CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

PRELIMINARY DESIGN REPORT

Engineering Services for the Capital Line South LRT Extension (Century Park to Ellerslie Road)

PREPARED FOR

Edmonton

Blackmud Creek Crossing - Environmental Impact Assessment

NOVEMBER 2024

Rev. 2

January 21, 2025 - Urban Planning Committee / City Council | IIS02804

Executive Summary

On behalf of Capital Line Partners, Associated Environmental Consultants Inc., the environmental division of Associated Engineering, completed this Environmental Impact Assessment (EIA) for the proposed Capital Line South Extension Light Rail Transit (LRT) bridge and multi-use trail (MUT) where the alignment crosses Blackmud Creek.

The 2019 EIA was revised in 2024 to include a summary of design changes, updated references, openness ratio calculation, regulatory legislation, a recent site visit, and updated ACIMS and FWMIS database searches.

The Capital Line South Extension will continue the track from Century Park to Ellerslie Road. This 4.5 km extension is one of several LRT projects that are currently underway within the City's LRT Network Program. This extension will provide integration with local neighbourhoods, support transit-oriented development, and increase ridership (Click on the interactive image on the right to see the South LRT Extension Fly-Through Video; City of Edmonton 2021).

The Capital Line South Extension LRT crosses Blackmud Creek, which is part of the Whitemud and Blackmud Ravine network and is within the North Saskatchewan River Valley Area Redevelopment Plan (ARP), Bylaw 7188. The ravine contains a series of connecting trails and boardwalks throughout the river valley. Under Bylaw 7188, the protection of the river valley environment provides Edmontonians with a contiguous recreation and open space system and retains the existing designated residential areas (City of Edmonton 2018). The neighbouring areas are primarily residential and land on either side of the existing bridges is owned by the City of Edmonton. The Project Area for the EIA includes the North Saskatchewan River Valley zone north and south of the proposed bridge location and extends 10 m beyond the limit of construction to the east and west.

The proposed project work triggers municipal and provincial legislation. This EIA follows the Terms of Reference for the North Saskatchewan River Valley ARP (A Guide to Completing Environmental Impact Assessments) and considers the environmental impacts of the development of the LRT bridge and MUT.

Information reviewed for this EIA included publicly available data and information from government databases, previous studies and reports, regulatory documents, and other pertinent materials. As part of the EIA, a rare plant survey and wildlife survey of the Project Area were completed. Vegetation and wildlife species observed within the area were documented, as well as features of the existing bridges and the environment.

The key Valued Ecosystem Components (VECs) determined for this project include:

- Land use and zoning;
- Blackmud Creek floodplain and channel hydraulics;
- Topography and soil;
- Surface water, groundwater and aquatic habitat;
- Vegetation;
- Wildlife and movement corridors; and
- Historical resources.

The project is expected to have low environmental impacts since it will be conducted in a previously disturbed area and the concerns can be easily managed by following best management practices and minimizing disturbance where possible.

The delivery model for construction of the Capital Line South LRT is a Design Build, which will mean the design and construction will be awarded and delivered by a single proponent. Project construction will begin on parts of the project in late 2024, with construction expected to be completed within approximately three years after construction starts. Construction in the Blackmud Creek is expected to begin in 2025.

Table of Contents

List of Tables

List of Figures

The Blackmud Creek Crossing – Environmental Impact Assessment (EIA) report (Associated Environmental Consultants 2019) was originally reviewed and approved by the City of Edmonton in 2019. The Blackmud Creek Crossing project has now progressed to the Design/Build phase. During technical negotiations, edits to the design of the bridge have been made to account for affordability considerations. The outcome of these discussions has resulted in a bridge design and project footprint that has been narrowed by 4.6 m.

While we do not have detailed design drawings showing the changes, the decreased project footprint is expected to have less impacts on the project valued ecosystem components than the original design. In order for the final design to be compliant with the existing EIA sign off, important environmental considerations will still be adhered to. These include:

- maintaining an appropriate openness ratio for optimal terrestrial movement under the structures by ensuring greater than 3.5 m spacing between the existing 111 Street bridge and the new LRT bridge; and
- ensuring the limits of all construction (including temporary lay down areas) remain above the 1:5 year HWL of Blackmud Creek, and all bridge components remain above the 1:100 year flood event.

The report has been updated from the 2019 version to include updated references, openness ratio calculation, regulatory legislation, a recent site visit, restoration/naturalization information, and updated ACIMS and FWMIS database searches.

1 THE PROPERTY

The Capital Line South Extension is part of the City of Edmonton's Transportation Master Plan to expand light rail transit (LRT) service to all sectors of the City of Edmonton (the City) by 2040. To better meet the public transportation needs of its residents, the City is planning to extend the existing LRT system south from Century Park to the South City Limit. In 2008, City Council approved the Concept Plan for this extension (the Capital Line South Extension). The Concept Plan confirmed the LRT corridor (route) and alignment (where the tracks will be within the corridor).

In 2010, the preliminary design for a portion of the Capital Line South Extension, from Century Park to Ellerslie Road, was completed (AECOM 2010a). This 4.5 km line extension will expand the existing high-floor system and extend south from Century Park (111 Street at 24 Avenue) along the west side of 111 Street. It will cross Blackmud Creek and Anthony Henday Drive where it will turn west until continuing south again along 127 Street to Ellerslie Road. The Heritage Valley Park and Ride Facility, LRT Station, and Operations and Maintenance (O&M) facility will be located at the south end of the alignment (between 127 and 135 Streets). The alignment will include an underpass at 23 Avenue and bridge crossings at Blackmud Creek and Anthony Henday Drive.

Blackmud Creek is part of the North Saskatchewan River Valley and any new work in the river valley is to be reviewed under the North Saskatchewan River Valley Area Redevelopment Plan (ARP), Bylaw No. 7188 (City of Edmonton 2018). As per Bylaw 7188, the City's Parks and Biodiversity office determined that an

Environmental Impact Assessment (EIA) was to be completed for the project activities and approved prior to construction. This EIA report focuses on the development of the LRT bridge and multi-use trail (MUT) where the alignment crosses Blackmud Creek and is within the ARP (Figure 1-1).

This EIA follows the Terms of Reference for the North Saskatchewan River Valley ARP (A Guide to Completing Environmental Impact Assessments) and considers the environmental impacts of the development of the LRT bridge and MUT at the Blackmud Creek Crossing.

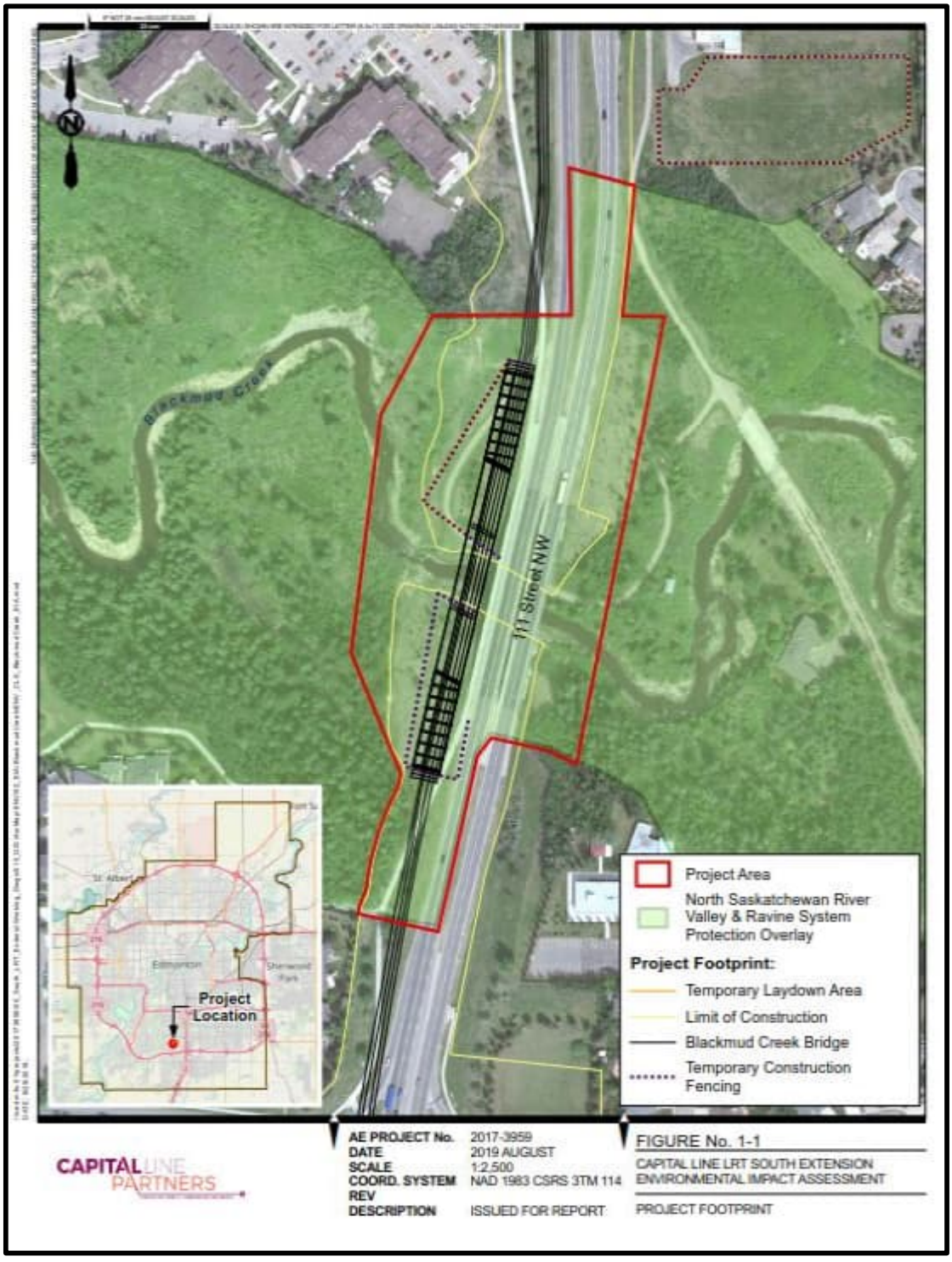


Figure 1-1
Project Location

1.1 OBJECTIVE OF ASSESSMENT

Development within the North Saskatchewan River Valley is regulated under the North Saskatchewan River Valley Area Redevelopment Plan (City of Edmonton 2018). The proposed construction of the LRT bridge over Blackmud Creek has triggered completion of this EIA for review and approval by the City of Edmonton's Planning Department.

The objective of this EIA is to assess the potential environmental impacts of the LRT bridge and MUT construction and develop strategies to avoid, minimize, or mitigate negative impacts. This report will:

- Describe the proposed project;
- Characterize the baseline environment;
- Identify the potential environmental impacts of the construction, operation, and maintenance of the bridge;
- Describe the mitigation strategies and procedures to avoid or reduce environmental impacts; and
- Identify any residual environmental impacts that cannot be reasonably mitigated.

1.2 PROJECT RATIONALE AND SITE LOCATION

The Capital Line South Extension is an important part of the City's LRT expansion program. This extension will form part of the existing Capital Line and will provide integration with local neighbourhoods, support transit-oriented development, and increase ridership.

Initially, four LRT bridge types were considered which included a concrete arch bridge, a single tower cable stayed bridge, a single arch suspension bridge and a concrete girder bridge (AECOM 2010a). Upon review by the City, the first three options were abandoned based on visual impacts, which were deemed inappropriate for the surroundings, and maintenance concerns.

After this preliminary review, three bridge concepts were presented at public forums and included:

1. A girder bridge carrying the LRT and MUT;
2. A concrete girder bridge carrying the LRT and a separate stressed ribbon bridge for the MUT; and
3. An arch-suspension bridge carrying both the LRT and MUT.

In order to reduce environmental impacts to the Blackmud Creek ravine, the City of Edmonton indicated a preference for the single bridge concept and therefore Option 2 was eliminated (AECOM 2010a). The remaining options both have an overall length, including abutments of 207.1 m. To minimize excavation for girder lines and based on public feedback and cost considerations, Option 1 was chosen. For each bridge concept described above, the openness ratio remained the same because only the girder design was changed.

1.3 STUDY AREA AND CONTEXT

The study area of the EIA includes two designated areas: Project Footprint and Project Area (Table 1-1).

Table 1-1
Spatial Boundaries of Environmental Impact Assessment

Area Designation	Definitions
Project Footprint	The area that will be directly disturbed for construction, operation, and maintenance of the new bridge and MUT including the project components, the limit of construction and laydown areas (Figure 1-1).
Project Area	The area within the North Saskatchewan River Valley zone north and south of the proposed bridge location and extending 10 m beyond the limit of construction to the east and west; the immediate area that will be directly affected by the project.

The Project Area is located within the North Saskatchewan River Valley in the City of Edmonton and is part of the Whitemud and Blackmud Ravine network. Whitemud and Blackmud Ravine contain a network of existing trails and boardwalks. Per City of Edmonton Bylaw 7188, the protection of the River Valley environment is important in order to provide Edmontonians with a contiguous recreation and open space system as well as to retain the existing designated residential areas (City of Edmonton 2018). The neighbouring areas are primarily residential. The land on either side of the existing bridges is owned by the City. The bed and bank of Blackmud Creek is Crown land.

Historical land uses in the Project Area are determined using historical satellite and aerial photos, including black and white aerial imagery from Alberta Environment and Parks (AEP) Air Photo Distribution Services Imagery for the years including: 1950, 1969, 1976, 1984, 1993, 2001, 2008 and 2015 (Appendix A).

In the 1950, 1969 and 1976 air photos, Blackmud Creek is surrounded by forested area and the surrounding land use is agricultural. A winding road crossing the creek can be seen on the east side of the creek. In the 1984 air photo, residential development is the dominant land use north of the creek. Residential development dominates the surrounding land use, as seen on the 1993, 2001, and 2008 air photos. The development of 111 Street and the existing bridges over Blackmud Creek is evident in the 2001 air photo. Anthony Henday Drive can be seen south of the Project Area in the 2008 air photo. Residential development continues to extend south to Anthony Henday Drive, as seen in the 2015 air photo.

1.4 PROJECT DESCRIPTION

1.4.1 Regional Setting

Blackmud Creek is part of the Whitemud and Blackmud Ravine trail network. This trail network provides opportunities for year-round recreation, including walking, running, cross-country skiing, camping, hiking, snowshoeing, dog walking, nature observation, biking, berry picking and photography. Blackmud Creek meanders through the Whitemud and Blackmud Ravine and is part of the North Saskatchewan River Valley watershed. The area is surrounded by residential development and roadway infrastructure; increasing accessibility to the trail systems within Blackmud Ravine.

The ravine provides a corridor for wildlife movement to and from the North Saskatchewan River and optimal refuge areas within the continuous riparian areas.

1.4.2 Bridge Construction

The new bridge will be located on the west side of the two existing bridges that span Blackmud Creek and will have a vertical profile similar to the existing infrastructure. A MUT will be located on the west side of the LRT bridge, providing access for pedestrians and cyclists.

A curtain wall will be installed, running from the north and south grade to the north and south abutments. No retaining wall or fill will be required.

The delivery model for construction of the Capital Line South LRT is a Design Build (DB), which will mean the design and construction will be awarded and delivered by a single proponent.

A summary of the property information within the Project Area is provided in Table 1-2 below.

Figure 1-2 shows an artistic rendering of the proposed LRT bridge and MUT.

1.4.3 Storm Water Upgrades

Storm drainage from the LRT corridor (within the Blackmud Creek catchment area) is proposed to tie with the existing storm sewer system that outfalls directly to the Blackmud Creek. The existing system is underutilized for the 1:5 year design event and therefore has capacity to accommodate additional flows (AECOM 2010d).

Some of the existing catch basins and associated leads to the connecting storm manholes will need adjustments according to the 111 Street lane adjustments. The existing storm sewer mains are expected to remain unchanged except for two locations near the south and north ends of the bridge. At these locations, sewers will have to be re-aligned to avoid interfering with the bridge abutments. As the proposed bridge will parallel the existing there are no anticipated changes to the site drainage pattern.

Two oil and grit separators will be introduced in the storm pipe system at the north and south ends of the bridge (upstream of the existing outfalls) for quality control.

Figure 1-2
Artistic Rendering of the Proposed LRT Bridge and MUT

Table 1-2
Property Information for the Project Area

Parameter	Description
Current Zoning	The west side of the existing bridges is currently zoned as A, or Metropolitan Recreational Zone. This zone provides the opportunity for preserving natural areas and parkland along the river, creeks, ravines and other designated areas. The east side of the existing bridge is zoned as Agricultural Zone (AG) in the northeast and Urban Service Zone (US) in the southeast.
Municipal Address	The existing bridges are located in a road allowance. The municipal addresses (lot, block, and plan) of the surrounding areas are: • West side of existing bridge (2ER, 20, 8922759) • Southeast side of existing bridge (2A, 26, 9122219) • Northeast side of existing bridge (1ER, 26, 8923234)
Land-legal	SE and SW 31-51-24 W4M
Approximate GPS Location	53.444879, -113.517137
Nearest Watercourses	Blackmud Creek

1.4.4 Materials and Dimensions

Preliminary designs and details of the new bridge have been extrapolated from the preliminary design drawings (90% submission issue, Revision 1, 2018) for COE Integrated Infrastructure Services Project: South LRT Extension, Century Park to Ellerslie Road, Contract No. 931770 (Appendix B).

1.4.5 **Work Site Isolation**

No instream work is required for the construction of this project. Temporary erosion and sediment control (ESC) measures will be implemented around the construction area to prevent sediment-laden water from entering Blackmud Creek during construction. These measures will be designed to withstand construction runoff during heavy rainfall events. This is further discussed in Section 4.3.

During construction, the existing MUT will be redirected or closed and temporary site fencing will be erected to ensure public safety, protection of equipment while on site, and maintenance of high use wildlife trails. These fences will be designed with wildlife passage considerations by a wildlife specialist. Figure 1-1 shows the proposed location of temporary construction fencing within the project area. Traffic controls will also be implemented along 111 Street and the existing bridges.

1.4.6 Laydown and Staging Areas

Previously disturbed areas surrounding the existing bridges will be used for laydown and staging areas during construction. These areas will require fencing. These fences will be designed with wildlife passage considerations by a wildlife specialist. Figure 1-1 shows the proposed location of temporary construction fencing within the project area.

One laydown area will be located outside of the North Saskatchewan River Valley ARP, in the public utility lot northeast of the existing bridges (Figure 1-1). A second laydown area will be located along the existing recreational trail west of the proposed LRT bridge and MUT. Since this is inside the North Saskatchewan River Valley ARP and near Blackmud Creek, fuels, soil stockpiles, or any leachable or hazardous construction materials will not be permitted for storage at this laydown area.

1.4.7 **Construction Schedule**

Construction will begin on parts of the project in late 2024, with construction expected to be completed within approximately three years after construction starts. Construction in the Blackmud Creek is expected to begin in 2025.

1.5 REGULATORY FRAMEWORK

A summary of the environmental regulations and legislation that has been considered for the Blackmud Creek component of the Capital Line South Extension are included below. Table 1-3 further outlines a specific summary of the permit/approval applications that are required for construction. A comprehensive list of all permits/approvals, as well as applicable legislation should be included in the contractor's Environmental Construction Operations (ECO) Plan[1]. This project also needs to ensure compliance with the City-Wide Natural Area Management Plan (City of Edmonton 2014).

Prior to construction, the project should be reviewed to determine if the legislative requirements outlined are still relevant, current, and address any changes that may need to be considered.

1.5.1 Municipal Bylaws

1.5.1.1 North Saskatchewan River Valley Area Redevelopment Plan – Bylaw 7188

All development in the North Saskatchewan River Valley (including this project) must have specific approval under Bylaw 7188. The purpose of Bylaw 7188 is to protect the North Saskatchewan River Valley and Ravine System as part of Edmonton's valuable open space heritage and to establish the principles for future implementation plans and programs for parks development (City of Edmonton 2018). The following has been completed under the Bylaw 7188 review process:

[1] As required under the 2020 ECO Plan Framework.

- 60% structure review workshop, which included discussion on issues and concerns related to engineering design and environmental considerations, with Adonis Dichoso (Engineering Program Manager, LRT Delivery), Dulal Laha (Supervisor, Bridges and Auxiliary Structures), Cheryl Fereday (General Supervisor, Bridges, Structures and Open Space Maintenance), Meghana Valupadas (LRT Delivery), Roleza Marzan (Senior Civil Engineer, Integrated Infrastructure Services, LRT Delivery) and Kent Eklund on July 6, 2018;
- 90% structure review workshop, which included discussion on issues and concerns related to engineering design and environmental considerations, with Adonis Dichoso (Engineering Program Manager, LRT Delivery), Dulal Laha (Supervisor, Bridges and Auxiliary Structures), Cheryl Fereday (General Supervisor, Bridges, Structures and Open Space Maintenance), Roleza Marzan (Senior Civil Engineer, Integrated Infrastructure Services, LRT Delivery) and Kent Eklund on November 5, 2018;
- Pre-Scoping Meeting with Achyut Adihkari (Ecological Planner) and Catherine Shier (Principal Ecological Planner) and Capital Line Partners, Kent Eklund and Sandra Meidinger on November 24, 2017;
- Terms of Reference from Achyut Adhikari to Project Environmental Lead, Sandra Meidinger, on November 24, 2017.
- Formal notification from the City Project Manager (Adonis Dichoso) to City Planning on January 19, 2018;
- Confirmation of receipt and acknowledgement of project from City Planning (Achyut Adhikari) on January 19, 2018;
- An initial (informal) review of the draft EIA by City Planning (Achyut Adihkari and Catherine Shier) for preliminary comment on August 20, 2018 by Adonis Dichoso;
- Receipt of City Planning informal comments on October 4, 2018.

A meeting with the City Planning office is anticipated to occur once the draft EIA report has been completed. A formal meeting can be held after the submission of this draft.

Approval of this EIA (and Site Location Study) will be required by City Planning and Council before construction can begin.

1.5.1.2 Drainage Bylaw – Bylaw 18093

The purpose of Bylaw 18093 is to regulate surface drainage on public and private land and foster the well-being of the environment by prohibiting release of dangerous or hazardous materials into the sewerage system (City of Edmonton 2024).

Releases of water into storm sewers and watercourses must adhere to the requirements for restricted wastes in Schedule B of this Bylaw. Oil and grit separators will be installed in the storm pipe system on the north and south ends of the bridge, upstream of existing outfalls, for water quality control during

operation. Mitigation measures including erosion and sediment controls are to be incorporated into the ECO Plan to maintain compliance with this Bylaw during the construction phase of the project.

1.5.1.3 Corporate Tree Management Policy C456C

The Corporate Tree Management Policy C456C protects the tree canopy in the City from destruction, loss, or damage. Where protection of trees is not possible, the Urban Forestry Department determines the financial value of the trees to be removed based on size and species (City of Edmonton 2019, 2020). The City's Urban Forestry Department is to be contacted a minimum of four weeks prior to construction to review construction plans and tree protection. Any trees marked for removal to accommodate project work will be coordinated through Urban Forestry including a monetary fee for removal and compensation. Development of a Tree Preservation Plan will be required prior to site mobilization for any trees within 5 m of construction.

1.5.1.4 Community Standards Bylaw, Bylaw 14600

The Community Standards Bylaw, Bylaw 14600 (City of Edmonton 2023) regulates noise in the City. The Bylaw restricts construction activity to between 7 a.m. and 9 p.m. on any day other than Sunday or a holiday and between 9 a.m. and 7 p.m. on Sunday or a holiday.

1.5.1.5 EPCOR Drainage Services Bylaw 18100

The purpose of Bylaw 18100 is to approve the terms and conditions for drainage services and a mechanism whereby Drainage Services Guidelines may be implemented by EPCOR Water Services Inc. (City of Edmonton 2017).

Any releases of water into sanitary and combined sewers or into storm sewers and watercourses must adhere to the terms and conditions related to restricted wastes in Appendix B and C of this Bylaw, respectively.

1.5.1.6 Parkland Bylaw, Bylaw 2202

This Bylaw regulates the conduct and activities of people on Parkland in order to promote the safe, enjoyable and reasonable use of such property and to protect and preserve natural ecosystems for the benefit of all citizens of the City.

The contractor shall be responsible for obtaining any permits for activities occurring in Parkland areas that are not covered by another Bylaw.

1.5.2 Provincial Legislation

1.5.2.1 Environmental Protection and Enhancement Act

The *Environmental Protection and Enhancement Act* (EPEA) (R.S.A. 2000, c. E-12) supports and promotes the protection, enhancement, and wise use of the environment and is administered by AEP. The EPEA regulates some municipal infrastructure systems, such as stormwater drainage, wastewater systems, and potable water systems.

The new bridge construction will connect to the existing storm sewer system that outfalls directly to Blackmud Creek. Sewers will have to be realigned to avoid interfering with proposed bridge abutments. Since there will be an addition to the existing system, notification under the *Wastewater and Storm Drainage Regulation* established under EPEA (Alberta Regulation 119/1993) will be required. Under subsection 6(1) of the Regulation, extension and replacement of wastewater or stormwater collection systems require a notification to undertake the extension or replacement. Notification requires coordination with EPCOR Drainage Services.

1.5.2.2 Water Act

Work in or near a waterbody, including wetlands, is regulated under the *Water Act* (R.S.A. 2000, C. W-3) and watercourse crossings, including bridges, are addressed under the Act's *Code of Practice for Watercourse Crossings* (Alberta Environment and Parks 2019). Blackmud Creek is a mapped Class C waterbody on the Alberta Code of Practice 1:500,000 St. Paul Management Area Map and has a restricted activity period of April 16 to June 30 (AESRD 2012b). Under the Code of Practice, the proposed LRT bridge is considered a Type 1 crossing, as it is considered a single span (clear span) bridge, which does not have abutments that are placed within the bed or within the active channel of a water body (Alberta Environment and Parks 2019). Therefore, installation can be completed at any time of year and does not require recommendations from a qualified aquatic environment specialist (Alberta Environment and Parks 2019). A Code of Practice Notification under the *Water Act* needs to be submitted no less than 14 days prior to the work commencing. A Public Notification (i.e., local newspapers advertisement) may be required as part of the application process.

Dewatering activities may require an Approval under this Act if the dewatering occurs for a duration greater than 6 months. However, it is anticipated that the footings of the piers will be constructed through drilling and, therefore, dewatering will not be required.

1.5.2.3 Public Lands Act

Crown land, including the bed and shore of permanent and naturally occurring waterbodies, is regulated under the *Public Lands Act* (R.S.A. 2000, C. P-40); permanent occupation of Crown land typically requires a disposition[2].

The new Capital Line South Extension LRT crossing over Blackmud Creek is not anticipated to require a disposition, because it is a clear span bridge and will not occupy the "bed and shore" of Blackmud Creek; in other words, as long as the piers are outside of the ordinary water mark, a disposition is not required.

1.5.2.4 Historical Resources Act

Archaeological and paleontological resources are regulated under the *Historical Resources Act* (R.S.A. 2000, C. H-9). The Project Area is within an area that has a high potential for archeological resources (Historical Resource Value: 5, archaeological and palaeontological) and, as a result, requires Approval from Alberta Arts, Culture and Status of Women.

An application for *Historical Resources Act* approval was made with Alberta Culture and Status of Women and Approval was granted on July 13, 2022 (Appendix C). A Historical Resources Impact Assessment (HRIA) was not required.

Historical resources are further discussed in Sections 2.2.7 and 4.1.2.7.

1.5.2.5 Wildlife Act

The *Wildlife Act* (R.S.A. 2000, c. W-10) prohibits the willful molestation, disruption, or destruction of wildlife, or a house, nest, or den of wildlife.

The Project Area falls within two sensitive wildlife zones, the sensitive raptors (bald eagle) and sharp-tailed grouse zones (Government of Alberta 2015a) (Figure 2-2).

If bird surveys are required as part of construction mitigation activities, or if any animal relocation is planned, a permit under this Act will be required and must be obtained by a qualified environmental professional (Research Permit/Collection Licence).

1.5.2.6 Fisheries (Alberta) Act

Handling, capturing, or relocating fish is regulated under the *Fisheries (Alberta) Act* (R.S.A. 2000, c. F-16). For this project, no instream work is required and therefore the need to handle fish does not apply. If the project scope changes, a fish salvage may be required. Prior to the fish salvage, the fisheries biologist

[2] A disposition was in place beside the future Capital Line crossing, for existing 111 Street crossing and outfall; the 111 Street crossing disposition was cancelled on January 15, 2019 (DLO930764).

completing the salvage will need to obtain a Fish Research Licence under this Act. This work needs to be performed by a qualified individual with a project-specific Fish Research Licence.

1.5.2.7 Weed Control Act

The *Weed Control Act* (R.S.A., 2008, c. W-5.1) regulates weed species listed in Schedule 1 (prohibited noxious) and Schedule 2 (noxious) of the Act. Project activities must destroy weeds listed in Schedule 1, and control or prevent the spread of weeds listed in Schedule 2.

1.5.3 **Federal Legislation**

1.5.3.1 Fisheries Act

Fish and fish habitat are regulated under the *Fisheries Act* (R.S.C., 1985, c. F-14), which is administered by Fisheries and Oceans Canada (DFO). The *Fisheries Act* prohibits causing harmful alteration, disruption, or destruction of fish habitat (HADD) and causing the death of fish under sections 35(1) and 34.4(1), respectively.

Projects requiring in-water works that may cause HADD or the death of fish must submit a Request for Review (RfR) to DFO, if code of practices do not apply. DFO will determine if the Project can proceed under a Letter of Advice or if Authorization is required.

DFO also has Codes of Practice in place for routine and low impact works, including construction of clear span bridges (i.e. Code of Practice: Clear Span Bridges). The DB contractor is responsible for determining the applicability of this Code of Practice and completing necessary submissions as required.

1.5.3.2 Canadian Navigable Waters Act

The *Canadian Navigable Waters Act* (R.S.C. 1985, C. N-22) protects navigable waters and the public's right to travel on them. The *Act* can apply to anyone who is an owner of the works on navigable waters, interfering with navigation in Canadian Navigable Waters and/or planning something that affect navigation in navigable waters.

The DB contractor is responsible for determining the applicability of this Act and will be required to obtain approval, if required.

1.5.3.3 **Migratory Birds Convention Act, 1994**

The *Migratory Birds Convention Act*, 1994 (S.C. 1994, c. 22) protects migratory birds, their eggs, and their nests. Any project activities that may impact migratory birds, their eggs, or nests, should be reviewed and appropriate mitigation implemented. All clearing and stripping activities have potential to disturb migratory and non-migratory birds. Disturbance to active migratory bird nests is prohibited by the federal *Migratory*

Birds Convention Act, as is disturbance to active non-migratory bird nests protected by the provincial Wildlife Act. Timing constraints are further discussed in Section 3.2.5.

1.5.3.4 Migratory Birds **Regulation**s, 2022

The *Migratory Birds Regulations, 2022* (MBR 2022) (SOR/2022-105) provides protection to bird nests when they are considered to have a high conservation value for migratory birds. Effective July 30th, 2022, under the MBR 2022 it is now prohibited to damage, destroy, disturb, or remove migratory bird nests when they contain a live bird or a viable egg. There are 18 species of birds identified on Schedule 1, whose nests now have year-round nest protection, unless they have been shown to be abandoned. Table 1-3 below identifies which of these species may occur within the Edmonton area.

Table 1-3
Schedule 1 Species That May Occur Within the Edmonton Area

Scientific Name	Common Name
Ardea herodias	Great Blue Heron
Nycticorax nycticorax	Black-crowned Night Heron
Dryocopus pileatus	Pileated Woodpecker

1.5.3.5 Species at Risk Act

Activities with potential to impact a species at risk or species of concern and/or their habitat are regulated under the *Species at Risk Act* (SARA) (S.C. 2002, c. 29).

A permit will be required if any species at risk listed in Schedule 1 of SARA may be handled during project construction.

Table 1-4
Summary of **Legislative Requirements** for the Project

Legislation		Application Details	Approval No. / Application Outcome
Fisheries Act (federal)	Regulatory Item	Notification or Request for Review	Measures to Protect Fish and Fish Habitat
	Effective Date	NA	
	Expiry Date	NA	
	Regulatory Item	NA	
	Effective Date	NA	

Legislation		Application Details	Approval No. / Application Outcome
Migratory Birds Convention Act (federal)	Expiry Date	NA	Plan vegetation clearing activities outside the nesting period (April 15 to August 31) for migratory birds.
Migratory Birds Regulations, 2022	Regulatory Item	NA	Perform nest sweep prior to vegetation clearing activities. If a nest with a live bird or viable egg is observed from a Schedule 1 migratory bird species, the designated waiting period must be observed or a permit to relocate or destroy the nest may be applied for from the Canadian Wildlife Service.
	Effective Date	NA	
	Expiry Date	NA	
Environmental Protection and Enhancement Act (provincial)	Regulatory Item	Notification	Notification under the *Wastewater and Storm Drainage Regulation* established under EPEA (Alberta Regulation 119/1993) will be required.
	Effective Date	NA	
	Expiry Date	NA	
Water Act (provincial) – Code of Practice for Watercourse Crossings	Regulatory Item	Notification	Selected contractor will be required to provide a Notification under the Water Act, to be submitted 14 days prior to the work commencing.
	Effective Date	TBD	
	Expiry Date	TBD	
Public Lands Act (provincial)	Regulatory Item	Disposition (Undetermined) Applications for the new Capital Line Bridge: NA (no work in the bed and shore)	A disposition for the current vehicle and pedestrian bridge was cancelled on January 15, 2019. An amendment for the Capital Line Bridge is not anticipated to be required, as there will be no footprint within Crown land (bed and shore of Blackmud Creek).
	Effective Date	August 20, 1993	
	Expiry Date	August 19, 2018	

Legislation		Application Details	Approval No. / Application Outcome
Historical Resources Act (provincial)	Regulatory Item	Clearance obtained (no HRIA required)	Project File: 4715-09-023
	Effective Date	August 11, 2009	
	Expiry Date	NA	
NSRV Area Redevelopment Plan; Bylaw No. 7188	Regulatory Item	Environmental Impact Assessment (EIA)	In progress
	Effective Date	TBD	
	Expiry Date	NA	

2 ENVIRONMENTAL CONTEXT

2.1 ASSESSMENT METHODOLOGY

2.1.1 Database Searches

The EIA included a review of publicly available data and information to identify potential environmental impacts specific to the Project Area. Sources of information included:

- Fish and Wildlife Management Information System (FWMIS) (Government of Alberta 2022b);
- Alberta Conservation Information Management System (ACIMS) (Government of Alberta 2022a);
- *Historical Resources Act* listings (Government of Alberta 2015b);
- Government of Alberta Species at Risk Database (Government of Alberta 2020);
- Species at Risk Public Registry (Government of Canada 2022);
- Alberta Flood Hazard Map application (Government of Alberta 2022c);
- Urban Primary Land and Vegetation Inventory (uPLVI) Interpretation Manual and Mapping (City of Edmonton 2015);
- City of Edmonton Environmental Sensitivities Mapping Project (City of Edmonton 2016); and
- Agricultural Region of Alberta Soil Inventory Database (AGRASID) (Government of Alberta 2021).

