 7. Estimated Water Heights in the Modified Box Culvert Under Different Predicted Storm Events

APPENDIX D
GEOTECHNICAL INVESTIGATION

CT & Associates Engineering Inc.

#102, 14420 - 116 Avenue
Edmonton, Alberta T5M 4B4

Phone: (780) 451-1332 Fax: (780) 732-5300

TRANSMITTAL

To:	Invistec Consulting	Date:	April 21, 2017
Address:		Project:	Maple Stage 7 - Fulton Creek Crossing
		Email:	
Attention:	Petrea Chamney, CET	From:	Danny Niawchuk, P. Eng.

Petrea;

Subject: **Review of Fulton Creek Crossing Retaining Walls**
Maple Stage 7, Edmonton

As requested, CT & Associates Engineering Inc. has reviewed the provided drawings for the Fulton Creek Crossing culvert and retaining wall structure for the Maple Stage 7 Maple Road to be constructed across the Fulton Creek, in follow-up to our preparation of the following report:

"Geotechnical Investigation - Proposed Creek Crossing Adjacent to Maples Stage 6,
400 m Southeast of Maple Way NW and Maple Road NW, Edmonton, Edmonton, Alberta."
Prepared by CT & Associates Engineering Inc. for Lehndorff Land General Partner Inc. c/o DREAM,
August, 2015. CTA File No. 02-1998.

As part of our review, the following drawings were provided to CTA:

1) Invistec Consulting Drawing No. C015-001 - Maple Road Erosion and Sediment Control (dated February 28, 2017)
2) Invistec Consulting Drawing No. C103-002 - Maple Road Grading Plan (dated February 28, 2017)
3) Invistec Consulting Drawing No. C200-001 - Maple Road Sections (dated February 28, 2017)
4) Invistec Consulting Sheet No. 2 Rev. 00 - Planting Plan (dated March 13, 2017)
5) Tensar/Nilex Drawings PB-17-01-003-004 through 008 (all dated February 7, 2017) - including north and south elevations, cross sections, and details of culvert/roadway retaining walls

Our review comments are as follows:

Box Culvert

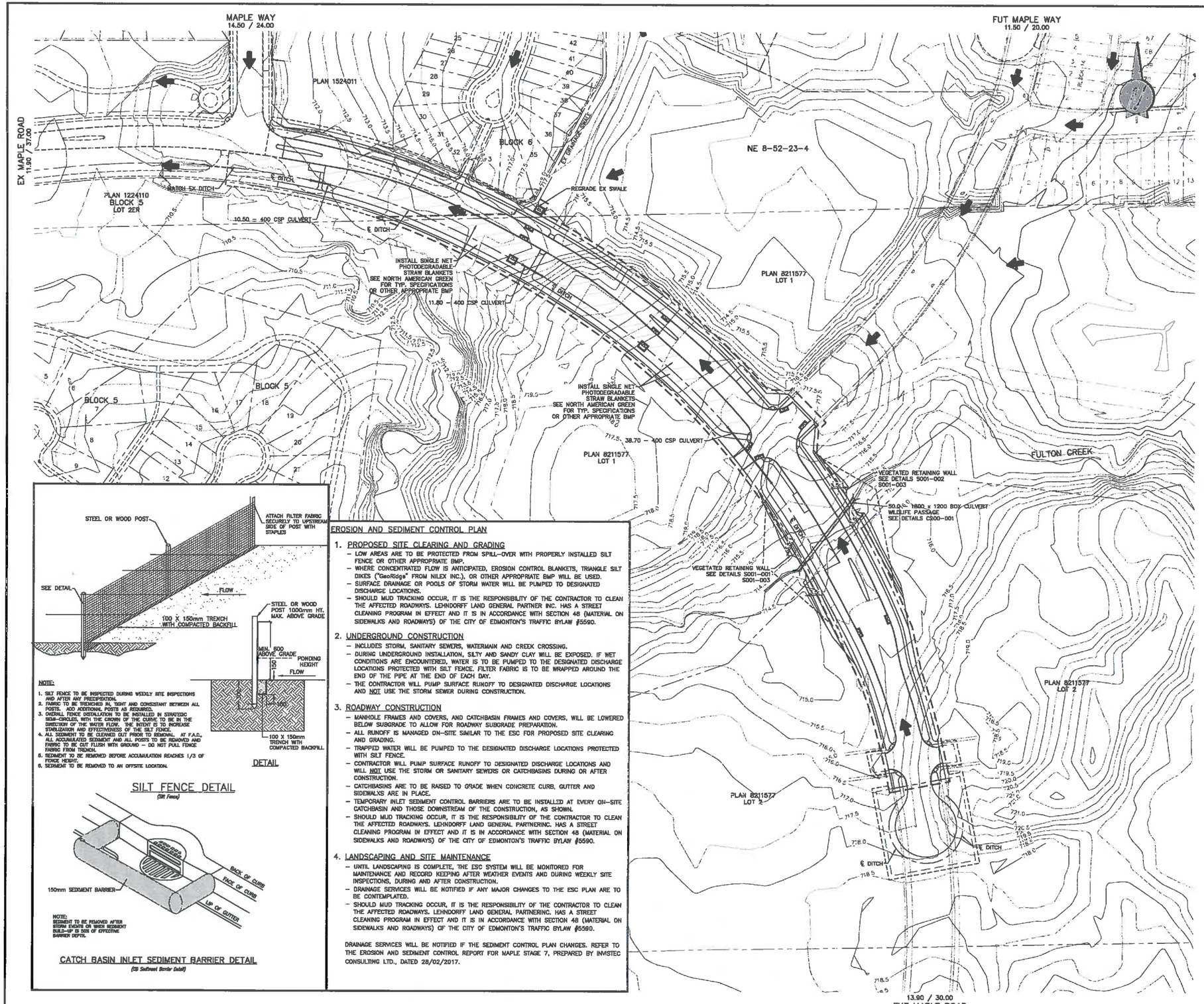
1) The requirements of our August, 2015 Geotechnical Investigation report for the box culvert have been included in the design, namely the 0.5 m thick gravel pad foundation (wrapped in geotextile), and weeping tile;
2) It is recommended that the base of the excavation for the gravel pad construction be inspected at time of excavation to ensure the gravel base is founded on a competent native soil sub-grade.

Retaining Wall/Scourshield

1) Overall, the retaining wall design as presented in the Tensar/Nilex design drawings appears to be of a suitable engineered nature for the roadway construction over the box culvert/wildlife crossing, as does the erosion control use of the 'Scourshield';
2) The granular backfill utilized within the roadway reinforcement should consist of a clean gravel (such as City of Edmonton Designation 3-20A (20 mm crushed gravel)), placed and compacted to 100% Standard Proctor Density, to be additionally reviewed and approved by the retaining wall designer;
3) Additional supporting technical discussion of the retaining wall reinforcement and erosion control product as requested by the City of Edmonton should be provided as part of detailed by the Tensar design engineer.

Regards!

Danny Nawchuk, P.Eng.
Attached (8 drawings)



NOTE:
1. SILT FENCE TO BE INSPECTED DURING WEEKLY SITE INSPECTIONS AND AFTER ANY PRECIPITATION.
2. FABRIC TO BE TRENCHED IN, TIGHT AND CONSISTANT BETWEEN ALL POSTS. ADD ADDITIONAL POSTS AS REQUIRED.
3. OVERALL FENCE DISTALLATION TO BE INSTALLED IN STRAIGHT SEMI-CIRCLES, WITH THE CROWN OF THE CURVE TO BE IN THE DIRECTION OF THE WATER FLOW. THE INTENT IS TO INCREASE STABILIZATION AND EFFECTIVENESS OF THE SILT FENCE.
4. ALL SEDIMENT TO BE CLEANED OUT PRIOR TO REMOVAL. AT F.A.C., ALL ACCUMULATED SEDIMENT AND ALL POSTS TO BE REMOVED AND FABRIC TO BE CUT FLUSH WITH GROUND — DO NOT PULL FENCE FABRIC FROM TRENCH.
5. SEDIMENT TO BE REMOVED BEFORE ACCUMULATION REACHES 1/3 OF FENCE HEIGHT.
6. SEDIMENT TO BE REMOVED TO AN OFFSITE LOCATION.

DETAIL

SILT FENCE DETAIL
(Silt Fence)

NOTE:
SEDIMENT TO BE REMOVED AFTER STORM EVENTS OR WHEN SEDIMENT BUILD-UP IS 50% OF EFFECTIVE BARRIER DEPTH.

CATCH BASIN INLET SEDIMENT BARRIER DETAIL
(CB Sediment Barrier Detail)

EROSION AND SEDIMENT CONTROL PLAN

1. PROPOSED SITE CLEARING AND GRADING
   - LOW AREAS ARE TO BE PROTECTED FROM SPILL-OVER WITH PROPERLY INSTALLED SILT FENCE OR OTHER APPROPRIATE BMP.
   - WHERE CONCENTRATED FLOW IS ANTICIPATED, EROSION CONTROL BLANKETS, TRIANGLE SILT DIKES ("GeoRidge" FROM NILEX INC.), OR OTHER APPROPRIATE BMP WILL BE USED.
   - SURFACE DRAINAGE OR POOLS OF STORM WATER WILL BE PUMPED TO DESIGNATED DISCHARGE LOCATIONS.
   - SHOULD MUD TRACKING OCCUR, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CLEAN THE AFFECTED ROADWAYS. LEHNDORFF LAND GENERAL PARTNER INC. HAS A STREET CLEANING PROGRAM IN EFFECT AND IT IS IN ACCORDANCE WITH SECTION 48 (MATERIAL ON SIDEWALKS AND ROADWAYS) OF THE CITY OF EDMONTON'S TRAFFIC BYLAW #5590.
2. UNDERGROUND CONSTRUCTION
   - INCLUDES STORM, SANITARY SEWERS, WATERMAIN AND CREEK CROSSING.
   - DURING UNDERGROUND INSTALLATION, SILTY AND SANDY CLAY WILL BE EXPOSED. IF WET CONDITIONS ARE ENCOUNTERED, WATER IS TO BE PUMPED TO THE DESIGNATED DISCHARGE LOCATIONS PROTECTED WITH SILT FENCE. FILTER FABRIC IS TO BE WRAPPED AROUND THE END OF THE PIPE AT THE END OF EACH DAY.
   - THE CONTRACTOR WILL PUMP SURFACE RUNOFF TO DESIGNATED DISCHARGE LOCATIONS AND NOT USE THE STORM SEWER DURING CONSTRUCTION.
3. ROADWAY CONSTRUCTION
   - MANHOLE FRAMES AND COVERS, AND CATCHBASIN FRAMES AND COVERS, WILL BE LOWERED BELOW SUBGRADE TO ALLOW FOR ROADWAY SUBGRADE PREPARATION.
   - ALL RUNOFF IS MANAGED ON-SITE SIMILAR TO THE ESC FOR PROPOSED SITE CLEARING AND GRADING.
   - TRAPPED WATER WILL BE PUMPED TO THE DESIGNATED DISCHARGE LOCATIONS PROTECTED WITH SILT FENCE.
   - CONTRACTOR WILL PUMP SURFACE RUNOFF TO DESIGNATED DISCHARGE LOCATIONS AND WILL NOT USE THE STORM OR SANITARY SEWERS OR CATCHBASINS DURING OR AFTER CONSTRUCTION.
   - CATCHBASINS ARE TO BE RAISED TO GRADE WHEN CONCRETE CURB, GUTTER AND SIDEWALKS ARE IN PLACE.
   - TEMPORARY INLET SEDIMENT CONTROL BARRIERS ARE TO BE INSTALLED AT EVERY ON-SITE CATCHBASIN AND THOSE DOWNSTREAM OF THE CONSTRUCTION, AS SHOWN.
   - SHOULD MUD TRACKING OCCUR, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CLEAN THE AFFECTED ROADWAYS. LEHNDORFF LAND GENERAL PARTNERING. HAS A STREET CLEANING PROGRAM IN EFFECT AND IT IS IN ACCORDANCE WITH SECTION 48 (MATERIAL ON SIDEWALKS AND ROADWAYS) OF THE CITY OF EDMONTON'S TRAFFIC BYLAW #5590.
4. LANDSCAPING AND SITE MAINTENANCE
   - UNTIL LANDSCAPING IS COMPLETE, THE ESC SYSTEM WILL BE MONITORED FOR MAINTENANCE AND RECORD KEEPING AFTER WEATHER EVENTS AND DURING WEEKLY SITE INSPECTIONS, DURING AND AFTER CONSTRUCTION.
   - DRAINAGE SERVICES WILL BE NOTIFIED IF ANY MAJOR CHANGES TO THE ESC PLAN ARE TO BE CONTEMPLATED.
   - SHOULD MUD TRACKING OCCUR, IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CLEAN THE AFFECTED ROADWAYS. LEHNDORFF LAND GENERAL PARTNERING. HAS A STREET CLEANING PROGRAM IN EFFECT AND IT IS IN ACCORDANCE WITH SECTION 48 (MATERIAL ON SIDEWALKS AND ROADWAYS) OF THE CITY OF EDMONTON'S TRAFFIC BYLAW #5590.

DRAINAGE SERVICES WILL BE NOTIFIED IF THE SEDIMENT CONTROL PLAN CHANGES. REFER TO THE EROSION AND SEDIMENT CONTROL REPORT FOR MAPLE STAGE 7, PREPARED BY INVISTEC CONSULTING LTD., DATED 28/02/2017.

LEGEND:
- SPILL DIRECTION
- DIRECTION OF MAJOR DRAINAGE
- SILT FENCE
- CATCHBASIN SEDIMENT BARRIER
- DEVELOPMENT BOUNDARY
- LIMIT OF CONSTRUCTION
- STRAW WATTLE
- EROSION BLANKET

NOTES:

REVISION:

		BY	APPD	DATE

ISSUE:

		BY	APPD	DATE
01	ISSUED FOR FIRST SUBMISSION	RR	KL	28/02/2017

PROJECT MANAGER: VINCENT LIU

CLIENT:
LEHNDORFF LAND GENERAL PARTNER INC.

PROJECT:
MAPLE ROAD
MAPLE WAY TO SOUTH OF FULTON CREEK

DRAWING TITLE:
EROSION AND SEDIMENT CONTROL

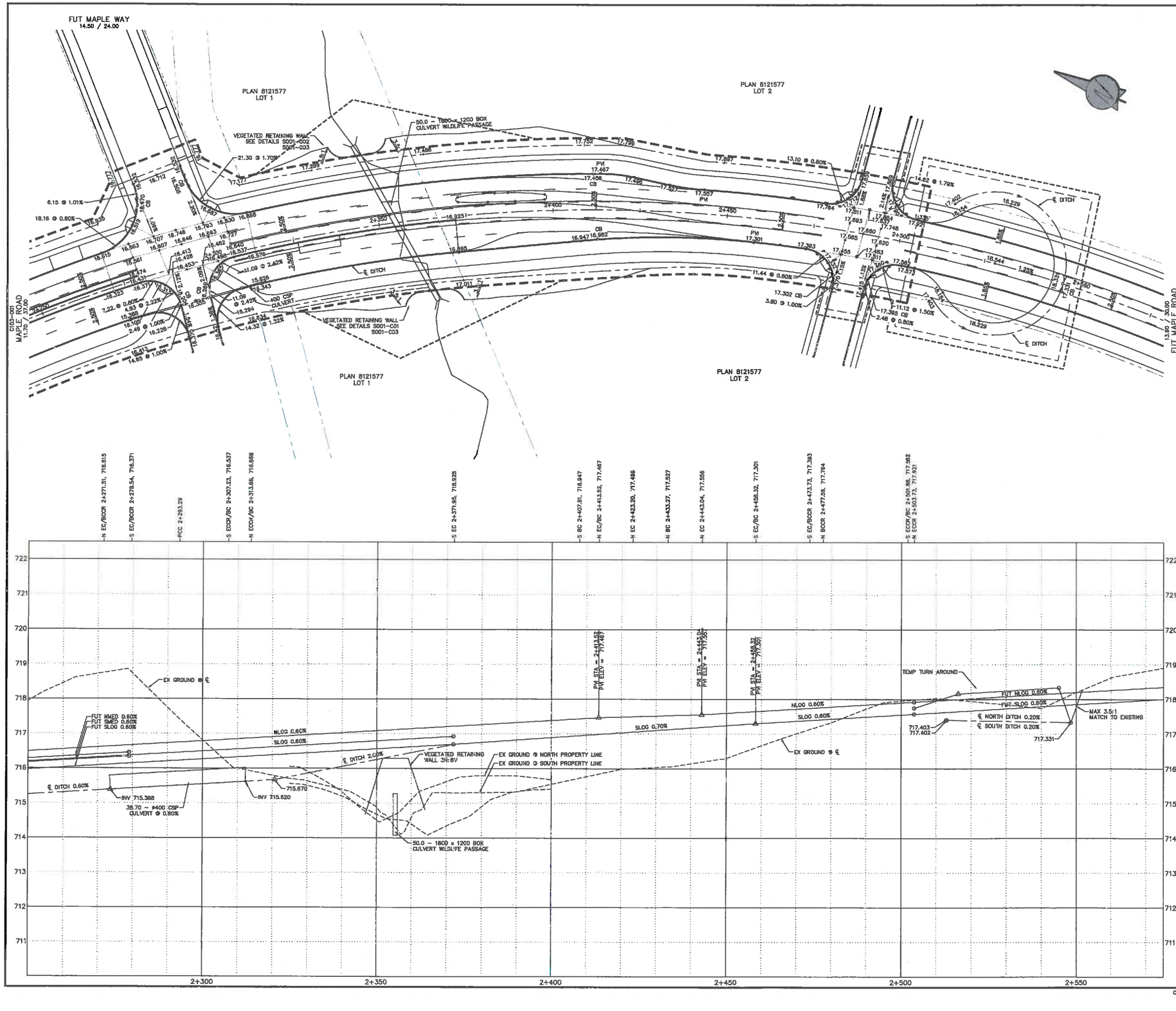
PROJECT NO: 2016-036

SCALE: 1:1000 (0 10 20 30 40 50)

DRAWING NO. C015-001

PERMIT / SEAL

Invistec Consulting Ltd.
10235 - 101 Street, 4th Floor
Edmonton Alberta, T5J 3G1
(780) 984 - 1816
www.invistec.ca



LEGEND:

- DEVELOPMENT BOUNDARY
- LIMIT OF CONSTRUCTION

NOTES:

1. CHAINAGES ARE BASED ON CENTERLINE CONTROL.
2. ELEVATION PREFIX 700.——
5. EXISTING ELEVATIONS (——)
6. ELEVATIONS ARE TO LIP OF GUTTER GRADES UNLESS OTHERWISE SHOWN.
7. ELEVATIONS ARE TO GEODETIC DATUM.
8. EDL – EDGE OF DRIVING LANE
9. RTB – RIGHT TURN BAY

REVISION:

		BY	APPD	DATE

ISSUE:

		BY	APPD	DATE
01	ISSUED FOR FIRST SUBMISSION	RR	KL	28/02/2017

PROJECT MANAGER: VINCENT LIU

CLIENT:
LEHNDORFF LAND GENERAL PARTNER INC.

PROJECT:
MAPLE ROAD
MAPLE WAY TO SOUTH OF FULTON CREEK

DRAWING TITLE:
MAPLE ROAD
STA 2+250 – STA 2+575
GRADING PLAN

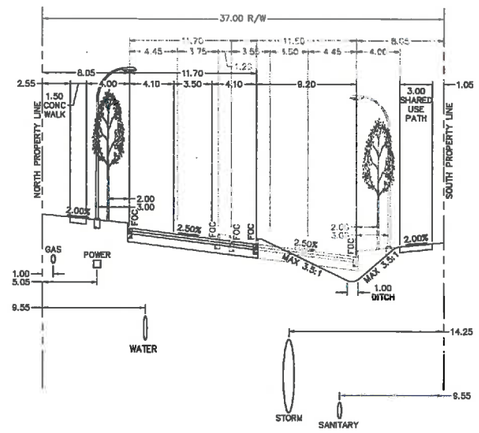
PROJECT NO: 2016-036

SCALE:
HORZ 1 : 50
VERT 1 : 50
0 5 10 15 20 25
0 0.5 1 1.5 2 2.5

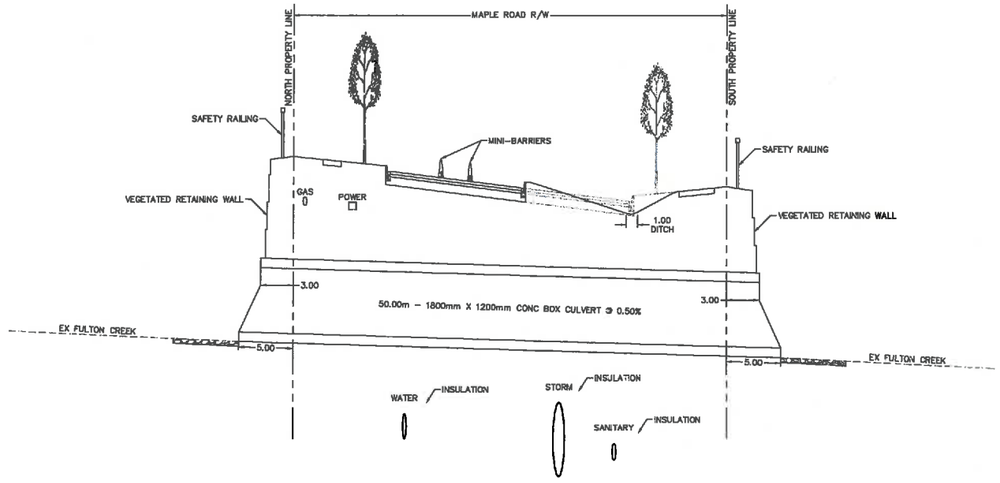
DRAWING NO.
C103-002

PERMIT / SEAL

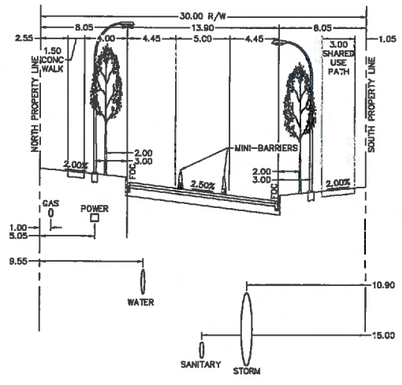
Invistec Consulting Ltd.
10235 – 101 Street, 4th Floor
Edmonton Alberta, T5J 3G1
(780) 984 – 1816
www.invistec.ca



SECTION A–A
STATION 24+225
HORIZONTAL SCALE: 1:250
VERTICAL SCALE: 1:50



FULTON CREEK WILDLIFE CROSSING
SECTION B–B
STATION 24+354.85
HORIZONTAL SCALE: 1:250
VERTICAL SCALE: 1:50



SECTION C–C
STATION 24+465
HORIZONTAL SCALE: 1:250
VERTICAL SCALE: 1:50

LEGEND:

NOTES:

REVISION:

		BY	APPD	DATE

ISSUE:

		BY	APPD	DATE
01	ISSUED FOR FIRST SUBMISSION	RR	KL	28/02/2017

PROJECT MANAGER: VINCENT LIU

CLIENT:
LEHNDORFF LAND GENERAL PARTNER INC.

PROJECT:
MAPLE ROAD
MAPLE WAY TO SOUTH OF FULTON CREEK

DRAWING TITLE:
SECTIONS

PROJECT NO: 2016–036

SCALE:

DRAWING NO.
C200–001

PERMIT / SEAL

PERMIT TO PRACTICE
INVISTEC CONSULTING LTD.
Signature _____
Date _____
PERMIT NUMBER: P 11404
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL ENGINEER ALBERTA
KEN LIU

Invistec Consulting Ltd.
10235 – 101 Street, 4th Floor
Edmonton Alberta, T5J 3G1
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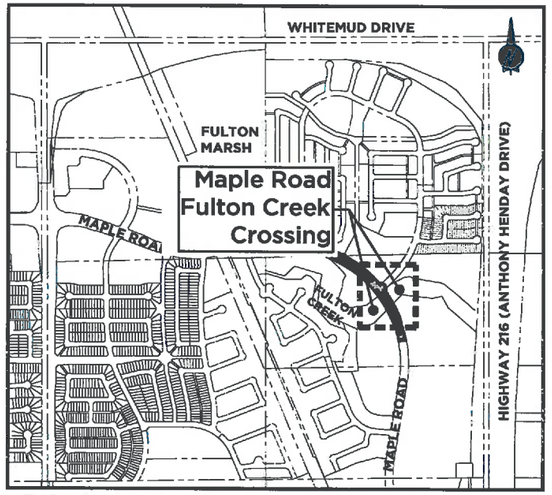


KEY PLAN - SCALE N.T.S

NOTES

ALL SEEDING ON 150MM CLASS **B** TOPSOIL

PLANTING NOTES:

1. CONTRACTOR TO CALL FIRST CALL AT 1-800-242-3447 TO HAVE EXISTING UTILITIES LOCATED PRIOR TO START OF ANY CONSTRUCTION.
2. CONTRACTOR TO ENSURE THAT ALL NECESSARY ARRANGEMENTS ARE MADE WITH THE PIPELINE COMPANIES CONCERNING THE MOVEMENT OF MATERIALS AND EQUIPMENT NEAR ANY PIPELINE RIGHT OF WAYS/
3. CONTRACTOR IS RESPONSIBLE FOR THE HOARDING OF ALL TREE WITHIN OR ADJACENT TO CONSTRUCTION AREAS.
4. CONTRACTOR IS RESPONSIBLE FOR HAULING OF ALL EXCESS MATERIALS OFF THE SITE
5. CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO LANDSCAPED AREAS AND MUST MAKE ALL NECESSARY RESTORATIONS AND REPAIRS
6. CONTRACTOR TO VERIFY ALL DIMENSIONS AND REPORT ANY DISCREPANCIES TO THE LANDSCAPE ARCHITECT
7. LAYOUT TO BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO CONSTRUCTION STARTING
8. ALL MEASUREMENTS IN METERS UNLESS OTHERWISE NOTED.
9. ALL PLANT MATERIAL TO BE NURSERY GROWN STOCK AND SHALL MEET OR EXCEED THE SPEC'S OF THE CDN NURSERY TRADES ASSOC. FOR SIZE, HT. SPREAD, GRADING QUALITY AND METHOD OF CULTIVATION
10. NO SUBSTITUTIONS OF MATERIALS, PRODUCTS OR QUANTITIES WITHOUT PRIOR CONSENT OF LANDSCAPE ARCHITECT.
11. ALL PLANT MATERIAL AND WORKMANSHIP TO CONFORM TO THE REQUIREMENTS OF THE CITY OF EDMONTON DESIGN AND CONSTRUCTION STANDARDS IN ITS MOST RECENT EDITION.
12. AREAS TO RECEIVE SOD TO HAVE TOPSOIL TO A DEPTH OF 100MM, AREAS TO RECEIVE SEED TO HAVE TOPSOIL TO A DEPTH OF 150MM, AREAS FOR PLANTING BEDS TO A DEPTH OF 450MM
13. 100MM WOOD CHIP MULCH ON ALL PLANTING BEDS
14. INSTALL TURF REINFORCEMENT MAT FOR ALL SEED MIX **A** AREAS AND SEED MIX **B** AREAS WITH SLOPES > 10:1 OR WITHIN 10M OF CREEK.

SEED MIXTURE A

CERTIFIED CANADA NO. 1 MIXTURE, FREE OF DISEASE, WEED SEEDS OR FOREIGN MATTER, MINIMUM GERMINATION OF 75%, MINIMUM PURITY OF 97% AND CONFORMING TO THE MIXES BELOW OR APPROVED ALTERNATIVES. ALL SEED MUST BE FROM A RECOGNIZED SEED FIRM, MEETING THE REQUIREMENTS FOR THE SEEDS ACT FOR CANADA NO. 1 SEED. SEED SHALL BE CERTIFIED NO. 1 GRADE A GERMINATION TEST AND/OR WEED SEED ANALYSIS MAY BE REQUESTED AND ALL LAWN SEED MUST COMPLY WITH FEDERAL AND PROVINCIAL SEED LAWS.

NON-MAINTAINED NATURALIZATION LANDSCAPING - WET MEADOW SEED MIX
10% AWNED WHEATGRASS (AGROPYRON TRACHYCAULUM VAR. UNILATERALE);
10% WESTERN WHEATGRASS (AGROPYRON SMITHII);
10% SLOUGHGRASS (BECKMANNIA SYZIGACHNE);
20% TUFTED HAIR GRASS (DESCHAMPSIA CAESPITOSA);
15% GIANT WILD RYE (ELYMUS PIPERI SYN. CINEREUS);
30% FOWL BLUEGRASS (POA PALUSTRIS);
5% ANNUAL RYEGRASS (LOLIUM MULTIFLORUM).