2.1.2 Literature Review

Previous studies completed within the Project Area and reviewed as part of the EIA included:

- Preliminary Design Report Blackmud Creek Bridge (AECOM 2010a);
- Edmonton South LRT Extension Environmental Overview (AECOM 2010b);
- Blackmud Creek Erosion Control Environmental Impact Assessment (Associated Environmental 2017); and
- Preliminary Geotechnical Investigation (AMEC 2010).

2.1.3 Hydraulic Assessment

In order to determine if the installation of the proposed piers will impact the hydraulic conditions within Blackmud Creek during the 1:2 year, 1:5 year, 1:100 year flood events and an extreme event (1:200 year flood event), a desktop review of the channel and banks inside the Project Area was conducted. The review incorporated LiDAR, Geographical Information System (GIS), a 2D numerical model from a previous planning study (Associated Engineering 2017), and preliminary engineering drawings for the South Capital Line bridge crossing. The review was conducted by Akinbola George, M.A.Sc., P.Eng., PMP (Senior Water Resource Engineer).

The preliminary design drawings were geo-referenced and a channel cross-section extracted from the LiDAR data. The proposed pier elevations were located within the extracted cross section and this was compared to the simulated water levels during the flood events.

2.1.4 Site Visits and Field Surveys

An early and late season rare plant survey was completed by Suzanne Card, M.Sc., P.Biol., P.Ag., of Associated Environmental, on June 12, 2018 and August 8, 2017, respectively, at two pre-determined locations along the proposed Capital Line South Extension corridor. Locations included sites on the west and east side of Blackmud Creek and a forested area south of Anthony Henday Drive and 127 Street.

The rare plant surveys followed the Alberta Native Plant Council (ANPC) Guidelines for Rare Vascular Plant Surveys in Alberta (2012). The Project Area was investigated using a floristic survey method with transect searches. Transect searches involved walking parallel transects within a site. Unique or special landscape features, such as microhabitats, ephemeral habitats, wet areas, or transition zones, were given special attention. Effectively, a combination of a meander and transect survey was performed to increase the chances of capturing any rare plant species within the Project Area (ANPC 2012).

The site was evaluated for the presence of rare plant communities and plants were identified using a hand lens and appropriate taxonomic keys. The area surveyed included a 60 m wide ROW (i.e. 20 m construction area and 40 m buffer) on the west side of the existing bridges along 111 Street and another transect within a 30 m ROW on the east side of 111 Street.

A follow-up field verification was completed by Sandra Meidinger, P. Biol., R.P. Bio. (Associated Environmental, Project Manager and Lead Biologist) and Suzanne Card on August 24, 2017 to confirm the new alignment.

Wildlife surveys were conducted on January 30 and February 27, 2018 by Strix Ecological to catalogue species presence and relative abundances using snow tracking techniques (with a focus on mammal species) and to locate high-use trails and important wildlife features (Appendix D).

A follow up site visit was completed by Suzanne Card and Andrea Zemrau, P. Biol. (Associated Environmental), on October 4th, 2024 to confirm current site conditions within the project area. The site visit identified that no substantial changes to landscape features, including vegetation communities and wildlife features, have occurred since the initial surveys were completed.

Field photographs are included in Appendix E.

2.2 BASELINE FEATURES

The Municipal Development Plan, The Way We Grow (City of Edmonton 2010), identifies the Blackmud and Whitemud Creeks as Biodiversity Core Areas. Within the City of Edmonton, the creeks are included in the North Saskatchewan River Valley Area Plan, Bylaw 7188. Adopted in 1985, Bylaw 7188 identifies a boundary for the river valley and ravine system and a set of policies and development approval procedures for lands within this boundary.

A review of the data from the City of Edmonton Environmental Sensitivities Mapping Project (City of Edmonton 2016) indicated that within 20 m of the Project Area, sensitivity scores range from very high to moderate. Very high scores indicate that the area has multiple ecological assets and cultural and/or physical constraints (City of Edmonton 2016). These scores occurred primarily at the top of the ravine. Moderate scores, occurring primarily along the existing bridge and within the valley, indicate that these areas have been influenced by past human use and limited distribution of ecological assets (e.g., rare species and unique landforms) occur here. Areas scored as moderate have a strong restoration potential which can benefit surrounding ecological assets.

2.2.1 Land Use and Zoning

Land use within the Project Area includes recreational use, habitat for plants and wildlife, and public transportation. A shared use path (SUP) is located on the west side of the southbound bridge crossing and connects with a recreational trail that descends into the ravine and extends through the Project Area to the east. The existing bridges provide an important connection between residential neighborhoods.

The west side of the existing bridges is currently zoned as A, or Metropolitan Recreational Zone. This zone provides the opportunity for preserving natural areas and parkland along the river, creeks, ravines and other designated areas. The east side of the existing bridge is zoned as Agricultural Zone (AG) in the northeast and Urban Service Zone (US) in the southeast.

There will be no changes to zoning associated with this project. However, the areas zoned as A and US are considered parkland and therefore the terms and conditions of the City's Parkland Bylaw (Bylaw 2202) apply to these areas.

2.2.2 Surface Water, Groundwater and Fish Habitat

Blackmud Creek, a sub-basin of Whitemud Creek, covers an area of 671 km^2. Both creeks are located in the Strawberry sub-basin of the North Saskatchewan River Valley. The substrate matrix throughout is dominated by fines; however, gravels also comprise a considerable component of the substrate, and cobbles are present in some areas in small quantities (Associated Environmental 2017). Substantial instream cover is provided by dense beds of aquatic macrophyte vegetation, large woody debris, beaver pond impoundments, and undercut banks. Overhead cover is substantial, especially in downstream reaches, and is provided by overhanging vegetation including grasses, shrubs, and trees.

The channel contains a well distributed series of riffles, runs, and pools. Riffles are present in most upstream reaches, with runs forming along the midstream reaches in the network. Pools are present immediately upstream of beaver dams and provide valuable overwintering habitat that is likely limited to these areas in the mid and upstream reaches of these creeks. Runs are present throughout the midstream reaches, and deep/dominant features are present in downstream reaches of the creeks.

Blackmud Creek typically supports several cyprinids, such as fathead minnow (*Pimephales promelas*), lake chub (*Couesius plumbeus*), longnose dace (*Rhinichthys cataractae*), pearl dace (*Margariscus margarita*), and trout-perch (*Percopsis omiscomaycus*), as well as stickleback species. Other species that likely use habitat in this creek include northern pike (*Esox lucius*), white sucker (*Catostomus commersoni*), and longnose sucker (*Catostomus catostomus*).

Groundwater characteristics were described in the geotechnical investigation performed by AMEC Earth & Environmental on January 8, 2010 (Appendix F). At the bottom of the valley, shallow water levels (2 m below surface) were found in the alluvial deposits above the bedrock. Along the valley walls, the groundwater level was deep and ranged from 8 to 10 m below ground surface.

The topography within the Project Area has been altered by prior site development activities including construction of the existing bridges. Slopes within the Project Area range from 20% to 33% (AMEC 2010), allowing for water movement downhill and preventing pooling. Organic material is present within the top 0.3 m of the soil (AMEC 2010), which reduces erodibility because it produces compounds that bind particles together, increasing aggregation and reducing the susceptibility of the particles to detachment by raindrop impact and surface run-off. Organic matter also improves soil biological activity and increases infiltration rates, reducing run-off and erosion potential.

A review of the current provincial flood hazard mapping indicates that Blackmud Creek at the crossing has not been mapped as floodway or flood fringe area (Government of Alberta 2022c). The elevations of the 1:2, 1:5, 1:100, and 1:200-year high water levels (HWL) were estimated to be 657.0 m a.s.l., 657.7 m a.s.l., 659.35 m a.s.l., and 659.7 m a.s.l., respectively (Figure 2-1).

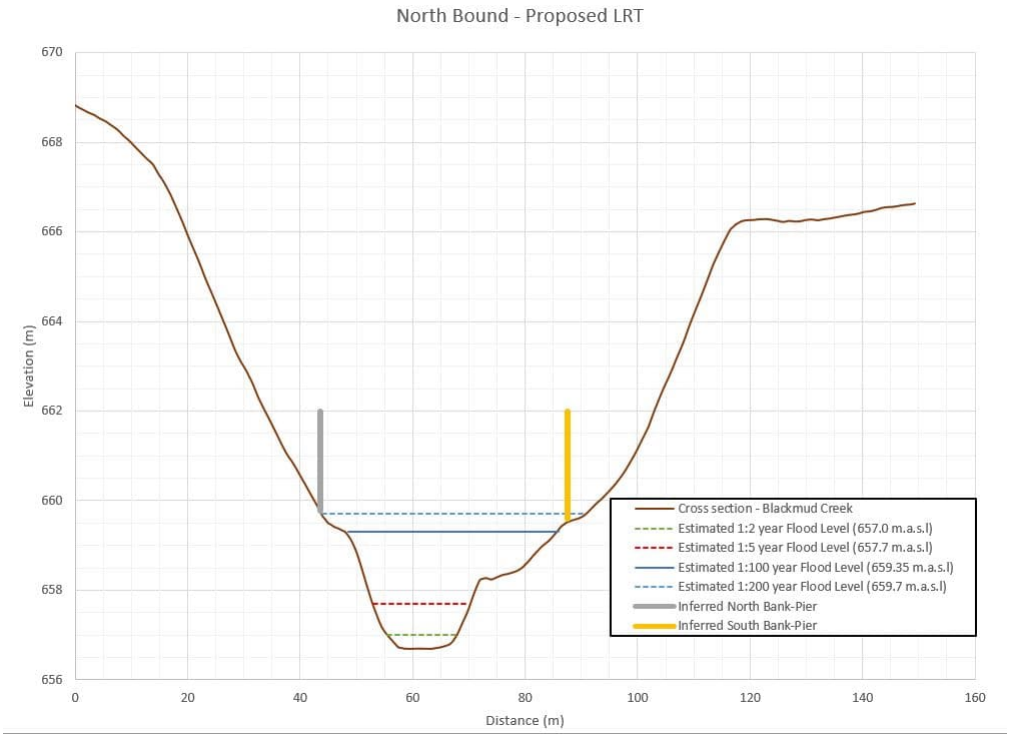


Figure 2-1
Estimated 1:2, 1:5, 1:100 and 1:200 year Flood Level
and Proposed LRT Bridge Pier l**ocations**

2.2.3 Geology/Geomorphology and Soils

The Project Area lies within the Central Parkland Natural Subregion of Alberta (Natural Regions Committee 2006). The dominant landform in this region is undulating glacial till plains, with approximately 30% hummocky, rolling and undulating uplands. Topography in the Edmonton area is generally rolling to flat, with minimal relief; however, the North Saskatchewan River Valley system is an important exception to this and the river valley is the dominant geomorphological feature in the region.

The Project Area contains a mix of steep slopes, rolling hills and a relatively flat floodplain. The dominant geomorphological feature on the river terrace is the Blackmud Creek channel. The Blackmud Creek valley is broad in relation to the size of the creek channel and is approximately 20 m deep along the alignment (AMEC 2010). On either side of the valley the terrain is relatively flat-lying and drops off in a north-westerly direction. The slopes along the north and south valley range from 3H:1V to 5H:1V (20 to 33% slopes), with valley walls outside of the bridge crossing having much steeper slopes.
Surficial materials are dominantly medium to moderately fine textured, moderately calcareous glacial till that may be a thin (less than 2 m) blanket over bedrock in some of the low-relief plains (Natural Regions

Committee 2006). Bedrock formations underlying the central Alberta unit of the Central Parkland Subregion include Upper Cretaceous shale, sandstone, and siltstone formations (Natural Regions Committee 2006). There is a significant component (10%) of glaciofluvial sands and organic deposits but only minor inclusions of glaciolacustrine materials (Natural Regions Committee 2006).

During the geotechnical investigation (AMEC 2010), four boreholes were drilled in the vicinity of the proposed LRT bridge at depths ranging from 8.8 to 17.6 m (Appendix F). The uplands within the valley are characterized as organic topsoil overlying clay fill and lacustrine clay underlain by clay till. Bedrock is characterized as being from the Edmonton Formation, with interbedded clay shale and sandstone. The bottom of the valley has thin alluvial deposits over shallow bedrock.

The Project Area is located within Soil Correlation Area 10 (Pedocan Land Evaluation Ltd. 1993), within the Thick Black Soil Zone of central Alberta. Soils are typically medium to fine textured Gray and Dark Gray Luvisols (Natural Regions Committee 2006). A search of the Agricultural Region of Alberta Soil Inventory Database (AGRASID) identified soils in the area as miscellaneous undifferentiated mineral soils (Government of Alberta 2021). Soils within the Project Footprint have been impacted by site development activities, including the construction of the existing bridges.

Based on the geotechnical investigation, the soils in the test holes consisted of, in descending order:

- Organic topsoil ranging from 0.2 to 0.3 m;
- Fill material in the top 0.5 m to 2.5 m characterized as silty clay;
- Lacustrine clay extending to depths of 3 to 7 m;
- Clay till to depths of 8 to 13 m described as silty, sandy clay; and
- Alluvial sediments and bedrock to completion depth.

The borehole logs are included in Appendix F.

The erosion potential in the Project Footprint is based on the analysis of the slope along with the infiltration capacity and erodibility rating of the soil unit. The geotechnical investigation (AMEC 2010) reported slopes ranging from 3H:1V to 5H:1V, corresponding to slope percentages of 33% and 20%, respectively. The soils in the test holes were primarily silty clay or clay. Using the erosion potential calculation in the Erosion and Sedimentation Control Guidelines (City of Edmonton 2022), the slopes are considered steep (over 15%) and the soil texture of silty clay corresponds to a medium erodibility rating, therefore the erosion potential is high.

Potential run-off at the site is based on the slope values and the permeability classification of the soils as determined during the geotechnical investigations. The highest degree slope found in the Project Area is 33%, or 3H:1V, which corresponds to a slope class of 7, or very strong slopes (Soil Classification Working Group 1998). Fine-grained soils are generally more compact and have smaller pore spaces than coarse-grained soils, resulting in reduced permeability and water infiltration. Fill material is present within the top

2.5 m, which was characterized as silty clay (AMEC 2010). This corresponds to a permeability classification of 5 (i.e., slow) (City of Calgary 2017). The runoff potential at this site is likely moderate to moderate high.

The presence of modifying factors within the Project Footprint is summarized in Table 2-1.

Table 2-1
Presence of Modifying Factors within the Project Footprint

Factor	Description
Presence of slope failure (active/inactive/recurrent)	None noted during site visit.
Evidence of river erosion	None noted during site visit.
Potential for high water table	At the bottom of the valley, shallow water levels (2 m below surface) were found in the alluvial deposits above the bedrock.
Previous mining activity	Land previously Papaschase Indian Reserve, therefore no previous mining activity anticipated.
Presence of slip-off slope	None noted during site visit.

A Soils Strategy Report (SSR) was developed in order to assess potential contamination along the entire length of the Capital Line and provide recommendations to manage any potential contamination during soil handling (Associated Environmental 2018). A Phase I Environmental Site Assessment (ESA), conducted by AECOM in 2010, identified two areas, associated with operational gas stations along the entire LRT route, where petroleum hydrocarbon impacts should be considered (AECOM 2010c). This report also identified the that the site of the former Ellerslie Hazardous Waste Management Facility has impacted soil and groundwater. Subsequently, a Phase II ESA was conducted in the former Facility where the OMF is proposed. A Phase II is also planned for the 23rd Ave intersection. All of these potentially impacted or confirmed impacted areas are greater than 0.6 km from the Blackmud Creek crossing. Refer to the SSR for any unidentified contaminated soil handling that may be encountered during construction.

The Edmonton Capital Line South Extension Soil Management Plan (Associated Engineering 2023) has been developed and will be followed during construction. It should be noted that only clean unimpacted materials will be used in the Blackmud creek area and therefore the beneficial reuse of soil will not apply to the project within the River Valley Bylaw Area.

2.2.4 Vegetation

2.2.4.1 Native Vegetation

Natural vegetation communities within the Central Parkland Natural Subregion include various community types that occur within grasslands, shrublands, forests, and wetlands (Natural Regions Committee 2006). Grassland communities typically include western porcupine grass (*Stipa spartea*), june grass (*Koeleria macrantha*), needle-and-thread grass (*Stipa comata*), blue grama grass (*Bouteloua gracilis*), dryland sedges, and pasture sagewort (*Artemisia frigida*) (Natural Regions Committee 2006). Plains rough fescue (*Festuca scabrella*), slender wheat grass (*Agropyron trachycaulum*), and smooth brome (*Bromus inermis*) occur in areas with increased soil moisture (Natural Regions Committee 2006). Shrublands support buckbrush (*Ceanothus cuneatus*), silverberry (*Elaeagnus* spp.), prickly rose (*Rosa acicularis*), chokecherry (*Prunus virginiana*), and Saskatoon (*Amelanchier alnifolia*) (Natural Regions Committee 2006). Forested areas vary greatly depending on soil moisture conditions; dominant tree species include trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white spruce (*Picea glauca*) while the understorey consists of Saskatoon, prickly rose, beaked hazelnut (*Corylus cornuta*) and various forbs and grasses (Natural Regions Committee 2006).

Five site types were delineated within the Project Footprint and mapped (Figure 2-2) according to the City of Edmonton Urban Primary Land and Vegetation Inventory (uPLVI) Interpretation Manual (City of Edmonton 2015). Vegetation communities were delineated to the extent of the Project Area.

General descriptions of each of the site types are as follows:

- Maintained grass (MG) – manicured lawn located adjacent to the existing bridges, dominated by quackgrass;
- Non-maintained grass / shrubs (NG) – these sites area located within the manicured lawn sites but are not regularly mowed and contain shrubs;
- Herbaceous grass (HG) – riparian areas with less than 6% tree cover and less than 10% shrub cover, characterised by narrow-leaf willow/common great bulrush/common tall manna grass;
- Medial shrub (MS) – areas with less than 6% tree cover and greater than 25% shrub cover, with shrub crowns touching but not interlocking; and
- Forested areas (FT) - characterised by white spruce/balsam poplar/red osier dogwood/prickly rose/saskatoon/wild sarsaparilla.

Since 2019, the categorization of the site types has changed. However, the changes do not impact the analysis of the area and therefore, no changes to Figure 2-2 have been made.

A complete list of the 60 plant species observed at the site is provided in Appendix G.

2.2.4.2 Rare Species

A search of the Alberta Conservation Information Management Systems (ACIMS) database (Government of Alberta 2022a included a 5-km radius from the rare plant Project Area to capture rare element occurrences in adjacent areas that have similar habitat.

The search results indicated 13 rare plant species with the potential to be encountered (Table 2-2).

A similar search of ACIMS for the Project Area in 2024 yielded no non-sensitive or sensitive element occurrences.

Table 2-2
Rare Plant Species with **Potential to be Encountered in Project Area** (2019)

Common Name	**Scientific Name**	SRank[1]	Preferred Habitat
Canada rice grass	*Piptatherum canadense*	S2	Open woods and hillsides[2]
Dot lichen	*Micarea melaena*	S1	Unknown[4]
Lichen	*Pseudevernia consocians*	S2	Conifers, mainly in forests[4]
Long-leaved bluets	*Houstonia longifolia*	S3	Sandy soil in open woods and on dunes; in grasslands[3]
Flat-topped white aster	*Doellingeria umbellata var. pubens*	S3	Moist woodlands and swampy sites, in moist thickets and meadows[3]
Ontario Rhodobryum moss	*Rhodobryum ontariense*	S1S2	Unknown[4]
Flat-fruited pelt lichen	*Peltigera horizontalis*	S2S4	Mossy soil, logs and rocks in forest[4]
Smooth sweet cicely	*Osmorhiza longistylis*	S3	Moist woods[3]
Beautiful branch moss	*Callicladium haldanianum*	S2	Soil and decomposing logs[4]
Moss	*Entondon concinnus*	S1S2	Soil or soil covered rocks in calcareous areas[4]
Moss	*Pohlia atropurpurea*	S2	Damp to wet, disturbed, or sandy or clayey soil, road banks, ditch banks, margins of lakes and ponds or streams[4]

Common Name	**Scientific Name**	SRank[1]	Preferred Habitat
Fallacious screw moss	*Didymodon fallax*	S2S3	Soil, silt, conglomerate, dolomite, sandstone, culverts, gypsum, shale and calcareous rock at moderate to high elevations [4]
Schleicher's silk moss	*Entodon schleicheri*	S2S3	Rocks along canyon walls in woods, rotting logs and shaded rock ledges[4]

1 Subnational Status Rank (SRank) definitions are used by ACIMS (Government of Alberta 2022a) and are adapted from the NatureServe ranking methodology.
2 Moss 1959
3 ANPC 2001
4 Tera 2014

S1: Known from five or fewer occurrences or especially vulnerable to extirpation because of other factor(s).
S2: Known from twenty or fewer occurrences or vulnerable to extirpation because of other factors.
S3: Known from 100 or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factors.
S4: Apparently secure. Taxon is uncommon but not rare. Potentially some cause for long term concern due to declines or other factors.
S#S#: A numeric range rank is used to indicate any range of uncertainty about the status of the taxon. Example - S2S3 or S1S3.

In addition to the 5-km radius search, a list of rare element occurrences found in the Central Parkland natural subregion was also reviewed prior to the field survey to evaluate all possible rare element occurrences in the Project Area (Government of Alberta 2022a).

No rare plant species were observed during the early or late season survey.

2.2.4.3 Invasive Species

During the rare plant survey, 14 invasive and non-native species (listed as exotic in the ACIMS database) were identified (Table 2-3).

The rare plant survey indicated the presence of restricted and noxious weed species as listed in the provincial *Weeds Regulation*. Three noxious weed species were identified in the survey area: Canada thistle (*Cirsium arvense*), perennial sow-thistle (*Sonchus arvensis*), and scentless chamomile (*Tripleurospermum*

inodorum). These species were found in previously disturbed areas, including the manicured areas directly surrounding the existing bridge structures and in the riparian areas surrounding Blackmud Creek.

Table 2-3
Invasive and Non-**native (exotic) Species within Rare Plant Project Area**

Common Name	**Scientific Name**	Invasive	Non-**Native (Exotic)**
Manitoba maple	*Acer negundo*	X	
Smooth brome	*Bromus inermis*	X	X
Creeping thistle	*Cirsium arvense*	X	X
Quackgrass	*Elymus repens*	X	X
Common toadflax	*Linaria vulgaris*		X
White sweet-clover	*Melilotus alba*	X	X
Yellow sweet-clover	*Melilotus officinalis*	X	X
Common plantain	*Plantago major*	X	X
Perennial sow-thistle	*Sonchus arvensis*	X	X
Common dandelion	*Taraxacum officinale*	X	X
Common goat's-beard	*Tragopogon dubius*	X	X
Alsike clover	*Trifolium hybridum*	X	X
Scentless chamomile	*Tripleurospermum inodorum*	X	X
Tufted vetch	*Vicia cracca*	X	X

2.2.5 Wildlife

The Blackmud Ravine is home to several wildlife species. The Project Area contains suitable habitat for wildlife and nesting habitat for migratory and non-migratory birds in the trees, shrubs, grasses, and waterbody areas adjacent to the proposed alignment, and in the adjacent forested areas.
Typical wildlife species within the grassland regions of the Central Parkland Subregion include upland sandpiper (*Bartramia longicauda*), Sprague's pipit (*Anthus spragueii*), Baird's sparrow (*Ammodramus bairdii*),

broad-winged hawk (*Buteo platypterus*), rose-breasted grosbeak (*Pheucticus ludovicianus*), and woodchuck (*Marmota monax*) (Natural Regions Committee 2006).

Within the shrubland and forested community types, typical wildlife species include red-tailed hawk (*Buteo jamaicensis*), least flycatcher (*Empidonax minimus*), Baltimore oriole (*Icterus galbula*), red-eyed vireo (*Vireo olivaceus*), yellow warbler (*Setophaga petechial*), white-tailed deer (*Odocoileus virginianus*), snowshoe hare (*Lepus americanus*), northern pocket gopher (*Thomomys talpoides*), and American porcupine (*Erethizon dorsatum*) (Natural Regions Committee 2006).

The Project Area is located within two provincial sensitive wildlife zones, "sharp-tailed grouse survey area" and "sensitive raptors range" for bald eagles (*Haliaeetus leucocephalus*) (Government of Alberta 2015a). It is also located southeast and outside of the Key Wildlife and Biodiversity Zone associated with the North Saskatchewan River (Figure 2-2). The Key Wildlife and Biodiversity Zone is considered to be a combination of key winter habitat for ungulates and higher habitat potential for biodiversity. Previous recordings of listed wildlife species within a 5 km radius are summarized in Table 2-4 (Government of Alberta 2022b).

Table 2-4
Wildlife Species Occurrences Documented within 5 km of the Project Area

Common Name	**Scientific** Name	Within 5 km	SARA[1]	COSEWIC[1]	*Wildlife Act* – Schedule 6 **Listing**[2]	2020 General Status[3]	Preferred Habitat	Likelihood to be found in Project Area
Alder flycatcher	*Empidonax alnorum*	☒	Not Listed	Not Listed	Not listed	Sensitive	Nests in thickets (including alder or willow) near muskegs, bogs, marshes, streams, lakeshores, forest margins or roads[4].	Moderate to high; May be found in vegetation along Blackmud Creek; previously sighted within 5 km (Government of Alberta 2022b)
American kestrel	*Falco sparverius*	☒	Not Listed	Not Listed	Not listed	Sensitive	Often found on telephone lines where it rests before hunting in nearby ditches, fields, meadows, and prairies[4].	Low; May use Project Area for hunting; previously sighted within 5 km (Government of Alberta 2022b)
Bald eagle	*Haliaeetus leucophalus*	☒	No status	Not at Risk	Not listed	Sensitive	Prefers areas near lakes and rivers in the mountain and northern regions of Alberta[4].	Low; Not listed within 5 km search area (Government of Alberta 2022b)
Bank swallow	*Riparia riparia*	☒	Threatened – Schedule 1	Threatened	Not listed	Sensitive	Inhabits low areas along rivers, streams, sand and gravel pits, and roadcuts. Nest burrows are nearly always in a vertical or near-vertical bank[4].	Moderate; May be found hunting along creek edge or in open areas surrounding creek; previously sighted within 5 km (Government of Alberta 2022b)
Barn swallow	*Hirundo rustica*	☒	Threatened – Schedule 1	Threatened	Not listed	Sensitive	Uses human structures for nest sites, especially near water bodies and gardens[4].	High; Most likely found nesting under the existing bridge, previously sighted within 5 km (Government of Alberta 2022b)
Barred owl	*Strix varia*	☒	Not Listed	Not Listed	Not listed	Sensitive	Inhabits swamps and dense forest but hunts in open areas. Found in the boreal forest, foothills, and Rocky Mountain regions[4].	Moderate; Likely to use this area for hunting; previously sighted within 5 km (Government of Alberta 2022b)
Canadian toad	*Bufo hemiophrys*	☒	No status	Not at Risk	Not listed	May be at Risk	Generally found in river valleys or along the margins of lakes with sandy soil[4].	Low to moderate; Generally, prefers habitat with sandy soil; previously sighted within 5 km (Government of Alberta 2022b)
Eastern phoebe	*Sayornis phoebe*	☒	Not Listed	Not Listed	Not listed	Sensitive	Often found in the vicinity of streams and lakes at the forest edge or near open areas (including farmyards)[6].	Moderate to high; May be found along creek edge or in open areas surrounding creek; previously sighted within 5 km (Government of Alberta 2022b)
Great blue heron	*Ardea herodias*	☒	Not Listed	Not Listed	Not listed	Sensitive	Generally found near standing water sources including lakes, ponds, and wetlands[4].	Low to moderate; Generally, prefers habitat with water sources; previously sighted within 5 km (Government of Alberta 2022b)
Little brown bat	*Myotis lucifugus*	☒	Endangered – Schedule 1	Endangered	Endangered	May be at Risk	They typically roost in caves and mines in the winter, and they can be found in trees, artificial structures, under rocks and in piles of wood in the summer. Foraging habitat is commonly forested lands near water[4].	Moderate to high; May be found along creek edge or in forested areas near the creek, outside of project lands; previously sighted within 5 km (Government of Alberta 2022b)

Common Name	**Scientific** Name	Within 5 km	SARA[1]	COSEWIC[1]	*Wildlife Act* – Schedule 6 **Listing**[2]	2020 General Status[3]	Preferred Habitat	Likelihood to be found in Project Area
Prairie long-tailed weasel	*Mustela frenata*	☒	No status	Not at Risk	Not listed	May be at Risk	Favored habitats include shrubby areas and open forests, field edges, riparian areas, swamps and marshes[4].	Moderate to high; May be found along creek edge or vegetated areas near the creek; previously sighted within 5 km (Government of Alberta 2022b)
Northern leopard frog	*Lithobates pipiens*	☒	Special Concern – Schedule 1	Special Concern	Endangered	At Risk	Found along the edges of ponds, marshes, streams, rivers, and lakes. Prefers clean water in open or lightly wooded areas[4].	Low; The range of this species has been dramatically reduced and it is thought to be absent from central Alberta[4]. Previously sighted within 5 km (Government of Alberta 2022b)
Northern long-eared bat	*Myotis septentrionalis*	☒	Endangered – Schedule 1	Endangered	Endangered	May be at Risk	They typically roost in caves and mines in the winter, and they can be found in trees, artificial structures, under rocks and in piles of wood in the summer. Foraging habitat is commonly forested lands near water[4].	Moderate to high; May be found along creek edge or in forested areas near the creek, outside of project lands; previously sighted within 5 km (Government of Alberta 2022b)
Peregrine falcon	*Falco peregrinus anatum/ tundrius*	☒	Special Concern – Schedule 1	Not at Risk	Endangered	At Risk	In urban areas, often found nesting on buildings and other man-made structures. In rural areas, found nesting on cliffs close to riparian or marsh habitats[4].	Low; Low suitability of nesting habitat within Project Area
Pileated woodpecker	*Dryocopus pileatus*	☒	Not listed	Not listed	Not listed	Sensitive	Prefers older, dense, canopied forest with mixed and deciduous woods. Becoming more prevalent in urban areas[4].	Moderate to high; Surrounding forest is deciduous with coniferous trees also present; previously sighted within 5 km (Government of Alberta 2022b)
Plains garter snake	*Thamnophis radix*	☒	Not listed	Not listed	Not listed	Sensitive	Prefers to inhabit grasslands, meadows, and open forests and is often found near wetland, lakes, and streams. They are commonly found under rocks and logs, anthropogenic structures, and underground cavities.	May be found along creek edge or vegetated areas near the creek; previously sighted within 5 km (Government of Alberta 2022b)
Red-sided garter snake	*Thamnophis sirtalis*	☒	Not Listed	Not Listed	Not listed	Sensitive	A habitat generalist that occupies forests, shrublands, wetlands, fields and rocky areas. Overwinter below the frost line in burrows, rock crevices, man-made structures, and other underground cavities[6]	High; Adaptable to many habitat types; previously sighted within 5 km (Government of Alberta 2022b)
Sharp-tailed grouse	*Tympacnuchus phasianellus*	Provincial Wildlife Zone	Not Listed	Not Listed	Not listed	Sensitive	Prefer brush and aspen groves in the parkland zone as well as the edges of forest cleanings near grain fields[4].	Low; Not likely to be found in project area as it prefers forest clearings near grain fields

1 Government of Canada. 2023. Species at Risk Public Registry. A to Z Species Index. http://www.sararegistry.gc.ca/sar/index/default_e.cfm. Accessed 10 October 2024.

2 Wildlife Regulation, Alberta Regulation 143/1997, Schedule 6. http://www.qp.alberta.ca/documents/Regs/1997_143.pdf Accessed 10 October 2024.

3 Government of Alberta. 2020. Wild Species Status Search https://www.alberta.ca/lookup/wild-species-status-search.aspx Accessed 10 October 2024

4 Government of Alberta. 2015. Wild Species Pages http://aep.alberta.ca/fish-wildlife/wild-species/default.aspx Accessed 10 October 2024.

5 Semenchuk, G., editor. 1992. The Atlas of Breeding Birds of Alberta. Federation of Alberta Naturalists, Edmonton, AB.

6 Canadian Herpetological Society. 2017. Red-sided garter snake and plains garter snake. http://www.canadianherpetology.ca/species/species_page.html?cname=Red-sided%20Gartersnake Accessed 10 October 2024.

2.2.5.1 Birds

The Project Area is located within the migratory nesting zone of B4, which has a nesting period from April 15 to August 31 (Government of Canada 2024). The general nesting period for owls and other birds of prey in this area is from February 15 to August 31.

As previously mentioned, the Project Area is located within the sharp-tailed grouse survey zone and the sensitive raptor range for bald eagles (*Haliaeetus leucophalus*). However, it does not support preferred habitat for sharp-tailed grouse or their leks, which generally is within brush areas near agricultural fields (Government of Alberta 2015c). Although bald eagles prefer habitats near lakes and rivers, they typically nest in forested areas that are adjacent to large water bodies away from highly developed areas (Cornell Lab of Ornithology 2019); therefore, the Project Area is not highly suitable for bald eagle nesting. Additionally, as bald eagles create relatively large stick nests and often return to the same nests each year (Government of Alberta 2015a) there is a low likelihood of an existing bald eagle nest in the Project Area.

During the wildlife surveys (Strix Ecological 2018), 13 species of birds were observed within the Project Area and include the pileated woodpecker (*Dryocopus pileatus*), hairy woodpecker (*Picoides villosus*), downy woodpecker (*Picoides pubescens*), rock pigeon (*Columba livia*), merlin (*Falco columbarius*), common raven (*Corvus corax*), blue jay (*Cyanocitta cristata*), black-billed magpie (*Pica hudsonia*), bohemian waxwing (*Bombycilla garrulus*), black-capped chickadee (*Poecile atricapillus*), red-breasted nuthatch (*Sitta canadensis*), white-breasted nuthatch (*Sitta carolinensis*), and house finch (*Haemorhous mexicanus*). The pileated woodpecker was the only species observed during the wildlife survey that falls under Schedule 1 of the *Migratory Birds Regulations, 2022* (MBR 2022) (SOR/2022-105). No pileated woodpecker nesting cavities were observed during the survey.

2.2.5.2 Amphibians

As Blackmud Creek passes through the Project Area, there is riparian habitat that may support amphibian use.

Documented occurrences of amphibians within 5 km of the Project Area include the Canadian toad (*Bufo hemiophrys*), active April to September (Government of Alberta 2015d), and the Northern leopard frog (*Rana pipiens*), active April to October (Government of Alberta 2015e). During active periods, the Canadian toad is generally mobile during the day and burrows into the ground at night. The Northern leopard frog is generally active at night and rests during the day in shallow pockets in the soil to absorb moisture and avoid predators. However, the distribution of Northern leopard frogs has contracted, and it has mostly disappeared from the central and western parts of Alberta (AESRD 2012a) making it highly unlikely that northern leopard frog would occur within the Project Area.