SEED MIX A AREA 994 m²

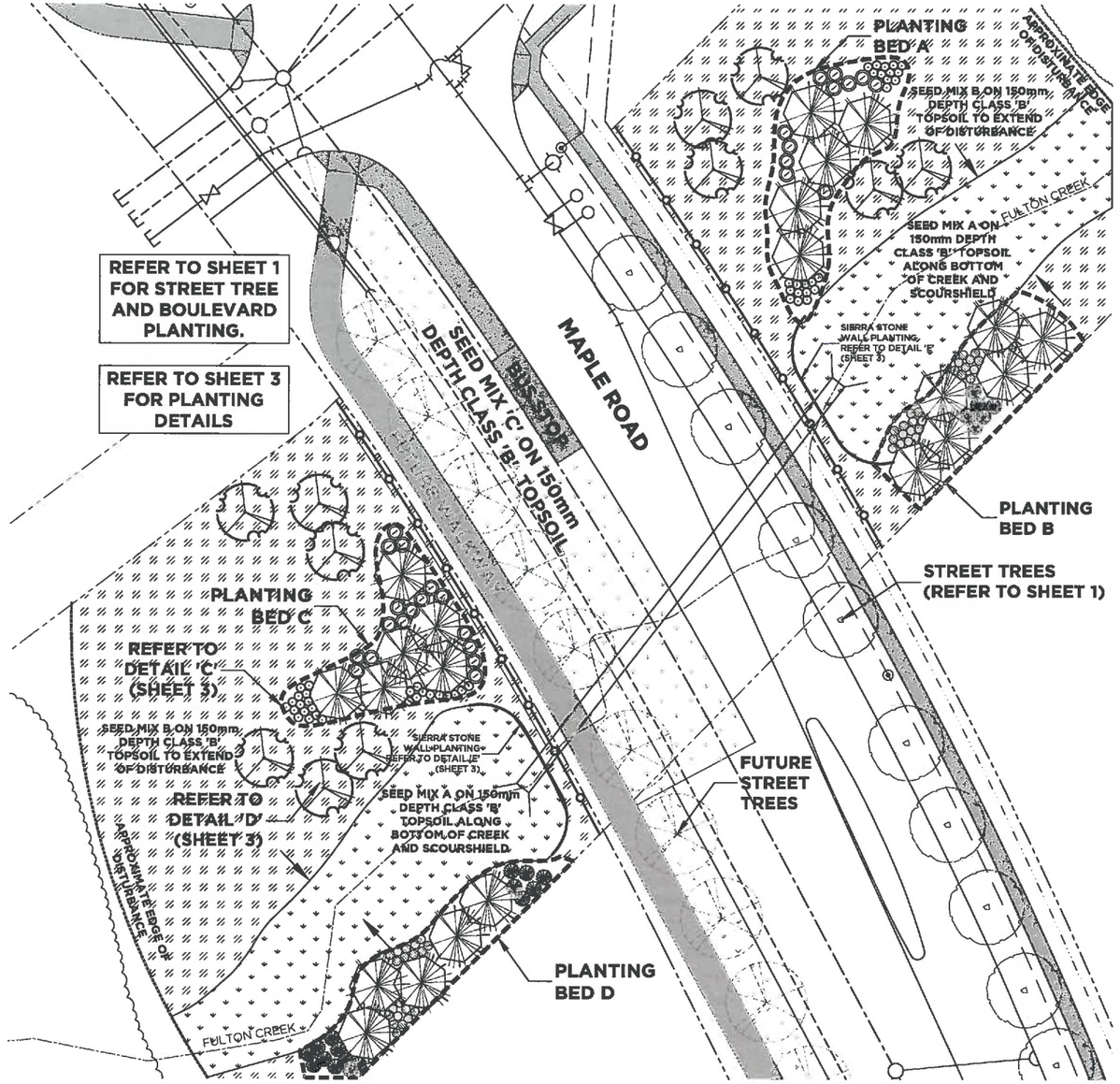
SEED MIXTURE B

CERTIFIED CANADA NO. 1 MIXTURE, FREE OF DISEASE, WEED SEEDS OR FOREIGN MATTER, MINIMUM GERMINATION OF 75%, MINIMUM PURITY OF 97% AND CONFORMING TO THE MIXES BELOW OR APPROVED ALTERNATIVES. ALL SEED MUST BE FROM A RECOGNIZED SEED FIRM, MEETING THE REQUIREMENTS FOR THE SEEDS ACT FOR CANADA NO. 1 SEED. SEED SHALL BE CERTIFIED NO. 1 GRADE A GERMINATION TEST AND/OR WEED SEED ANALYSIS MAY BE REQUESTED AND ALL LAWN SEED MUST COMPLY WITH FEDERAL AND PROVINCIAL SEED LAWS.

NON-MAINTAINED NATURALIZATION LANDSCAPING - DRY MEADOW SEED MIX

20% JUNEGRASS (KOELERIA MACRANTHA);
20% ROUGH FESCUE (FESTUCA CAMPESTRIS);
10% GREEN NEEDLEGRASS (STIPA VIRIDULA);
15% STREAMBANK WHEATGRASS (AGROPYRON RIPARIUM);
25% NORTHERN WHEATGRASS (AGROPYRON DASYSTACHYUM);
10% SHEEPS FESCUE (FESTUCA OVINA);
5% ANNUAL RYEGRASS (LOLIUM MULTIFLORUM).

SEED MIX B AREA 2160 m²



PLANT LIST

TREES	33				
SYMBOL	**QTY**	**COMMON NAME**	**BOTANICAL NAME**	**SIZE**	**REMARKS**
	11	Trembling Aspen	Populus tremuloides	50 mm cal.	B&B
	22	White Spruce	Picea glauca	2000 mm Ht.	B&B
SHRUBS	**144**				
SYMBOL	**QTY**	**COMMON NAME**	**BOTANICAL NAME**	**SIZE**	**REMARKS**
	22	Highbush Cranberry	Viburnum trilobum	2 gal	Container
	28	Saskatoon	Amelanchier alnifolia	2 gal	Container
	50	Wild Rose	Rosa acicularis	2 gal	Container
	44	Red Osier Dogwood	Cornus stolonifera	2 gal	Container

PLANTING BED A - 199.34 m²
5 White Spruce, 11 Saskatoon, 24 Wild Rose

PLANTING BED B - 180.9 m²
24 Red Osier Dogwood, 6 Highbush Cranberry, 6 White Spruce.

PLANTING BED C - 180.2 m²
6 White Spruce, 17 Saskatoon, 26 Wild Rose

PLANTING BED D - 174 m²
5 White Spruce, 16 Highbush Cranberry, 20 Red Osier Dogwood

Tree Setbacks from Utilities and Property Lines

1. Distance from Light Standards/ Power Hardware 3.5m
2. Distance from Fire Hydrants 3.5m
3. Distance from Stop Signs 3.5m
4. Distance from Yield Signs 3.5m
5. Distance from Transit Zones 3.5m*
6. Distance from Other Signs 2.0m
7. Distance from Private Property on Walkway R.O.W. 1.0m
8. Distance from Private Property on Open Parkland 3.0m
9. Distance from Private Property on Boulevards 1.0m
10. Distance from Shallow Underground Utilities 1.0m
11. Distance from Gas or Oil R.O.W. Contact Utility
12. Distance from Deep Underground Utilities 1.5m
13. Distance from Sanitary and Storm Sewers 1.8m
14. Distance to Sanitary and Storm Sewers and Manholes 2.0m
15. Distance from Water Mains 2.5m

*Ensure trees do not create sightline obstructions for vehicles approaching transit zones.

Note: Distances from overhead power utilities shall be as per the requirements established by the Utility Authority.

Landscape Contractor To Call 'alberta First Call At 1-800-242-3447 To Have All Existing Site Utilities Located Prior To Construction And Plant No Closer Than The Following Dimensions From The Services.

Landscape Contractor Is Responsible For Damages And Liabilities Incurred By Damages To Site Utilities.

Permit/Seal

The Alberta Association of Landscape Architects
Penny Dunford
BALANCE landscape architecture inc.

DATE: March 13, 2017

SCALE: 1:250 (0, 2.5, 5, 7.5, 10, 12.5)
ALL DIMENSIONS IN METERS UNLESS OTHERWISE SPECIFIED

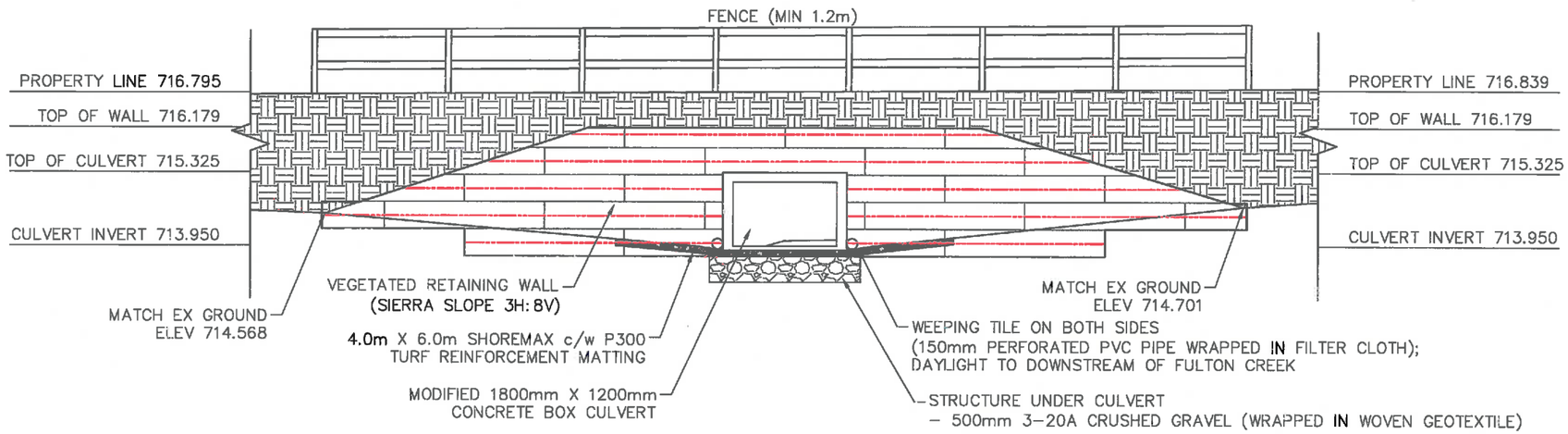
PROJECT NAME:
MAPLE ROAD
N.E. 1/4 SEC. 8-52-23-4

CLIENT NAME:
LEHNDORFF LAND GENERAL PARTNER INC.

DRAWING NAME:
MAPLE ROAD CROSSING - FULTON CREEK PLANTING PLAN

PROJECT NUMBER:	2016-036		
DRAWN:	FE	CHECKED:	PD/ RE
DESIGNED:	PD	APPROVED:	PD
SHEET NO.	02	REV.	00

Invistec Consulting Ltd.
10235 - 101 Street, 4th Floor
Edmonton , Alberta
T5J 3G1, Canada
Ph: (780) 984 - 1816



FULTON CREEK WILDLIFE CROSSING
SOUTH ELEVATION

HORIZONTAL SCALE: 1:100
VERTICAL SCALE: 1:100

LEGEND

TENSAR UNIAXIAL GEOGRID

UNIAXIAL GEOGRID TERMINATION OR EMBEDMENT LENGTH CHANGE

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar International Corporation
2500 Northwinds Pkwy, Suite 500
Alpharetta, Georgia 30009
(770) 344-2164

NILEX CIVIL ENVIRONMENTAL GROUP
Unearthing better results.
Nilex Civil Environmental Group
9304 39 Avenue
Edmonton, AB T6E 6L6
(780) 463-9535

Issue/Revisions

A	2017-02-07	ISSUED FOR INFORMATION	-

Project Number: PB-17-01-003
Date Drawn: FEBRUARY 7, 2017
Scale: 1:100
Designed By: -
Drawn By: DT
Checked By: -

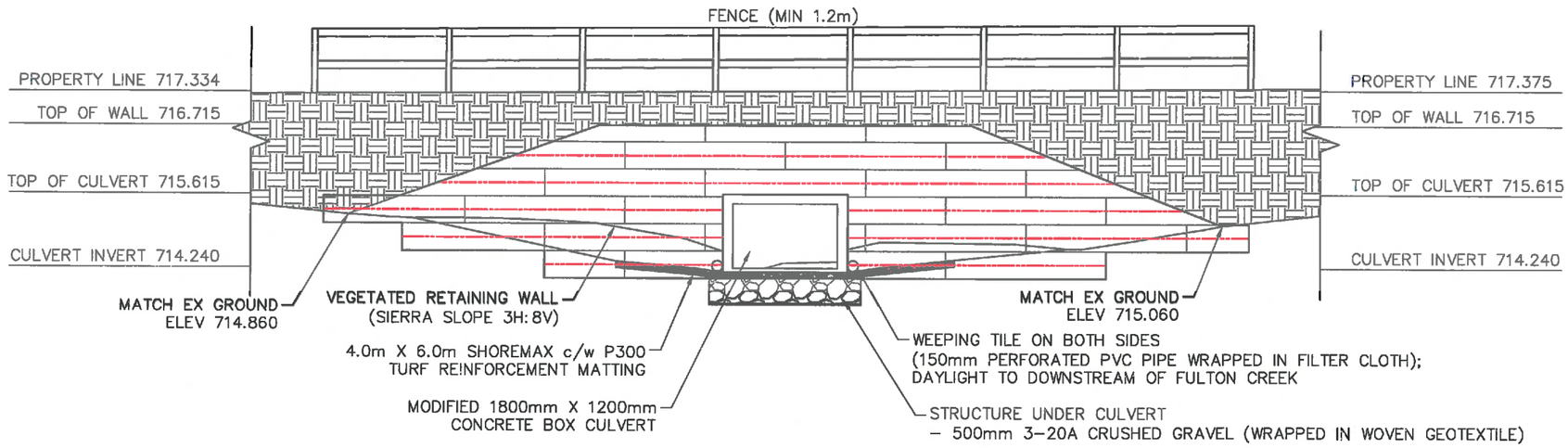
Project
FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title
SOUTH ELEVATION VIEW

Drawing Number
PB-17-01-003-004

A
Rev.

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER



FULTON CREEK WILDLIFE CROSSING
NORTH ELEVATION

HORIZONTAL SCALE: 1:100
VERTICAL SCALE: 1:100

LEGEND

TENSAR UNIAXIAL GEOGRID

UNIAXIAL GEOGRID TERMINATION OR EMBEDMENT LENGTH CHANGE

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar International Corporation
2500 Northwinds Pkwy, Suite 500
Alpharetta, Georgia 30009
(770) 344-2154

NILEX CIVIL ENVIRONMENTAL GROUP
Unearthing better results.
Nilex Civil Environmental Group
6304 38 Avenue
Edmonton, AB T6E 6L8
(780) 463-9535

Issue/Revisions

A	2017-02-07	ISSUED FOR INFORMATION	-

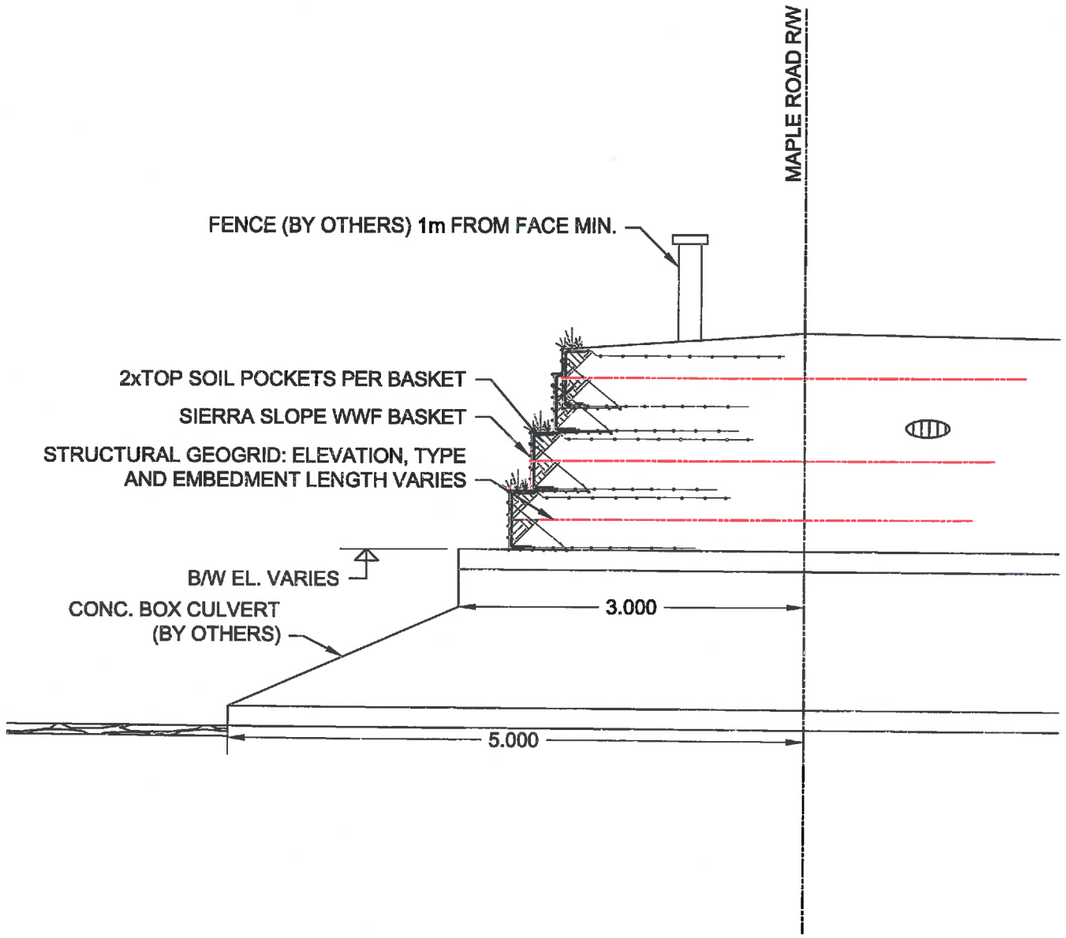
Project Number: PB-17-01-003
Date Drawn: FEBRUARY 7, 2017
Scale: 1:100
Designed By: -
Drawn By: DT
Checked By: -