2.2.5.3 Mammals

Strix Ecological conducted wildlife surveys on January 30 and February 27, 2018 (Appendix D). The surveys focused on cataloguing the presence and relative abundance of wildlife, specifically mammal species, and locating high-use trails and important wildlife features (Strix Ecological 2018). The survey area included habitat within 150 m of the proposed LRT bridge and MUT, within public property. Snow tracking transect surveys were completed.

Evidence of 11 mammal species was observed during the surveys, with red squirrel (*Tamiasciurus hudsonicus*) and snowshoe hare (*Lepus americanus*) being observed directly. No dens were observed during the surveys. A summary of their abundance and residency status is provided in Table 2-5.

Table 2-5
Evidence of Species Observed During Wildlife Surveys

Species	Abundance (Number of Signs observed on January 30, 2018)	Abundance (Number of Signs observed on February 27, 2018)	Preferred Habitat	Residency Status
Coyote *(Canis latrans)*	82	57	All parts of the valley	Present year-round
Red fox *(Vulpes vulpes)*	0	2	Low number of signs. Found near creek on west side of 111 street.	
Least weasel *(Mustela nivalis)*	0	1	Low number of signs. Found near top of ravine on northeast side of Blackmud Creek.	
Long-tailed weasel *(Mustela frenata)*	16	0	Locations with long grass, naturalized ditches on either side of 111 Street and natural openings in the trees	
White-tailed deer *(Odocoileus virginianus)*	18	81	Localized in ravine for foraging and travel	

Species	Abundance (Number of Signs observed on January 30, 2018)	Abundance (Number of Signs observed on February 27, 2018)	Preferred Habitat	Residency Status
Moose *(Alces americanus)*	0	1	Low number of signs. Found at top of ravine on southwest side of Blackmud Creek.	
Snowshoe hare *(Lepus americanus)*	75	76	Localized patches of thick understory	
White-tailed jackrabbit *(Lepus townsendii)*	0	1	Low number of signs. Found at top of ravine on northwest side of Blackmud Creek.	
Red squirrel *(Tamiasciurus hudsonicus)*	33	61	South bank of the creek among the white spruce trees	
Beaver *(Castor canadensis)*	0	3	Low number of signs. Found within creek and riparian area on west side of 111 street and in upland area on northeast side of 111 street.	
Small rodents or shrews	30	23	Locations with long grass, naturalized ditches on either side of 111 Street and natural openings in the trees	

2.2.6 Wildlife Movement Corridor

The Blackmud Ravine provides a continuous movement corridor throughout the North Saskatchewan River Valley for several wildlife species, including small (e.g., mice, squirrels, chipmunks, and rabbits) and large mammals (e.g., coyotes, deer and occasionally moose).

The City of Edmonton Environmental Sensitivities Mapping Project (City of Edmonton 2016) identified potential coyote winter pinchpoints within the Project Area (Figure 2-2). Pinchpoints are defined as areas where connectivity is limited by development or open space adjacent to vegetated corridors (City of Edmonton 2016).

The wildlife survey verified the use of the Project Area by terrestrial and arboreal species. Results of the wildlife survey indicate that four high-use trails, created by coyote and white-tailed deer, exist within the Project Footprint (Appendix D):

- A coyote trail located along the ridge above the north bank, west of 111 Street, which connects trails in the ravine bottom with hare-rich hunting locations;
- A trail that leads east over 111 Street to another short trail;
- A trail along the creek edge through an open, brushy area, used heavily by both deer and coyote, and likely used for both foraging/hunting and travel; and
- The frozen creek, which is used as a pathway.

All trails avoid overlap with, or scatter near, man-made paths and roads. Potential conflict areas occur west of 111 Street on the south side of the creek, especially along the edge of the trees and into the shrub/birch habitat near the creek. This area seems to be a crossroads for both coyote and deer and, if blocked by construction, could disrupt their movement along the creek.

2.2.7 Historical Resources

The Project Area is located in an area that has high potential for archaeological and paleontological resources (Historical Resource Value: 5, a,p). Regulatory requirements are outlined in the provincial *Historical Resources Act* (Section 1.5.2.4) and mitigation measures are described in Section 4.3.

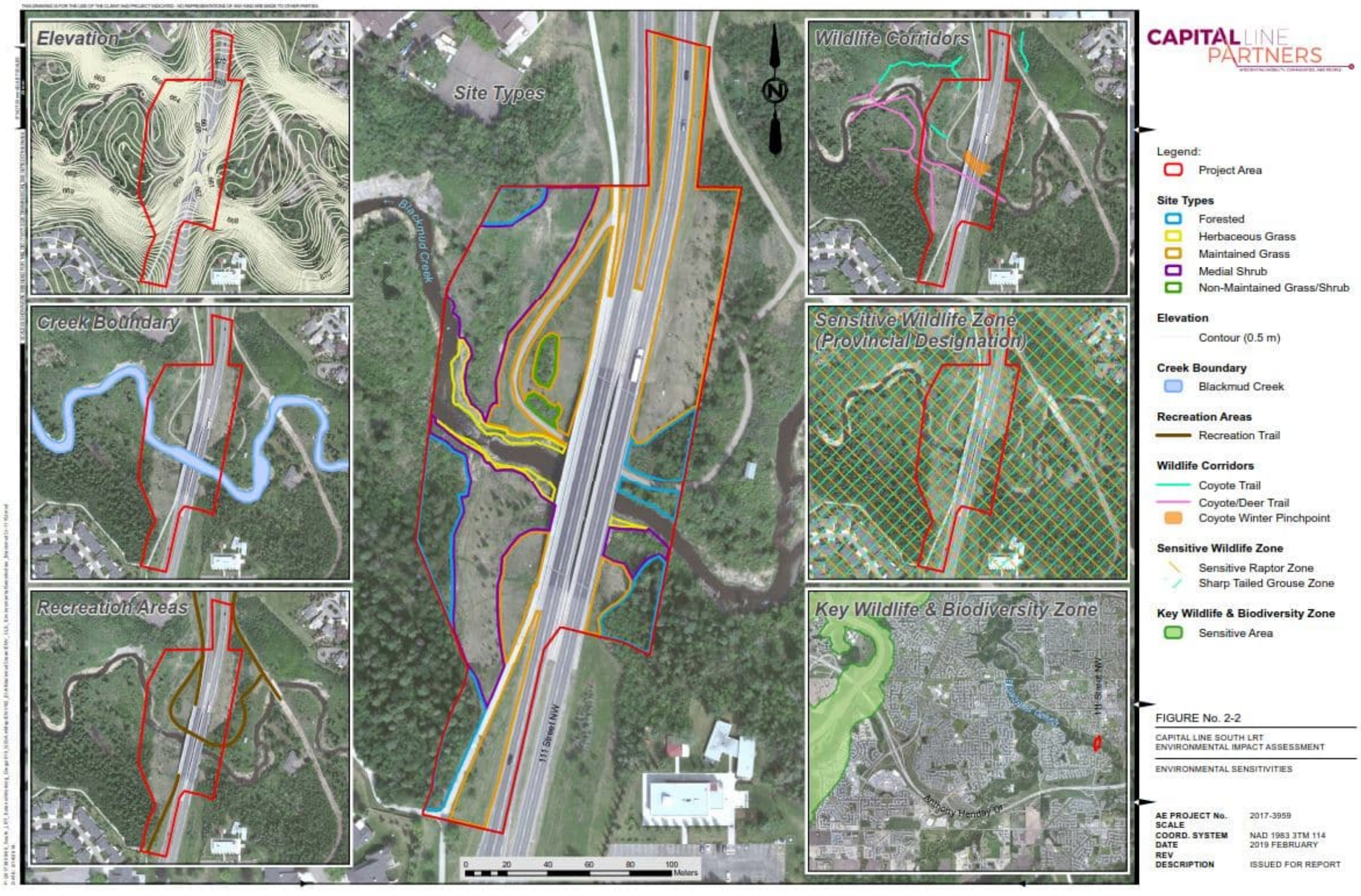


Figure 2-2
Environmental Sensitivities Map

3 THE PROJECT

Project-specific activities associated with site preparation, construction, landscaping, and operation are summarized in Table 3-1 below.

Table 3-1
Standard **Activities** Associated with all Phases of the Project

Project Phase	Standard Activities
Site Preparation	• Preparation of trail detour and traffic accommodation plans • Delineate construction/laydown areas and access routes • Relocate and protect existing utilities • Install temporary erosion and sediment control measures • Clear vegetation
Construction	• Provide vehicle traffic management and road closures • Conduct significant earthworks • Concrete pours to be determined by the Contractor at the time of design • Conduct bank stability works
Landscaping	• Adopt appropriate revegetation strategy depending on the plant community • Implement planting plan in accordance with Restoration plan and follow guidelines as outlined in the Design and Construction Standards Volume 5 Landscaping (City of Edmonton 2022). • Implement planting plan which incorporates wildlife passage design as outlined in the Wildlife Passage Engineering Design Guidelines (Stantec 2010). • Only native species of wild provenance shall be installed. No cultivars are permitted
Operation	• Regular track maintenance will include track corridor sweeping as required • Train maintenance will be conducted at the Operation and Maintenance Facility, outside of the Blackmud Creek.

3.1 CONCEPT PLANS AND DRAWINGS

Preliminary design drawings (90% submission issue, Revision 1, 2018) for COE Integrated Infrastructure Services Project: South LRT Extension, Century Park to Ellerslie Road, Contract No. 931770 are located in Appendix B.

4 PROJECT IMPACTS AND MITIGATION MEASURES

4.1 ASSESSING IMPACTS

4.1.1 Impact Analysis Method

The findings of the desktop review and field inspection (Section 2) guided the assessment of environmental impacts related to this project. Environmental impacts were assessed by analyzing the existing site conditions (baseline) in relation to project phases, Planning and Design, Construction and Operation. Where impacts on the baseline conditions are expected, consideration is given to minimize impacts through mitigation strategies and best management practices (BMPs).

The following Valued Ecosystem Components (VECs) are based on the baseline environment in the Project Area:

- Land use and zoning;
- Blackmud Creek floodplain and channel hydraulics;
- Topography and soil;
- Surface water, groundwater, and aquatic habitat;
- Vegetation;
- Wildlife and movement corridors; and
- Historical resources.

The potential impacts on these VECs are rated based on the proposed construction and operation of the LRT within the Blackmud Ravine. The anticipated direction, magnitude, duration, nature, spatial extent, and likelihood are described in Table 4-1.

Table 4-1
Attributes Used to Describe Potential Impacts

Impact Characteristic	Description	
Direction[1]	Negative, Positive, Neutral	If the impact on the VEC is negative or adverse (i.e., less favourable), positive (i.e., an improvement), or neutral (i.e., no change).
Magnitude[1]	Negligible, Low, Medium, High	Size or severity of the impact. The amount of change in a measurable parameter or variable relative to the baseline condition, guideline value, or other defined standard.
Duration[1]	Short-term, Medium-term, Long-term	The length of time the impact persists. It considers the various phases of the Project, including site preparation/construction, operations/build-out, and closure (i.e. landscaping), as well as the length of time for the environmental component to recover from the disturbance.
Nature	Direct, Indirect	If the VEC is directly or indirectly impacted.
Spatial extent	Local, Regional	If the impact to the VEC occurs on a relatively small (i.e. local) scale or a large (i.e. regional) scale.
Likelihood	High, Moderate, Low	The probability the impact to the VEC will occur without mitigation measures in place.

[1] Definitions adapted from Environmental Assessment Program Glossary of Environmental Assessment Terms and Acronyms Used in Alberta (Government of Alberta 2010).

4.1.2 Site-Specific Impacts

4.1.2.1 Land Use and Zoning

Changes in land use and zoning are not anticipated as part of the project. However, as this project occurs in the North Saskatchewan River Valley ARP, City Council must approve this EIA and the SLS prior to the commencement of the project. Potential impacts of the project related to land use and zoning are summarized in Table 4-2.

A noise impact study was completed in May 2019 by ACI Acoustical Consultants Inc.(2019). Results of the study indicate that the resident's northwest of 111 Street and 23 Avenue and northeast of 111 Street and 9 Avenue, outside of the project area boundary, will have higher projected noise levels. All projected noise levels along the proposed South Light Rail Transit (SLRT) Extension project were below 65dBA and therefore, additional noise mitigation measure will not be required (ACI Acoustical Consultants Inc. 2019).

Traffic analysis has been completed for the project and is expected to have minimal impacts on land use in the area and overall, a positive impact on traffic flow due to the LRT expansion. Specifically, the LRT is expected to have the following positive impacts on traffic (R. Betker, Personal Communication, 2018):

- A decrease in traffic in single vehicles and on buses. The forecasted future traffic volumes, while still increasing on 111 Street, do not increase as much with the LRT expansion;
- Creation of an additional and more convenient transportation option for the Twin Brooks neighbourhood;
- Results in an upgraded pedestrian corridor on 111 Street; and
- A decrease in neighbourhood / shortcutting traffic, particularly through the Skyrattler neighbourhood, as people avoid the train crossings.

Impacts related to biodiversity land use in the Project Area, including aquatic habitat, plants and wildlife, are discussed in detail below in Sections 4.1.2.4, 4.1.2.5, and 4.1.2.6.

Table 4-2
Potential Impacts to Land Use and Zoning

Baseline Feature / Environmental **Sensitivity**	**Direction** and **Description of Potential** Impact	**Characteristic of Impact Before Mitigation** Measures	**Potential for Cumulative Impacts**
Parkland Bylaw, North Saskatchewan River Valley Area Redevelopment Plan Bylaw	Negative – Degradation of Parkland / North Saskatchewan River Valley areas	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Long-term Likelihood: High	Degradation of Parkland / NSRV areas would occur from cumulative impacts to other VECs during construction and operation phases of the project.
Recreational Use of MUT	Negative – Restricted access of MUT system in river valley and on existing bridge structure	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Short-term Likelihood: High	NA
Traffic on existing bridge structures	Negative – Temporary lane closures and restrictions to traffic flow during construction phase	Nature: Direct Magnitude: Medium Spatial Extent: Regional Duration: Long-term Likelihood: High	NA
Adjacent residential neighborhoods	Negative – Noise during construction and operational phases	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Short-term Likelihood: High	NA
Adjacent residential neighborhoods	Negative – Reduced visual aesthetics during operational phase	Nature: Direct Magnitude: Low Spatial Extent: Local Duration: Long-term Likelihood: High	NA

4.1.2.2 Blackmud Creek Floodplain and Channel Hydraulics

Potential negative impacts of the project to the hydrology of Blackmud Creek have been largely mitigated through the detailed design of the proposed bridge structures. The piers will be above the simulated 1:100-year HWL (estimated at 659.35 m) and it will be a clear span bridge across Blackmud Creek. In addition, the piers will be in line with the existing piers of the 111 Street bridge crossing; therefore, it is anticipated that there will be negligible changes to the water flow and velocity during a 1:100-year HWL (Figure 2-1).

Based on the preliminary design drawings (90% submission issue, Revision 1, 2018) is has been determined that:

- The pre-development hydraulic conditions will remain the same after post-development up to the 1:100-year flood event;
- The proposed piers are not expected to constrict the channel at the crossing; and
- The proposed piers are not expected to increase the velocities and the rate of erosion within the downstream portion of Blackmud Creek as there will be no constriction of the channel at the crossing.

During the construction phase of the project negative impacts to Blackmud Creek hydrology are not anticipated as there will be no instream water work. The limit of construction has been established using the 1:5-year As such, isolation measures will not be required; however, the contractor may need to develop contingency measures as part of the project specific Environmental Construction Operations (ECO) Plan in the event of a flood exceeding the 1:5-year HWL.

4.1.2.3 Topography and Soil

Due to steep slopes associated with the Blackmud Creek river valley and soils with high erodibility the bridge structures could result in slope failure and erosion. Preliminary engineering accounted for potential impacts to topography and soil due to steep slopes and highly erodible soils in the Project Area. These impacts as well as impacts to topography and soils from earthworks, vegetation removal, operation of equipment, and handling of chemical and hazardous materials during construction are summarized in Table 4-3.

Table 4-3
Potential Impacts to Topography and Soil

Baseline Feature / Environmental **Sensitivity**	**Direction** and **Description of Potential** Impact	**Characteristic of Impact Before Mitigation** Measures	**Potential for Cumulative Impacts**
Steep slopes, soils with high erodibility, and moderate to high runoff potential	Negative – Slope instability / failure due to use of fill material and / or design of bridge structures	Nature: Direct Magnitude: High Spatial Extent: Local Duration: Medium-term Likelihood: Moderate	Eroded soil could cause sedimentation into Blackmud Creek that would have potential impacts to the aquatic ecosystem at the source and downstream of erosion location
Steep slopes, soils with high erodibility, and moderate to high runoff potential	Negative – Erosion of soil from earthworks, vegetation removal, and equipment operation during construction	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Short-term Likelihood: High	Eroded soil could cause sedimentation into Blackmud Creek that would have potential impacts to the aquatic ecosystem at the source and downstream of erosion location
Undetermined, miscellaneous mineral soils	Negative – Loss or admixing of soil from earthworks and improper handling and storage of soil	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Short-term Likelihood: Moderate	Loss or admixing of soil may result in reduced vegetation establishment and growth during restoration. Soil material may need to be imported for restoration. Weeds may be brought to the site on equipment that has not been properly cleaned or through the import of fill material.

Baseline Feature / Environmental **Sensitivity**	**Direction** and **Description of Potential** Impact	**Characteristic of Impact Before Mitigation** Measures	**Potential for Cumulative Impacts**
Undetermined, miscellaneous mineral soils	Negative – Contamination of soil due to leaks or spills during construction	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Short-term Likelihood: High	Spilled or leaked substances may cause contamination of Blackmud Creek and could have potential impacts to the aquatic ecosystem downstream
Undetermined, miscellaneous mineral soils	Negative – Compaction of soil due to heavy equipment operation and material storage during construction	Nature: Direct Magnitude: Low Spatial Extent: Local Duration: Short-term Likelihood: Low	Compacted soils could prevent successful reestablishment of vegetation and could result in damage to trees

4.1.2.4 Surface Water, Groundwater, **and Aquatic Habitat**

The crossing of Blackmud Creek for the proposed LRT track will be a clear span girder bridge with piers that are above the 1:100 year HWL (Figure 2-1). Additionally, the limit of construction has been established above the elevation of the 1:5 year HWL of Blackmud Creek to provide a buffer from construction activity. As such, no instream work will be required and direct impacts to the Blackmud Creek from the project are not anticipated. Indirect impacts to Blackmud Creek may occur as part of the construction and operation phase of the project and are summarized in Table 4-4.

No salts or chemicals will be used on the track. Sand will potentially accumulate due to the train. Use of a separator at the ends of the bridge drainage network has been incorporated into the design. This will collect the sand washed off the track in spring to ensure nothing enters Blackmud Creek (P. Therrien, personal communication, 2018).

Maintenance of the rails may require that they are grinded once a year to ensure the rail profile matches the wheels of the train (P. Therrien, personal communication, 2018). This work would take place over the course of a few hours and as such, the potential impacts are anticipated to be negligible.

Driven steel 'H' piles and cast in place concrete piles have been planned in preliminary engineering and therefore, no dewatering is anticipated as part of construction and no concrete will come in contact with groundwater. As such, the interaction between project components and activities and the local groundwater is anticipated to be negligible.

Table 4-4
Potential Impacts to Surface Water, Groundwater, **and Aquatic Habitat**

Baseline Feature / Environmental **Sensitivity**	**Direction** and **Description of Potential** Impact	**Characteristic of Impact** Before **Mitigation** Measures	**Potential for Cumulative Impacts**
Blackmud Creek and associated aquatic habitat	Negative – Contamination of Blackmud Creek due to leaks or spills during construction that cannot be immediately contained within the limit of construction	Nature: Indirect Magnitude: Medium Spatial Extent: Local to regional Duration: Short-term to Long-term Likelihood: Moderate	NA
Blackmud Creek and associated aquatic habitat	Negative – Sedimentation into stormwater catch basins or the Blackmud Creek due to accumulation of sand caused by the train during the operation phase	Nature: Indirect Magnitude: Low Spatial Extent: Local Duration: Short-term Likelihood: Moderate	NA

4.1.2.5 Vegetation

Bridge structures have been designed to occur on the west side of the existing bridges that cross Blackmud Creek (Appendix B). The vegetation on the west side of the existing bridges consists primarily of previously disturbed vegetation communities with few trees and low potential for rare plants; and therefore, impacts to vegetation is minimized in comparison to locating the proposed bridge structures on the east side of the existing bridges.

Preliminary engineering designs were completed to minimize the Project Footprint on areas with native and naturalized vegetation including forested, medial shrub, and herbaceous grass vegetation communities. Limits of construction were established to avoid as much tree removal and vegetation clearing as possible including a buffer around the Blackmud Creek that follows the elevation above the 1:5 year HWL (Figure 1-1). In addition, one of the two laydown areas that will be required for the construction phase of the project has been located outside of the North Saskatchewan River Valley ARP (Figure 1-1).

Despite the mitigations that have been incorporated into the preliminary engineering designs impacts to vegetation are anticipated and these are summarized in Table 4-5.

Table 4-5
Potential Impacts to Vegetation

Baseline Feature / Environmental **Sensitivity**	**Direction** and **Description of Potential Impact**	**Characteristic of** Impact Before **Mitigation Measures**	**Potential for Cumulative Impacts**
Native and / or naturalized vegetation	Negative – Loss of native vegetation through vegetation clearing during construction	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Medium-term Likelihood: High	Unsuccessful reestablishment of vegetation could result in higher potential for soil erosion and sedimentation. Additionally, loss of native vegetation may result in decreased habitat availability and biodiversity of wildlife
Trees	Negative – Removal and / or damage of trees during construction	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Long-term Likelihood: High	Loss of trees may result in increased instability of soils, decreased habitat for arboreal wildlife species, and fewer nesting sites for birds
Rare plants	Negative – Loss of rare plant species	Nature: Direct Magnitude: High Spatial Extent: Local Duration: Long-term Likelihood: Low	If a rare plant species is identified in subsequent rare plant surveys, the loss of that individual or local population could negatively impact the regional population.
Weeds	Negative – Establishment and / or spread of weeds	Nature: Direct Magnitude: Low Spatial Extent: Local Duration: Short-term Likelihood: Moderate	Spread of weed species could result in decreases in native plant species and reduced likelihood of successful restoration
Existing vegetation communities	Positive – Restoration of vegetation though seeding and planting	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Long-term Likelihood: High	Restoration will promote the aesthetic appeal of the River Valley to recreational users of the trail systems. Also, restoration will provide slope and soil stabilization and habitat and movement corridors for wildlife species.

4.1.2.6 Wildlife and Movement Corridors

Various wildlife species including small and large mammals, migratory and non-migratory birds, sensitive species and species at risk, and potentially amphibians and reptiles use the Project Area as habitat and an important movement corridor. During construction, it is anticipated that the installation of pilings will be the most acoustically disruptive activity toward wildlife. The potential impacts related to wildlife and wildlife movement are summarized in Table 4-6.

Table 4-6
Potential Impacts to Wildlife and Movement Corridors

Baseline Feature / Environmental **Sensitivity**	**Direction** and **Description of Potential** Impact	**Characteristic of Impact Before Mitigation** Measures	**Potential for Cumulative Impacts**
Wildlife	Negative – Harassment of wildlife and human / wildlife conflict during construction phase	Nature: Direct Magnitude: Low Spatial Extent: Local Duration: Short-term Likelihood: Moderate	Harassment of wildlife could deter/prevent wildlife from using habitat in the Project Area.
Wildlife	Negative – Mortality of wildlife from being struck by train car during operational phase	Nature: Direct Magnitude: High Spatial Extent: Local Duration: Short-term Likelihood: Moderate	Collisions between wildlife and train car could threaten human safety. Additionally, carcasses of dead animals could attract scavengers to the LRT tracks and result in further collisions or human / wildlife conflict
Wildlife corridors, coyote winter pinchpoint, high use trails used by coyote and deer	Negative – Disruption to wildlife movement through blockage of corridors and construction noise and coyote pinchpoint and potentially deterring wildlife from using accessible corridors	Nature: Direct / Indirect Magnitude: Medium Spatial Extent: Regional Duration: Moderate-term Likelihood: High	Potentially restricting the movement of wildlife could be detrimental to the regional population dynamics
Species at Risk (Barn swallow)	Negative – Disturbance of potentially active barn swallow nests	Nature: Direct Magnitude: Medium Spatial Extent: Local	Preventing barn swallows from using existing bridge structures as habitat

Baseline Feature / Environmental **Sensitivity**	**Direction** and **Description of Potential** Impact	**Characteristic of Impact Before Mitigation** Measures	**Potential for Cumulative Impacts**
	associated with existing bridge structures	Duration: Moderate-term Likelihood: Moderate	could be detrimental to the regional population
Species at Risk (Barn swallow)	Neutral – Use of proposed bridge structure for nesting (assuming that the existing bridges already support nesting barn swallows during the nesting period)	Nature: Direct Magnitude: Medium Spatial Extent: Local Duration: Long-term Likelihood: Moderate	NA
Nesting birds (migratory and non-migratory)	Negative – Disturbance or destruction of active bird nests in vegetation or on existing bridge structures during construction phase	Nature: Direct Magnitude: High Spatial Extent: Local Duration: Short-term Likelihood: Moderate	Preventing nesting birds from using habitats within the Project Area could be detrimental to the regional populations
Wildlife	Neutral – Restoration of areas within the Project Footprint to vegetated areas that will provide habitat and promote movement of wildlife	Nature: Direct Magnitude: High Spatial Extent: Local / Regional Duration: Long-term Likelihood: High	Provides habitat and linkages for wildlife movement maintaining connections to support regional population dynamics

4.1.2.7 Historical Resources

Historical Resources clearance has been obtained for the Project Area from Alberta Culture and Tourism. As much of the Project Footprint has been previously disturbed and no historic sites have been identified in this area there is a low probability of impacting historical resources.

4.2 IDENTIFYING CUMULATIVE IMPACTS

Cumulative effects assessments consider the combined effects of the project with historic, existing or reasonably foreseen projects or activities (ASPB 1994) and determine if the project has an effect on a VEC (CEAA 1999).

Because the new bridge and MUT will be constructed in an area that has been previously disturbed by prior site development activities including construction of the existing bridges, the cumulative impacts of the new bridge are expected to be low.

A comprehensive LRT system is expected to have overall positive impacts within the City. The LRT is expected to reduce vehicular traffic and congestion and thereby minimize greenhouse gas emissions. Cumulative impacts for each VEC are addressed in Section 4.1.

4.3 MITIGATION MEASURES

Table 4-7 provides a summary of the mitigation strategies for each applicable VEC to be implemented during the Planning and Design, Construction, and Operational phases of the project. Potential impacts have been avoided or minimized through preliminary engineering as much as possible and are summarized in the Planning and Design phase in Table 4-7.

The changes to the detailed design associated with the Design/Build in 2024 are expected to be within a decreased footprint. The width of the footprint has been reduced from 45 m to 40.4 m. This change has resulted in an increased openness ratio of 27 m, where previously it was 24 m. The openness calculation has been revised in Table 4-7 under wildlife and movement corridors to reflect this change.

Table 4-7
Mitigation Measures Associated with Valued Ecosystem Components of the Project

VEC	**Potential Impact**	Phase of Project	Design / **Operational Mitigation Measures**	**Construction Mitigation Measures**
Land use and zoning	Degradation of Parkland / North Saskatchewan River Valley areas	Planning & Design / Construction	• Preliminary engineering designs have minimized the Project Footprint on areas with native and naturalized vegetation including the establishment of one laydown area outside of the North Saskatchewan River Valley ARP. • Limits of construction has been established above the 1:5 year HWL of Blackmud Creek and avoids as much tree removal and vegetation clearing as possible.	Contractor will develop and follow environmental mitigations in the project-specific ECO plan to minimize impacts to Parkland areas, including, but not limited to: equipment maintenance/spill prevention; responsible soil, waste, and debris disposal; restoration of the project's disturbance footprint as per approved landscaping plans. The ECO plan will confirm all terms and conditions from approval under Bylaw 7188 are followed.
	Restricted access of MUT system in river valley and on existing bridge structure	Construction	N/A	• Trail closures will adhere to the City's Trail Closures Procedures and will be approved through River Valley Operations. • During construction, the existing MUT will be closed and site fencing will be erected to ensure public safety, protection of equipment, and maintenance of high use wildlife trails while on site. As part of the contractors Transportation Accommodation Strategy (TAS), an alternative connection must be made to ensure the continuity of the trail system. Fencing will be developed with input from a wildlife specialist. Figure 1-1 shows the proposed location of temporary construction fencing within the project area.
	Temporary lane closures and restrictions to traffic flow during construction phase	Construction	N/A	• Closures to the shared use path and traffic lanes associated with the existing bridges will be managed by the contractor and dependent on City of Edmonton approval. • Residents will be able to utilize the existing bridges for vehicle traffic throughout the project. Traffic controls will also be implemented along 111 Street and the existing bridges.
	Noise during construction and operational phases	Planning & Design / Construction / Operational	• Preliminary engineering designs include a visual screening wall and planting of deciduous trees to minimize noise and aesthetic impacts.	• Adhere to noise restrictions outlined under Bylaw 14600. Construction activities will occur between 7 a.m. and 9 p.m. on any day other than Sunday or a holiday and between 9 a.m. and 7 p.m. on Sundays or holidays.
	Reduced visual aesthetics during operational phase	Operational	• Preliminary engineering designs of proposed infrastructure match the existing bridges (no major visual or aesthetic changes are expected).	Restoration of the Project Footprint will occur following approved landscaping plans.
Blackmud Creek floodplain and channel hydraulics	Changes to pre-development hydraulic conditions.	Planning & Design	• The bridge and piers were designed above the 1:100 year HWL. • Design-Build Consultant to conduct an updated hydraulic analysis to verify the HWL, flow rate, and design of the pier structures to be used in final designs.	Limit of construction has been established above the 1:5 year HWL, no isolation will be required.
Topography and soil	Slope instability / failure due to use of fill material and / or design of bridge structures	Planning & Design	• Soil nails (steel or fiberglass bars inserted into the ground) or an equivalent and approved option will be incorporated into final designs. Permanent ESC measures will be evaluated and incorporated into the final design, as required.	Fill material will not be added to the top of the slope and long, pile-supported abutments are proposed to reduce impacts associated with slope stability.

VEC	**Potential Impact**	Phase of Project	Design / **Operational Mitigation Measures**	**Construction Mitigation Measures**
	Erosion of soil from earthworks and equipment operation during construction	Construction	• As described above, project temporary disturbance footprint was minimized as much as possible on design drawings.	• An Erosion and Sediment Control (ESC) Plan will be developed and incorporated into the project-specific ECO Plan. All ESC measures are to follow the requirements outlined in the City of Edmonton's Erosion and Sedimentation Control Guidelines and comply with the requirements of the Schedule, including Section 9 (City of Edmonton 2005). • Temporary ESC measures will be implemented throughout the Project Footprint, as needed, following the specifications of the ESC Plan.
	Loss or admixing of soil from earthworks and improper handling and storage of soil	Construction	N/A	• Design-Build Contractor to follow the soil handling strategies outlined in the Soils Strategy Report and the Edmonton Capital Line South Extension Soil Management plan. • Soil material of different types (e.g. topsoil and subsoil) should be salvaged and stored separately. • Maintain a minimum of 3 m between stockpiles of different materials (e.g. topsoil and subsoil). • Replace or remove soils as soon as possible to minimize the duration of soil stockpiling. • Install erosion and sediment control measures, such as silt fence, tarps and/or tackifiers on and around soil stockpiles.
	Contamination of soil due to leaks or spills during construction	Construction	N/A	• Design-Build Contractor to follow the soil handling strategies outlined in the Soils Strategy Report. • Detailed information on the handling, storage and disposal of hazardous materials and waste will be incorporated into the project-specific ECO Plan. • Ensure all machinery is clean and free of oil and grease and stays within the limit of construction. • Routine equipment inspections will be conducted to ensure equipment is free of defects or leaks. • Drips trays will be used for any fueling activities and will be located beneath stationary equipment with potential to leak, such as generators or mobile light standards. • Hazardous and / or deleterious substances will be stored in a designated location, outside of the North Saskatchewan River Valley ARP, with adequate containment. • No fuel, including waste fuel and waste oil, storage will occur in the Blackmud Creek River Valley or within 100 m of the Blackmud Creek River Valley boundary. • Ensure spill kits, equipped with river booms and absorbent pads, are kept at the site at all times. • Ensure that all spills are immediately contained and reported to the appropriate authorities as per City's ENVISO program and following the Alberta Release Reporting Regulation of EPEA.

VEC	**Potential Impact**	Phase of Project	Design / **Operational Mitigation Measures**	**Construction Mitigation Measures**
				• Contractor will clean and remove all contaminated materials in the event of a spill or a leak ensuring that contaminated material is disposed at an appropriate facility.
	Compaction of soil due to heavy equipment operation and material storage during construction	Construction	• As described above, project temporary disturbance footprint was minimized as much as possible on design drawings.	• Contractor will be required to sequence project earthworks to avoid construction and operation of heavy equipment during periods of soil saturation. • Following reapplication subsoils will be ripped and topsoils disced. Also, vehicle use on reapplied soils will be minimized.
Surface water, groundwater, and aquatic habitat	Contamination of Blackmud Creek due to leaks or spills during construction that cannot be immediately contained within the limit of construction	Construction	• Project footprint constrained outside and above the 1:5 year HWL, and no instream works.	• Maintenance and fueling will occur at least 30 m from storm / sewer system catch basins. • Equipment maintenance and repairs will not take place in the Blackmud Creek River Valley. • Spill kits, equipped with river booms and absorbent pads, will be kept at laydown area within North Saskatchewan River Valley ARP throughout construction. • Detailed information on the handling, storage and disposal of hazardous materials and waste will be incorporated into the project-specific ECO Plan. • Ensure all machinery is clean and free of oil and grease and stays within the limit of construction. • Routine equipment inspections will be conducted to ensure equipment is free of defects or leaks. • Drips trays will be used for any fueling activities and will be located beneath stationary equipment with potential to leak, such as generators or mobile light standards. • Hazardous and / or deleterious substances will be stored in a designated location outside of the North Saskatchewan River Valley ARP, with adequate containment. • No fuel storage, including waste fuel and waste oil, will occur in the Blackmud Creek River Valley or within 100 m of the Blackmud Creek River Valley boundary. • Ensure that all spills are immediately contained and reported to the appropriate authorities as per City's ENVISO program and following the Alberta Release Reporting Regulation of EPEA. • Contractor will clean and remove all contaminated materials in the event of a spill or a leak ensuring that contaminated material is disposed at an appropriate facility. If the use of heavy slow-moving equipment will be required during construction, the following mitigation measures will apply: • Equipment maintenance and repairs will not take place in the Blackmud Creek River Valley. • No fuel, including waste fuel and waste oil, storage will occur in the Blackmud Creek River Valley and within 100 m of the Blackmud Creek River Valley boundary.

VEC	**Potential Impact**	Phase of Project	Design / **Operational Mitigation Measures**	**Construction Mitigation Measures**
				• Refueling will not occur within 30 m of a watercourse except where there is no other feasible alternatives. In the event refueling must occur within 30 m of a watercourse or waterbody, the following mitigations will be followed: o Equipment will be inspected prior to bringing to site. o Documentation of inspection will be maintained at the main site office. o Operators will be trained in refueling, maintenance, and spill response procedures. o No-smoking signage will be visible, and smoking will be prohibited in the vicinity of any refueling operation. o Service vehicles used for refueling will have grounding straps and automatic shut-off valves and will be monitored by the operator at all times. o Operators are to be stationed at both ends of the hose during fueling unless both ends are visible and readily accessible by one operator. Fuel remaining in the hose is to be returned to the storage tank. o A fire extinguisher and spill kits (including drip pads, containment booms, absorbent material, etc.) and drip trays will be present during refueling. o Storm inlet protection (e.g., sandbags) shall be installed at the location of any stormwater inlet within 30 m of a refueling operation prior to refueling. o Waste hydrocarbons and filters will be disposed off-site in accordance with regulatory requirements.
	Sedimentation of Blackmud Creek due to erosion during construction that cannot be immediately contained within the limit of construction	Construction	• Vegetation clearing will not occur in the riparian area of Blackmud Creek as the limit of construction has been established above the 1:5 year HWL. This vegetation buffer should reduce sedimentation of Blackmud Creek during construction.	• Erosion and sediment control measures will be established along the perimeter of the limit of construction adjacent to Blackmud Creek, per the project-specific ESC plan.
	Sedimentation into stormwater catch basins or the Blackmud Creek due to accumulation of sand caused by the train during the operation phase	Planning & Design / Operational	• Use of a separator at the ends of the bridge drainage network has been incorporated into the design to prevent sedimentation into Blackmud Creek.	N/A
Vegetation	Loss of native vegetation through vegetation clearing during construction	Planning & Design / Construction	• Bridge structures have been designed on west side of existing bridges to minimize impacts to native and naturalized vegetation. • Preliminary engineering designs have minimized the Project Footprint on areas with native and naturalized vegetation. • Limits of construction has been established to avoid as much tree removal and vegetation clearing as possible and is above the 1:5 year HWL of Blackmud Creek to avoid impacts the riparian vegetation. • Laydown areas are prescribed to the contractor in design drawings. One laydown area is outside of the North Saskatchewan River Valley ARP boundary and other laydown overlaps with previously disturbed vegetation communities (non-native species).	• Delineating the construction area using flagging, staking, or fencing, prior to construction starting will be required to prevent unnecessary loss of vegetation. Any delineation measures used should allow for wildlife passage. Figure 1-1 shows the proposed location of temporary construction fencing within the project area. • Fencing will be installed in such a way that it promotes wildlife passage at high use trails and pinchpoints, human safety, and the protection of vegetation. Riparian vegetation will be protected. • Disturbed areas must be addressed in the Restoration Plan.

VEC	**Potential Impact**	Phase of Project	Design / **Operational Mitigation Measures**	**Construction Mitigation Measures**
	Removal and / or damage of trees during construction	Planning & Design / Construction	• As described above, project temporary disturbance footprint was minimized as much as possible on design drawings.	• A Tree Protection Plan will be developed and incorporated into the project-specific ECO Plan. • A minimum of four weeks prior to the start of construction a meeting with the City's Forestry department will be conducted to review construction and tree protection plans. • Development of a Tree Preservation Plan, prior to site mobilization, is required for any trees within 5 m of construction. • Prior to construction, all City of Edmonton trees within 5 meters of the construction area shall be protected in accordance with the Tree Protection Guidelines, as well as to designate the trees outside the appointed construction work zone. During construction and/or installation, no vehicles, equipment, construction supplies, or debris shall be placed within 5 metres of any tree situated on the City of Edmonton Road Right-Of-Way, Boulevard, Green space/buffer, or Parkland area without the approval of a City of Edmonton Urban Forester.
	Loss of rare plant species	Planning & Design / Construction	• Conduct early and late season rare plant surveys at least one season prior to vegetation clearing.	• If rare plants are found in the Project Area during construction, report observation immediately to the City and consult with an environmental professional to advise on the proper mitigation measures.
	Establishment and / or spread of weeds	Construction	• As described above, project temporary disturbance footprint was minimized as much as possible on design drawings. • The Landscape plan and Restoration plan will consider the following native shrub, forb, and grass species for incorporation into the plans in order to promote wildlife usage, cover and diversity: Shrubs: Red-osier dogwood (*Cornus stolonifera*) Prickly rose (*Rosa acicularis*) Canada buffaloberry (*Shepherdia canadensis*) Forbs: Tall Goldenrod (*Solidago alitissima*) Smooth Fleabane (*Erigeron glabellus*) Smooth Aster (*Aster laevis*) Northern Bedstraw (*Galium boreale*) Grasses: Bearded Wheat Grass (*Agropyron subsecundum*) Canada Wild Rye (*Elymus Canadensis*) Green Needle Grass (*Stipa viridula*) June Grass (*Koeleria macrantha*) Purple Oat Grass (*Schizachne purpurascens*)	• An Integrated Pest Management Plan will be completed by the contractor and accepted by the City prior to completing any site activities. • The Integrated Pest Management Plan will incorporate weed management and will follow the Contractors Environmental Responsibility Package, which is part of the City's environmental management program (ENVISO). • Noxious weeds in the limits of construction will be controlled using methods in accordance with the City's Herbicide Ban. • All ESC measures must be free of hay and straw to prevent the spread of non-native seeds. • All equipment will be cleaned prior to arriving on site and prior to leaving to prevent introduction of weed species from other sites, and to prevent the spread of the weed species known to be present on this site. • Weed identification guides, such as the Alberta Invasive Plant Identification Guide (Wheatland County 2013), should be kept on site for reference by construction personnel. If any prohibited noxious weeds are identified they must be destroyed. • Revegetating the site promptly after completion of construction activities will reduce the potential for the introduction or spread of weeds in the area. Native plants will be selected in accordance with the site's baseline conditions and biodiversity. • A Restoration Plan will be completed by the contractor and reviewed and accepted by the City of Edmonton Ecological Planners prior to completing any site activities. • Monitor restored areas to confirm revegetation efforts are successful.

VEC	**Potential Impact**	Phase of Project	Design / **Operational Mitigation Measures**	**Construction Mitigation Measures**
	Restoration of vegetation though seeding and planting	Planning & Design / Construction	• N/A	• Restoration will be conducted as per approved Landscape Plans that follow the City's Design and Construction Standards for Landscaping (City of Edmonton, 2017).
Wildlife and movement corridors	Harassment of wildlife and human / wildlife conflict	Construction	• N/A	• ECO Plan will detail mitigation measures, including no feeding instructions to workers, and food waste handling and disposal.
	Disturbance to active nest/nest cavity within project footprint for species listed on Schedule 1 of the Migratory Birds Regulations, 2022.	Planning & Design / Construction	• N/A	• Schedule construction activities within the Blackmud Creek River Valley outside of the sensitive bird nesting window, from April 15 to August 30. • If construction occurs within the sensitive bird and bird of prey nesting windows, pre-construction wildlife sweeps will be conducted by a qualified professional wildlife biologist. If active nests or nesting cavities are discovered the biologist will develop appropriate mitigation (e.g., spatial and temporal buffers) in consultation with the Canadian Wildlife Service and/or EPA, as necessary. • Pre-construction wildlife sweep results will be valid up to seven days. If vegetation clearing is delayed beyond up to seven days, a new pre-construction wildlife sweep will be conducted. • If active nests, breeding wildlife, or protected species are discovered during construction, work will stop, and the project's avian wildlife biologist and Project Manager will be contacted. The 'project's avian wildlife biologist will develop appropriate mitigation (e.g., spatial and temporal buffers) in consultation with a qualified professional wildlife biologist, the Canadian Wildlife Service and/or EPA, as necessary. • If a nest or cavity which are known to be reused by migratory birds (listed in Schedule 1 of the Migratory Birds regulations, 2022) is found (i.e., pileated woodpecker cavity) consultation with a qualified professional wildlife biologist will be required to determine mitigation measures or to obtain a permit to relocate or destroy a migratory bird nest.
	Mortality of wildlife from being struck by train car during operational phase	Planning & Design / Operational	• Design fencing to restrict access to the LRT tracks and funnel wildlife to crossing points. For large terrestrial animals, fences should be 2.0 to 3.0 m tall and chain link is recommended. If fencing is extensive, escape routes such as jump-outs or one-way gates may be required (Stantec 2010). • Plan vegetation planting to guide wildlife to appropriate crossing points, in the form of linear vegetation towards crossing beneath the bridge.	N/A
	Disruption to wildlife movement through blockage of corridors and coyote pinchpoint and potentially	Planning & Design / Construction / Operational	• Retaining walls, piles and abutments have been designed parallel to the existing bridge structures to avoid creating constrictions or barriers to wildlife movement.	• Develop a fence decommissioning schedule for the temporary construction fence that factors in wildlife movement in the Project Area. • Temporary fencing will be installed during construction in such a way that it promotes wildlife passage at high use trails and pinchpoints, human safety, and the

VEC	**Potential Impact**	Phase of Project	Design / **Operational Mitigation Measures**	**Construction Mitigation Measures**
	deterring wildlife from using accessible corridors		• Ensure final design allows for spacing between existing bridges and proposed bridge of at least 3.5 m. The current bridge has been designed with a 5.58 m spacing to allow light to enter the corridor and reduce the impact to wildlife movement. This space will allow for light, which will assist in terrestrial movement. • Ensure final design allows for appropriate openness ratio, greater than 1.5 m for large terrestrial wildlife (Stantec 2010). The current openness ratio of the bridge is 27 m (10 m x 110 m / 40.4 m). This calculation includes the full width of the existing road/bridge. • Next phase of designs will be required to include Wildlife Passage Engineering Design Guidelines (Stantec 2010) outlined in Appendix H of this report and incorporate these into all phases of project as applicable. • Select lighting designed to reduce light pollution, as outlined in the Wildlife Passage Engineering Design Guidelines (Stantec 2010). • Limit of construction has been established above the 1:5 year HWL of Blackmud Creek and will allow a corridor for wildlife passage during construction. • A Restoration Plan will be developed by the contractor. Revegetation will involve the selection of native plants in accordance with the site's baseline conditions and biodiversity and will support avian use.	protection of vegetation. Fences will be designed with wildlife passage considerations by a wildlife specialist. Figure 1-1 shows the proposed location of temporary construction fencing within the project area. • The limit of construction has been established above the 1:5-year HWL which protects riparian habitat and allows for wildlife movement within the high-use trail along the Creek. Any ESC measures installed will be at this limit to protect amphibian habitat and movement. • During construction, the area should be inspected each morning to ensure wildlife is not trapped by the ESC measures. Silt fencing, if installed to the correct depth or weighted down at the base, may also work as amphibian exclusion fencing to deter them from entering the project work area. • To reduce impacts on amphibians in the area, habitat should be protected from the risks of contamination and sedimentation while working near Blackmud Creek. • Installation of pilings is considered to be the most potentially disruptive activity to wildlife movement during the construction phase. Piling installation will occur in winter, when possible, and will be restricted by the Noise Bylaw and so will occur during daylight hours.
	Use of proposed bridge structure for nesting by birds such as barn swallows	Operational	No mitigation is required.	• ECO Plan will outline routine monitoring of bird nests within the construction area to confirm no harassment of nesting birds due to construction activities. • Ensure soil stockpiles have slopes of less than 70 degrees to limit potential bank nesting species (i.e., bank swallows).
	Disturbance or destruction of active bird nests in vegetation or on existing bridge structures during construction phase	Construction	• N/A	• Vegetation clearing activities are to be conducted outside of sensitive bird nesting window. This window is from February 15 to August 31. Therefore, vegetation clearing should be planned from September 1 to February 14. • An environmental professional is to be consulted if clearing activities are to occur within the bird nesting period and pre-construction nest surveys are to be conducted, if needed.
	Disturbance of potentially active barn swallow nests associated with existing bridge structures	Construction	• N/A	• Schedule construction activities at Blackmud Creek bridge crossing outside of the migratory bird nesting window. This window is from April 15 to August 31. Therefore, work should be planned from September 1 to April 15.

VEC	**Potential Impact**	Phase of Project	Design / **Operational Mitigation Measures**	**Construction Mitigation Measures**
				• Consult an environmental professional if equipment operation and construction activities are to occur adjacent to the existing bridge at Blackmud Creek within the migratory bird nesting window and ensure pre-construction nest surveys are conducted if needed. If active barn swallow nests are discovered during construction period stop work and contact a Canadian Wildlife Service Biologist to discuss mitigation.
	Restoration of areas within the Project Footprint to vegetated areas that will provide habitat and promote movement of wildlife	Construction / Operational	• Incorporate native species representing multiple structural layers into Landscaping Plan and Restoration Plan to provide habitat that is similar to native vegetation communities and provide cover for various species of wildlife to use for movement. • Plan woody vegetation planting to occur in a network of connected areas or in aggregated patches with close proximity to facilitate movement of wildlife in areas that are under cover. • An important wildlife passage exists along the southwest boundary of the site. Landscaping Plan/Restoration Plan should incorporate low forbs and grasses in this area and keep this area open to ensure consistency with pre-disturbance conditions.	
Historical resources	Potential for disturbance of previously undocumented archaeological or paleontological resources.	Planning & Design / Construction	• Preliminary engineering designs have maximized the Project Footprint within areas that have been previously disturbed. • Include the Clearance letter in the procurement package.	• If any historical resources are encountered during construction, work must stop, and project personnel should contact Alberta Arts, Culture and Status of Women immediately.

The development of the new bridge and MUT at Blackmud Creek will require a number of plans to be generated by the Contractor in order to comply with this EIA. These plans are summarized in Table 4-8.

The Design-Build Consultant will be required to complete a detailed hydraulic analysis to verify the HWL, flow rate, and design of the pier structures targeted for the design build. They are also responsible for submitting the Landscape Plan to Natural Areas Operations and Ecological Planners for review.

Table 4-8
Environmental Plans to be Required of the Design-Build Contractor

Environmental Plan	Summary
Environmental Construction Operations (ECO) Plan	• Shall include procedures and drawings identifying the environmental protection requirements and impacts associated with construction. • Shall include plans and procedures to avoid, minimize, and mitigate environmental impacts of construction. • Shall include monitoring plans required to verify compliance with measures, plans and procedures. • The City of Edmonton has implemented an environmental management system (EMS) known as Enviso and it is registered to the ISO 14001 Standard. Enviso provides a way for the City to manage and improve environmental performance. As part of this system, the contractor is responsible for following the requirements outlined in the Contractor Environmental Responsibility Package (CERP) and any additional operational controls specified by Enviso that may be applicable to this project.
	<u>Tree Protection Plan</u> Shall identify trees that require protection and provide measures for hoarding and protection of trees during construction. This plan shall follow requirements from a City of Edmonton Urban Forester.
	<u>Erosion and Sedimentation Control (ESC) Plan</u> Shall contain ESC requirements, measures and procedures that apply to the project and shall contain a detailed description of all equipment and materials required for implementation of the plan. This plan should include measures to prevent indirect impacts on fish habitat in Blackmud Creek due to the proximity of the project to the creek. This plan shall follow the City of Edmonton Erosion and Sedimentation Control Guidelines (City of Edmonton 2005).
	<u>Integrated Pest Management Plan</u> • Shall address pest management (e.g., weed and exotic species) including control and preventative measures.

Environmental Plan	Summary
	• Shall include measures to reduce the need and use of chemical control measures and if used the protocols for their use near water bodies.
	Hazardous Substances and Waste Management Plan Shall include site-specific handling practices for Hazardous Substances brought onto the land or during project work and a strategy, measures and procedures for storing and disposing of waste.
	Bat Mitigation Plan Shall include measures to mitigate the effects of the project on bats.
	Dust Management Plan Shall include site-specific mitigation measures to prevent potential dust emissions from project construction activities.
	Contamination Management Plan Shall include measures to prevent contamination, identify and manage releases, and remediate releases and/or spills.
	Construction Soil Management Sub-Plan Shall include guidelines for all soil management activities.
	Restoration Plan Must be developed by a Restoration Specialist and be submitted to the City of Edmonton's Ecological Planners for review and approval. Native species discussed in Section 4, Table 4-7 above to be incorporated in the plans to promote wildlife usage, cover and diversity. A pre-construction and post-construction inspection will be required and needs to be arranged by contacting Land Development at parkslandscapeinventory@edmonton.ca to request inspections. Specific requirements for the DB contractor for inclusion into the restoration plans are outlined in Section 4.3.1 below. Indigenous engagement will be considered when selecting plant species for the restoration plan.

4.3.1 Naturalization

Schedule 10 of the Design Build Contract detail the Contractor requirements for development, implementation, and monitoring of naturalization within the Blackmud Creek area. Naturalization will occur immediately following construction to mitigate erosion in the river valley and will be monitored until the hand-back requirements outlined below are met. The process will include the development of a Naturalization Plan which will be available for review by the City.

The General Requirements have three different prescriptions for the naturalization areas which are as follows:

(i) Naturalization Area NA-1: a parcel situated along the upper slope position west of new Infrastructure in Blackmud Creek River Valley.
(ii) Naturalization Area NA-2: a parcel situated along the midslope positions west of the new Infrastructure in Blackmud Creek River Valley.
(iii) Naturalization Area NA-3: a parcel situated on the southwest bank of Blackmud Creek and is a transitional area to the undisturbed natural forest.

The naturalization objectives the Design-Builder will be guided by for the Naturalization Areas is to establish the following communities, as shown in Schedule 10 Appendix A Figure provided in Appendix L:

(i) at Naturalization Area NA-1: a mix of native grassland and native shrubs comprising species that are tolerant of the local microclimate. Limited transition buffers of manicured grass are permitted immediately adjacent to existing manicured areas. Shrubs are spread evenly throughout and provide 30% of total plant cover at the Landscape Final Completion Date. Shrubs and grasses shall be native species with a proven capacity to successfully compete against invasive exotic species of shrubs.
(ii) at Naturalization Area NA-2: a native shrub-grassland community, where shrubs comprise 70% of total vegetation cover at the Landscape Final Completion Date. Shrubs shall be native species with a proven capacity to successfully compete against invasive exotic species of shrubs.
(iii) at Naturalization Area NA-3: a native tree-shrub community where trees comprise at least 40% cover of the total Naturalization Area, shrubs provide at least 30% cover of the Naturalization Area and native grasses, forbs and natural and functional organic matter comprise at least 30% of the ground cover at the Landscape Final Completion Date. Shrubs, grasses and forbs shall be native species that have a proven capacity to successfully compete against invasive exotic species.

(a) With respect to all Naturalization Areas, Design-Builder shall:
    (i) make the boundaries of such Naturalization Areas irregular so that the shape of the area appears natural; and
    (ii) feather such Naturalization Areas into the adjacent natural or reclaimed forested areas.
(b) Design-Builder shall Design and Construct grading in the Naturalization Areas to smoothly transition and tie-in the Naturalization Areas to the surrounding Lands and other lands, provided

that no grading shall extend beyond the boundaries of the Lands, and to ensure Positive Drainage of all areas without adversely affecting adjacent lands, whether inside or outside the boundary of the Lands. For NA-1, overall final grades shall be similar in elevation and aesthetic to the pre-disturbance condition.

The Design Builder will be required to develop a Naturalization Plan, which will be subject to City review and Acceptance, will include:

(i) a detailed description of maintenance strategies and practices for the Naturalization Areas, which shall focus on ecologically sound practices, to be implemented immediately upon completion of reclamation activities and to continue to the Landscape Final Completion Date, including:
  (1) integrated pest management;
  (2) use of organic or environmentally-friendly weed control products and methods that produce vigorous and healthy plant material; and
  (3) a requirement that where plant performance results are not satisfactory, soils shall be tested to identify soil remediation requirements and Design-Builder shall undertake any soil replacement, replenishment or other remediation as required to ensure plant performance.

(ii) requirements that the following plan must adhered to include:
  (1) only native species of wild provenance shall be seeded, planted or otherwise installed in the Naturalization Areas. Native cultivars are acceptable for grasses only;
  (2) a minimum of 12 species shall be incorporated into the seed mixes and planting palettes developed for each Naturalization Area, with up to half represented in the seed mix, at least three species shall be shrubs, at least one shrub shall be a species that achieves at least 2.0 m in height at maturity, and at least two species shall be trees;
  (3) a minimum of 50% of trees shall have a maximum caliper of 50 mm;
  (4) the maximum height for coniferous trees shall be 2.0 m and the minimum height shall be 1.0 m, and there shall be an equal distribution of tree ages and an equal number of trees at the minimum and maximum heights;
  (5) the minimum size for shrubs shall be #1 pot size as per CNLA standards;
  (6) the use of mulch is permitted in the Naturalization Areas directly after planting but mulch shall be limited to one application;
  (7) shrub and tree plantings shall be irregularly spaced, and groupings, if used, shall have irregular, ill-defined boundaries. Plantings are meant to appear natural, not horticultural;
  (8) mowing of the Naturalization Areas shall only be permitted during the first two growing seasons following planting, shall be limited to twice per season, shall be timed to occur before invasive species seed set and shall not occur after 15 September;
  (9) coniferous trees shall be setback a minimum of 2 m from the edge of mature tree canopy to pedestrian areas and paths; and
  (10) Naturalization plantings shall consist of species that are drought tolerant and appropriate to site conditions. Naturalized areas shall serve to anchor and stabilize soil in such a way

that controls erosion and that prevents introduction of sediments into watercourses or the municipal stormwater system.

(iii) Design-Builder shall ensure that all landscaping, reclamation work and Naturalization in or about Blackmud Creek River Valley complies with the City's "Wildlife Passage Engineering Design Guidelines" (June 2010), and Design-Builder shall accordingly demonstrate to the City that Design-Builder has made suitable and effective provision for wildlife movement through those areas.

(iv) With respect to Blackmud Creek River Valley, Design-Builder shall:

(i) install one Wildlife Crossing Bench on each abutment slope of the Blackmud Creek River Valley, each to be placed roughly mid-slope on the abutment slope and each having a minimum height clearance of 3.1 m (height) and a width of 1.5 m, as measured from top of headslope to the face of the retaining wall;

(ii) provide effective small animal security cover features;

(iii) ensure that the Design of all wildlife crossing structures is integrated with the Naturalization Areas, so that the crossing structures are considered an integral feature during the development of the Naturalization Areas;

(iv) In consultation with a wildlife biologist, the Design-Builder will ensure that suitable lighting beneath the extended bridge structure will not be prohibitive to wildlife and avian movement; and

(v) Design-Builder will include plantings to support bird use around the Blackmud Creek LRT Bridge.

The project requirements include specific requirements for fencing in the Blackmud Creek River Valley which include:

(a) Immediately upon occupation of the areas at Blackmud Creek River Valley, Design-Builder shall install temporary fencing marking the limits of the Lands where that boundary is within 5 m of areas vegetated with trees and shrubs to restrict incidental access and afford protection to the adjacent vegetated areas. These fence locations shall be adjusted as required to reflect any vegetation clearing. Temporary fencing shall be removed before Construction Completion.

(b) Design-Builder shall install fencing that fully encloses each Naturalization Area, and which shall:

(i) be compatible in visual appearance, including with respect to colour, material and texture, with the aesthetics of the Naturalization Areas, and Constructed of a material that minimizes the visual impact of the fencing;

(ii) be of sufficient height to discourage public access to the Naturalization Areas; and

(iii) not preclude wildlife movement through Blackmud Creek River Valley.

Post restoration the Design Builder will be responsible to complete the following activities until the site meets the Vegetation Handback requirements:

(iv) Design-Builder shall maintain, water, repair, weed, reseed, replant, reinstall, and conduct other work in accordance with the requirements of the DB contract, the Accepted Naturalization Plan and as otherwise required, to ensure that at the Landscape Final Completion Date each

Naturalization Area meets the requirements for that area described below (collectively, the "Vegetation Handback Requirements"):

(i) for each Naturalization Area:

(1) the area is clean and free of debris and refuse;

(2) the area has a natural, vigorous aesthetic;

(3) all plant material required to be planted in the area as described in the Accepted Naturalization Plan has been planted and is in good horticultural condition, free from disease and damage;

(4) the area has at least 100% of the total tree and shrub density specified for the area in the Naturalization Plan;

(5) for Naturalization Areas NA-1, NA-2, and NA-3 each area has a ground vegetation stratum, with a minimum of 90% organic ground cover, consisting of at least 40% grass cover and there are no bare patches greater than 0.5 m2; and

(6) the community composition and cover is as per the Accepted Naturalization Plan.

5 ENVIRONMENTAL MONITORING

An environmental monitor will be retained by the Contractor before the project is initiated to monitor site preparation and construction activities. The monitor will be registered, or eligible to be registered, in a related professional association in Alberta (e.g. Alberta Society of Professional Biologists, Alberta Institute of Agrologists, Eco Canada), or certified as a Certified Professional in Erosion and Sediment Control by the Erosion and Sediment Control Association of Canada with two years' experience in construction monitoring and environmental compliance. Environmental monitors shall have the responsibility and authority for:

- Developing and implementing all environmental monitoring and inspection programs as required under Section 13 [Environmental Compliance Monitoring and Inspection Programs];
- Implementing the environmental auditing program as required under Section 13 [Environmental Compliance Monitoring and Inspection Programs];
- Ensuring that the results of all monitoring, inspection and audits are reported as required under Applicable Law and to the City as required under this Agreement; and
- Stopping any or all of the Project Work if any environmental monitoring, inspection or audit indicates that the Project Work does not comply with any of Design-Builder's Environmental Obligations.

The environmental monitor will be required to:

- Fulfill regulatory compliance obligations stipulated on respective regulatory approvals;
- Complete wildlife sweeps and rare species surveys prior to site clearing, as required;
- Provide, initiate, and guide the implementation of the mitigation strategies discussed in project ECO and ESC Plans;
- Complete routine inspections of the entire construction site and adjacent areas every 7 days or within 24 hours following a precipitation event (greater than 12 mm of rainfall within 24 hours or snowmelt event) to verify mitigation measures are being used as per the ECO Plan;
- Inspect erosion and sediment control devices prior to ground disturbance and during a precipitation event (greater than 12 mm of rainfall within 24 hours or snowmelt event);
- Monitor weather conditions and prepare contingency measures for flood events that may reach elevations at or above the limit of construction; Fuel tank inspections will occur at initial installation and monthly; hazardous materials and waste storage locations will be monitored every 7 days; Monitor wildlife access through the construction area;
- Construction setbacks resulting from bird/wildlife surveys will be monitored daily when a setback is established;
- Any non-compliances or wildlife encounters will be reported to the Contractor Representative and the City of Edmonton;
- Tree roots exposed in critical root zones during construction will be monitored daily by the project arborist with respect to the tree health and burlap moisture level;

- The project site will be monitored for weeds monthly during the growing season, except for the naturalization area of Blackmud Creek Ravine where at least 10 monitoring events will be conducted per growing season;
- Site-preparation and construction progress will be documented and photographed;
- During winter shut-down, the entire construction site will be monitored every 14 days; and
- Ensure compliance with Community Standards Bylaw 14600 for construction hours of operation.

5.1 ENVIRONMENTAL AUDITING

Upon direction from the City, the Owner's team will conduct environmental auditing of the project and communicate with the project team in regards to regulatory and compliance issues.

6 PUBLIC CONSULTATION

The following public consultation activities have been completed by Kinnickinink Studios and the results are summarized in Table 6-1. The environmental sensitivities and associated mitigation measures have been presented in a public information/open house format, allowing participants to review and comment on the results of the EIA.

Indigenous Engagement was started in 2017 for this site and is ongoing. A separate report for the Indigenous Engagement will be included as an appendix in the final EIA submission.

Prior to construction, the City of Edmonton's Neighbourhood Resource Coordinator should be contacted to ensure that appropriate community notification has been completed.

Table 6-1
Summary of Public Consultation Activities

Public Consultation	Date	Summary
Summer 2017 Survey	August and September, 2017	This survey was conducted to validate the 2013 preliminary design with regards to theme, look and feel of the corridor, and treatment of structures, including the bridges. The survey gathered information on the publics' understanding of the Capital Line South Extension, comments and concerns and provided input on the existing preliminary design and the potential changes.
Information Session	November 29, 2017	This session included display boards, a video of an LRT train running along the CLSE route, project are maps, and staff were all part of the information sharing. Questions were encouraged and answered. Feedback was collected from the public through a survey that was available at the event, and online for two weeks afterwards, and from comments provided on project maps at the event.
Summer 2018 Survey	August 6 to September 6, 2018	This survey was conducted to inform the public about City Administration's proposed recommendations for grade separations at the intersections of Saddleback Road, and 9 and 12 Avenues with 111 Street NW, and to gather public preferences on the grade separations to supplement the Council report being prepared for the November 6, 2018 public hearing. This survey also

Public Consultation	Date	Summary
		gathered input on a potential LRT station between 9 and 12 Avenues on 111 Street NW (Twin Brooks).
Public Meetings	September 18 and 20, 2018	This "Advise" level of public engagement was held to provide information on the CLSE and for the public to advise and/or confirm the preliminary design updates, specifically on the integration of the Operations and Maintenance Facility, the proposed Twin Brooks Station, the Anthony Henday Drive Bridge, and the updated streetscape, connections and other amenities in the communities.

7 CONCLUSIONS AND SUPPORTING INFORMATION

The work associated with the construction of the new LRT bridge and MUT is expected to have low environmental impacts since it will occur in a previously disturbed area and no instream work is required. Any environmental impacts will be avoided or minimized by following best management practices and mitigation measures as summarized in Table 4-7.

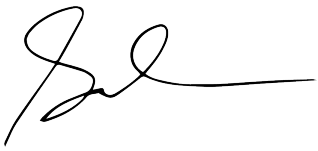
Environmental monitoring is recommended during construction to ensure that applicable mitigation measures are followed, as outlined in Table 4-7. City personnel should be notified immediately of any wildlife encounters or other environmental concerns relating to this project. Environmental permits and approvals, the project ECO Plan, and ESC Plan should be adhered to and available on site during all project work.

Closure

This report was prepared for the City of Edmonton to assess the potential environmental impacts associated with the proposed development of the LRT bridge and MUT over Blackmud Creek.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering Alberta Ltd.



Suzanne Card, M.Sc., P.Biol., P.Ag.
Environmental Scientist
Project Biologist

Sandra Meidinger, P.Biol., R.P.Bio.
Manager, Environmental
Senior Reviewer

References

ACI Acoustical Consultants Inc. 2019. Environmental Noise Impact Assessment for the Edmonton South LRT Extension (Century Park Station to Ellerslie Road. Edmonton, AB.

AECOM. 2010a. City of Edmonton South LRT Extension Century Park Station to Ellerslie Station Preliminary Design Report Blackmud Creek Bridge. AECOM, Edmonton, AB.

AECOM. 2010b. Edmonton South LRT Extension Environmental Overview. AECOM Canada Ltd. Red Deer, Alberta.

AECOM. 2010c. Phase I Environmental Site Assessment South Light Rail Transit Extension. Edmonton, Alberta.

AECOM. 2010d. South LRT Extension Century Park to Ellerslie Preliminary Design Report Executive Summary. AECOM Canada Ltd. Red Deer, Alberta.

Alberta Environment and Parks. 2019. Code of Practice for Watercourse Crossings,. King's Printer. Edmonton, Alberta.

Alberta Environment and Sustainable Resource Development (AESRD). 2012a. Alberta Northern Leopard Frog Recovery Plan, 2010-2015. Alberta Environment and Sustainable Resource Development, Alberta Species at Risk Recovery Plan No. 20. Edmonton, Alberta.

Alberta Environment and Sustainable Resource Development (AESRD). 2012b. St. Paul Management Area Map. Queen's Printer. Edmonton, Alberta.

Alberta Native Plant Council (ANPC). 2001. Rare Vascular Plants of Alberta. University of Alberta Press, Edmonton, Alberta.

Alberta Native Plant Council (ANPC). 2012. Guidelines for Rare Vascular Plant Surveys in Alberta – 2012 Update. Available online at: http://anpc.ab.ca/wp-content/uploads/2015/01/Guidelines-For-Rare-Plant-Surveys-in-AB-2012-Update.pdf. Accessed 10 October 2024.

Alberta Society of Professional Biologists. 1994. Cumulative Effects Assessment in Canada: From Concept to Approach. 333 pg.

AMEC Earth & Environmental. 2010. Preliminary Geotechnical Report SLRT – Proposed Bridge Over Blackmud Creek. Edmonton, Alberta.

Associated Engineering. 2017. Blackmud/Whitemud Creek Surface Water Management Study Final Report. Edmonton, Alberta.

Associated Environmental. 2017. Blackmud Creek Erosion Control Environmental Impact Assessment. Edmonton, Alberta.

Associated Environmental. 2018. Soil Strategy Report. Edmonton, Alberta.

Associated Engineering. 2023. Edmonton Capital Line South Extension Soil Management. Edmonton, Alberta.

Betker, R. 2018. Personal communication. Email on January 4, 2019.

Canadian Environmental Assessment Agency. 1999. The Cumulative Effects Assessment Practitioner's Guide. Prepared by the Cumulative Effects Working Group and AXYs Environmental Consulting Ltd. Available online at: https://publications.gc.ca/site/eng/416924/publication.html. Accessed 10 October 2024.

City of Edmonton. 2005. Erosion and Sedimentation Control Guidelines. Available online at: https://www.alidp.org/projects/city-of-edmonton-erosion-and-sedimentation-control-guidelines. Accessed 10 October 2024.

City of Edmonton. 2010. The Way We Grow Municipal Development Plan Bylaw 15100. Available online at: https://www.edmonton.ca/public-files/assets/document?path=PDF/Appendix-E.ii_Excerpt-of-City-of-Edmonton-Municipal-Development-Plan-Bylaw-15100.pdf. Accessed 10 October 2024.

City of Edmonton. 2014. City-Wide Natural Area Management Plan. Edmonton, AB. Available online at: https://www.edmonton.ca/public-files/assets/document?path=PDF/City-Wide_Natural_Area_Management_Plan.pdf. Accessed 10 October 2024.

City of Edmonton. 2015. Urban Primary Land and Vegetation Inventory (uPLVI). Spatial Data. 2015 edition. Prepared for: Parks and Biodiversity Section, Sustainable Development, the City of Edmonton, Alberta. Prepared by: Greenlink Forestry Inc. Edmonton Alberta.

City of Edmonton. 2016. Environmental Sensitivity Project, Model data. Prepared for: The City of Edmonton, Alberta. Prepared by: Solstice Canada. Edmonton, Alberta.

City of Edmonton. 2017. Bylaw 18100 Drainage Bylaw. Available online at: http://sirepub.edmonton.ca/sirepub/cache/2/31eemk1loive1ofqlh3lf0h5/647564010320191153 13715.PDF . Accessed 24 January 2018.

City of Edmonton. 2018. North Saskatchewan River Valley Area Redevelopment Plan Bylaw 7188. Adopted on February 26, 1985, Office Consolidation, November 2018. Available online at: https://www.edmonton.ca/public-files/assets/document?path=plans_in_effect/North_Saskatchewan_River_ARP_Consolidation.pdf.