Project
FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title
NORTH ELEVATION VIEW

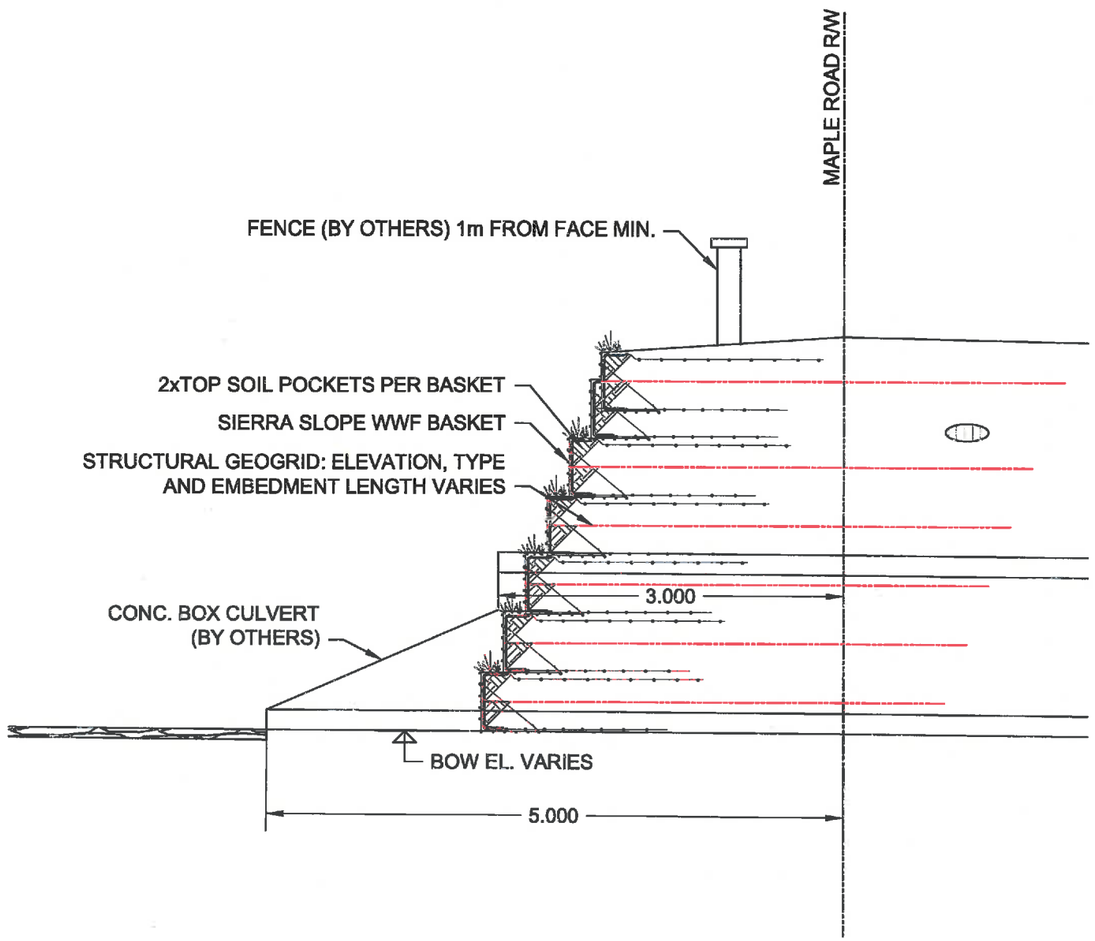
Drawing Number
PB-17-01-003-005

Rev. A



CROSS SECTION OVER THE CULVERT

SCALE: 1:50



CROSS SECTION BESIDE THE CULVERT

SCALE: 1:50

LEGEND

- TENSAR UNIAXIAL GEOGRID
- UNIAXIAL GEOGRID TERMINATION OR EMBEDMENT LENGTH CHANGE

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar.

Tensar International Corporation
2500 Northwinds Pkwy, Suite 500
Alpharetta, Georgia 30009
(770) 344-2154

NILEX CIVIL ENVIRONMENTAL GROUP
Unearthing better results.

Nilex Civil Environmental Group
9304 39 Avenue
Edmonton, AB T6E 5L8
(780) 463-9535

Issue/Revisions

—	—	—	-

Project Number: PB-17-01-003
Date Drawn: FEBRUARY 7, 2017
Scale: 1:100
Designed By: -
Drawn By: DT
Checked By: -

Project: FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title: TYPICAL CROSS SECTIONS

Drawing Number: PB-17-01-003-006

Rev.

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER

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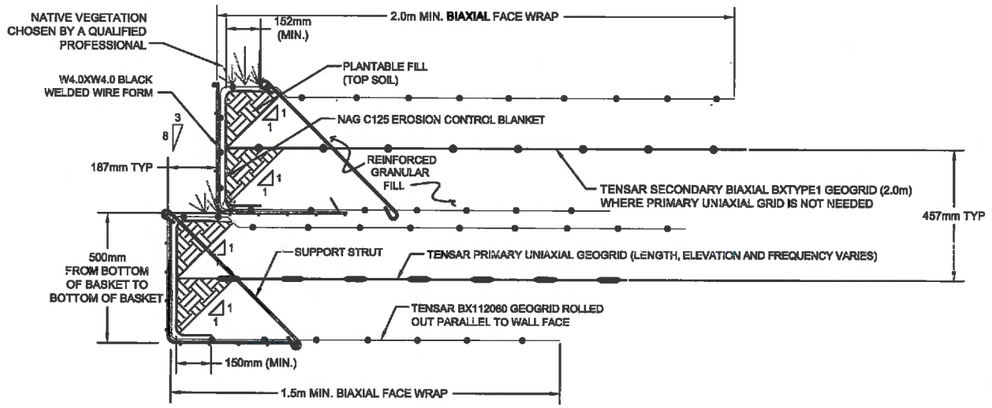
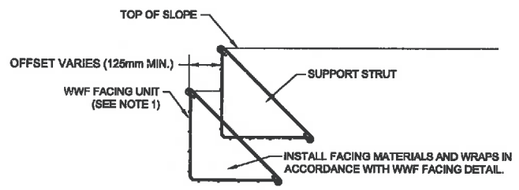
February 13, 2017 12:03:52 PM



SIERRA SLOPE WELDED WIRE STEPPED FACE DETAIL

NOT TO SCALE

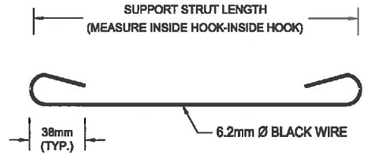


NOTES:

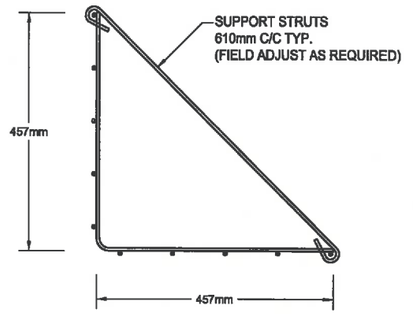
1. SEE WELDED WIRE FORM (WWF) FACING DETAIL FOR FACING MATERIALS AND DIMENSIONS.
2. SET TOPMOST WWF FACING UNIT INSIDE WWF FACING UNIT BELOW TO FOLLOW GRADE.
3. HORIZONTAL WIRES OF TOPMOST WWF FACING UNIT MAY BE CUT TO ALLOW INSTALLATION OVER STRUTS OF WWF FACING UNIT BELOW.
4. USE AT TOP OF SLOPE AND TOP OF CULVERT WHERE REQUIRED.

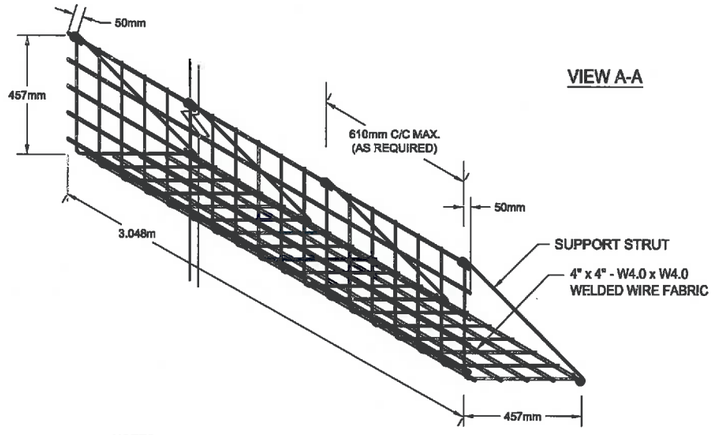
SIERRA SLOPE NESTING DETAIL

NOT TO SCALE



SUPPORT STRUT

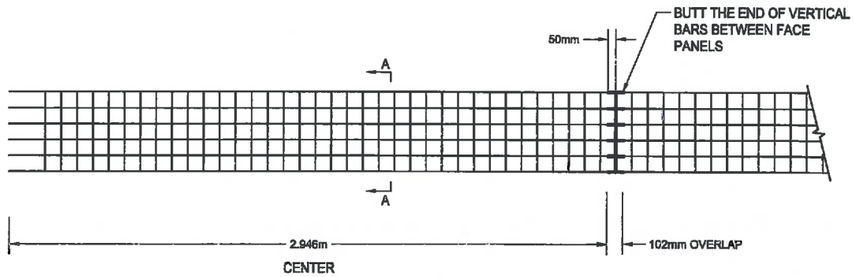




VIEW A-A

NOTES:

1. FACING TO CONSIST OF PREFABRICATED WWF 4" x 4" - W4.0 x W4.0 FORMS.
2. ALL FORMS AND STRUTS WILL BE FABRICATED WITH BLACK WIRE.
3. OVERALL LENGTH OF WIRE FORMS IS 10'-0". EFFECTIVE CONSTRUCTED WIDTH IS 9'-8" WITH 4" OVER LAPPING AT ENDS.



WELDED WIRE FORM FACING UNIT

NOT TO SCALE

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar International Corporation
2500 Northwinds Pkwy, Suite 500
Alpharetta, Georgia 30009
(770) 344-2154

NILEX
CIVIL ENVIRONMENTAL GROUP
Unearthing better results.
Nilex Civil Environmental Group
8304 39 Avenue
Edmonton, AB T6E 6L8
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Issue/Revisions			
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Project Number: PB-17-01-003
Date Drawn: FEBRUARY 7, 2017
Scale: NTS
Designed by: -
Drawn By: DT
Checked by: -

Project: FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title: TYPICAL DETAILS

Drawing Number: PB-17-01-003-007

Rev: ---

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER.

February 13, 2017 11:59:23 AM

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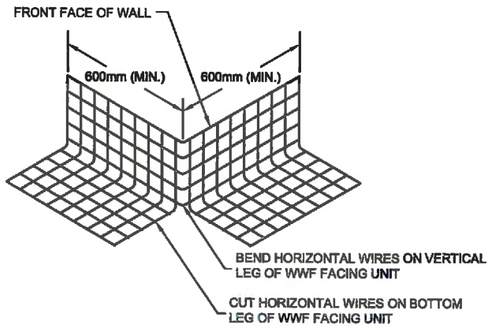
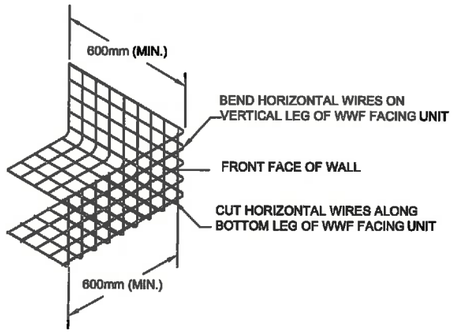


NOTE: MAINTAIN 600mm (MIN.) OF WIRE FORM ON EACH SIDE OF BEND.

WELDED WIRE FORM INSIDE CORNER UNIT
NOT TO SCALE



NOTE: MAINTAIN 600mm (MIN.) OF WIRE FORM ON EACH SIDE OF BEND.

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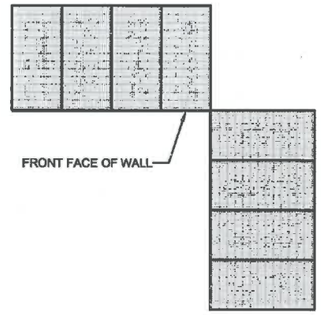
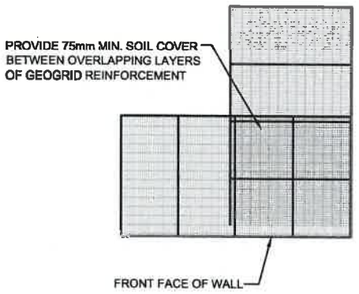
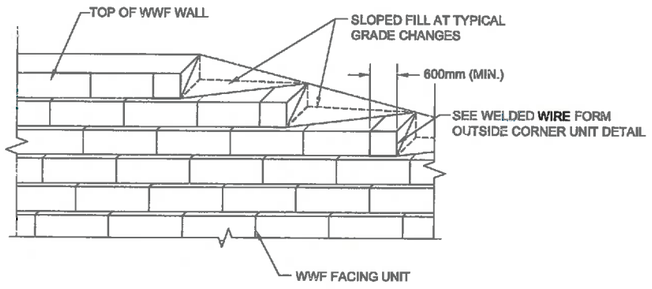
NOT TO SCALE



GEOGRID 90° CORNER DETAIL
NOT TO SCALE

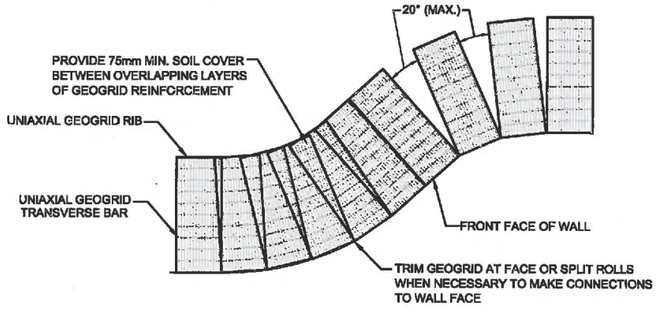


GEOGRID 90° CORNER DETAIL
NOT TO SCALE



NOTES:
1. SEE WELDED WIRE FORM (WWF) FACING DETAIL AND WWF OUTSIDE CORNER UNIT DETAIL FOR FACING MATERIALS AND DIMENSIONS.
2. INSTALL ADJACENT WWF FACING UNITS TO PROVIDE 100mm OVERLAP OF HORIZONTAL WIRES.

TOP OF WWF WALL, FINISHING DETAIL
NOT TO SCALE



GEOGRID PLACEMENT ON CURVES DETAIL - PLAN VIEW
NOT TO SCALE

W:\Projects\Potential Projects\PB-17-01-003 Maple Rd - Fulton Crk\ACAD\Working folder\PB-17-01-003.dwg

February 13, 2017 11:59:47 AM

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

Tensar.
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Edmonton, AB T6E 6L8
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Issue/Revisions

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Project Number: PB-17-01-003
Date Drawn: FEBRUARY 7, 2017
Scale: NTS
Designed By: -
Drawn By: DT
Checked By: -

Project: FULTON CREEK UNDER MAPLE ROAD
SIERRA SLOPE

Sheet Title: TYPICAL DETAILS

Drawing Number: PB-17-01-003-008

Rev. ---

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER

CT & Associates Engineering Inc.

GEOTECHNICAL INVESTIGATION

PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6

400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA

Prepared for

LEHNDORFF LAND GENERAL PARTNER INC.
c/o
DREAM

AUGUST 2015

CTA File No. 02-1998

CT & Associates Engineering Inc.

GEOTECHNICAL INVESTIGATION

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AUGUST 2015

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Prepared by,

CT & ASSOCIATES ENGINEERING INC.

Danny Mawchuk, P. Eng.

Mirek Witkos, P. Eng.
DSL/MJW/lsn

PERMIT TO PRACTICE
CT & ASSOCIATES ENGINEERING INC.
Signature
Date AUGUST 31, 2015
PERMIT NUMBER: P 7826
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

#102, 14420 - 116 Avenue, Edmonton, Alberta T5M 4B4 Ph. (780) 451-1332 Fax. (780) 732-5300

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APPENDICES

Appendix A	Drawings
Appendix B	Site Photos
Appendix C	Borehole Logs
Appendix D	Historical Air Photos

1.0 INTRODUCTION

This report presents the results of a Geotechnical Investigation conducted by CT & Associates Engineering Inc. (CTA) for the proposed creek crossing over the Fulton Creek along the future Maple Road extension and to the southeast of the Fulton Marsh, in southeast Edmonton, Alberta.

Authorization to proceed with this assessment was provided by Mr. Ken Black of DREAM on May 14, 2105.

2.0 SITE DESCRIPTION AND PROJECT OBJECTIVE

2.1 SITE LOCATION

The proposed Fulton Creek crossing location is situated to the east of the Maple Stage 6 lands, within the lands with the municipal address of 3904 Meridian Street NW, about 400 m southeast of the intersection of Maple Way NW and Maple Road NW and the existing Fulton Marsh, Edmonton.

A site plan of the property and alignment of the roadway extension is shown on Drawings No. A-1 and A-2, Appendix A.

2.2 ROADWAY EXTENSION

The Maple area is now undergoing preliminary stages of residential development, including rough-grading and municipal infrastructure construction.

The future Maple Road extension is to consist of an ultimate four lane arterial roadway with associated turning bays to the future local residential roadways.

The future roadway is to extend from the existing Maple Road and Maple Way intersection and then turn southerly through the subject area, crossing over the beginnings of the Fulton Creek, and then connect to a future intersection at the location of Maple Road and 8 Street NW. In this vicinity the Fulton Creek is a shallow drainage channel (Photos 1 and 2, Appendix B), with mature trees and vegetation surrounding it.

A cross-section of the future Maple Road roadway elevation and existing ground elevations, as prepared by Invistec Consulting Inc., is presented on Drawing A-3, Appendix A.

2.3 PROJECT DESCRIPTION

Based on the future crossing of the Maple Road over the Fulton Creek, an engineered crossing will be required. This crossing is proposed to consist of a concrete "box culvert" (1.8 m tall by 1.2 m wide), with the roadway constructed over top. It is understood that the roadway will sit approximately 2 m higher in elevation than the existing creek elevation, and with the base of the box culvert to be placed at approximately 714.2 m elevation.

As such, as part of planning for the future Maple Road extension and crossing construction, this geotechnical investigation has been initiated to:

1) Provide geotechnical assessment of existing drainage channel condition, including identification of areas of instabilities and erosion, and potential run-off/infiltration and erosion potential, and construction recommendations to mitigate such concerns.

2) To determine and evaluate the subsurface soils and groundwater conditions over the proposed crossing location and approach roadways, such to provide general design criteria and construction guidelines for the proposed box culvert design and construction.

3.0 SITE INVESTIGATION PROGRAM

3.1 HISTORICAL STUDY AND SITE RECONNAISSANCE

A review of historical information, including historical air photos, previous site studies, mine maps, and a detailed site visit was conducted on May 28, 2015 to assess existing topographic conditions within the study area, with subsequent site reviews completed during the progress of the study.

3.2 DRILLING PROGRAM

The drilling program was conducted on July 22, 2015, and consisted of drilling a total of four (4) boreholes and installation of four (4) piezometers. This included:

- Two boreholes, drilled to depths between 13.0 m and 13.4 and both with piezometer installations, immediate adjacent to the creek crossing; and
- Two boreholes, drilled to 3.8 m depth, at the approach areas to the northwest and southeast of the crossing.

Drilling was conducted with a B-61 truck-mounted drill rig, and supervised at all times by a CT & Associates Engineering Inc. engineer. Disturbed samples were taken from auger cuttings typically at 0.8 m intervals. Standard Penetration Testing (SPT) was conducted at 1.5 m intervals, from which disturbed samples were also taken.

Borehole elevations were surveyed relative to geodetic elevation. Drawings No. A-1 and A-2, Appendix A, shows the borehole locations with boreholes logs included in Appendix C.

3.3 LABORATORY TESTING PROGRAM

Laboratory testing was conducted on representative soil samples, for the determination of natural moisture content, Atterberg Limits, and soluble sulphate concentration. Test results are presented on the individual borehole logs contained in Appendix C.

4.0 SITE CONDITIONS

4.1 EXISTING SURFACE FEATURES

Based on review of the existing conditions of the crossing location:

- The surface drainage channel, the beginnings of the Fulton Creek, extends from east to west through the study area, connecting to the Fulton Marsh to the northwest;
- The drainage channel separates the ongoing residential lands to the north from undeveloped and vegetated lands to the south, and is estimated at 1 m to 2 m wide and in the order of 1 m (and less) deep (Photos 3 and 4);
- The area of the crossing and creek is generally covered with mature trees and vegetation, extending to about 15 m to the northwest and southeast of the creek;
- At the time of the site review there was only a very low water flow present within the creek (Photos 5 and 6).

4.2 REVIEW OF SITE HISTORY

4.2.1 Historical Air Photos

As part of this investigation, CTA reviewed historical air photos of the subject site. Our review is summarized as follows:

- The areas immediately to the north and south of the creek have been undeveloped and vacant, grassy land, with no surface grading or other activities in the area;
- No instabilities or erosion effects are observed in the historical air photos of the drainage channel.

Representative historical air photos are presented in Appendix D, with current air photo (2014) presented on Drawings No. A-1 and A-2, Appendix A.

4.2.2 Coal Mines

Based on review of "Atlas: Coal Mine Workings of the Edmonton Area" (Taylor, R.S., 1971) and ERCB records, there have been no former coal mining activities present in the subject areas or near vicinity.

4.3 SOIL CONDITIONS

Generally, the proposed crossing site is covered with a topsoil and organic soil layer between 0.3 m to 0.8 thick, which is then underlain by a firm to stiff, wet till-like clay extending to between 0.8 m and 4.1 m depth. A stiff clay till was then encountered extending to the remaining borehole depths of the boreholes, approximately 13.4 m depth.

A generalized soil stratigraphy is summarized in Table 1. Details of the soil stratigraphy can be found in the borehole logs in Appendix C.

TABLE 1
GENERALIZED SOIL STRATIGRAPHY

Material	Soil Description	Approximate Depth to Top of Stratum (m)	Average Thickness of Stratum (m)
TOPSOIL/ORGANIC SOIL	Organic, silty, sandy, some clay, wet, dark brown to black	0.0	0.4 - 0.5
TILL-LIKE CLAY	Silty, sandy, trace coal and pebbles, moist to wet, low plastic, firm dark greyish brown	0.3 - 0.8	0.5 - 3.3
CLAY TILL	Silty, sandy, trace coal and pebbles, moist to wet, low plastic, stiff, dark greyish brown	0.8 - 4.1	> 9.3

4.4 GROUNDWATER CONDITIONS

At the completion of the drilling program, groundwater was only encountered at the locations of the deep boreholes, Boreholes No. 15-01 and 15-02, at 12.5 m and 10.1 m depth respectively.

Four groundwater monitoring wells were installed for groundwater measurement purposes. Twenty-eight (28) days after drilling completion, the groundwater level was measured at the locations of Boreholes No. 15-01, 15-02 and 15-04 at between 2.5 m and 5.6 m below the existing ground surface. No water was encountered at the location of Borehole No. 15-03.

The measured groundwater is likely related to perched effects from sand layers in the clay till deposit.

Water level readings and monitoring well installation details are provided in Table 2.

TABLE 2

SUMMARY OF PIEZOMETER INSTALLATION AND WATER LEVEL READINGS

Piezo No.	Piezo. Depth (m)	Intersected Lithology	Ground Elevation (m)	Depth to Water at Time of Installation (July 22, 2015) (m)	Groundwater Level Readings (August 18, 2015)	
					Depth to Water (m)	Elevation (m)
BH-1	13.0	Clay Till	715.9	12.5	2.1	713.8
BH-2	13.0	Clay Till	715.4	10.1	5.6	709.8
BH-3	3.8	Clay Till	719.1	Dry	Dry	< 715.3
BH-3	3.8	Clay Till	715.7	Dry	2.5	713.2

Note: Borehole elevations were surveyed relative to geodetic elevation

5.0 GEOTECHNICAL ASSESSMENT OF EXISTING SITE CONDITIONS

5.1 SUMMARY OF SITE CONDITIONS

The existing conditions of the drainage channel are characterized as follows:

- The existing creek and drainage channel extends east to west through the study area, and ultimately connecting to the Fulton Marsh to the northwest;
- The drainage channel separates the ongoing residential lands to the north from undeveloped and vegetated lands to the south, and is estimated at 2 m to 4 m wide and in the order of 1 to 1.5 m deep;
- The area of the crossing and creek is generally well vegetated with mature trees and vegetation, extending about 15 m to the northwest and southeast of the creek;
- Soils conditions consist of a thin topsoil and organic soil, over till-like clay and clay till that extended to greater than 13 m depth. Local groundwater conditions are at between 2.1 m to 5.6 m depth;
- At the time of the site review there was minimal water flow within the creek channel. The creek area is to be protected as Environmental Reserve as part of future development of the area.

5.2 GEOTECHNICAL ASSESSMENT OF CONDITIONS

The following geotechnical assessment of the drainage channel conditions is presented following in Table 3 (following page), in accordance with the City of Edmonton North Saskatchewan River Valley ARD Screening Assessment - Section D.

TABLE 3

GEOTECHNICAL ASSESSMENT OF DRAINAGE CHANNEL

Item		Comment	Assessment and Conclusion
		HYDROLOGY	
1	Potential Run-Off [1]	Low to medium plastic clay and clay till, with surrounding areas to be landscaped with municipal and residential development and the ER area to be protected as part of ongoing development • Infiltration Capacity - Rating of 2 • Slope - Rating of 1	Potential Run-off - 3 (Moderate)
2	Erosion Potential [2]	• Slope - Rating of 1 • Infiltration Capacity - Rating of 2 • Erodability - Rating of 2	Erosion Potential - 1 (Low)
3	Depth of Water Table	Measured at greater than 2.1 m depth	Minimal impact due to water table (related to perched water from sand layers within the clay till layer)
		GEOLOGY	
4	Lateral Erosion	• No existing erosion observed • Area of crossing to be protected during construction and maintained on a permanent basis, with the surrounding ER to be maintained	Practically no impacts to creek channel due to future lateral erosion effects
5	Seepage Points	• No Seepage Points observed at ground surface and along creek channel • Periodic sand layers in till at depth	Practically no impacts to creek channel due to seepage effects
6	Mining	• No previous mining in the area	No impacts
7	Upland Development	• Upland areas along creek to be maintained for public access along creek channel, with controlled and engineered development. ER area to be protected as part of ongoing development	Practically no impacts to creek channel due to seepage effects
8	Maintenance Techniques with Existing Land Uses	• Public properties to be permanently maintained along creek channel, with controlled and engineered development	Practically no impacts to creek channel due to future maintenance
9	Slope Removal / Alteration	• Depth of drainage channel is less than 1.5 m, thus minimal slope effects due to topographic changes	Practically no impacts to creek channel due to slope alteration

TABLE 3 cont'd
GEOTECHNICAL ASSESSMENT OF DRAINAGE CHANNEL

Item		Comment	Assessment and Conclusion
		VEGETATION	
10	Value to Stability of Vegetation	• Existing vegetation to east and west within ER to be maintained. Construction area of box culvert crossing at the creek to be protected and armoured as part of construction. • Future public walkways to be permanently maintained and completed with grass and shrubs	Minimal impact due to vegetation and loss of vegetation
		SOILS/GROUNDWATER	
11	Dominant Soil	Low to medium plastic clay and clay till	n/a
12	Erodability	• Slope - Rating of 1 • Infiltration Capacity - Rating of 2 • Erodability - Rating of 2	Low erodability and run-off potential
13	Trafficability	Low to medium plastic till-like clay and clay till	Very good trafficability
14	Shrink/Swell Potential	Low to medium plastic till-like clay and clay till	Low to moderate shrink/swell
15	Frost Heave Potential	Low to medium plastic till-like clay and clay till	Low to moderate frost heave potential
16	Infiltration Capacity	Infiltration Capacity - Rating of 2	Low Infiltration capacity

Notes: [1] In accordance with NSRV-ARP Potential Run-off analysis table

[2] In accordance with NSRV-ARP Erosion Potential analysis table

6.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

6.1 GENERAL GUIDELINES

It is understood that the proposed drainage crossing is to be constructed with a concrete box culvert (1.8 m tall by 1.2 m wide), with the future roadway to be about 2 m higher in elevation than the existing creek and the box culvert base to be at an elevation of about 714 m.

The site is good for crossing design and construction, with no significant design of construction considerations required.

6.2 BOX CULVERT STRUCTURE

6.2.1 Design

The box culvert can be designed based on the following:

- Based on the encountered conditions and with a base condition prepared as outlined in Section 6.2.2, an allowable soil bearing capacity below the box culvert of 100 kPa, or on an ultimate bearing pressure of 250 kPa with a resistance factor of 0.5 (yet to be applied), using limit states design. The box culvert should be cast on a clean, undisturbed surface with no loose or disturbed material allowed to remain on the bearing surface of the footing excavation prior to culvert placement. The base of the excavation should be protected from rain, snow, wetting, drying and inflow of surface and ground water at all times. The box culvert should not be constructed directly onto or over frozen soil and it should be protected from freezing during the construction process;

- Based on the height of the box culvert (1.8 m), lateral earth pressures of short retaining walls can be determined based on the following. Additional surcharges due to traffic loadings should also be applied:

  $P_L = 10 \times H$ where P_L = lateral earth pressure (kPa)
  H = height of retaining wall (m);

- Sideslopes adjacent to the box culvert should be maintained to a maximum slope of 1(v) : 3(h), with the area protected from erosion as soon as possible, with landscape or erosion protection placed.

6.2.2 Base Construction

Below the box structure:

- All existing trees, vegetation, and organic soils at the crossing location are required to be removed during site preparation;
- Over the base of the culvert, where a soft to firm, wet native clay is anticipated (due to the presence of the creek), a provision of a 0.5 m thick sub-cut to competent soil and replacement with a 20 mm crushed gravel (compacted to 100% Standard Proctor Density) wrapped in a woven geotextile (Niles 2006 or equivalent) will be required;
- Any utilities below the box culvert should be placed at a minimum of 1 m depth below the base of the box culvert. Trench backfill below the box culvert should be compacted to a minimum of 98% SPD. It is also recommended to provide insulation over these utilities. Details of this material and extent of insulation to be placed can be provided at later stages of design.