City of Edmonton. 2019. Guidelines for Evaluation of Trees. Available online at: https://www.edmonton.ca/public-files/assets/document?path=PDF/GuidelinesforEvaluationofTrees.pdf. Accessed 10 October 2024.

City of Edmonton 2020. Corporate Tree Management and Tree Reserve Procedure. Available online at: https://www.edmonton.ca/sites/default/files/public-files/assets/PDF/Corporate-Tree-Management-Tree-Reserve-Procedure.pdf?cb=1728570837 Accessed 10 October 2024.

City of Edmonton. 2021. South LRT Extension Fly-Through Video. Available online at: https://www.edmonton.ca/projects_plans/transit/capital-line-south. Accessed 10 October 2024.

City of Edmonton. 2022. Design and Construction Standards Volume 5 Landscaping. Available online at: https://www.edmonton.ca/sites/default/files/public-files/COE-IM-GUIDE-0010-v02-20220110DesignandConstructionStandardsVolume5_Landscaping_DSO.pdf?cb=1728575327. Accessed 10 October 2024.

City of Edmonton. 2023. Community Standards Bylaw 14600. Available online at: https://www.edmonton.ca/public-files/assets/document?path=Bylaws/C14600.pdf. Accessed 10 October 2024.

City of Edmonton. 2024. Bylaw 18093 Drainage Bylaw. Available online at: https://www.google.com/search?q=city+of+edmonton+bylaw+18093&sourceid=ie7&rls=com.microsoft:en-US:IE-Address&ie=&oe=. Accessed 10 October 2024.

Cornell Lab of Ornithology. 2019. All About Birds. Cornell Lab of Ornithology, Ithaca, New York. Available online at: https://www.allaboutbirds.org/guide/. Accessed 10 October 2024.

Environmental Protection and Enhancement Act, R.S.A. 2000, C. E-12. Available online at: http://www.qp.alberta.ca/documents/Acts/E12.pdf. Accessed 10 October 2024.

Environmental Protection and Enhancement Act, Wastewater and Storm Drainage Regulation, Alberta Regulation 119/1993, Consolidated up to 170/2012. Available online at: http://www.qp.alberta.ca/documents/Regs/1993_119.pdf. Accessed 10 October 2024.

Fisheries Act, R.S.C. 1985, c. F-14. Available online at: http://laws-lois.justice.gc.ca/eng/acts/F-14/ Accessed 10 October 2024.

Fisheries (Alberta) Act, R.S.C. 2000, c. F-16. Available online at: http://www.qp.alberta.ca/documents/Acts/F16.pdf. Accessed 10 October 2024.

Government of Alberta. 2010. Environmental Assessment Program Glossary of Environmental Assessment Terms and Acronyms Used in Alberta. Available online at: https://open.alberta.ca/dataset/9e003166-dc60-4f8a-8c76-a7ba164ad0bf/resource/4e0c6fe0-d8e1-4222-b297-33a55fa782e2/download/4901034-2010-eap-glossary-environmental-assessment-terms-acronyms-used-alberta-updated-2010-02.pdf. Accessed 10 October 2024.

Government of Alberta. 2015a. Sharp Tailed Grouse and Sensitive Raptor Overlay. Available online at http://abadata.ca/AbaData2. Accessed 10 October 2024.

Government of Alberta. 2015b. Historical Resource Values Overlay. Available online at http://abadata.ca/AbaData2. Accessed 10 October 2024.

Government of Alberta. 2015c. Wild Species: Sharp-tailed Grouse (*Tympanuchus phasianellus*). Available online at: https://www.alberta.ca/lookup/wild-species-status-search.aspx. Accessed 10 October 2024.

Government of Alberta. 2015d. Wild Species: Canadian Toad (*Anaxyrus hemiophrys*). Available online at: https://www.alberta.ca/lookup/wild-species-status-search.aspx. Accessed 10 October 2024.

Government of Alberta. 2015e. Wild Species: Northern Leopard Frog (*Rana pipiens*). Available online at: https://www.alberta.ca/lookup/wild-species-status-search.aspx Accessed 10 October 2024.

Government of Alberta. 2020. Species At Risk database. Alberta Environment and Parks. Available online at: https://www.alberta.ca/lookup/wild-species-status-search.aspx Accessed 10 October 2024.

Government of Alberta. 2021. Alberta Soil Information Viewer (AGRASID). Polygon 14284. Landform Report: Alberta Agriculture and Rural Development, Agriculture and Agri-Food Canada. Available online at: http://www4.agric.gov.ab.ca/agrasidviewer/. Accessed 10 October 2024.

Government of Alberta. 2022a. Alberta Conservation Information Management System (ACIMS). Alberta Parks. Available online at: https://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-acims/search-acims-data/. Accessed 10 October 2024.

Government of Alberta. 2022b. Fish and wildlife management information system (FWMIS). Alberta Environment and Protected Areas. Available online at: https://geospatial.alberta.ca/FWIMT_Pub/Viewer/?TermsOfUseRequired=true&Viewer=FWIMT_Pub. Accessed 10 October 2024.

Government of Alberta. 2022c. Flood Hazard Map Application. https://floods.alberta.ca/. Accessed 10 October 2024.

Government of Canada. 2023. Measures to Protect Fish and Fish Habitat. Available online at: https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html. Accessed 10 October 2024.

Government of Canada. 2022. Species at Risk Public Registry. Available online at: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html. Accessed 10 October 2024.

Government of Canada. 2024. General Nesting Periods of Migratory Birds in Canada. Available online at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods.html. Accessed 10 October 2024.

Historical Resources Act, R.S.A. 2000, C. H-9. Available online at: http://www.qp.alberta.ca/documents/Acts/h09.pdf. Accessed 10 October 2024.

Migratory Birds Convention Act, 1994, S.C. 1994, c. 22. Available online at: http://laws-lois.justice.gc.ca/eng/acts/M-7.01/. Accessed 10 October 2024.

Migratory Birds Regulations, 2022, SOR/2022-105. Available online at: https://laws-lois.justice.gc.ca/eng/regulations/SOR-2022-105/index.html. Accessed 10 October 2024.

Moss, E.H. 1959. Flora of Alberta Second Edition. University of Toronto Press. Toronto, Ontario.

Natural Regions Committee. 2006. Natural Regions and Subregions of Alberta. Available on the Internet at: www.albertaparks.ca/media/2942026/nrsrcomplete_may_06.pdf. Accessed 10 October 2024.

Pedocan Land Evaluation Ltd. 1993. Soil Series Information for Reclamation Planning in Alberta. Conservation and Reclamation Council Report No. RRTAC 93-7 (2 volumes). ISBN 0-7732-6041-2.

Public Lands Act, R.S.A. 2000, C. P-40. Available online at: http://www.qp.alberta.ca/documents/Acts/P40.pdf. Accessed 10 October 2024.

Soil Classification Working Group. 1998. The Canadian System of Soil Classification. NRC Research Press, Ottawa, Ontario.

Species at Risk Act, S.C. 2002, c. 29. Available online at: http://laws-lois.justice.gc.ca/eng/acts/s-15.3/. Accessed 10 October 2024.

Stantec. 2010. Wildlife Passage Engineering Design Guidelines. Stantec Consulting Ltd. Edmonton, Alberta.

Strix Ecological Consulting. 2018. Mammal Snow Tracking – LRT Extension – Blackmud Creek & 111 Street, Edmonton, AB.

Therrien, P. 2018. Personal communication. Phone conversation on December 14, 2018.

Tera. 2014. Environmental and Socio-Economic Assessment for the Proposed Nova Gas Transmission Ltd. Cutbank River Lateral Loop No.2 (Pinto Creek Section) Pipeline and the Musreau Lake North Receipt Meter Station: Appendix A. Available online at: https://apps.neb-one.gc.ca/REGDOCS/File/Download/2558642. Accessed 10 October 2024.

The City of Calgary. 2022. Erosion and Sediment Control Guidelines, 2022. Calgary, Alberta.

Water Act, R.S.A. 2000, C. W-3. Available online at: http://www.qp.alberta.ca/documents/Acts/w03.pdf. Accessed 10 October 2024.

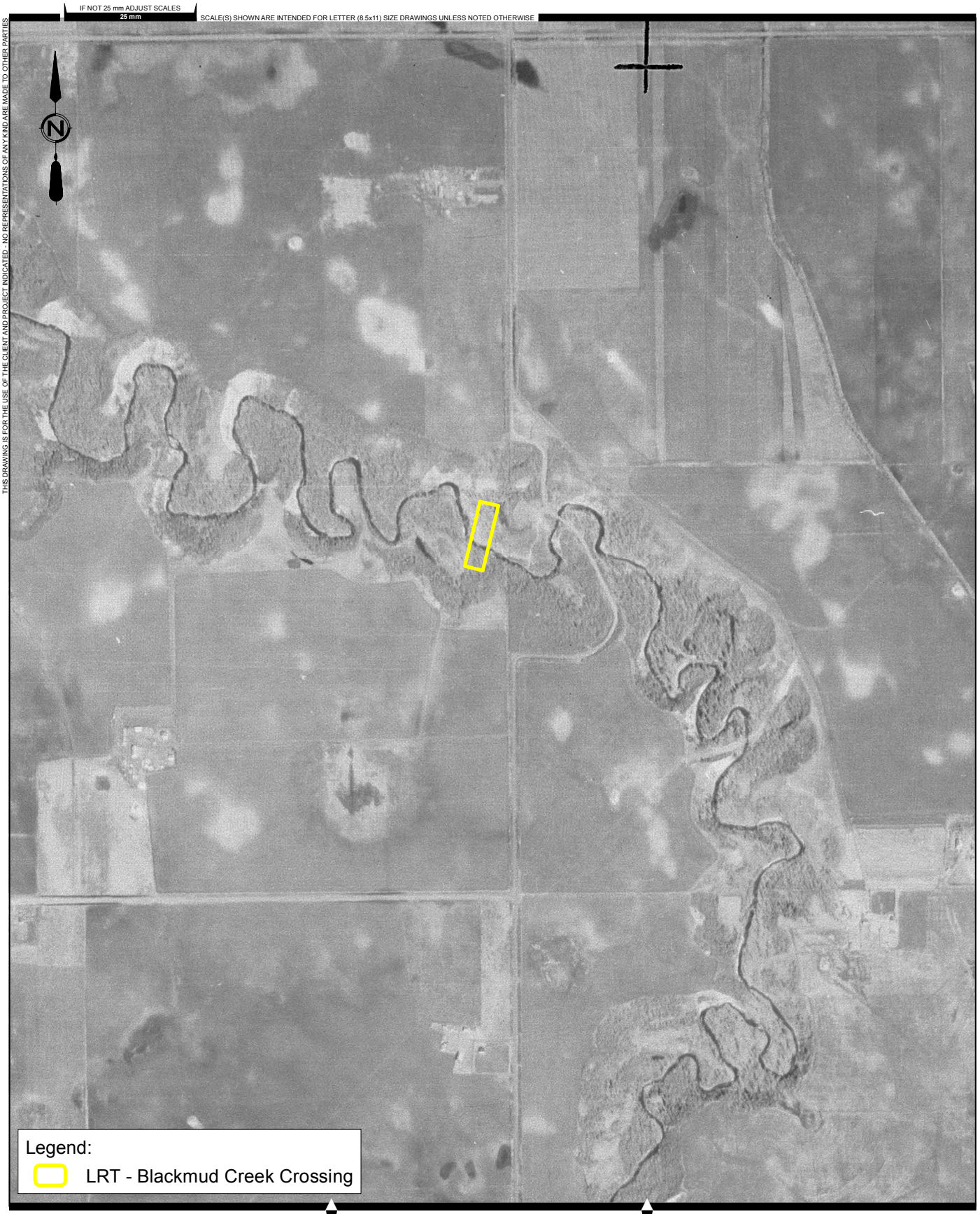
Weed Control Act. S.A. 2008, c. W-5.1. Available online at: www.qp.alberta.ca/documents/Acts/W05P1.pdf. Accessed 10 October 2024.

Wheatland County. 2013. Alberta Invasive Plant Identification Guide. http://open.alberta.ca/dataset/8bb61884-bbfb-4640-bd5d-96f6e633d4ee/resource/275f7dbe-8116-4d81-ba95-329df950be7e/download/6740590-2013-Alberta-Invasive-Plant-Identification-Guide-2013-06-13.pdf. Accessed 10 October 2024.

Wildlife Act, R.S.A. 2000, C. W-10. Available online at: http://www.qp.alberta.ca/documents/Acts/W10.pdf. Accessed 10 October 2024.

Appendix A - Recent and Historical Air Photos

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE



P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\ArcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

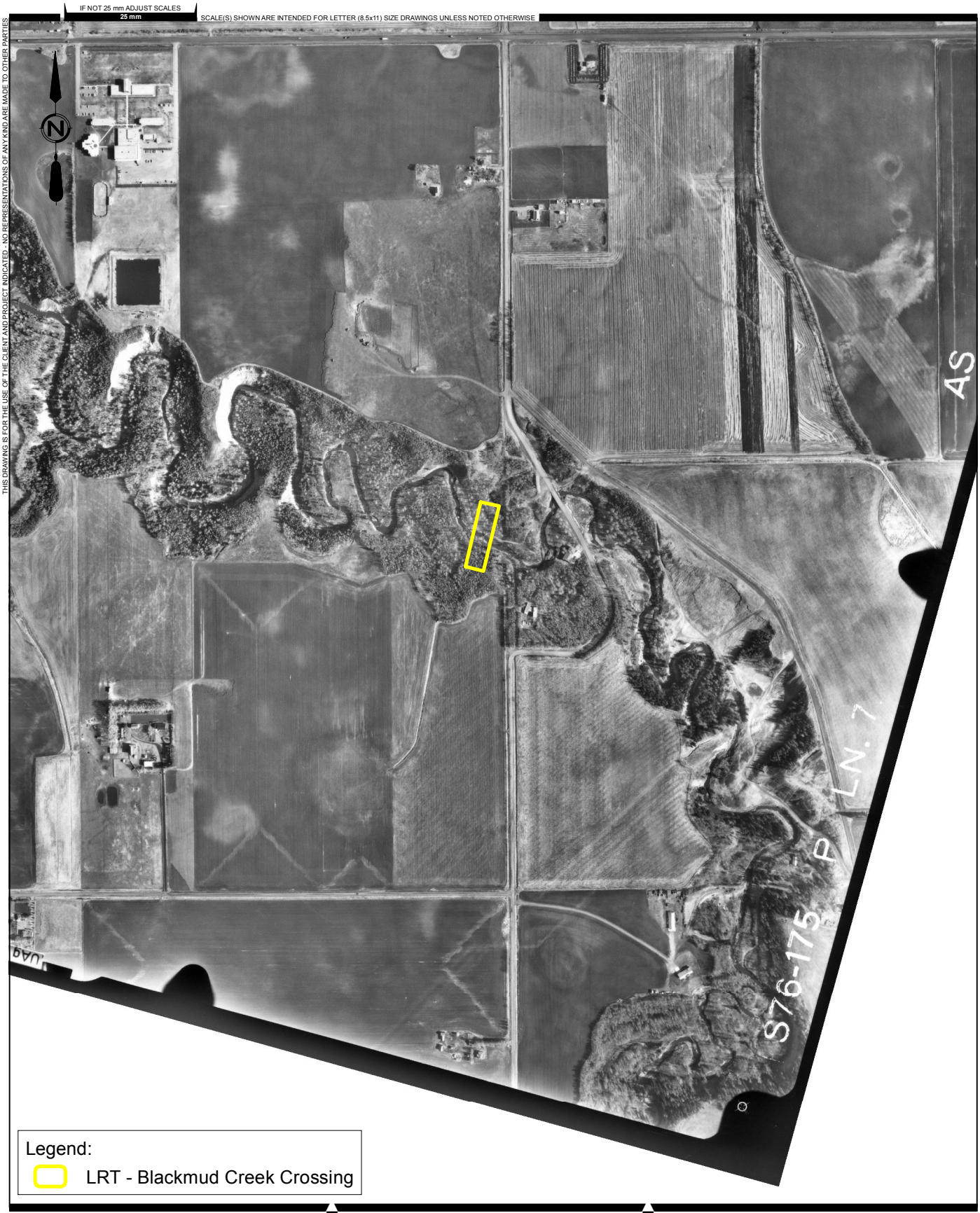
AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

FIGURE No. 1

CAPITAL LINE SOUTH LRT

BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
04-05-1950

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Legend:
LRT - Blackmud Creek Crossing

P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\ArcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

FIGURE No. 1

CAPITAL LINE SOUTH LRT

BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
05-03-1976

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE

P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\ArcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

FIGURE No. 1

CAPITAL LINE SOUTH LRT

BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
05-10-1969

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE

P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\ArcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

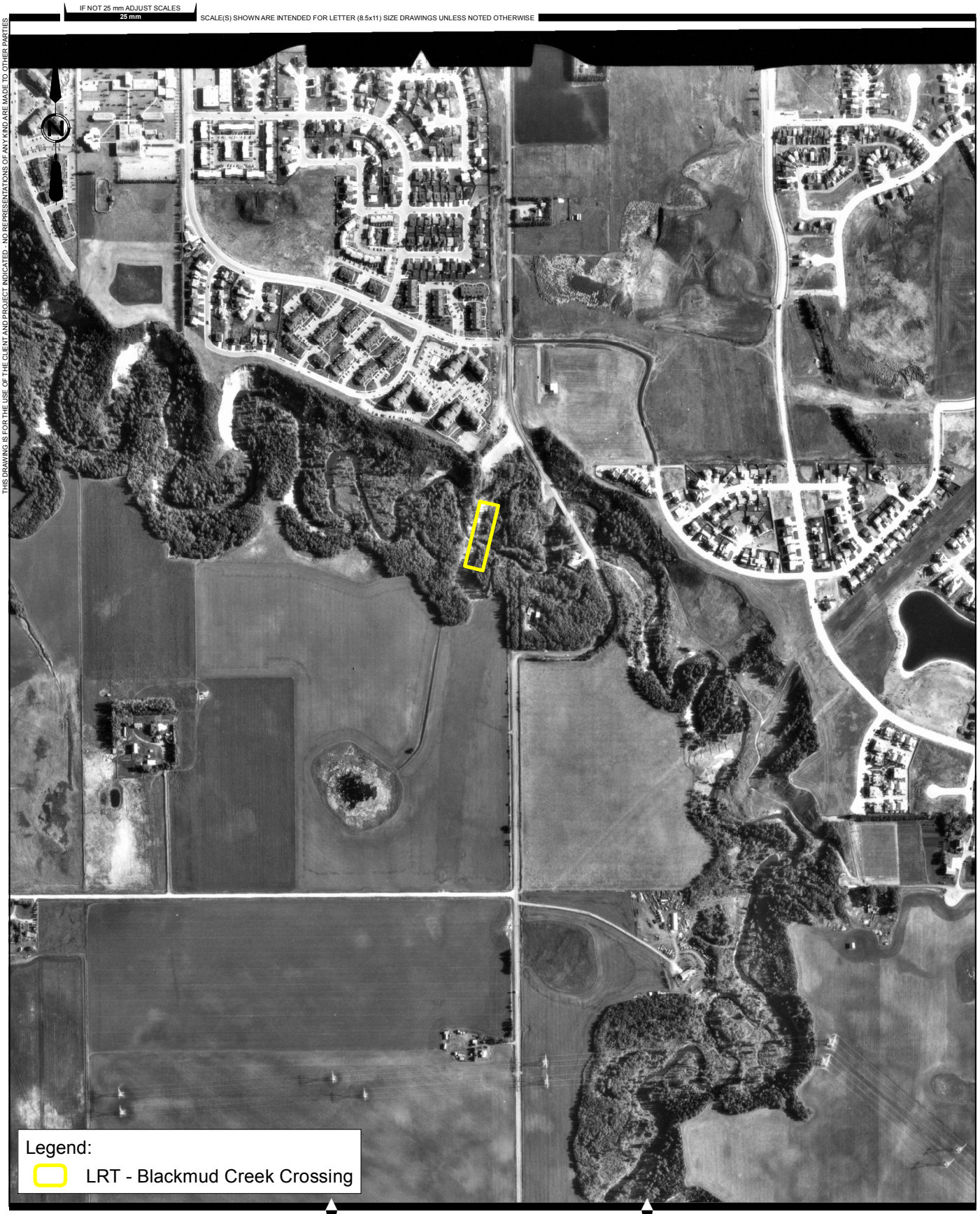
FIGURE No. 1

CAPITAL LINE SOUTH LRT

BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
05-12-1993

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE



P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\ArcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

FIGURE No. 1

CAPITAL LINE SOUTH LRT

BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
06-14-1984

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE

P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\arcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

FIGURE No. 1

CAPITAL LINE SOUTH LRT

BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
04-01-2001

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE

P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\arcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

FIGURE No. 1

CAPITAL LINE SOUTH LRT

BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
10-01-2008

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE

P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\ArcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

FIGURE No. 1

CAPITAL LINE SOUTH LRT

BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
2015

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5x11) SIZE DRAWINGS UNLESS NOTED OTHERWISE

P:\2017\3959\00_South_LRT_Extensi\Working_Dwgs\010_GIS\ArcMap\ENV\02_EIA\ENV_EIA_HistoricalAirphotos.mxd
DATE: 3/1/2018.

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

AE PROJECT No.	2017-3959
DATE	2018 MARCH
SCALE	1:10,000
COORD. SYSTEM	NAD 1983 CSRS 3TM 114
REV	
DESCRIPTION	ISSUED FOR REPORT

FIGURE No. 1

CAPITAL LINE SOUTH LRT

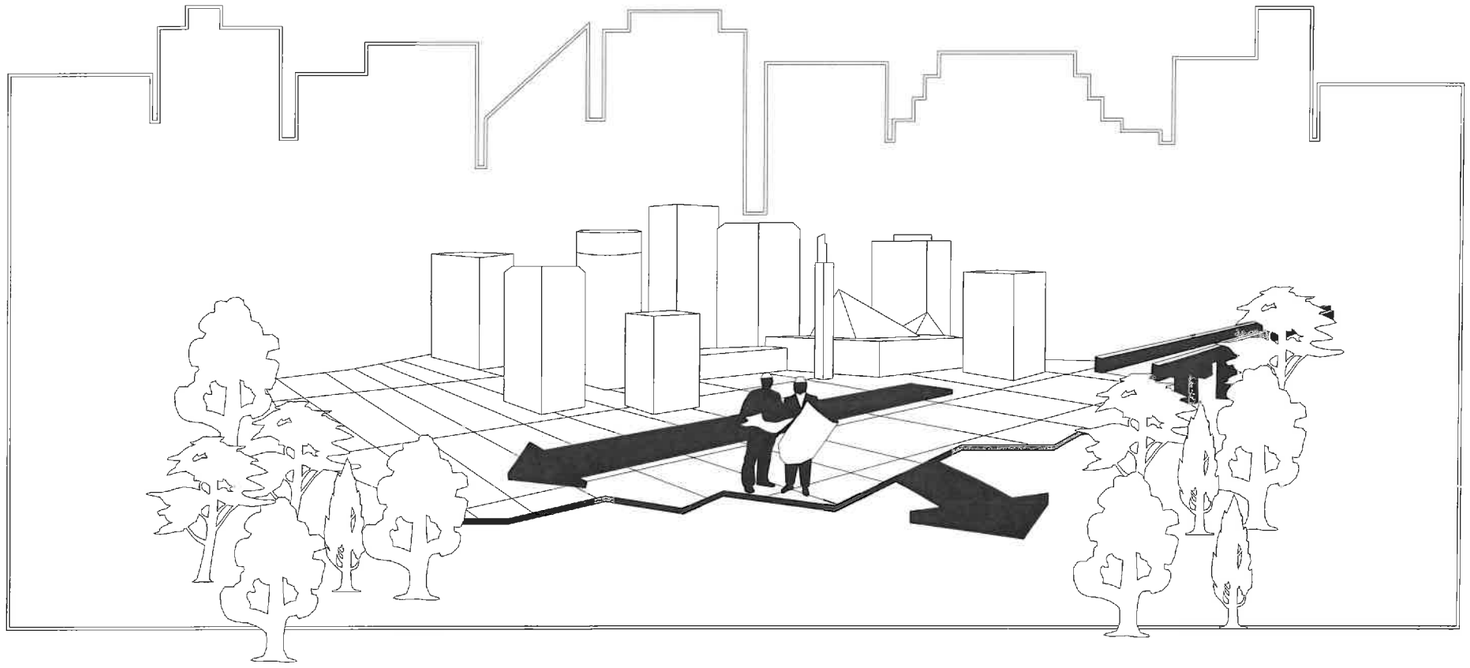
BLACKMUD CREEK CROSSING
HISTORICAL AIR PHOTOS
2016

Appendix B - Preliminary Design Drawings

THE CITY OF Edmonton

CAPITAL CONSTRUCTION

LRT EXPANSION BRANCH



SOUTH LRT EXTENSION
CENTURY PARK TO ELLERSLIE ROAD

DIRECTOR, SPECIAL PROJECTS — DATE
LRT DELIVERY | INTEGRATED INFRASTRUCTURE SERVICES

CONTRACT No. D931770

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES AND PEOPLE

CROSSING AT BLACKMUD CREEK
90% SUBMISSION TO CLIENT - 20180CT22

PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DRAWING STANDARDS LEGEND

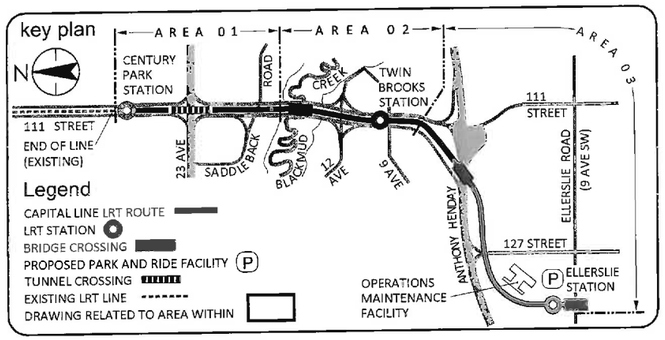
PROJECT NAME

LOCATION

SOUTH LRT EXTENSION - CENTURY PARK TO ELLERSLIE ROAD

THE CITY OF EDMONTON

KEY PLAN



THE KEY PLAN (EXAMPLE SHOWN ABOVE) ON EACH DRAWING SHEET PROVIDES TWO IMPORTANT ITEMS OF INFORMATION

1. THE AREA WHICH IS APPLICABLE TO THE DRAWING. PRIMARILY FOR DRAWING SET NAVIGATION PURPOSES, THE PROPOSED OVERALL SITE BOUNDARY IS DIVIDED INTO THREE (3) AREAS

   AREA 01
   AREA 02
   AREA 03

   - THE AREA DESIGNATOR IS REPRESENTED IN THE FIRST TWO (2) NUMBERS OF THE CONSULTANT DRAWING NUMBER
   - WHEN A DRAWING APPLIES TO ALL AREAS (01, 02, AND 03), THE PREFIX "00" IS USED

2. A MARKER IDENTIFYING THE LOCATION (APPROX) OF THE AREA SHOWN ON THE DRAWING (WHEN IT APPLIES)
   - GREEN RECTANGLE MARKER:

DRAWING NUMBERING SYSTEM

DRAWING NUMBER LEGEND

AREA	DISCIPLINE DESIGNATOR LEVEL 1	DISCIPLINE DESIGNATOR LEVEL 2	DISCIPLINE NUMBER SERIES	SEQUENCIAL NUMBER (1-999)
00	D	D	1	001

EXAMPLE: 00 - DD - 1001

DISCIPLINE DESIGNATOR DESCRIPTORS

DISCIPLINE TYPE	DISCIPLINE DESIGNATOR LEVEL 1	DISCIPLINE DESIGNATOR LEVEL 2	DESCRIPTION
ARCHITECTURE	A		
		AD	ARCHITECTURE DEMOLITION
		AE	ARCHITECTURE ELECTRICAL
CIVIL	C	CD	CIVIL DEMOLITION
		CG	CIVIL GRADING
		CI	CIVIL IMPROVEMENTS
		CP	CIVIL PAVING
		CS	CIVIL SITE
		CT	CIVIL TRANSPORTATION
		CU	CIVIL UTILITIES
DRAINAGE	D		
ELECTRICAL	E		
		EL	ELECTRICAL LIGHTING
		EP	ELECTRICAL POWER
		ET	ELECTRICAL TRACTION POWER
		EC	ELECTRICAL CATENARY
		EU	ELECTRICAL UNDEGROUND
		ER	ELECTRICAL RIGHT OF WAY
		ES	ELECTRICAL SIGNALS
GENERAL	G		
LANDSCAPE	L		
		LP	LANDSCAPE PLANTING
		LR	LANDSCAPE TREE REMOVAL AND RELOCATION
MECHANICAL	M		
		MH	MECHANICAL HVAC
		MF	MECHANICAL FIRE PROTECTION
		MP	MECHANICAL PLUMBING & PIPING
ROADS	R		
		RD	ROADS DEMOLITION
		RT	ROADS TRAFFIC ACCOMODATION
		RM	ROADS MARKING
STRUCTURAL	S		

DISCIPLINE NUMBER SERIES

1	GENERAL (COVER SHEET, DRAWING INDEX, STANDARDS LEGEND)
9	TRACK AND INTEGRATED SYSTEMS
10	TRACTION POWER SUBSTATIONS & CATENARY
11	OPERATIONS AND MAINTENANCE (O&M) AND OPERATIONS CONTROL CENTRE
12	STRUCTURES
13	ROADWAYS, CYCLIST AND PEDESTRIAN
15	DRAINAGE
16	LRT STATIONS
17	TRANSIT CENTRES / PARK AND RIDES
18	LANDSCAPE
19	UTILITIES
21	GEOTECHNICAL

PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DRAWING INDEX

PROJECT NAME: SOUTH LRT EXTENSION - CENTURY PARK TO ELLERSLIE ROAD

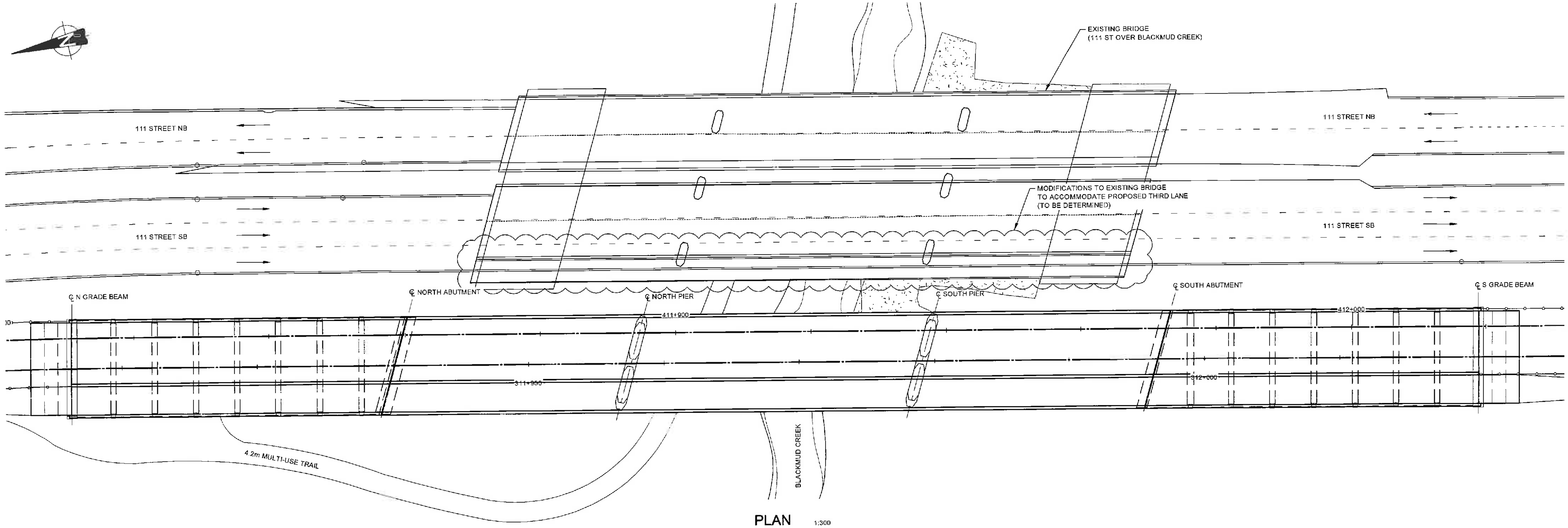
LOCATION: THE CITY OF EDMONTON

DRAWING NO.		DRAWING TITLE	
CITY	CONSULTANT	LINE 1	LINE 2
1000 GENERAL			
	00-G-1043		COVER SHEET
	00-G-1044		DRAWING STANDARDS LEGEND
	00-G-1045		DRAWING INDEX

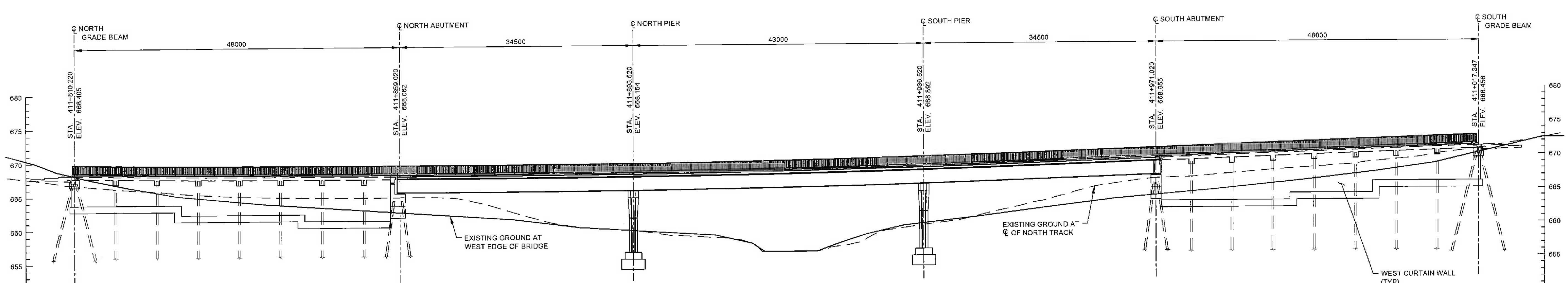
DRAWING NO.		DRAWING TITLE	
CITY	CONSULTANT	LINE 1	LINE 2
12000 STRUCTURES			
BRIDGE			
	02-S-12201	111 STREET AT BLACKMUD CREEK	GENERAL ARRANGEMENT
	02-S-12202	111 STREET AT BLACKMUD CREEK	SITE PLAN
	02-S-12203	111 STREET AT BLACKMUD CREEK	SOUTH ABUTMENT SHEET 1
	02-S-12204	111 STREET AT BLACKMUD CREEK	SOUTH ABUTMENT SHEET 2
	02-S-12205	111 STREET AT BLACKMUD CREEK	NORTH ABUTMENT SHEET 1
	02-S-12206	111 STREET AT BLACKMUD CREEK	NORTH ABUTMENT SHEET 2
	02-S-12207	111 STREET AT BLACKMUD CREEK	PIERS
	02-S-12208	111 STREET AT BLACKMUD CREEK	DECK - SHEET 1
	02-S-12209	111 STREET AT BLACKMUD CREEK	DECK - SHEET 2
	02-S-12210	111 STREET AT BLACKMUD CREEK	TRANSITION SLAB

DRAWING NO.		DRAWING TITLE	
CITY	CONSULTANT	LINE 1	LINE 2

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION



PLAN 1:300



ELEVATION 1:300

NOTE:
STATIONS AND ELEVATIONS ARE GIVEN AT ℄ NORTH TRACK AND SHALL BE ADJUSTED TO OBTAIN THE CORRESPONDING ELEVATION AT ℄ SOUTH TRACK

PLOT DATE: 10/22/2018 11:06:33 AM
SAVE DATE: 10/22/2018 11:03:49 AM SAVED BY: CRBL

consultant

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES AND PEOPLE

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

stamps

PRELIMINARY DESIGN NOT FOR CONSTRUCTION

scale horizontal AS SHOWN
vertical

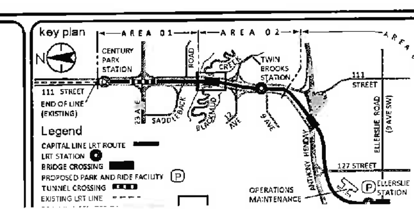
drawn

city of edmonton project no

permit

seal

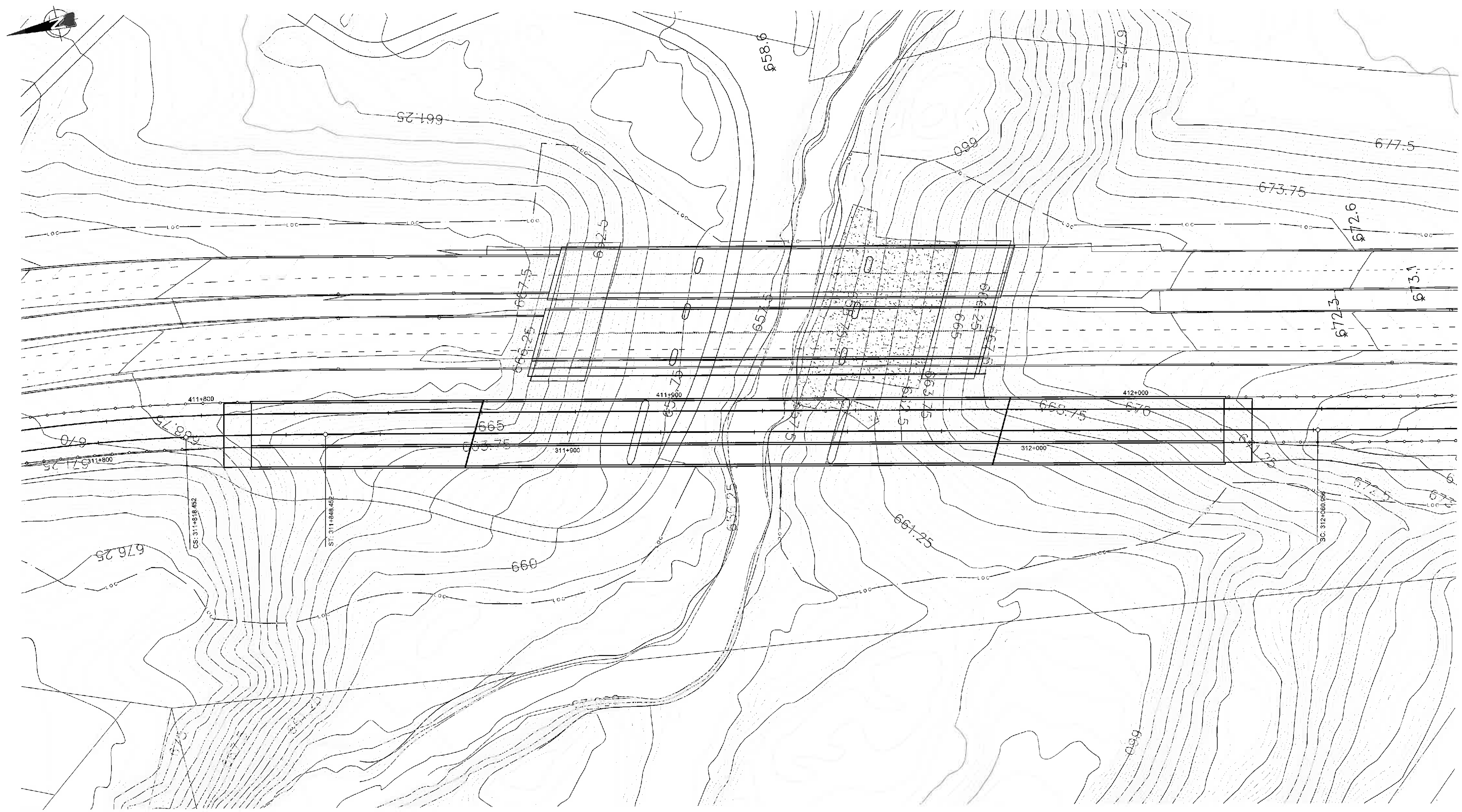
key plan



client
THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

drawing title
CIVIL
STRUCTURES

project
SOUTH LRT EXTENSION
SOUTH LRT EXTENSION
CENTURY PARK TO
ELLERSLIE ROAD
EDMONTON, ALBERTA



PLAN 1:400

SITE PLAN

PLOT DATE: 10/22/2018 9:51:02 AM
SAVE DATE: 10/19/2018 1:12:17 PM SAVED BY: CRBL
DWG PATH: o:\a095000\a097735\cad\03-drawings\working drawings\12000 structures\02-s-12202.dwg

consultant

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES AND PEOPLE

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

stamps

PRELIMINARY DESIGN NOT FOR CONSTRUCTION

scale horizontal AS SHOWN
vertical

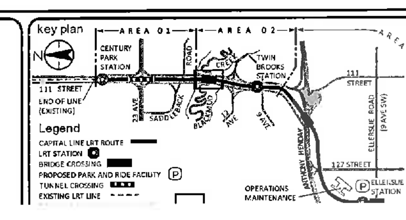
drawn

city of edmonton project no

permit

seal

key plan



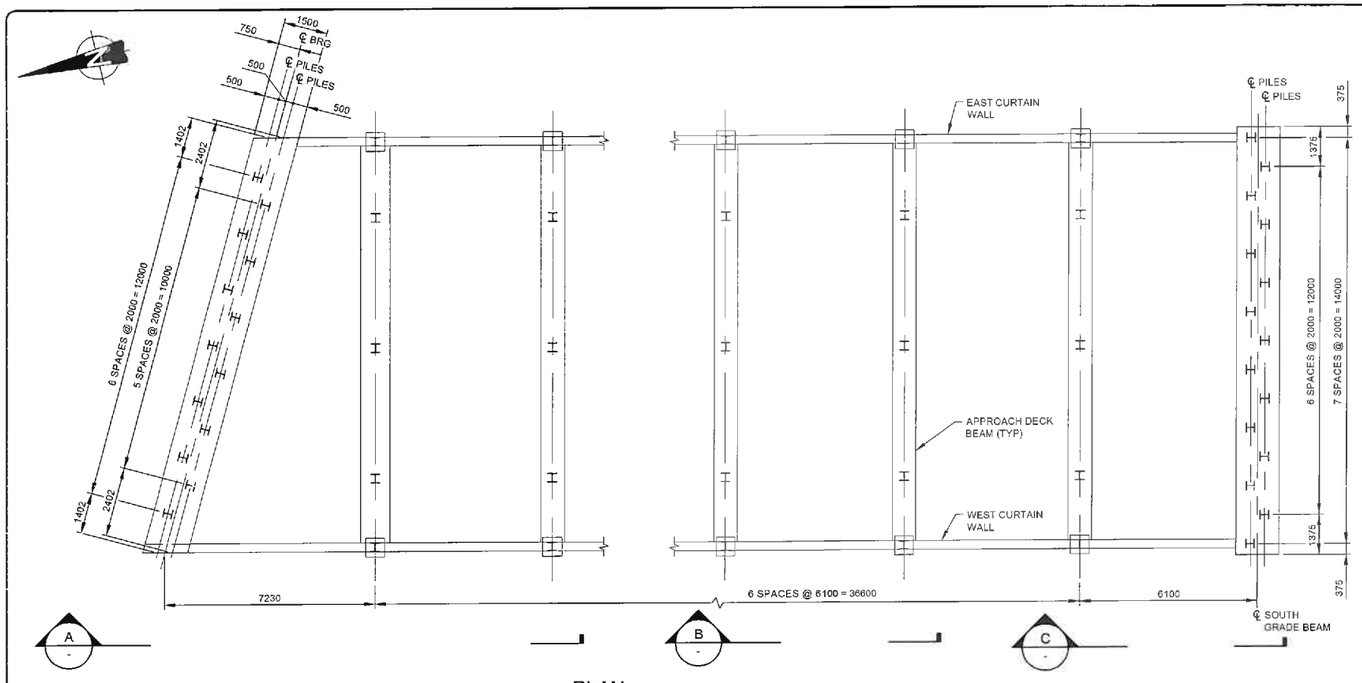
client

THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

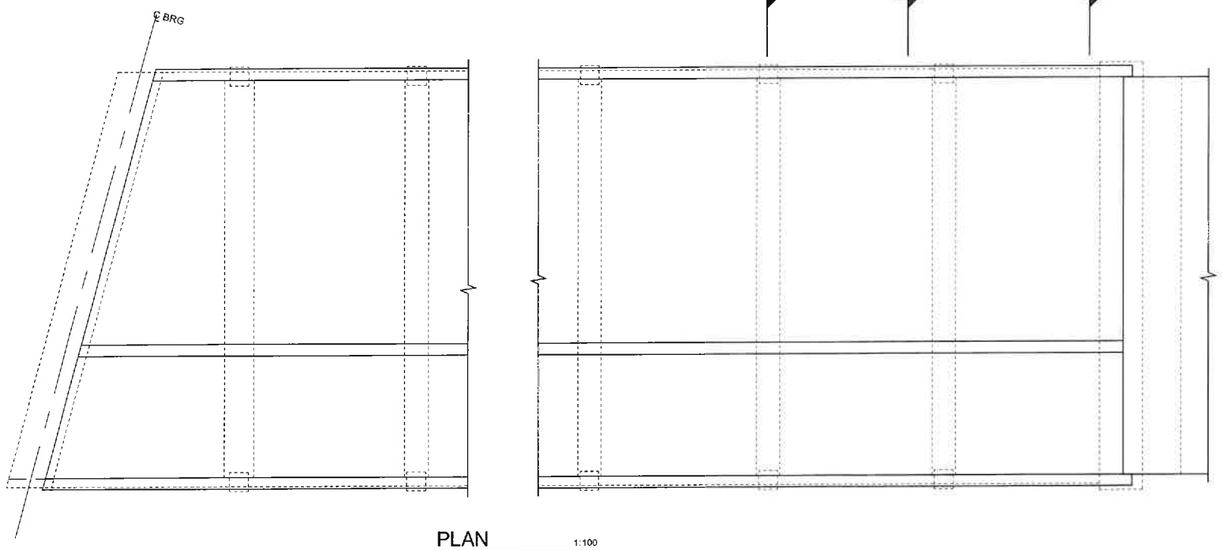
drawing title
CIVIL
STRUCTURES
BRIDGE

project
SOUTH LRT EXTENSION

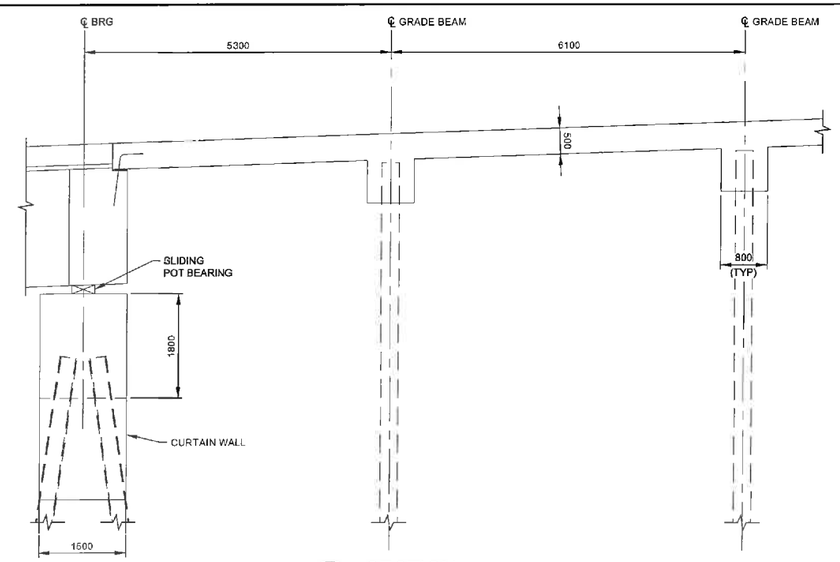
SOUTH LRT EXTENSION
CENTURY PARK TO
ELLERSLIE ROAD
EDMONTON, ALBERTA



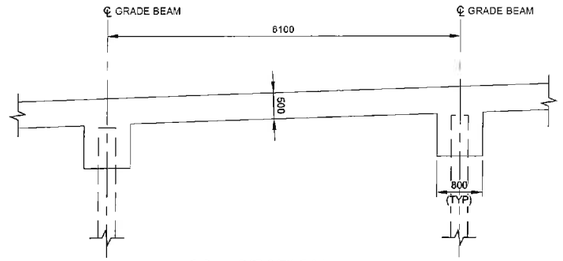
PLAN 1:100
SOUTH ABUTMENT FOUNDATION



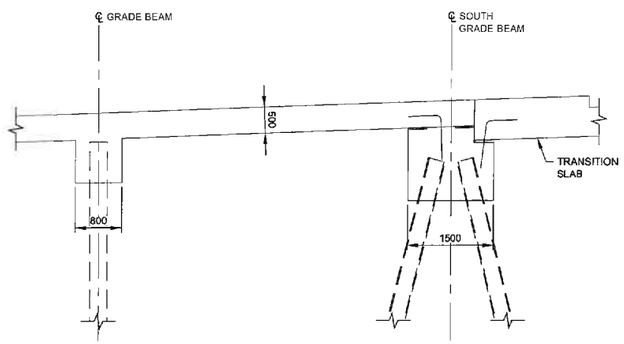
PLAN 1:100
SOUTH ABUTMENT
(TRANSITION SLAB NOT SHOWN)



A - SECTION 1:50
ABUT SEAT



B - SECTION 1:50
TYPICAL BEAM



C - SECTION 1:50
GRADE BEAM

PLOT DATE: 10/22/2018 11:09:27 AM
SAVE DATE: 10/22/2018 8:59:30 AM SAVED BY: CRBL
DWG PATH: o:\a095000\a097735\cad\03-drawings\working drawings\12000 structures\02-s-12203.dwg

consultant
CAPITAL LINE PARTNERS
INTEGRATED LIFE-CYCLE SOLUTIONS FOR PEOPLE

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

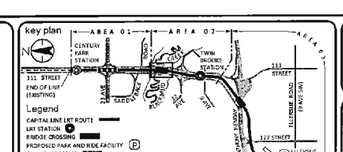
stamps
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

scale horizontal AS SHOWN
vertical

drawn
city of edmonton project no

permit

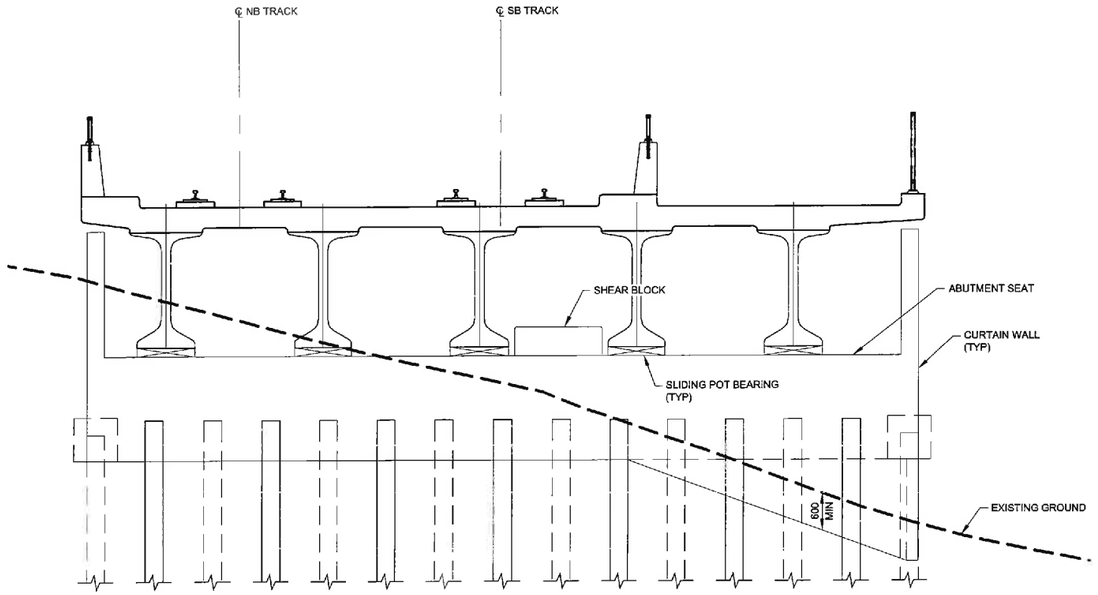
seal

key plan


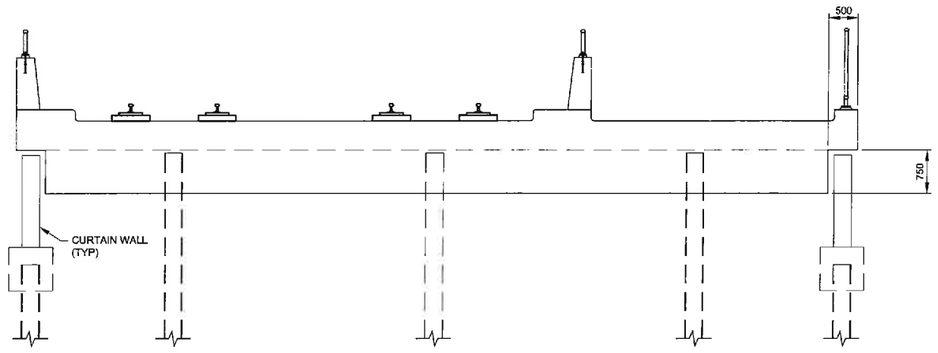
client
THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

drawing title
CIVIL
STRUCTURES
BRIDGE

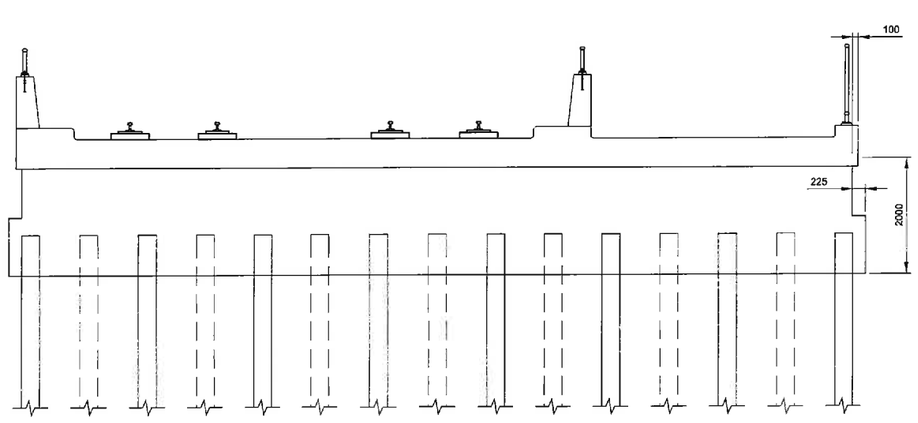
project
SOUTH LRT EXTENSION
SOUTH LRT EXTENSION
CENTURY PARK TO ELLERSLIE ROAD
EDMONTON, ALBERTA



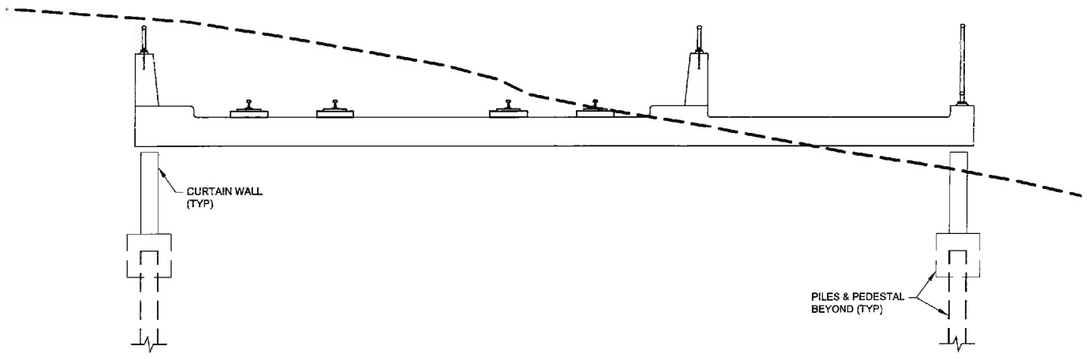
TYPICAL SECTION 1:50
ABUTMENT SEAT ELEVATION
FACING SOUTH



D / 12203 SECTION 1:50
AT CENTER OF TRANSVERSE BEAM
FACING SOUTH



F / 12203 SECTION 1:50
SOUTH GRADE BEAM
FACING SOUTH



E / 12203 SECTION 1:50
BETWEEN TRANSVERSE BEAMS
FACING SOUTH

PLOT DATE: 10/22/2018 11:17:06 AM
SAVE DATE: 10/22/2018 9:10:07 AM SAVED BY: CRBL
DWG PATH: c:\a095900\ea007735\case003-drawings\working drawings\12000 structures\02-s-12204.dwg

consultant
CAPITAL LINE PARTNERS
INTEGRATION | QUALITY | COMMITMENT | INNOVATION

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

stamps
PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

scale horizontal AS SHOWN
vertical

drawn
city of edmonton project no

permit

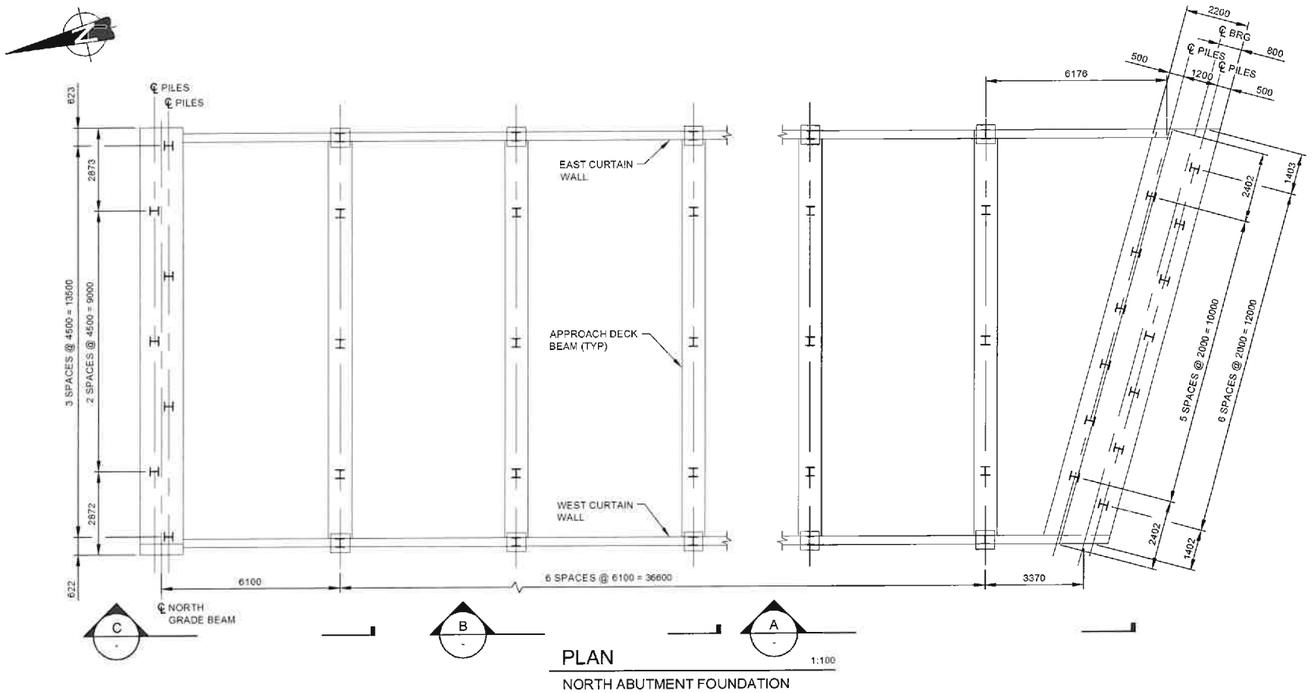
seal

key plan

client
THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

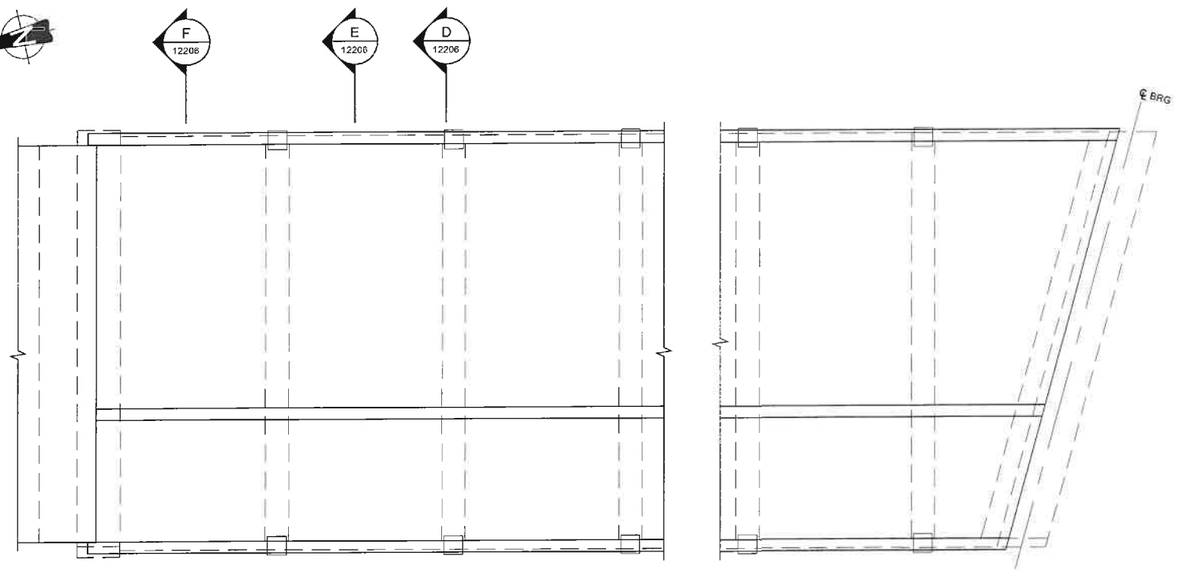
drawing title
CIVIL
STRUCTURES
BRIDGE

project
SOUTH LRT EXTENSION
SOUTH LRT EXTENSION
CENTURY PARK TO ELLERSLIE ROAD
EDMONTON, ALBERTA



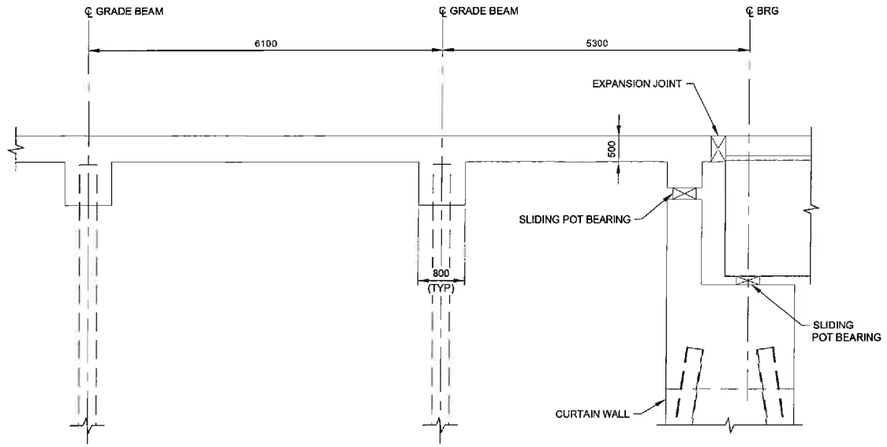
PLAN 1:100

NORTH ABUTMENT FOUNDATION



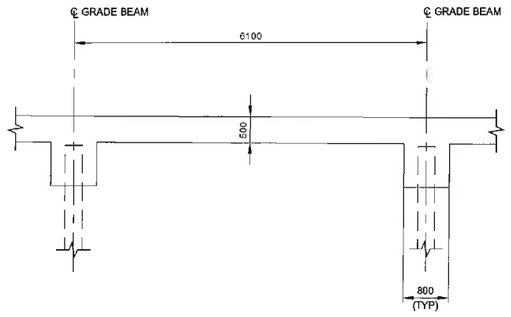
PLAN 1:100

NORTH ABUTMENT



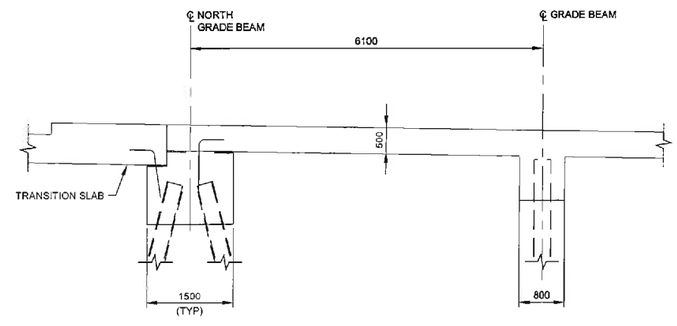
A SECTION 1:50

ABUT SEAT



B SECTION 1:50

TYPICAL BEAM



C SECTION 1:50

GRADE BEAM

PLOT DATE: 10/22/2018 11:26:39 AM
SAVE DATE: 10/22/2018 8:48:39 AM SAVED BY: CRBL
DWG PATH: o:\ab95000\ab97735\cad\03-drawings\working drawings\120903 structures\02-c-12205.dwg

consultant

CAPITAL LINE PARTNERS

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

stamps

PRELIMINARY DESIGN NOT FOR CONSTRUCTION

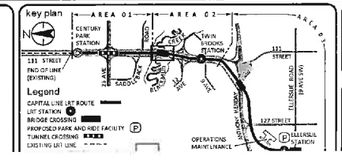
scale horizontal AS SHOWN
vertical

drawn | city of edmonton project no

permit

seal

key plan



client

THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

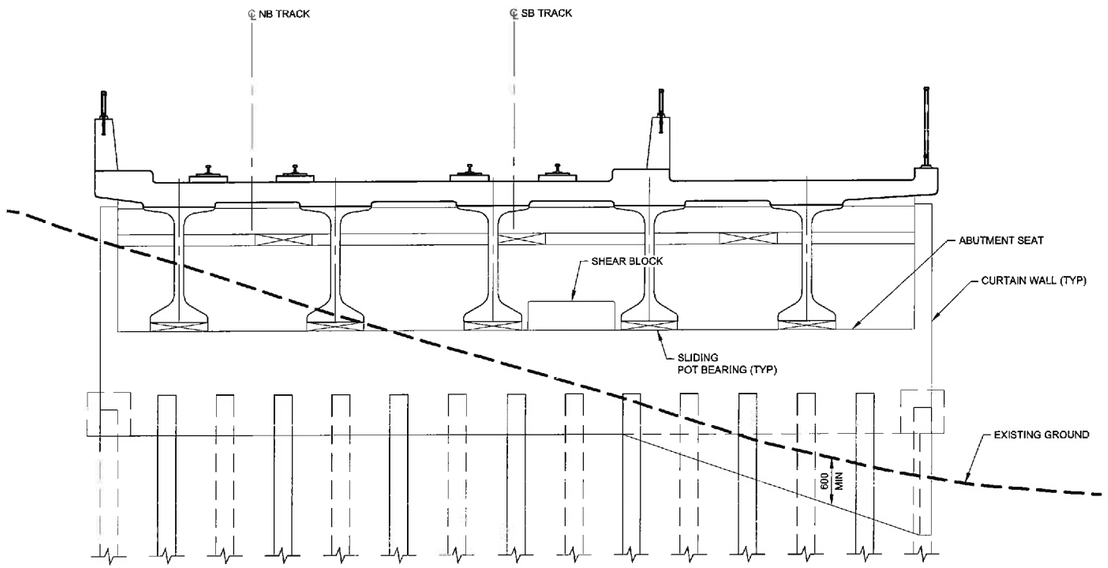
drawing title

CIVIL
STRUCTURES
BRIDGE

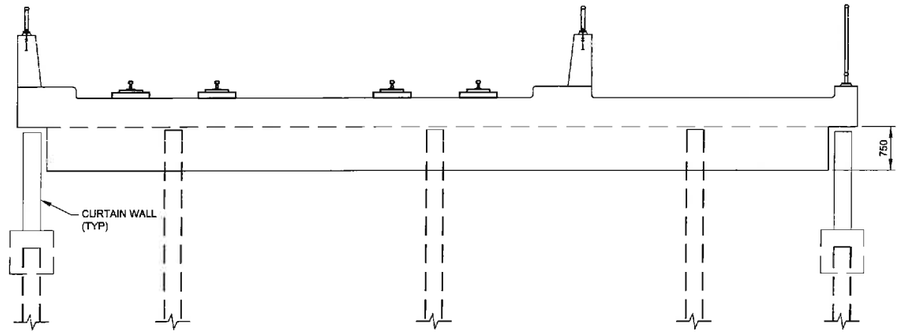
project

SOUTH LRT EXTENSION

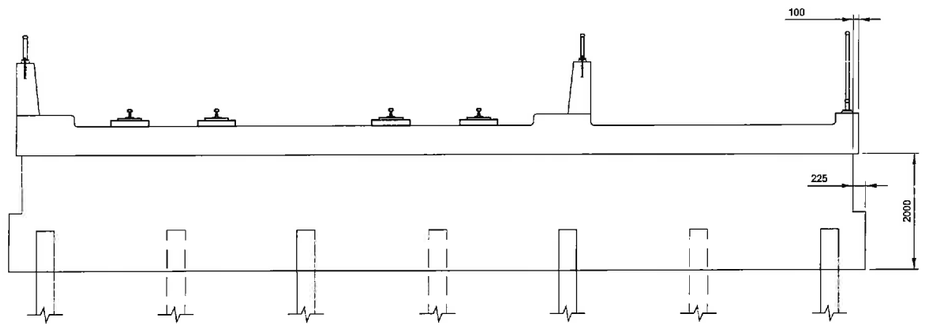
SOUTH LRT EXTENSION
CENTURY PARK TO ELLERSLIE ROAD
EDMONTON, ALBERTA



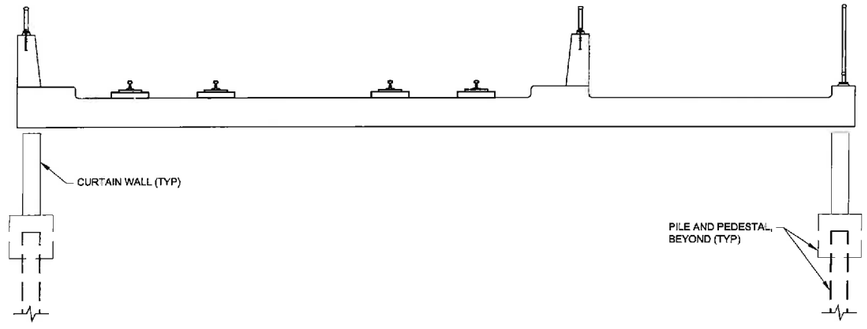
TYPICAL SECTION 1:50
FACING SOUTH



D / 12205 SECTION 1:50
AT CENTER OF TRANSVERSE BEAM
FACING SOUTH



F / 12205 SECTION 1:50
NORTH GRADE BEAM
FACING NORTH



E / 12205 SECTION 1:50
BETWEEN TRANSVERSE BEAM
FACING SOUTH

PLOT DATE: 10/22/2018 11:39:06 AM
SAVE DATE: 10/22/2018 9:23:11 AM SAVED BY: ORBL
DWG PATH: o:\u095000\u097739\cad\03-drawings\working drawings\12000 structures\02-s-12206.dwg