6.2.3 Weeping Tile

It is recommended that a weeping tile be placed along both sides of the box culvert, such to allow for drainage of any water that accumulates behind the wall.

The weeping tile should consist of a standard 150 mm slotted PVC pipe (wrapped with filter cloth), daylighting to the downstream side of the box culvert.

6.2.4 Backfill Adjacent to Box Culvert

Backfill materials for the excavation immediately along the box culvert should be to a minimum of 95% SPD, with protection of the box culvert structure. Should the construction process allow, the compaction efforts can be increased to 98% SPD.

6.3 APPROACH FILL - SITE PREPARATION AND COMPACTION STANDARDS

As the proposed crossing roadway is to be approximately 2 m higher in elevation than the existing creek, additional fill for the approach construction will be required.

All vegetation, trees, and organic materials over the roadway alignment will require removal during site preparations.

Prior to the fill placement, the site will should be inspected by a CT & Associates Engineering Inc. engineer to ensure proper excavation to native soils. The bottom of the excavation should be proof-rolled to detect any soft spots prior to engineered sub-grade construction.

Any additional imported fill materials required to be placed should consist of low to medium plastic clayey materials, or granular materials.

All engineered clay fill materials should be compacted to minimum of 98% Standard Proctor Dry Density at 2% above optimum water content for the upper 1.5 m, and to 95% SPD (optimum to 4% above optimum) below 1.5 m, in maximum 150 mm compacted thickness lifts, in order to provide proper sub-grade support for the roadway approaches. Precautions and reduction of the required density compaction adjacent to the box-structure at the crossing (95% SPD) should be taken into consideration.

Standard City of Edmonton roadway structures can then be utilized based on the roadway classification.

It is emphasized that the moisture content of the fill materials should be maintained on the "wet side of optimum" during compaction in order to minimize future swelling potential of the clay fill materials.

Engineered fill construction requires full-time monitoring and testing by the geotechnical consultant during construction. All fill materials utilized should be by the approval of CT & Associates Engineering Inc.

Drying of the excavated native till-like clay and clay till materials will be required to ensure the backfill can be compacted to the required criteria. Alternatively, replacement of the materials with an imported material, as approved by CT & Associates, is a viable option.

6.4 SITE CLASSIFICATION FOR SEISMIC RESPONSE

Based on the encountered soil conditions, the subject site can be classified as Class D (Table 4.1.8.4.A. of NBCC 2005) as the foundation of the building will be placed within clayey/silty soils of firm to stiff consistency.

6.5 CEMENT TYPE

Four soil samples were tested for water soluble sulphate concentrations. The test results were all less than 0.02% (by weight), indicating a negligible to low potential degree of sulphate attack on concrete.

As such, Type GU (Type 10) cement is applicable. Air entrainment of 4% to 6% by volume is recommended for all concrete exposed to freezing temperatures and/or native soils.

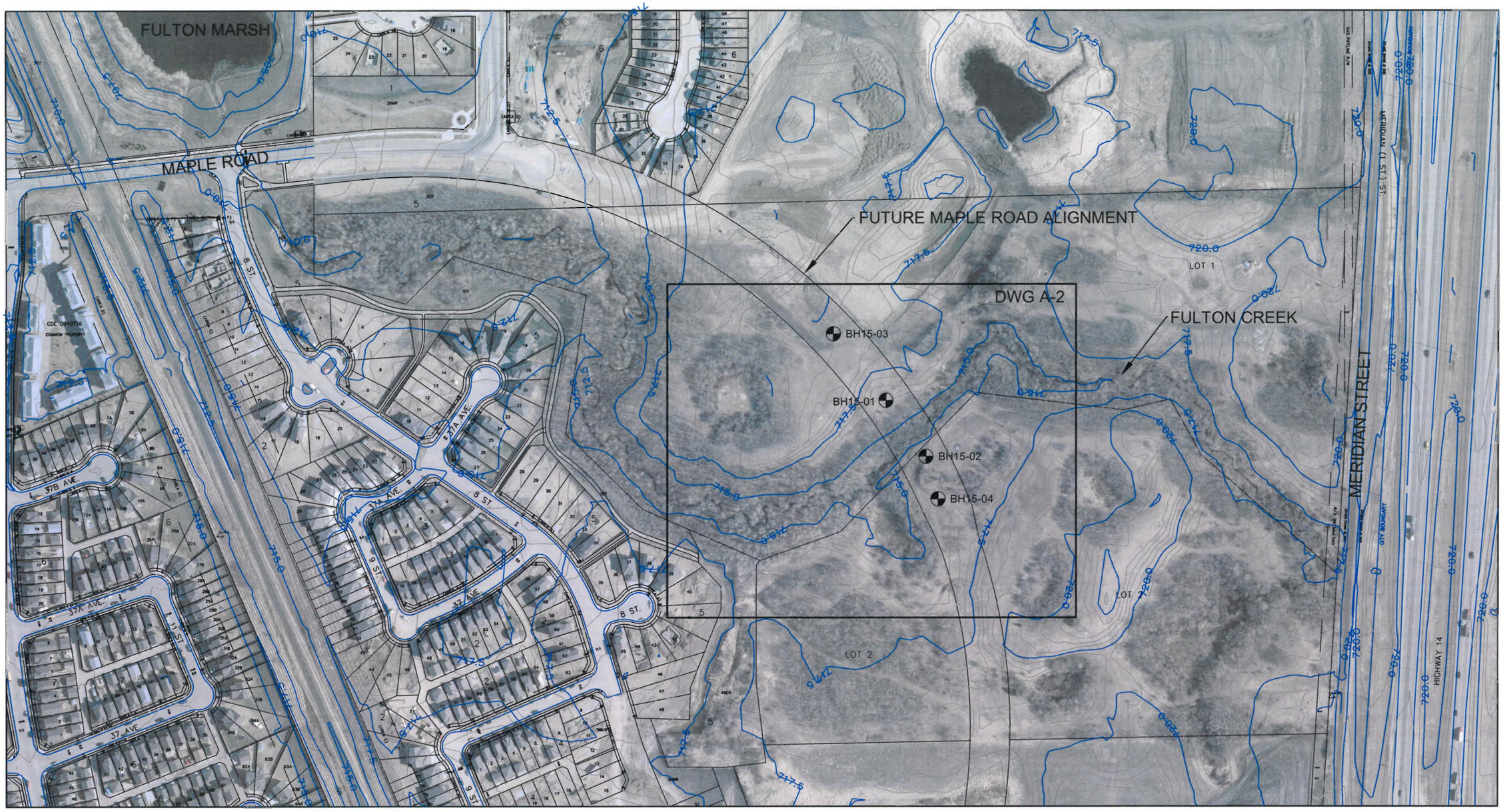
7.0 CLOSURE

This report has been prepared in accordance with generally accepted geotechnical practices and procedures.

Classification of soil and groundwater conditions within the report have been based on generally accepted engineering practices in this area. Conditions identified during the field work, and thereby recommendations presented within this report are considered to be reasonably representative of the site. If however, conditions other than those presented are identified during any other work on the subject property, CT & Associates Engineering Inc. should be notified, and given an opportunity to review or modify our recommendations in light of new findings.

APPENDIX A

DRAWINGS



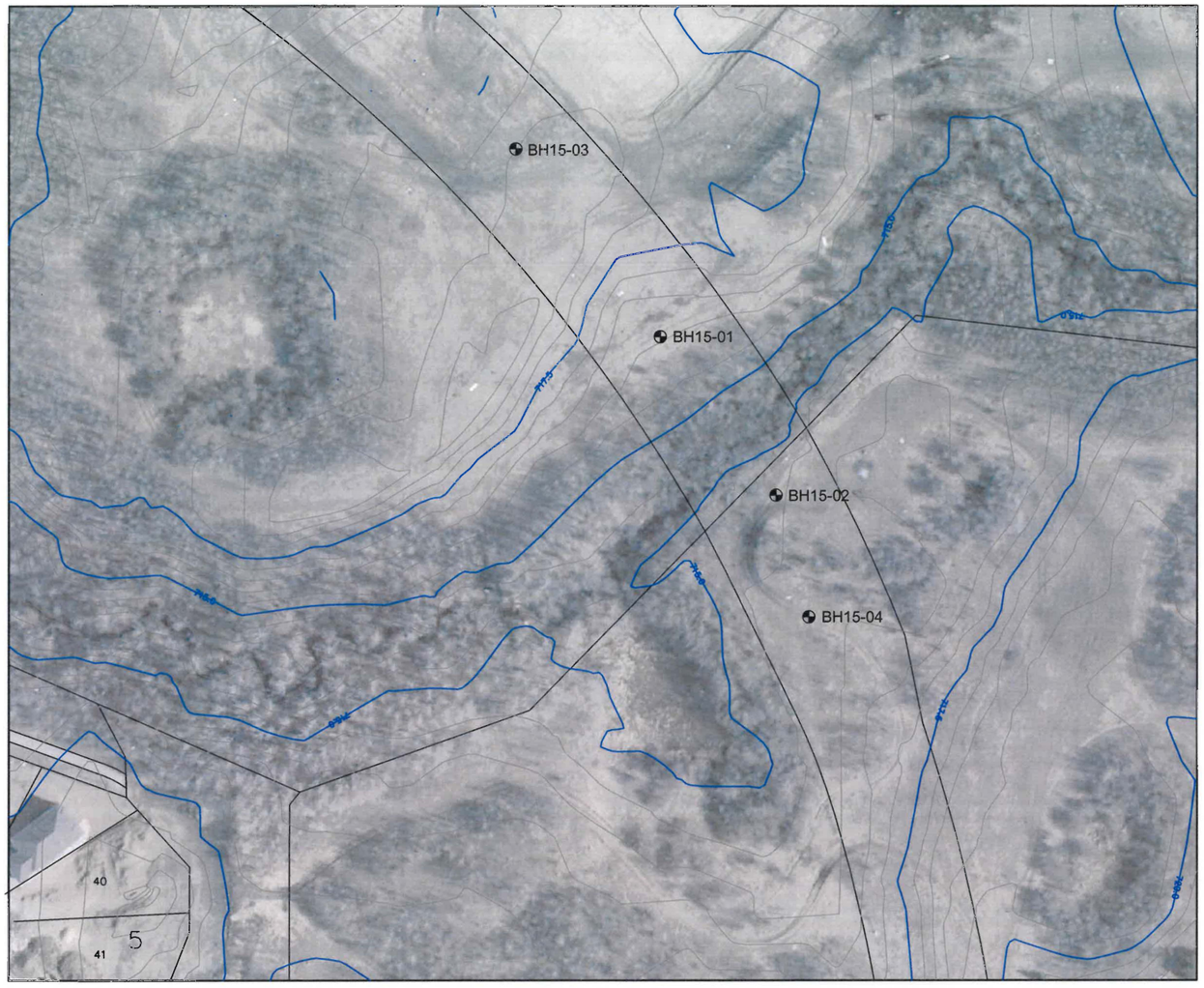
APPROXIMATE SCALE (meters)

0 60 120

NOTES:

1. Site topography based on City of Edmonton Air Photo (2014)
2. Approximate Scale 1:3,000
3. Contour interval = 0.5 m

CTA	CT & ASSOCIATES ENGINEERING INC.			PROJECT	GEOTECHNICAL ASSESSMENT OF CREEK CROSSING ADJACENT TO MAPLE STAGE 6 EDMONTON, ALBERTA
CLIENT	DREAM			TITLE	SITE LOCATION & BOREHOLE LOCATIONS
DATE	AUG. 16, 2015	DWN. DSN	CHKD. DSN	FILE NO.	02-1998-A1
				DWG. NO.	A-1



N

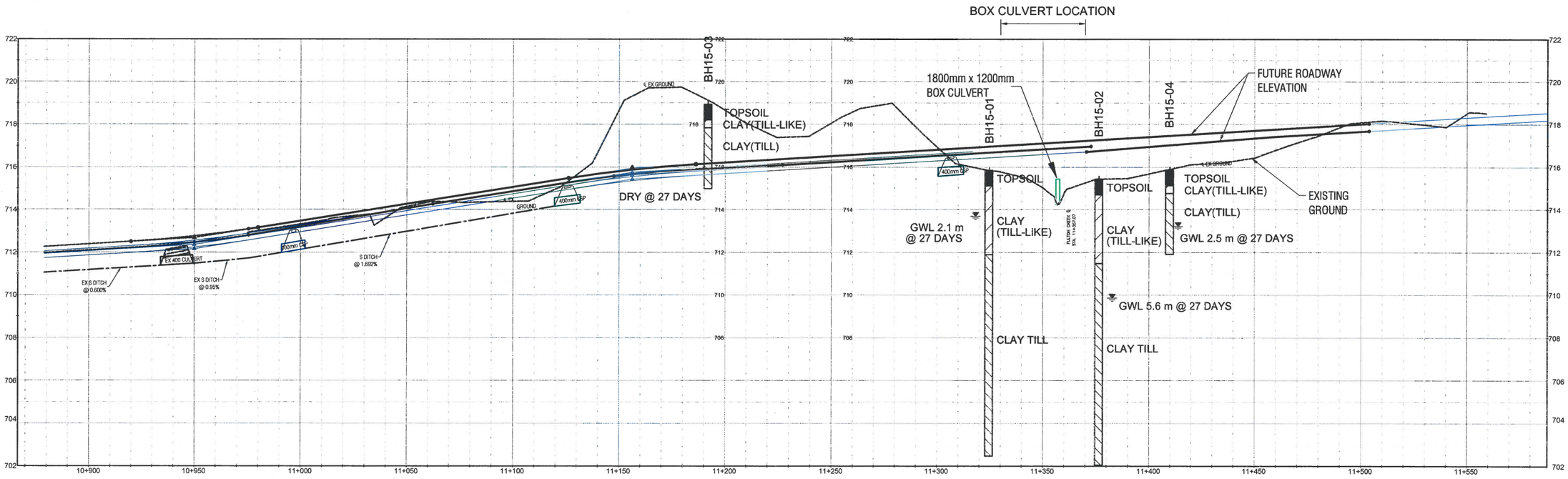
APPROXIMATE SCALE (meters)

0 30 60

NOTES:

1. Site topography based on City of Edmonton Air Photo (2014)
2. Approximate Scale 1:1,500
3. Contour interval = 0.5 m

CT & ASSOCIATES ENGINEERING INC.				PROJECT: GEOTECHNICAL ASSESSMENT OF CREEK CROSSING ADJACENT TO MAPLE STAGE 6 EDMONTON, ALBERTA	
CLIENT: DREAM				TITLE: AREA OF CROSSING AND BOREHOLE LOCATIONS	
DATE: AUG. 16, 2015	DWN.: DSN	CHKD.: DSN		FILE NO.: 02-1998-A2	DWG. NO.: A-2



CROSS-SECTION ALONG MAPLE ROAD (AS PER INVISTEC)

CT & ASSOCIATES ENGINEERING INC.				PROJECT: GEOTECHNICAL ASSESSMENT OF CREEK CROSSING ADJACENT TO MAPLE STAGE 6 EDMONTON, ALBERTA	
CLIENT: DREAM				TITLE: CROSS-SECTION ALONG MAPLE ROAD AND CROSSING	
DATE: AUG. 16, 2015	DWN.: DSN	CHKD.: DSN		FILE NO.: 02-1998-A3	DWG. NO.: A-3

APPENDIX B

SITE PHOTOS

Photo 1: Area of roadway approach to creek area, to north of creek and looking southeast.

Photo 2: Area of roadway approach to creek area, to south of creek and looking northwest.

Photo 3: Area of roadway approach near culvert crossing, to north of creek and looking south.

Photo 4: Area of roadway approach near culvert crossing, to south of creek and looking northeast.

Photo 5: Creek condition and water flow (July 14, 2015).

Photo 6: Creek condition and water flow (July 14, 2015).

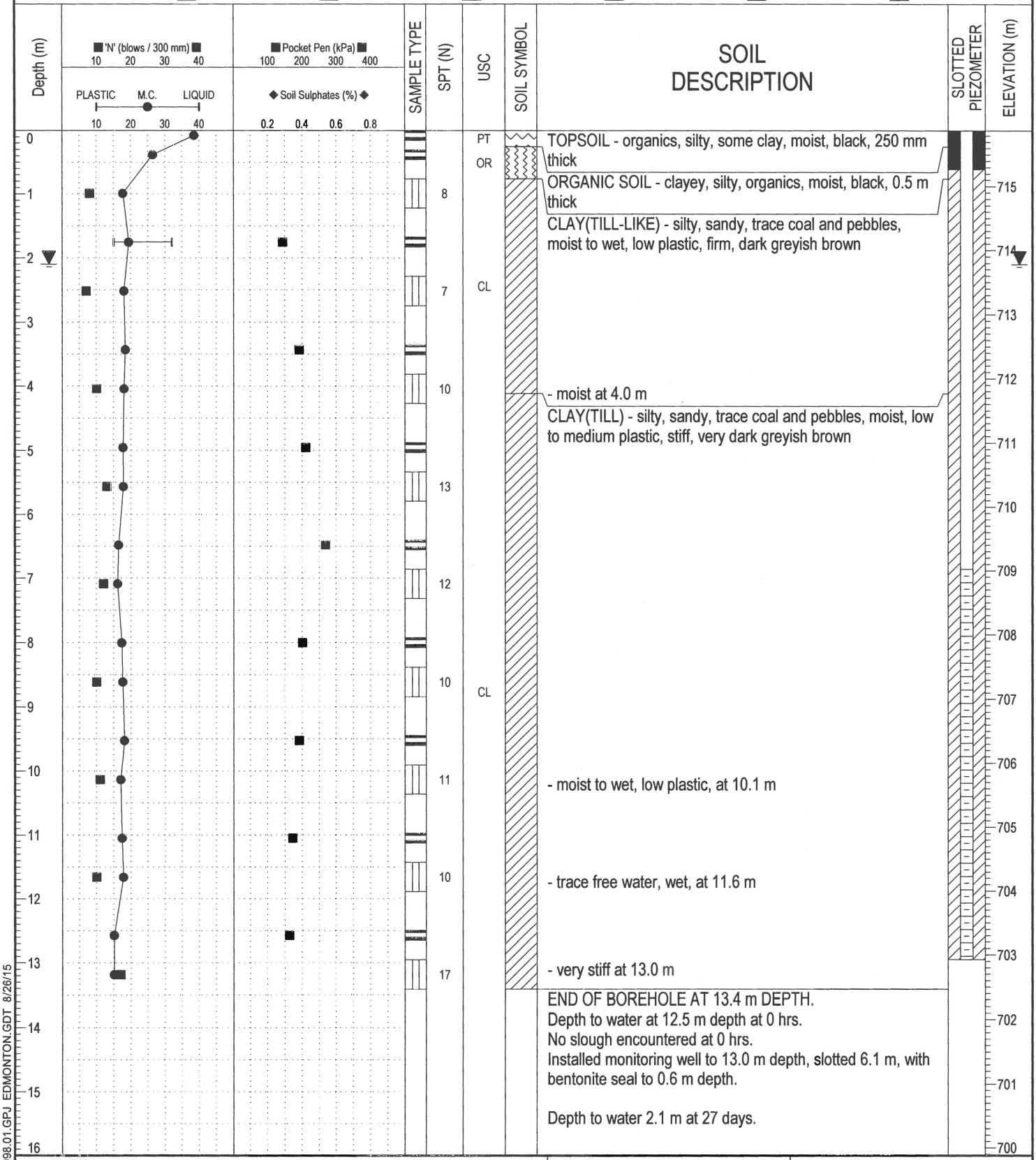
APPENDIX C

BOREHOLE LOGS

GEOTECHNICAL INVESTIGATION	B-61 TRUCK MOUNTED DRILL RIG	BOREHOLE NO: **BH15-01**
MAPLE ROAD CREEK CROSSING	UTM ZONE: -	PROJECT NO: 02-1998
100 m NE OF 8 ST. NW AND 34 AVE. NW., EDM., AB	SOLID STEM AUGER	ELEVATION: 715.88 m

SAMPLE TYPE: Shelby Tube | SPT | Disturbed | No Recovery | A Casing | Cored Sample

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



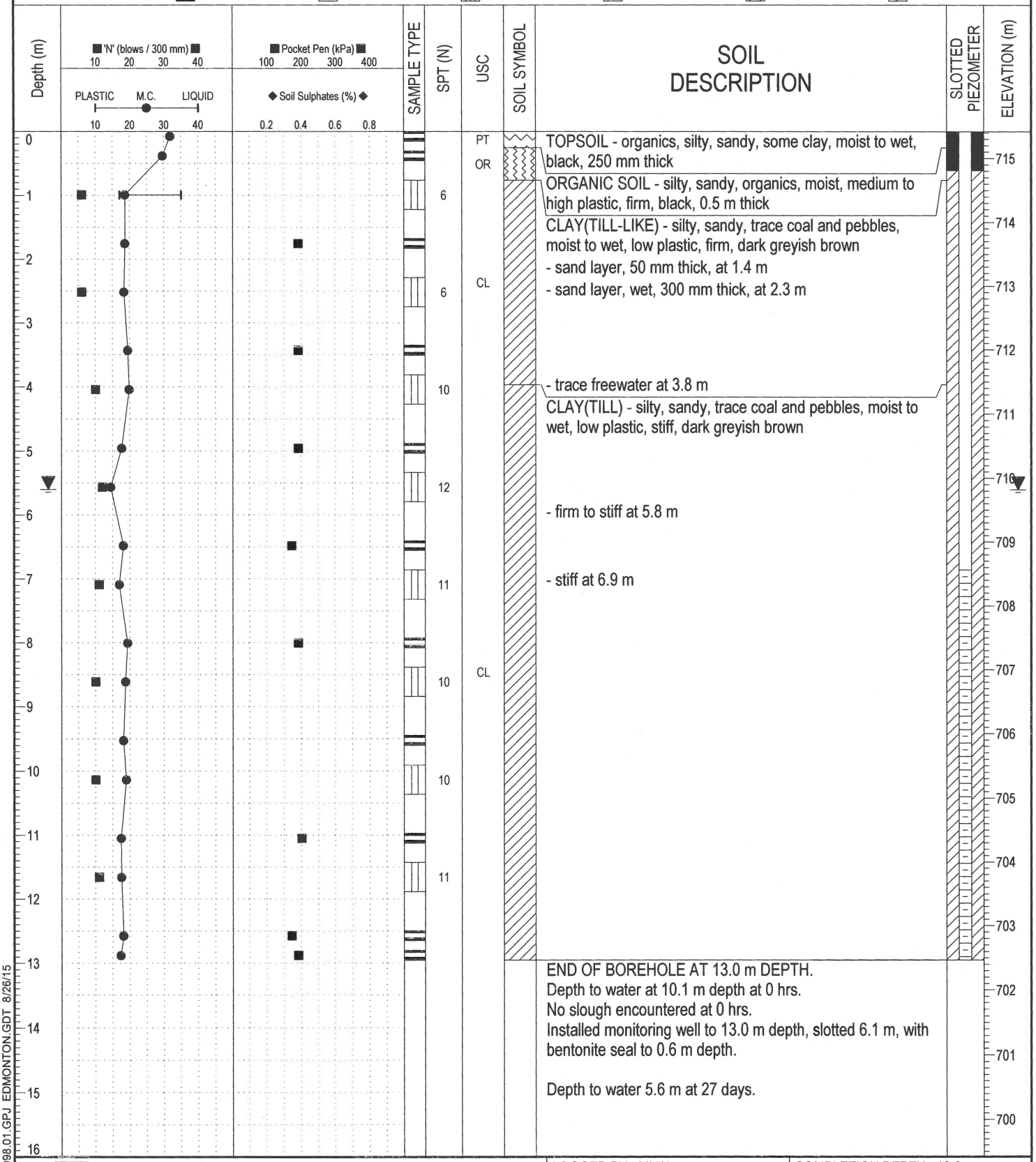
CT & ASSOCIATES ENGINEERING INC.	LOGGED BY: MLW	COMPLETION DEPTH: 13.4 m
	REVIEWED BY: DSN	COMPLETION DATE: 7/22/15
	Fig. No: C-1	Page 1 of 1

GEO 02-1998.01.GPJ EDMONTON.GDT 8/26/15

GEOTECHNICAL INVESTIGATION	B-61 TRUCK MOUNTED DRILL RIG	BOREHOLE NO: **BH15-02**
MAPLE ROAD CREEK CROSSING	UTM ZONE: -	PROJECT NO: 02-1998
100 m NE OF 8 ST. NW AND 34 AVE. NW., EDM., AB	SOLID STEM AUGER	ELEVATION: 715.42 m

SAMPLE TYPE: Shelby Tube; SPT; Disturbed; No Recovery; A Casing; Cored Sample

BACKFILL TYPE: BENTONITE; PEA GRAVEL; SLOUGH; GROUT; DRILL CUTTINGS; SAND



TOPSOIL - organics, silty, sandy, some clay, moist to wet, black, 250 mm thick

ORGANIC SOIL - silty, sandy, organics, moist, medium to high plastic, firm, black, 0.5 m thick

CLAY(TILL-LIKE) - silty, sandy, trace coal and pebbles, moist to wet, low plastic, firm, dark greyish brown

- sand layer, 50 mm thick, at 1.4 m
- sand layer, wet, 300 mm thick, at 2.3 m

- trace freewater at 3.8 m

CLAY(TILL) - silty, sandy, trace coal and pebbles, moist to wet, low plastic, stiff, dark greyish brown

- firm to stiff at 5.8 m

- stiff at 6.9 m

END OF BOREHOLE AT 13.0 m DEPTH.
Depth to water at 10.1 m depth at 0 hrs.
No slough encountered at 0 hrs.
Installed monitoring well to 13.0 m depth, slotted 6.1 m, with bentonite seal to 0.6 m depth.

Depth to water 5.6 m at 27 days.

CT & ASSOCIATES ENGINEERING INC.

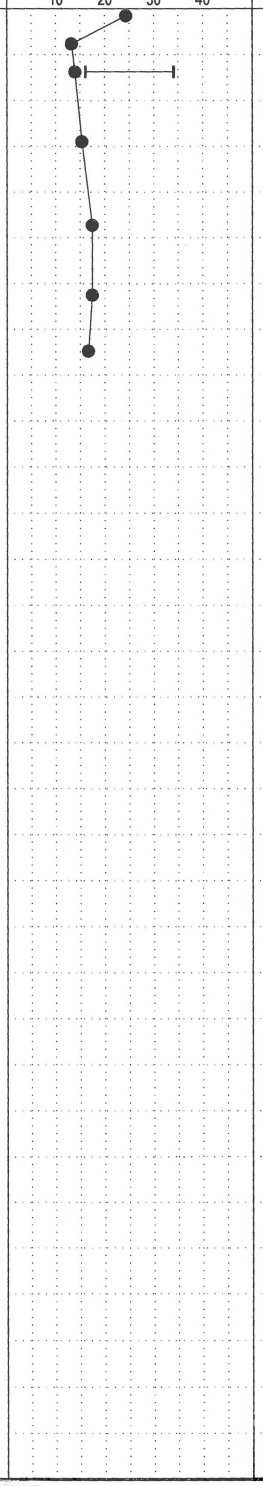
LOGGED BY: MLW	COMPLETION DEPTH: 13.0 m
REVIEWED BY: DSN	COMPLETION DATE: 7/22/15
Fig. No: C-2	Page 1 of 1

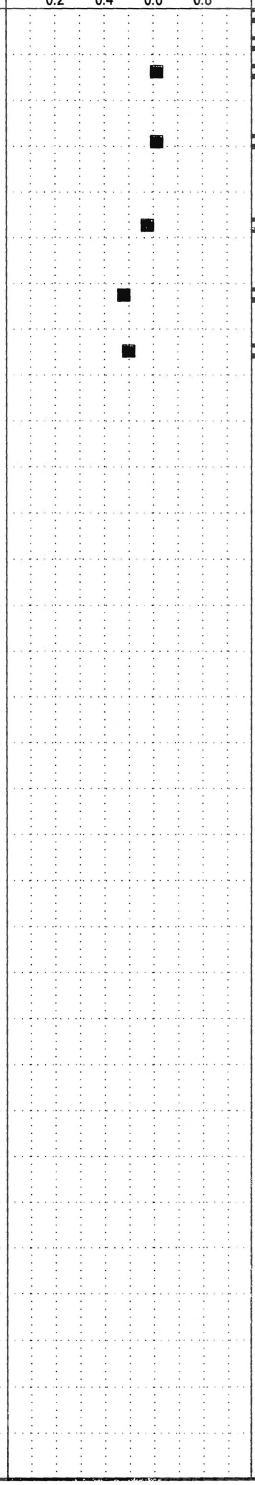
GEO 02-1998.01.GPJ EDMONTON.GDT 8/26/15

GEOTECHNICAL INVESTIGATION	B-61 TRUCK MOUNTED DRILL RIG	BOREHOLE NO: **BH15-03**
MAPLE ROAD CREEK CROSSING	UTM ZONE: -	PROJECT NO: 02-1998
100 m NE OF 8 ST. NW AND 34 AVE. NW., EDM., AB	SOLID STEM AUGER	ELEVATION: 719.09 m

SAMPLE TYPE: Shelby Tube; SPT; Disturbed; No Recovery; A Casing; Cored Sample

BACKFILL TYPE: BENTONITE; PEA GRAVEL; SLOUGH; GROUT; DRILL CUTTINGS; SAND





Depth (m)	SAMPLE TYPE	SPT (N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SLOTTED PIEZOMETER	ELEVATION (m)
0			PT OR SILT		TOPSOIL - organics, silty, sandy, some clay, damp, black, 150 mm thick		719
					ORGANIC SOIL - organics, silty, clayey, trace sand, moist, black, 300 mm thick		
1					SILT - trace sand, dry to damp, low plastic, dark greyish brown		718
2			CL		CLAY(TILL) - silty, sandy, trace coal and pebbles, moist, low plastic, stiff, dark greyish brown		717
3					- stiff at 2.3 m		716
4					END OF BOREHOLE AT 3.8 m DEPTH. No water or slough encountered at 0 hrs. Installed monitoring well to 3.8 m depth, slotted 3.1 m, with bentonite seal to 0.6 m depth.		715
5					Dry well at 27 days.		714
6							713
7							712
8							711
9							710
10							709
11							708
12							707
13							706
14							705
15							704
16							

CT & ASSOCIATES ENGINEERING INC.