consultant
CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITY AND PEOPLE

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

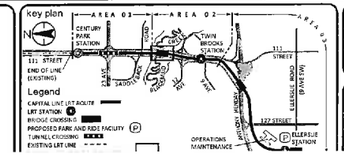
stamps
PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

scale horizontal AS SHOWN
vertical

drawn R. CROWLEY
city of edmonton project no

permit

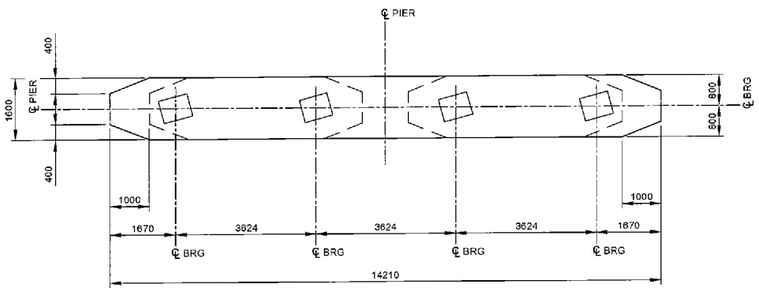
seal

key plan


client
THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

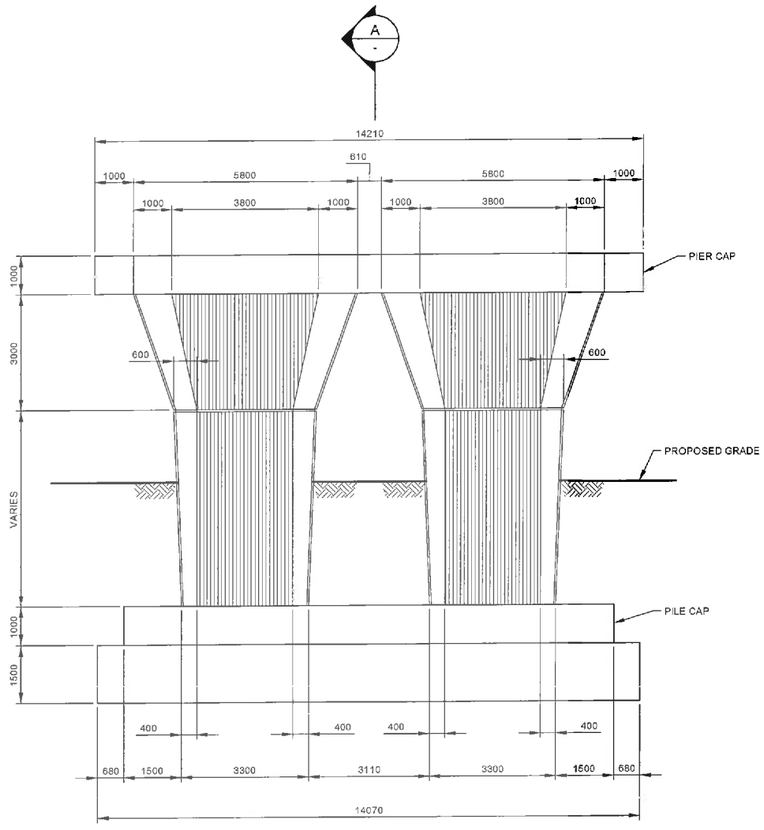
drawing title
CIVIL
STRUCTURES
BRIDGE

project
SOUTH LRT EXTENSION
SOUTH LRT EXTENSION
CENTURY PARK TO
ELLERSLIE ROAD
EDMONTON, ALBERTA

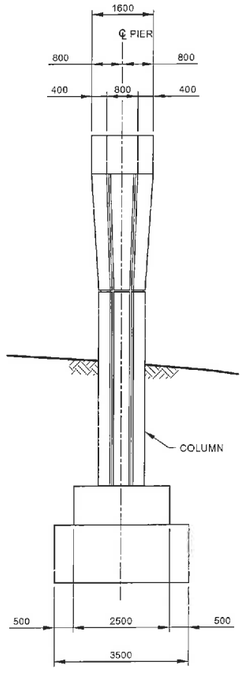


PLAN 1:75
PIER CAP

PLAN 1:75
PILE CAP



ELEVATION 1:75



ELEVATION 1:75
SIDE VIEW

PLOT DATE: 10/19/2018 1:21:19 PM
SAVE DATE: 10/19/2018 11:44:42 AM SAVED BY: CRBL
DWG PATH: o:\ab95300\ab97739\cad\03-drawings\working drawings\12000 structures\02-s-12207.dwg

consultant
CAPITAL LINE PARTNERS

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

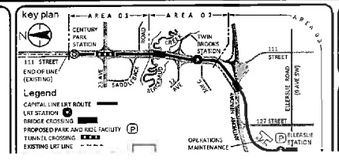
stamps
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

scale horizontal AS SHOWN
vertical

drawn
city of edmonton project no

permit

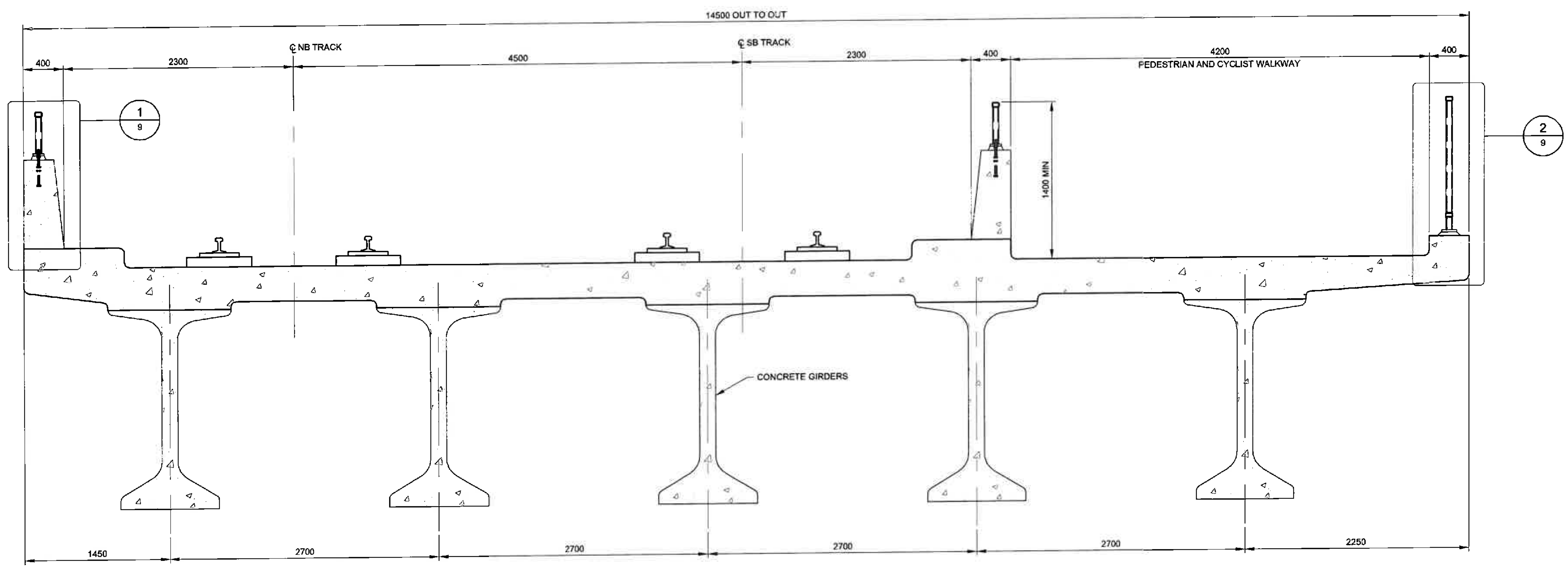
seal

key plan


client
THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

drawing title
CIVIL
STRUCTURES
BRIDGE

project
SOUTH LRT EXTENSION
SOUTH LRT EXTENSION
CENTURY PARK TO ELLERSLIE ROAD
EDMONTON, ALBERTA



TYPICAL SECTION 1:25

PLOT DATE: 10/19/2018 11:01:35 AM
SAVE DATE: 10/15/2018 12:03:01 PM SAVED BY: CRBL
DWG PATH: o:\a095000\a097735\cad\03-drawings\working drawings\12000 structures\02-s-12208.dwg

consultant: CAPITAL LINE PARTNERS — INTEGRATING MOBILITY, COMMUNITIES AND PEOPLE

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

stamps: **PRELIMINARY DESIGN NOT FOR CONSTRUCTION**

scale: horizontal AS SHOWN; vertical

drawn

city of edmonton project no

permit

seal

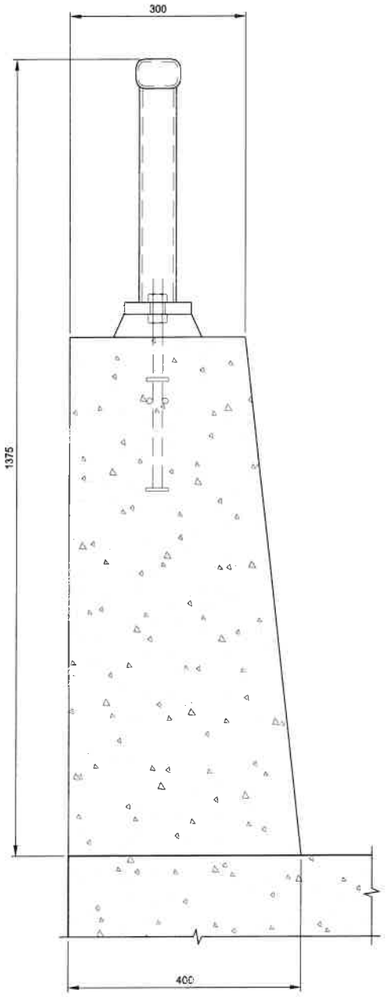
key plan

client: THE CITY OF Edmonton CAPITAL CONSTRUCTION, LRT EXPANSION BRANCH

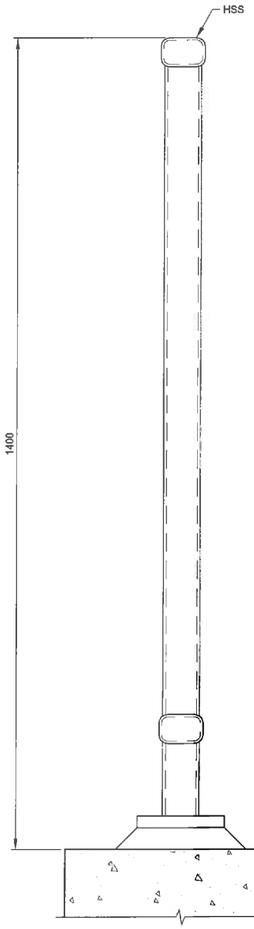
drawing title: CIVIL STRUCTURES BRIDGE

project: SOUTH LRT EXTENSION

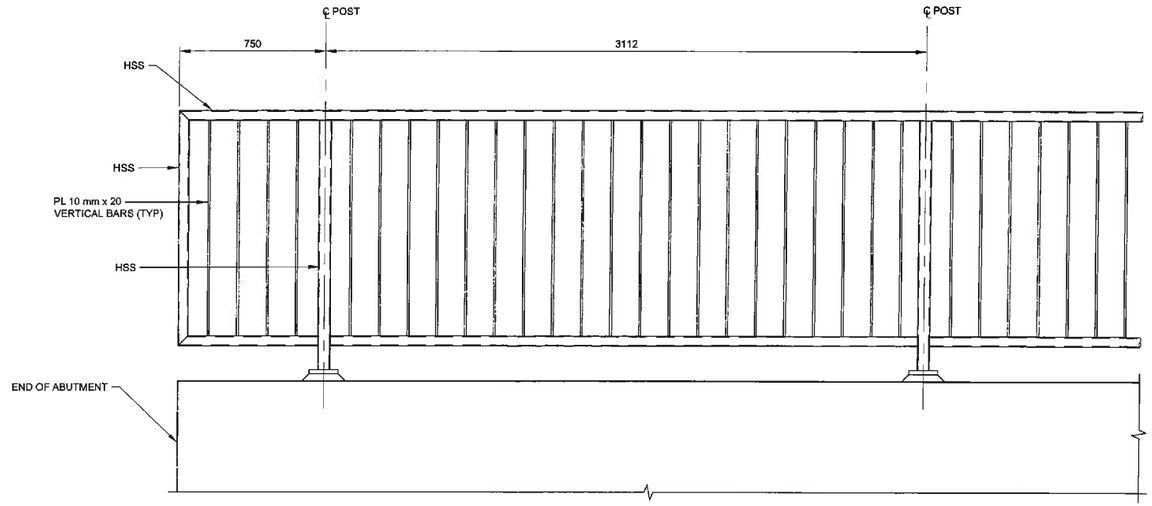
SOUTH LRT EXTENSION CENTURY PARK TO ELLERSLIE ROAD
EDMONTON, ALBERTA



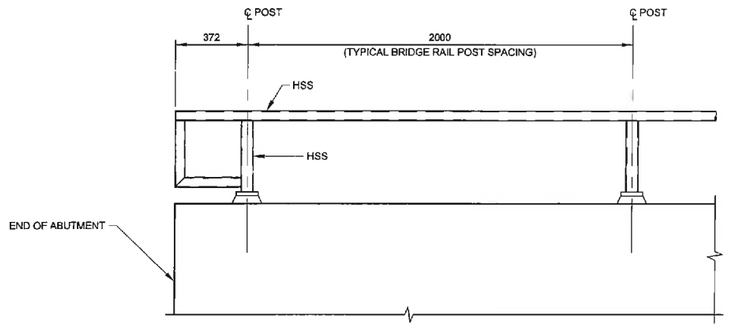
1/8 DETAIL 1:5
BARRIER



2/8 DETAIL 1:5
HANDRAIL



DETAIL 1:15
TYPICAL HANDRAIL LAYOUT



DETAIL 1:15
TYPICAL BRIDGE RAIL LAYOUT

PLOT DATE: 10/19/2018 10:36:22 AM
SAVE DATE: 10/19/2018 10:12:37 AM SAVED BY: CRBL
DWG PATH: o:\all\95900\al\97795\dac\03-drawing\working drawings\122000 structures\02-s-122005.dwg

consultant
CAPITAL LINE PARTNERS

9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

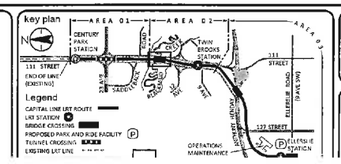
stamps
PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

scale horizontal AS SHOWN
vertical

drawn
city of edmonton project no

permit

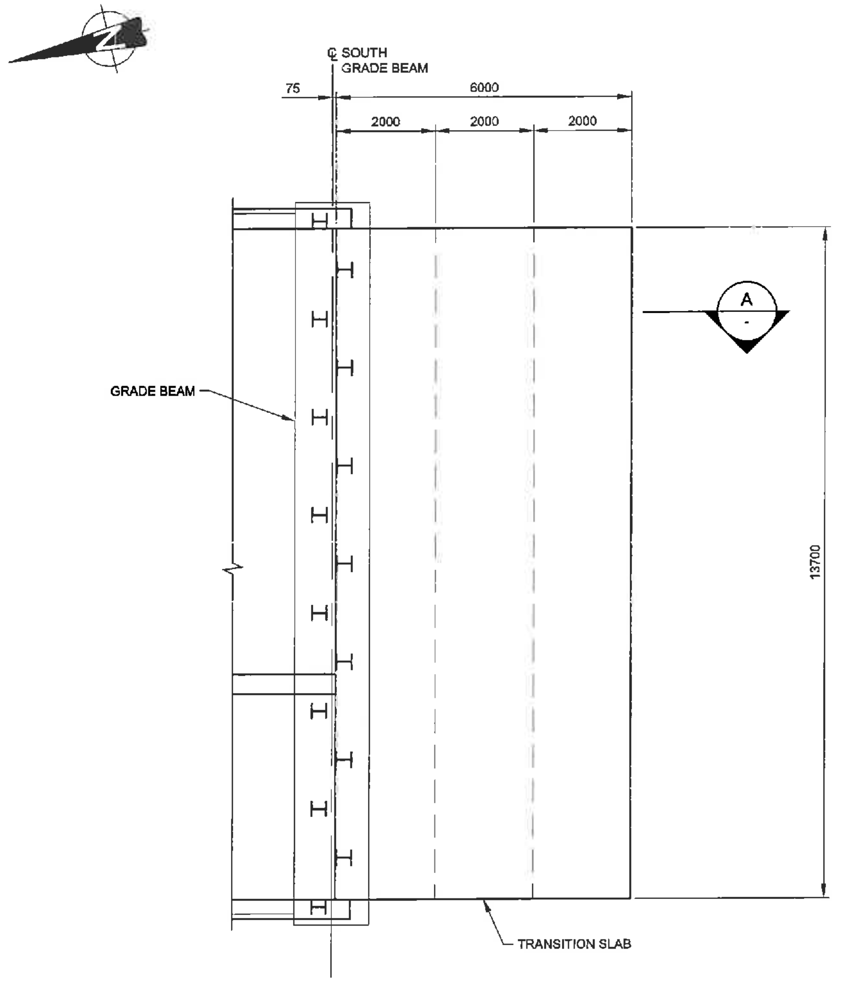
seal

key plan


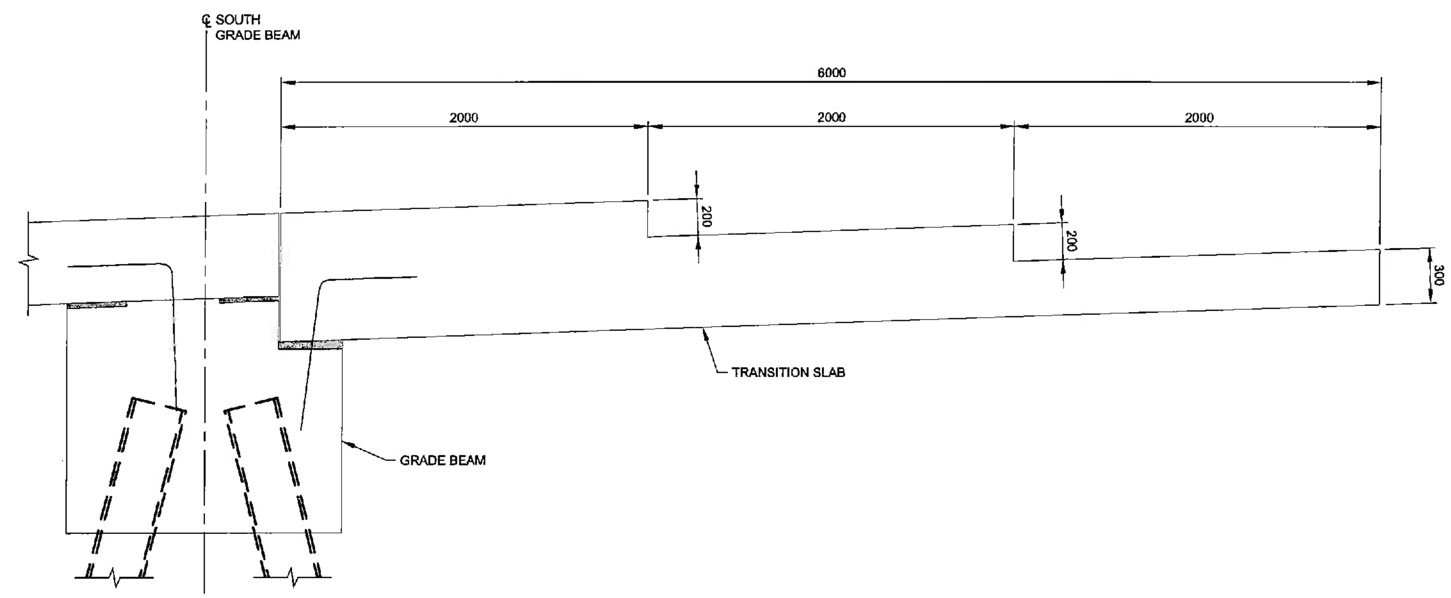
client
THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

drawing title
CIVIL
STRUCTURES
BRIDGE

project
SOUTH LRT EXTENSION
SOUTH LRT EXTENSION
CENTURY PARK TO ELLERSLIE ROAD
EDMONTON, ALBERTA



PLAN 1:75
TRANSITION SLAB



(A) SECTION 1:20
SOUTH TRANSITION SLAB SHOWN, NORTH TRANSITION SLAB SIMILAR

PLOT DATE: 10/22/2018 11:35:47 AM
SAVE DATE: 10/19/2018 9:06:04 AM SAVED BY: CRBL
DWG PATH: o:\a095000\a097735\cad\03-drawings\working drawings\12000 structures\02-s-12210.dwg

consultant
CAPITAL LINE PARTNERS

No.	Description	Date	By
9			
8			
7			
6			
5			
4			
3			
2			
1	ISSUED FOR 90% SUBMISSION TO CLIENT	2018OCT22	SA

stamps
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

scale horizontal AS SHOWN
vertical

drawn
city of edmonton project no

permit

seal

key plan

client
THE CITY OF Edmonton CAPITAL CONSTRUCTION
LRT EXPANSION BRANCH

drawing title
CIVIL
STRUCTURES
BRIDGE

project
SOUTH LRT EXTENSION
SOUTH LRT EXTENSION CENTURY PARK TO ELLERSLIE ROAD
EDMONTON, ALBERTA

Appendix C - **Statement of Justification and Historical** Resources Clearance

Government of Alberta
Culture and Community Spirit

Historic Resources Management
Old St. Stephen's College
8820 – 112 Street
Edmonton, Alberta T6G 2P8
Canada
Telephone: 780-431-2300
www.culture.alberta.ca

FACSIMILE TRANSMITTAL

Historic Resources Management Branch
Land Use Planning
Old St. Stephen's College
8820 – 112 Street
Edmonton, AB T6G 2P8

Phone: (780) 431-2373
Fax: (780) 422-3106

FROM: Margret Ingibergsson

TO: Name: Nick Oke
Address: AECOM

Fax No.: 780-486-7070

We are sending you page(s), including this one.

Date: FAXED AUG 12 2009

MESSAGE:

Government of Alberta
Culture and Community Spirit

Historic Resources Management
Old St. Stephen's College
8820 – 112 Street
Edmonton, Alberta T6G 2P8
Canada
Telephone: 780-431-2300
www.culture.alberta.ca

August 11, 2009

Project File: 4715-09-023

Mr. Nick Oke
AECOM
17007 - 107 Avenue
Edmonton AB T5S 1G3

Dear Mr. Oke:

SUBJECT: **CITY OF EDMONTON**
AGENT BEING AECOM
SOUTH LIGHT RAIL TRANSIT EXTENSION
WITHIN TOWNSHIP 51, RANGES 24 & 25, W4M
***HISTORICAL RESOURCES ACT* CLEARANCE**

Alberta Culture and Community Spirit has received information from The Archaeology Group regarding plans for the proposed South Light Rail Transit Extension from Century Park to Ellerslie Road. Ministry staff have reviewed the potential for this project to impact historic resources and have concluded that an **Historic Resources Impact Assessment is not required.** Therefore, *Historical Resources Act* clearance is granted to proceed with the development of this project.

HISTORICAL RESOURCES ACT REQUIREMENTS

Reporting the discovery of historic resources: Pursuant to Section 31 of the *Historical Resources Act*, should any historic resources be encountered during activities associated with land surface disturbance operations, the Historic Resources Management Branch must be contacted immediately. It may then be necessary for further instructions regarding the documentation of these resources to be issued. Should you require additional information or have any questions concerning the above, please contact me at 780-431-2374 or by e-mail at margret.ingibergsson@gov.ab.ca.

On behalf of the Historic Resources Management Branch, I would like to thank officials of the City of Edmonton and AECOM for their cooperation in our endeavour to conserve Alberta's past.

Sincerely,

M. Ingibergsson

Margret Ingibergsson
Land Use Planner

cc: Walt Kowal, The Archaeology Group

Statement of Justification for *Historical Resources Act* Requirements for projects other than small-scale oil and gas

Project Name or Project Identifier
South LRT Extension – Century Park to Ellerslie Road: Preliminary Design

Disposition Type & Number

Name: Angela Younie
Corporate name of consulting company: The Archaeology Group
Phone number: (780) 438-4262
Fax number: (780) 439-4285
E-mail address: amyounie@gmail.com

Name of proponent contact: Carole Cej, Project Manager
Corporate name of proponent: City of Edmonton, LRT Expansion
Address: Capital Construction Department, 17th Floor, Century Place, 9803-102A Ave Edmonton AB, T5J 3A3
Phone number: (780) 944-3727
Fax number: (780) 496-6635
E-mail address: carole.cej@edmonton.ca

Name of agent: Nick Oke, Senior Environmental Scientist/Project Manager
Corporate name of agent: AECOM
Address: 17007 -107 Avenue, Edmonton, Alberta T5S 1G3
Phone number: (780) 486-7000
Fax number: (780) 486-7070
E-mail address: nick.oke@aecom.com

Lands Affected

Legal Description	Land Ownership Type	HRV
30, 31, 32-051-24-W4M	Crown Untitled	N/A
NE, SE-25-051-25-W4M	Crown Untitled	5 (a)
5, 6-52-24-W4M	Crown Untitled	N/A

Activity type and Anticipated Ground Disturbance

The proposed project is for the extension of Edmonton's south LRT from the Century Park Station to Ellerslie Road. Ground disturbance would include the excavation of an underpass for the LRT line at 23rd Avenue, surface disturbances for the landscaping and creation of the proposed line, and the creation of a transit station, including train platform, transit centre, parking area, and associated roads and maintenance building. Also proposed are the creation of two power substations located along the LRT line, and a LRV storage station located within the Anthony Henday Transportation and Utility Corridor.

Project size

Approximately 5.2 km of railway, plus approximately 32 ha for the Ellerslie train station, transit centre, and parking area in the eastern half of SE-25-051-25-W4M.

Existing Disturbance

Existing disturbance is present in the form of pre-existing roadways, bridges, overpasses, subdivision developments, and landscaping, and occurs along the majority of the proposed route. The line is proposed to cross the Blackmud Creek next to the 111 St Bridge, in an area that has been previously disturbed by landscaping and ground disturbance associated with the bridge construction, as well as subdivision and apartment block development. A parking lot, transit station, and a portion of the LRT line are proposed to be developed along the eastern edge of the University of Alberta Experimental Farm, which includes pre-existing disturbance in the form of buildings, roads, and cultivation. The substations, and the LRV storage facility are located along existing roadways and utility corridors.

Landscape and Environmental Information

The proposed *South LRT Extension – Century Park to Ellerslie Road: Preliminary Design* is located within the Central Parkland Natural Subregion, on glaciolacustrine sediments of bedded silt and clay. Natural vegetation and undisturbed land are almost entirely absent as the study area is entirely within the City of Edmonton, and includes developed subdivisions, highways, and commercial areas, and the University of Alberta Experimental Farm. Within this area, the project crosses the Blackmud Creek and borders near the Whitemud Creek, both of which include relatively undisturbed terrain in and around the creek valleys, with the exception of existing trails, bridges and highway crossings.

Archaeological Resources

Borden #	HRV	Site Type	Relationship to activity	Anticipated Impacts
FiPj-56	0	campsite	Outside impact area	None
FiPj-57	0	campsite	Outside impact area	None
FiPj-58	0	campsite	Outside impact area	None
FiPj-59	0	campsite	Outside impact area	None
FiPj-60	0	isolated find	Outside impact area	None
FiPj-61	0	campsite	Outside impact area	None
FiPj-62	0	campsite	Across 111 St from LRT	None
FiPj-64	0	scatter	Outside impact area	None
FiPj-65	0	kill-site	Outside impact area	None
FiPj-71	0	scatter	Outside impact area	None
FiPj-89	0	isolated find	Outside impact area	None
FiPj-90	0	scatter	Outside impact area	None
FiPj-106	0	isolated find	Outside impact area	None
FiPj-107	0	scatter >10	Outside impact area	None
FiPj-108	0	scatter <10	Outside impact area	None
FiPj-109	0	scatter <10	Outside impact area	None
FiPj-118	0	scatter >10	Outside impact area	None

Historic Structure(s)	Anticipated Impacts
Mine #1256 (48486)	Near but outside of impact area; None
Mine #1492 (51118)	Near but outside of impact area; None
Mine #1419 (51119)	Outside of impact area; None
Mine #1233 (51120)	Outside of impact area; None
Mine #1560 (51121)	Outside of impact area; None
Mine #1684 (51122)	Outside of impact area; None
Mine #1477 (51123)	Outside of impact area; None
Mine #1748 (51124)	Outside of impact area; None
Mine #1285 (51125)	Outside of impact area; None
Mine #1462 (51126)	Outside of impact area; None
Mine #1559 (51127)	Outside of impact area; None
Mine #1594 (51128)	Outside of impact area; None
Mine #1646 (51129)	Outside of impact area; None
Mine #1750 (51130)	Near but outside of impact area; None
Mine #1658 (51131)	Near but outside of impact area; None
Mine #877 (51135)	Outside of impact area; None
Mine #1177 (51136)	Outside of impact area; None
Mine #1059 (51137)	Outside of impact area; None
Mine #1034 (51138)	Outside of impact area; None
Mine #29 (51139)	Outside of impact area; None
Mine #1022 (51140)	Outside of impact area; None
Rabbit Hill School (90765)	Outside of impact area; None
Shelter (81862; FiPj-136)	Outside of impact area; None
Permit Number(s)	Relationship to proposed development footprint
79-200	Within project area
80-002	Within project area
80-057	Within project area
80-141	Near project area
86-081	Near project area
87-080	Within project area
89-034	Near project area
90-062	Near project area
90-085	HRIA: Blackmud trail system near 111 St
99-031	HRIA: Anthony Henday including within project area
99-133	HRIM: Site FiPj-107
00-159	Near project area
01-191	Near project area
01-332	Within project area
01-333	Within project area
02-112	Near project area
02-145	Near project area
03-071	Near project area
04-106	Near project area
04-168	Near project area
04-253	Near project area
05-063	Near project area
05-388	Outside of project area
07-146	Outside of project area
08-058	Near project area

Illustrative Materials

Figure 1: Map of Proposed LRT Route (City of Edmonton and Delcan)
Figure 2: Heritage Resources Project Map
Photos 1-3: Blackmud Creek Crossing

Evaluation

The proposed LRT line and associated facilities for the *South LRT Extension – Century Park to Ellerslie Road: Preliminary Design* are located within the City of Edmonton, and generally follow previously developed roadways and utility corridors (Figure 1). Surrounding previous developments include shopping centres and subdivisions, as well as the University of Alberta Experimental Farm at the south end of the project area.

Terrain in the project area is generally flat, but includes the Blackmud and Whitemud Creek valleys. In order to limit ground disturbance in the environmentally and culturally sensitive Blackmud Creek valley area, the LRT line is proposed to be integrated with the current crossing on 111 Street (Photos 1-4), with a bridge for the LRT line built to the west of the existing bridge. The line is also proposed to run through the eastern edge of lands currently used as the University of Alberta Experimental farm.

The proposed development area, especially the northern portion, has been heavily surveyed since 1979 (23 HRIA permits; 1 HRIM permit, and 1 Monitoring permit) for a variety of development projects, including subdivisions (79-200, 80-057, 86-081, 87-080, 01-332, 01-333, 02-112 04-168, 04-253), the Anthony Henday freeway and utility corridor (99-031, 99-133, 03-071), and local parks and trail systems (80-141, 90-085, 00-159). Survey under these permits has been focused in the areas near the Whitemud and Blackmud Creek valleys. These features indicate a high potential for the discovery of heritage resources, and a high number of archaeological sites have been previously discovered in the vicinity, generally found along the Whitemud Creek Valley and its tributaries to the west of the project area. A few sites are also located along the Blackmud Creek. Surveys for a variety of projects have been previously conducted in the vicinity of the 111St bridge at the Blackmud Creek, with no sites found within the project impact zone.

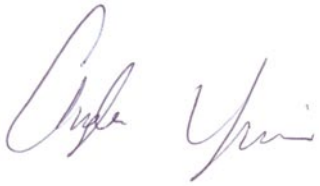
A total of 17 archaeological sites and 4 historic sites have been previously recorded near the project area, with many more located in the vicinity (Figure 2), however, no known sites are located within the project impact zone.. Two quarter sections of land within the project boundaries have been designated an HRV of 5 for archaeology due to the high number of large, significant archaeological sites found 500 m to the west of the project area, on lands designated HRV 4 near the Whitemud Creek. The majority of historic sites near the area are associated with mining activity in the Whitemud Creek valley, and will not be disturbed by the proposed LRT development.

The development of the Ellerslie Transit station will involve the disturbance of a large portion of the terrain designated an HRV of 5, and currently used as the University of Alberta Experimental farm (Figures 1 & 2). However, this land has been previously disturbed by cultivation, as well as by the development of numerous buildings and parking lots associated with the experimental farm. It is also located from 400 m to over 1 km away from the Whitemud Creek Valley edge, where most of the previously discovered sites in the vicinity are located.

Recommendations (*Recommendations regarding archaeological resources must be made by a professional archaeologist.)*

The proposed *South LRT Extension – Century Park to Ellerslie Road: Preliminary Design* is located within the City of Edmonton, and generally follows previously developed roadways and utility corridors. The project area includes land of high heritage potential, including sections designated an HRV of 5 for archaeology, and the Whitemud and Blackmud Creek valleys; however, the project area has been subjected to multiple previous surveys, and has been previously disturbed by municipal, commercial and residential construction. No previously recorded historic or archaeological sites will be disturbed by the development. The Blackmud Creek crossing is planned to be developed in the area of the existing bridge on 111 Street, thereby limiting ground disturbance and focusing within previously disturbed areas. The Ellerslie transit station, including train platform, transit centre, parking area, and associated roads and maintenance building, will be located on land designated an HRV of 5 for archaeology; however, these lands have been previously disturbed by cultivation and infrastructure associated with the University of Alberta Experimental Farm.