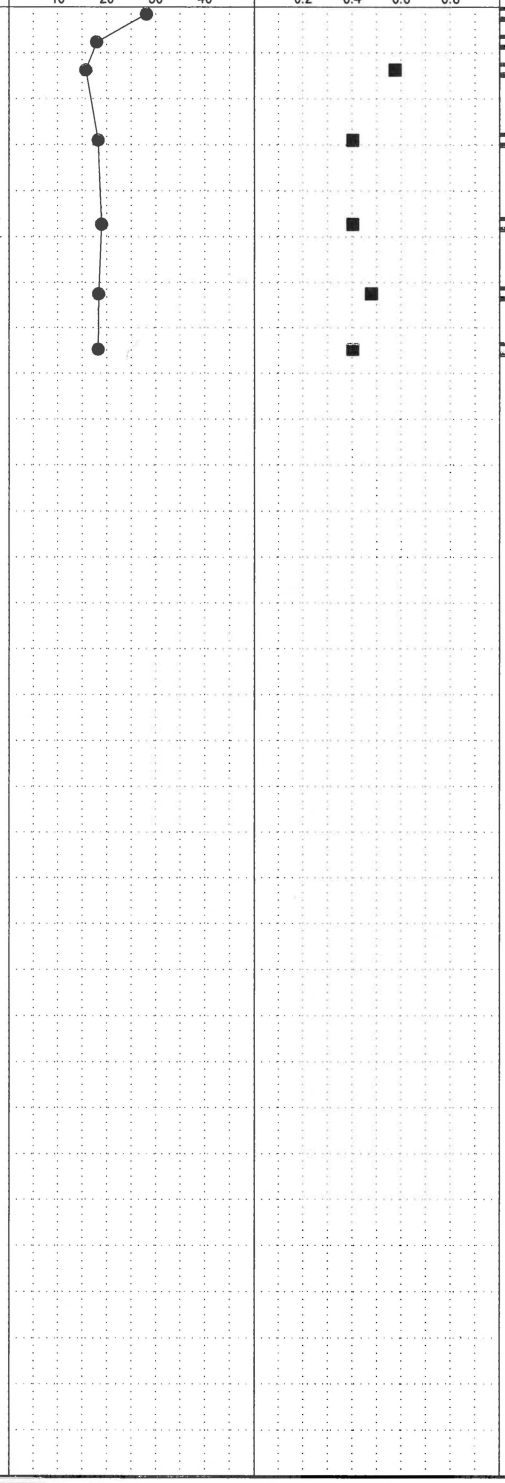
LOGGED BY: MLW	COMPLETION DEPTH: 3.8 m
REVIEWED BY: DSN	COMPLETION DATE: 7/22/15
Fig. No: C-3	Page 1 of

GEO 02-1998.01.GPJ EDMONTON.GDT 8/26/15

GEOTECHNICAL INVESTIGATION	B-61 TRUCK MOUNTED DRILL RIG	BOREHOLE NO: **BH15-04**
MAPLE ROAD CREEK CROSSING	UTM ZONE: -	PROJECT NO: 02-1998
100 m NE OF 8 ST. NW AND 34 AVE. NW., EDM., AB	SOLID STEM AUGER	ELEVATION: 715.65 m

SAMPLE TYPE: Shelby Tube | SPT | Disturbed | No Recovery | A Casing | Cored Sample

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



Depth (m)	SAMPLE TYPE	SPT (N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SLOTTED PIEZOMETER	ELEVATION (m)
0			PT OR CL		TOPSOIL - organics, silty, sandy, some clay, moist, black, 120 mm thick		715
1					ORGANIC SOIL - organic, some clay, moist, black, 180 mm thick		
					CLAY(TILL-LIKE) - silty, sandy, trace coal and pebbles, moist, medium plastic, firm, dark greyish brown		714
2			CL		CLAY(TILL) - silty, sandy, trace coal and pebbles, moist, low plastic, stiff, dark greyish brown		713
3							712
4					END OF BOREHOLE AT 3.8 m DEPTH. No water or slough encountered at 0 hrs. Installed monitoring well to 3.8 m depth, slotted 3.1 m, with bentonite seal to 0.6 m depth. Depth to water 2.5 m at 27 days.		711
5							710
6							709
7							708
8							707
9							706
10							705
11							704
12							703
13							702
14							701
15							700
16							

CT & ASSOCIATES ENGINEERING INC.

LOGGED BY: MLW	COMPLETION DEPTH: 3.8 m
REVIEWED BY: DSN	COMPLETION DATE: 7/22/15
Fig. No: C-4	Page 1 of 1

GEO 02-1998.01.GPJ EDMONTON.GDT 8/26/15

APPENDIX D

HISTORICAL AIR PHOTOS

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1949)

APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT: GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA		
CLIENT: LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM			TITLE: SITE AIR PHOTO - 1949		
DATE: AUG. 19, 2015	DWN.: PWD	CHKD.: DSN	FILE NO.: 02-1998-D1		DWG. NO.: 1

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1962)

APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.		PROJECT	GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA
CLIENT	LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM	TITLE	SITE AIR PHOTO - 1962
DATE AUG. 19, 2015	DWN. PWD / CHKD. DSN	FILE NO.	02-1998-D2 / DWG. NO. 2

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1967) APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT: GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA		
CLIENT: LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM			TITLE: SITE AIR PHOTO - 1967		
DATE: AUG. 19, 2015	DWN.: PWD	CHKD.: DSN	FILE NO.: 02-1998-D3	DWG. NO.: 3	

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1971) APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT: GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA		
CLIENT: LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM			TITLE: SITE AIR PHOTO - 1971		
DATE: AUG. 19, 2015	DWN.: PWD	CHKD.: DSN	FILE NO.: 02-1998-D4	DWG. NO.: 4	

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1974)

APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT: GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA		
CLIENT: LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM			TITLE: SITE AIR PHOTO - 1974		
DATE: AUG. 19, 2015	DWN.: PWD	CHKD.: DSN	FILE NO.: 02-1998-D5	DWG. NO.: 5	

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1980)

APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT	GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA	
CLIENT	LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM		TITLE	SITE AIR PHOTO - 1980	
DATE AUG. 19, 2015	DWN. PWD	CHKD. DSN	FILE NO. 02-1998-D6		DWG. NO. 6

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1984)

APPROXIMATE SCALE 1 : 5 000

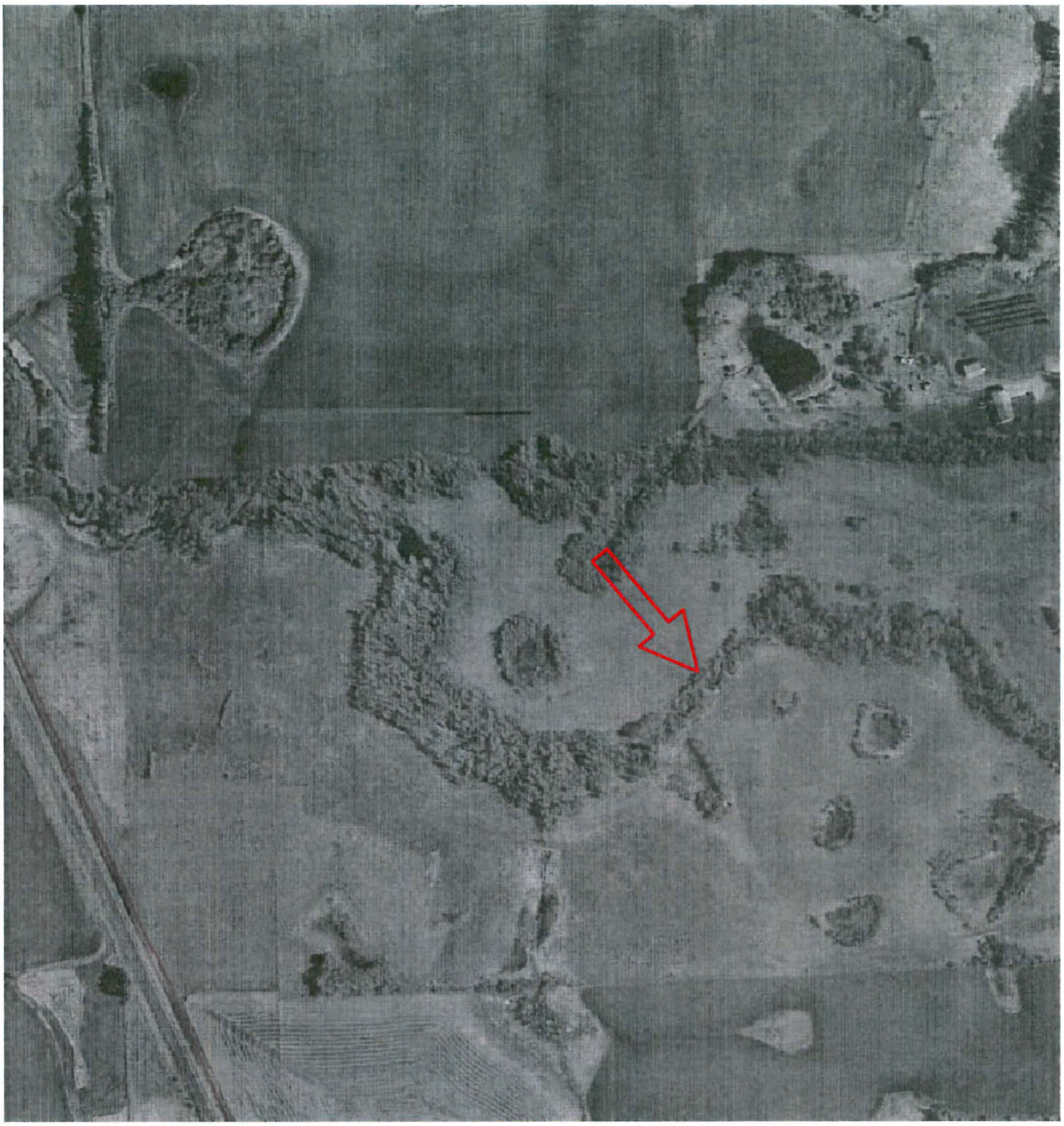
CT & ASSOCIATES ENGINEERING INC.

PROJECT: GEOTECHNICAL INVESTIGATION
PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6
400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW
EDMONTON, ALBERTA

CLIENT: LEHNDORFF LAND GENERAL PARTNER INC.
c/o
DREAM

TITLE: SITE AIR PHOTO - 1984

DATE	DWN.	CHKD.	FILE NO.	DWG. NO.
AUG. 19, 2015	PWD	DSN	02-1998-D7	7



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1990)

APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT	GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA	
CLIENT	LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM		TITLE	SITE AIR PHOTO - 1990	
DATE AUG. 19, 2015	DWN. PWD	CHKD. DSN	FILE NO. 02-1998-D8		DWG. NO. 8

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1995) APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT: GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA		
CLIENT: LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM			TITLE: SITE AIR PHOTO - 1995		
DATE: AUG. 19, 2015	DWN.: PWD	CHKD.: DSN	FILE NO.: 02-1998-D9	DWG. NO.: 9	

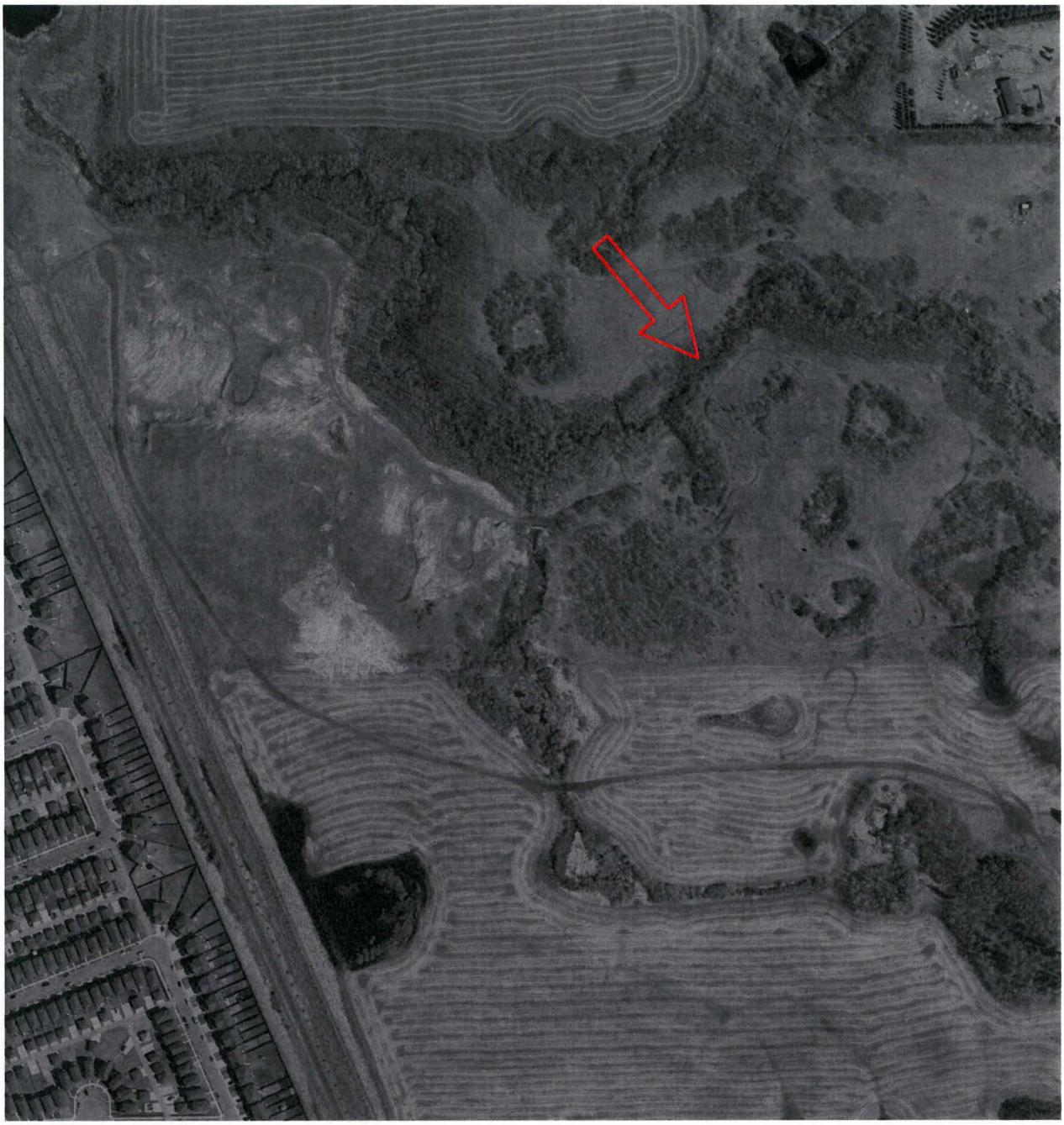
NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (2001)

APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT: GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA		
CLIENT: LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM			TITLE: SITE AIR PHOTO - 2001		
DATE: AUG. 19, 2015	DWN.: PWD	CHKD.: DSN	FILE NO.: 02-1998-D10		DWG. NO.: 10

NOTE: BASED ON CITY OF EDMONTON TRANSPORTATION AIR PHOTO (2008) APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT	GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA	
CLIENT	LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM		TITLE	SITE AIR PHOTO - 2008	
DATE AUG. 19, 2015	DWN. PWD	CHKD. DSN	FILE NO. 02-1998-D11		DWG. NO. 11



NOTE: BASED ON CITY OF EDMONTON TRANSPORTATION AIR PHOTO (2011)

APPROXIMATE SCALE 1 : 5 000

CT & ASSOCIATES ENGINEERING INC.			PROJECT	GEOTECHNICAL INVESTIGATION PROPOSED CREEK CROSSING ADJACENT TO MAPLE STAGE 6 400 m SOUTHEAST OF MAPLE WAY NW AND MAPLE ROAD NW EDMONTON, ALBERTA	
CLIENT	LEHNDORFF LAND GENERAL PARTNER INC. c/o DREAM		TITLE	SITE AIR PHOTO - 2011	
DATE AUG. 19, 2015	DWN. PWD	CHKD. DSN	FILE NO. 02-1998-D12		DWG. NO. 12