Due to intensive previous heritage survey activity and ground disturbance, there is a low potential for the discovery of intact, previously unrecorded heritage resources within the project area, and **no further work is recommended for the *South LRT Extension – Century Park to Ellerslie Road: Preliminary Design*.**

Recommendations made by:	Date:
 (Angela Younie)	July 3, 2009

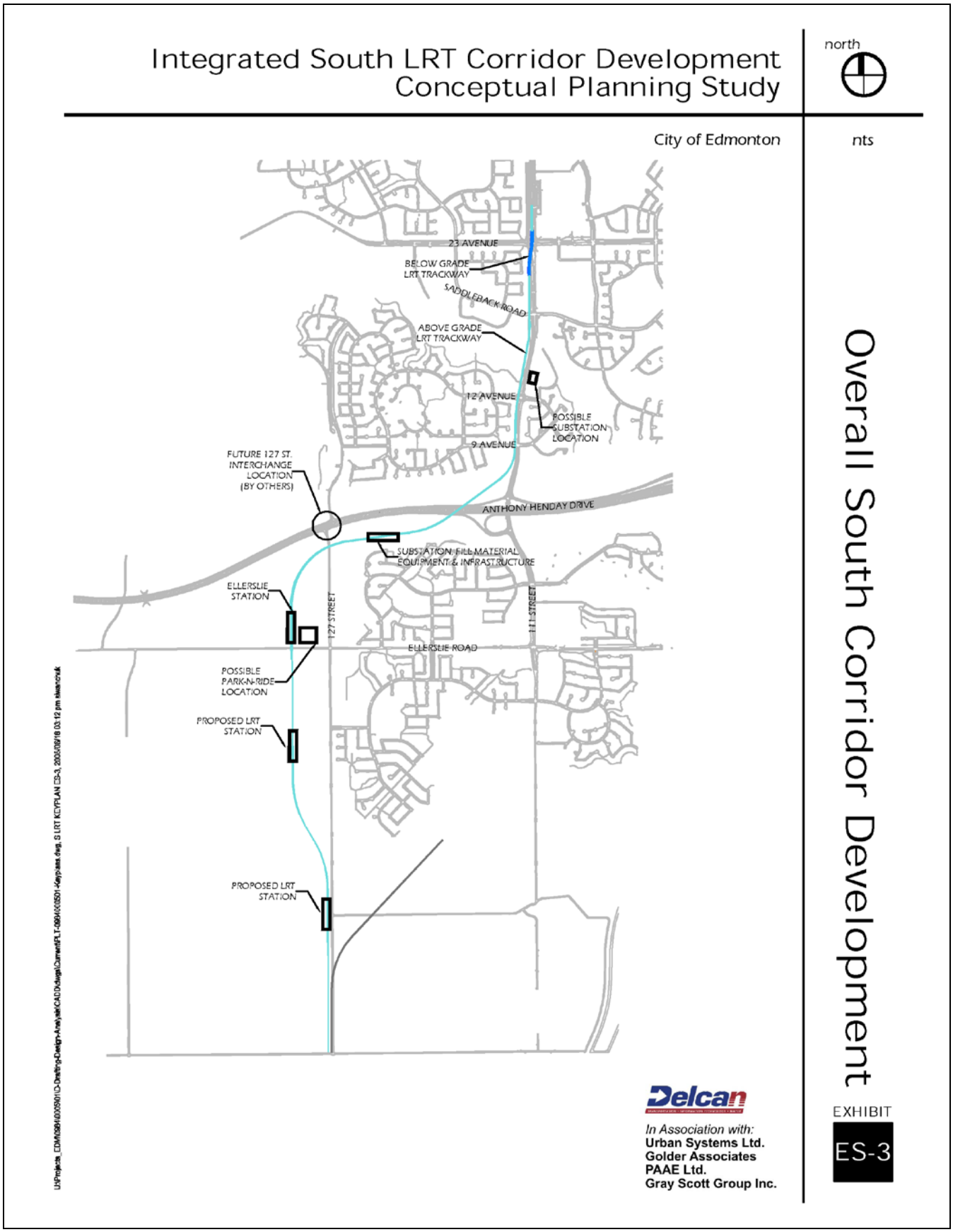
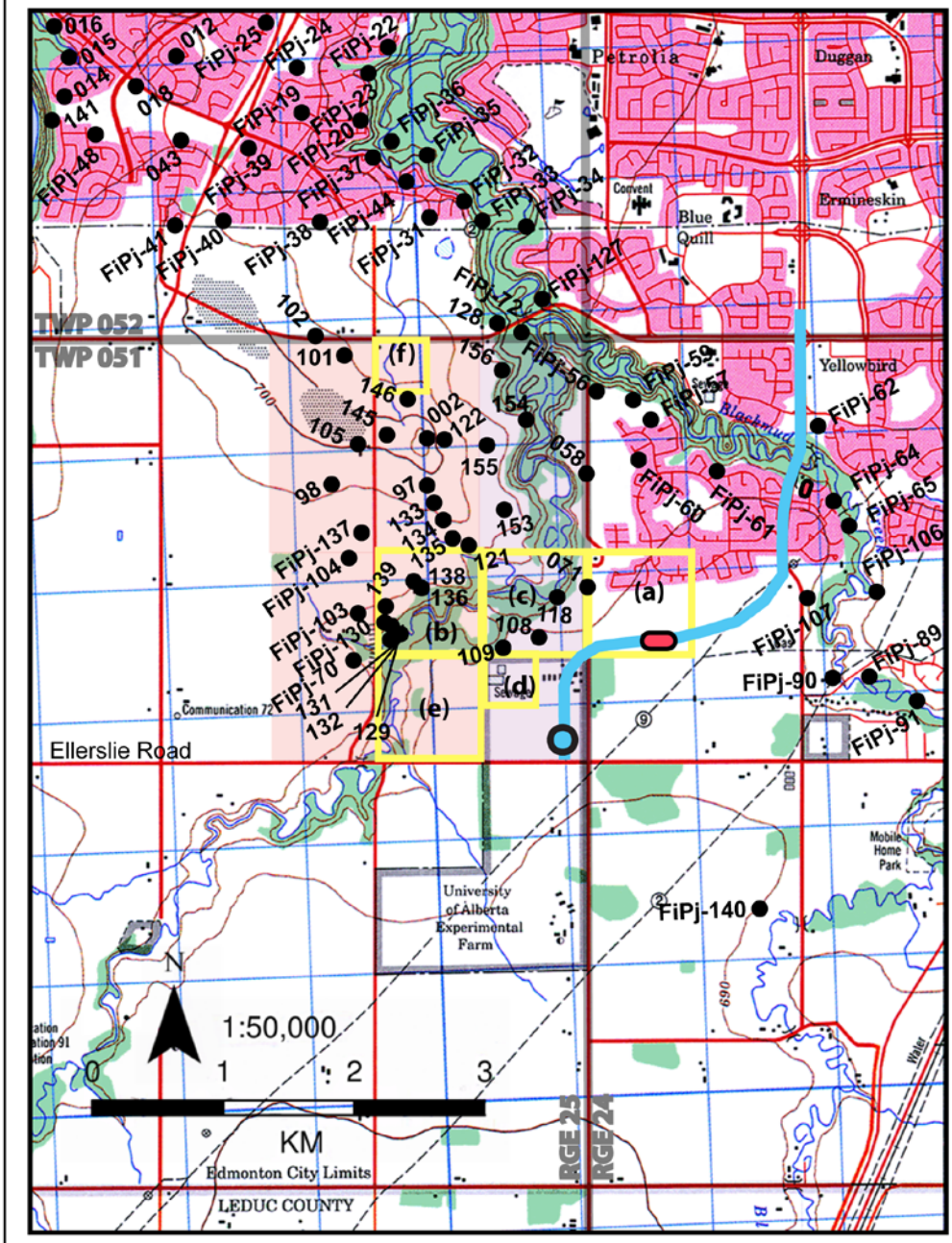


Figure 1: Route 2 as Recommended by the Integrated South LRT Corridor Development Conceptual Planning Study.



Integrated South LRT Corridor Development
Heritage Mall to Ellerslie Road

- LRT Line
- Station and Parking Lot
- Substation Location
- Historic Site Area
- Archaeological Site
- Land Designated HRV 4
- Land Designated HRV 5

Historic Sites:

(a) NW-30-051-24-W4M
Mine #1256 (48486)

(b) NW-25-041-25-W4M
Mine #877 (51135)
Mine #1177 (51136)
Mine #1059 (51137

11-25-051-25-W4M
Mine #1560 (51121)
Mine #1684 (51122)
Mine #1477 (51123)
Mine #29 (51139)

12-25-051-25-W4M
Mine #1022 (51140)
Mine #1285 (51125)
Mine #1462 (51126)
Mine #1559 (51127)

5 & 12-25-051-25-W4M
Mine #1748 (51124)

13-25-051-25-W4M
Mine #1646 (51129)
Mine #1594 (51128)
Shelter (81862; FiPj-136)

(c) NE-25-051-25-W4M
Mine #1750 (51130)

15-25-051-25-W4M
Mine #1658 (51131)

(d) 07-25-051-25-W4M
Mine #1492 (51118)

(e) 04-25-051-25-W4M
Mine #1419 (51119)

05-25-051-25-W4M
Mine #1233 (51120)

06-25-051-25-W4M
Mine #1034 (51138)

(f) 13-36-051-25-W4M
Rabbit Hill School (90765)

Figure 2: Heritage Resources Associated with the Integrated South LRT Corridor Development, Heritage Mall to Ellerslie Road.

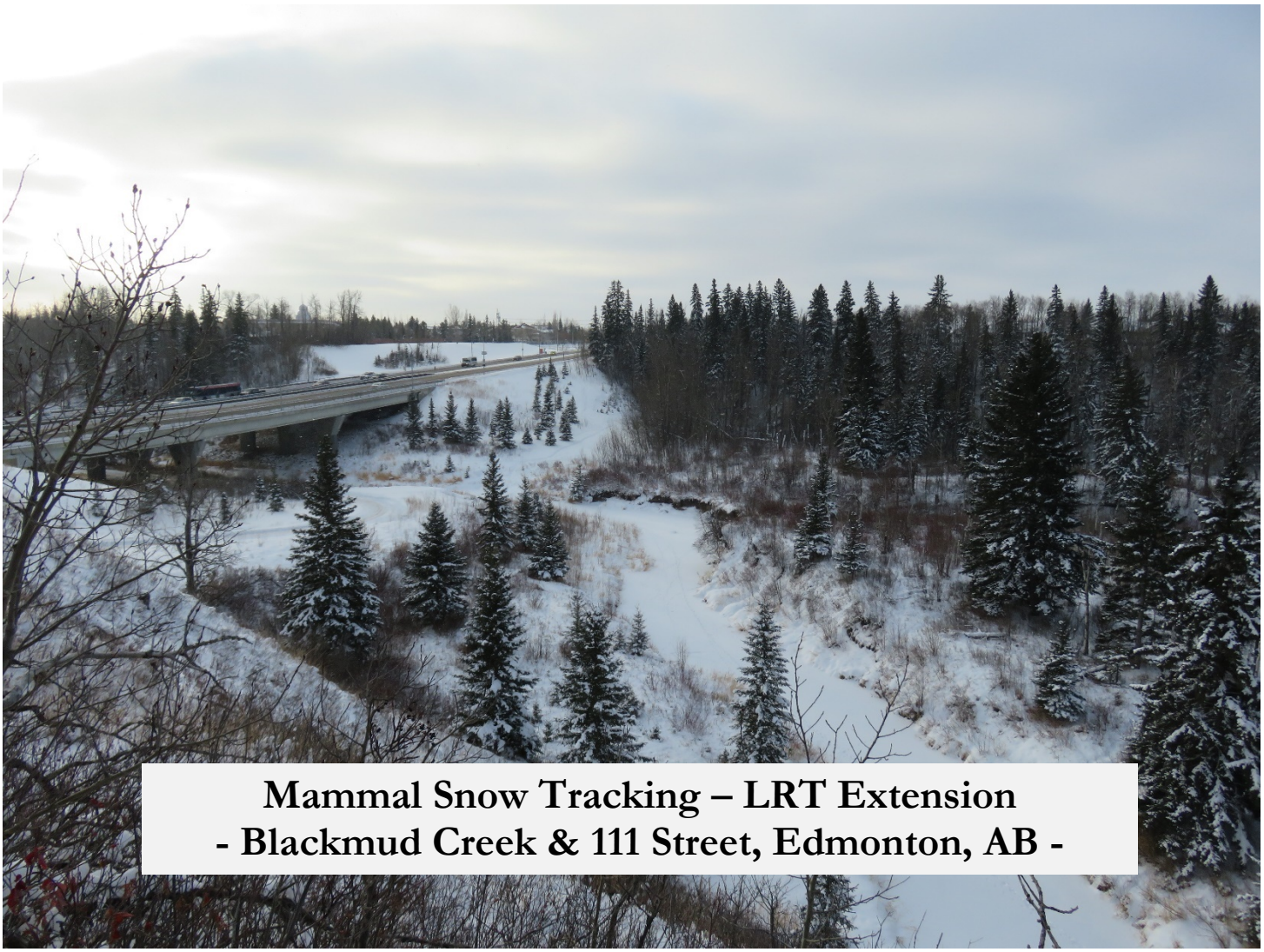
Photo 1: View southeast of current landscaping and roadway disturbances at the proposed Blackmud Creek Crossing

Photo 2: View southeast of current roadway and bridge disturbances on the west side of the bridge at the proposed Blackmud Creek crossing.

Photo 3: View west of landscaping and construction disturbances along 111 St, on the north side of the bridge. A detailed view of the disturbed terrain in the trees at the far left of this photo can be seen in Photo 4.

Photo 4: View facing east of the disturbed terrain on the north end of the bridge, at the top of the slope on the west side of 111 St.

Appendix D - Wildlife Survey Report



Mammal Snow Tracking – LRT Extension
- Blackmud Creek & 111 Street, Edmonton, AB -

Date: **March, 2018**

Prepared for: **Associated Engineering, Edmonton, AB**

Prepared by: **STRIX Ecological Consulting, Tofield, AB**
www.STRIXeco.ca

STRIX
Ecological

BACKGROUND

The City of Edmonton is planning the construction of a bridge over the Blackmud Creek ravine as part of the Light Rail Transit (LRT) extension in south Edmonton. Before construction begins, preliminary wildlife surveys must be completed to:

1) Catalogue species presence and abundance using snow tracking techniques, with focus on mammal species.
2) Locate animal high-use trails and important wildlife features.

The data collected will help in mitigating the impact of construction in this semi-wild environment. This survey was initiated to ensure compliance with the Alberta Wildlife Act.

STUDY AREA

The survey area consisted of about 10.5ha of forest, creek, and road allowance at the intersection of 111 Street and the Blackmud Creek, between 12 Avenue NW and 19 Avenue NW, in Edmonton, Alberta. All potential wildlife habitat within 150m of the proposed LRT line, outside of private property, was surveyed (Figure 1). The dominant habitat types included mature mixwood of white spruce and balsam poplar, young trembling aspen, and shrubland consisting of paper birch, wolf willow, red-osier dogwood, and wild rose.

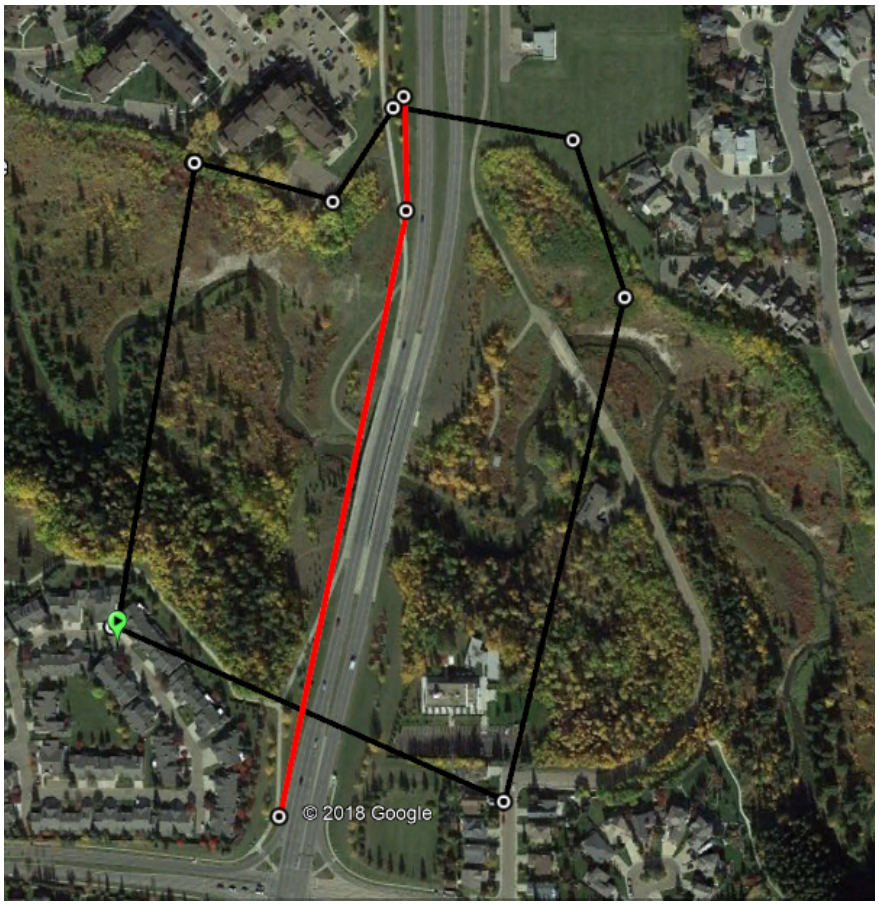


Figure 1: Study area, bounded in black, 150m to either side of the proposed LRT line (red).

METHODS

Snow tracking transect surveys were conducted on the second (2) and thirteenth (13) days after snowfall events. A snowfall event is defined as at least 1cm of fresh snow. New snowfall amounts were determined using Environment Canada's historical weather data (Government of Canada, 2018). Track eradication can also occur with strong wind events. Surveys were conducted on January 30 (day 2) and February 27 (day 13), 2018 by STRIX biologists Loreley Will Kaps and Meaghan Bouchard. Transects were spaced approximately 25m apart to ensure adequate coverage of the ravine. Surveys extended as far as 150m from the proposed LRT line within appropriate wildlife habitat but outside of private property. Both survey iterations were conducted on or near the same transects to provide comparable data (Figure 2).

Figure 2: Survey coverage 150 meters to either side of 111 street by biologists. Non-surveyed sections in the eastern portion were private land.

All fresh animal tracks and features were identified and marked on GPS, and notes were taken on species, number of individuals, trail presence, and other related observations. If tracks were too numerous to count, a presence of five (5) was recorded. The number of tracks observed does not correspond to the number of animals present, since a single track may be crossed by multiple survey transects, or the animal may travel back and forth on the same trail or area. The data generalizes what species were present and the areas most utilized.

RESULTS AND DISCUSSION

Species Presence

Over the two survey days, sign of 11 species were observed, including coyote, red fox, long-tailed weasel, least weasel, deer (assumed to be white-tailed deer), moose, snowshoe hare, white-tailed jackrabbit, red squirrel, beaver, and small rodents or shrews (Table 1). Only red squirrel and snowshoe hare were observed directly, indicating that these animals, especially deer and coyote, may be most active at night or twilight.

The most common sign observed was snowshoe hare (figure 6), which preferred localized patches of thick, bushy understory. White-tailed deer sign (figure 5) was found throughout but most commonly near the creek along trails. Round one showed a trail made by approximately three deer as they foraged and traveled through the ravine. Coyote was third most numerous (figure 3) and occupied all treed parts of the valley. Red squirrel sign (figure 7) was limited almost exclusively to the south bank among the white spruce trees. Small mammals, including mice, voles, and shrews (figure 8) were found in locations with long grass, most notably the naturalized ditches on either side of 111 Street, and natural openings in the trees. Long-tailed weasel (figure 4) tracks observed in round one show one or more individuals hunting in areas where mice and other small mammals might be found. Lastly, low numbers of sign were detected for beaver, red fox, least weasel, white-tailed jackrabbit and moose.

Several species of bird were observed during the surveys and included Pileated Woodpecker, Hairy Woodpecker, Downy Woodpecker, Rock Pigeon, Merlin, Common Raven, Blue Jay, Black-billed Magpie, Bohemian Waxwing, Black-capped Chickadee, Red-breasted Nuthatch, White-breasted Nuthatch and House Finch.

High-Use Trails

Several high-use trails created by coyote and white-tailed deer were noted (figure 10). The first was a coyote trail running along the ridge above the north bank, west of 111 Street. It connected trails in the ravine bottom with hare-rich hunting locations and lead east over 111 Street to another short trail. The next major trail system ran along the creek edge through the open brushy area, converging under the bridge. This was used heavily by both deer and coyote, and likely used for both foraging/hunting and travel. Lastly, the frozen creek itself was used as a pathway. All trails avoid overlap with or scatter near man-made paths and roads.

Potential conflict areas occur west of 111 Street on the south side of the creek, especially along the edge of the trees and into the shrub/birch habitat near the creek. This area seems to be a crossroads for both coyote and deer and if blocked by construction could disrupt their movement along the creek.

Table 1: Species and the number of their sign observed during each round.

Species	Round 1 (January 30)		Round 2 (February 27)	
	Number of sign Observed	Number observed	Number of sign Observed	Number observed
Beaver	0	0	3	0
Coyote	82	0	57	0
Least weasel	0	0	1	0
Long-tailed weasel	16	0	0	0
Moose	0	0	1	0
Red fox	0	0	2	0
Red Squirrel	33	1	61	1
Small rodents or shrews	30	0	23	0
Snowshoe hare	75	0	76	1
White-tailed deer	18	0	81	0
White-tailed jackrabbit	0	0	1	0

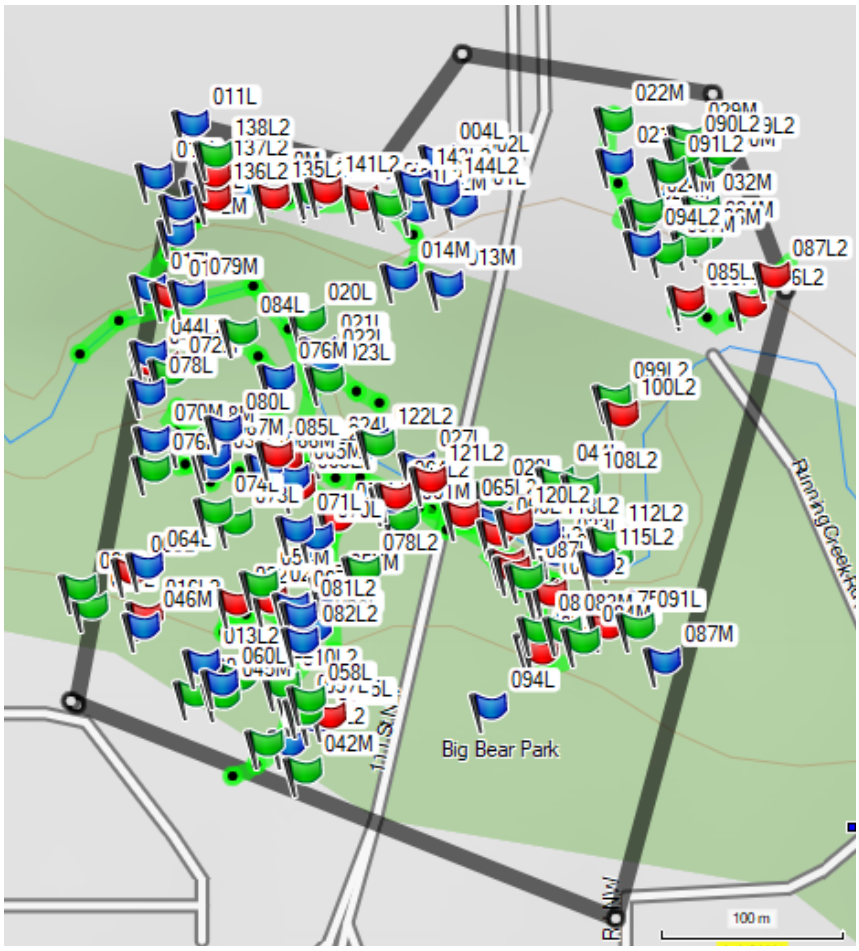


Figure 3: Coyote presence within the study area. Red flags indicate the highest concentration where more than five (5) tracks or sign were observed. Blue flags represent moderate concentration of 2-4 sign. Green flags represent single sign observations. Green lines represent high-use trails.

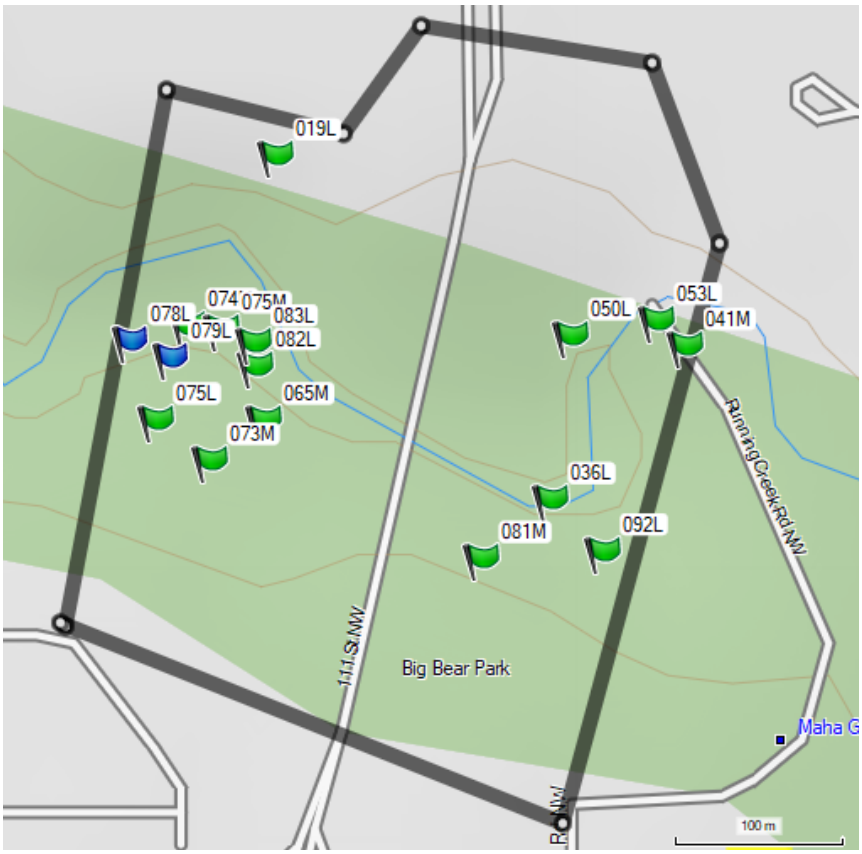


Figure 4: Long-tailed Weasel presence within the study area. Blue flags represent moderate concentration of 2-4 sign. Green flags represent single sign observations.

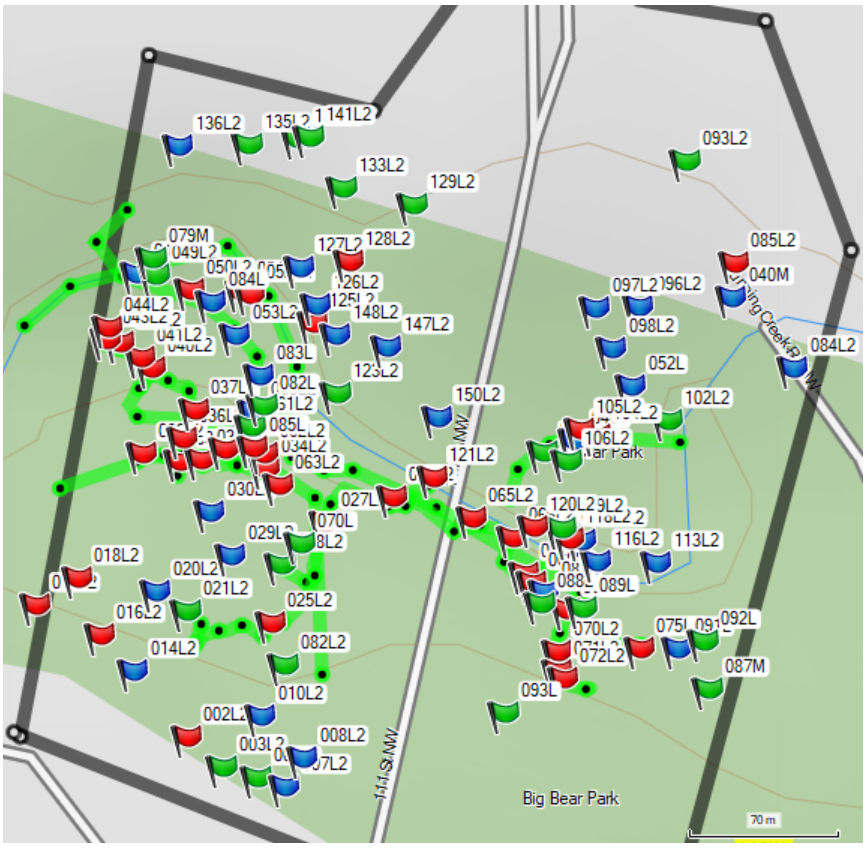


Figure 5: White-tailed deer presence within the study area. Red flags indicate the highest concentration where more than five (5) tracks or sign were observed. Blue flags represent moderate concentration of 2-4 sign. Green flags represent single sign observations. Green lines represent high-use trails.

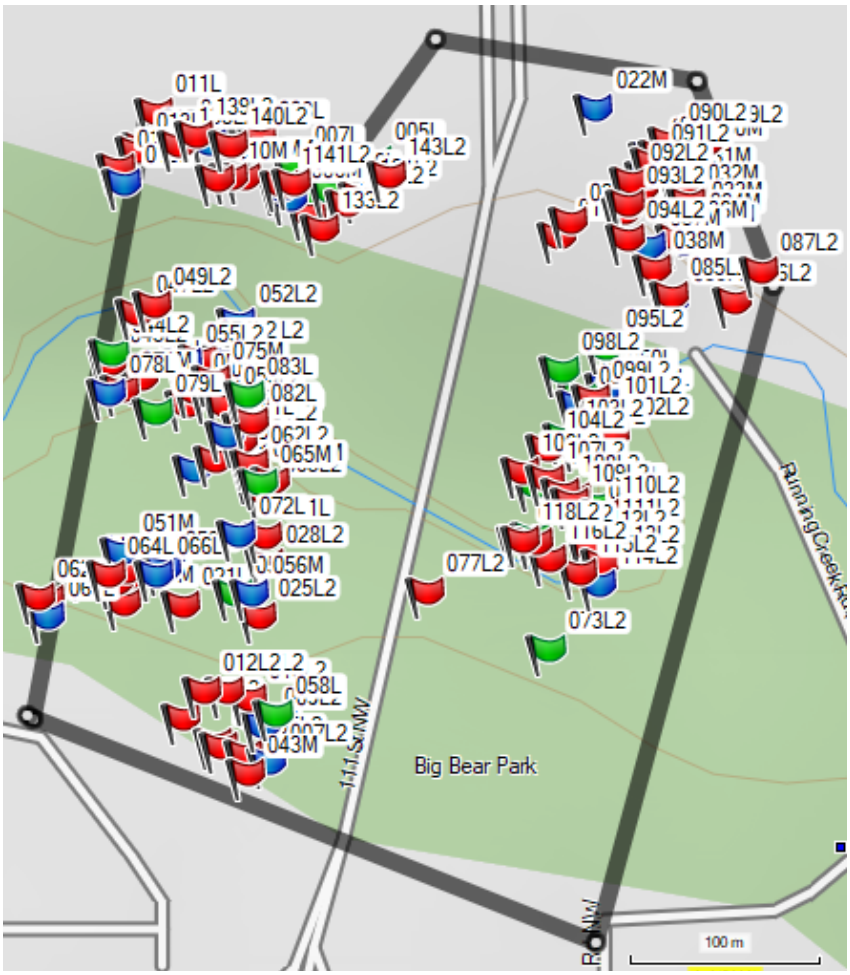


Figure 6: Snowshoe hare presence within the study area. Red flags indicate the highest concentration where more than five (5) tracks or sign were observed. Blue flags represent moderate concentration of 2-4 sign. Green flags represent single sign observations.

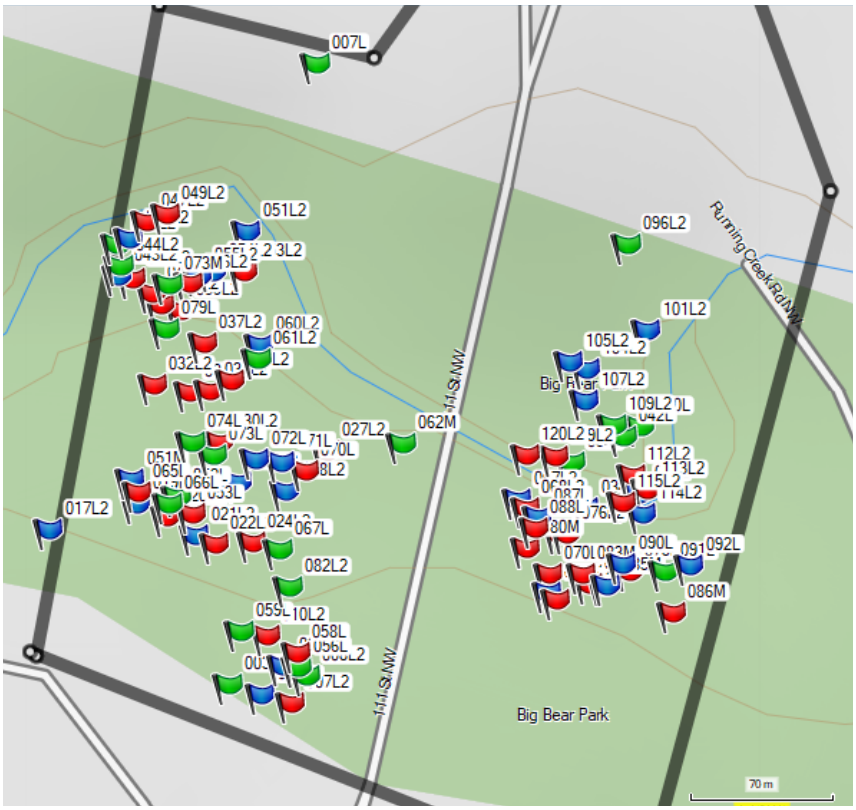


Figure 7: Red squirrel presence within the study area. Red flags indicate the highest concentration where more than five (5) tracks or sign were observed. Blue flags represent moderate concentration of 2-4 sign. Green flags represent single sign observations.

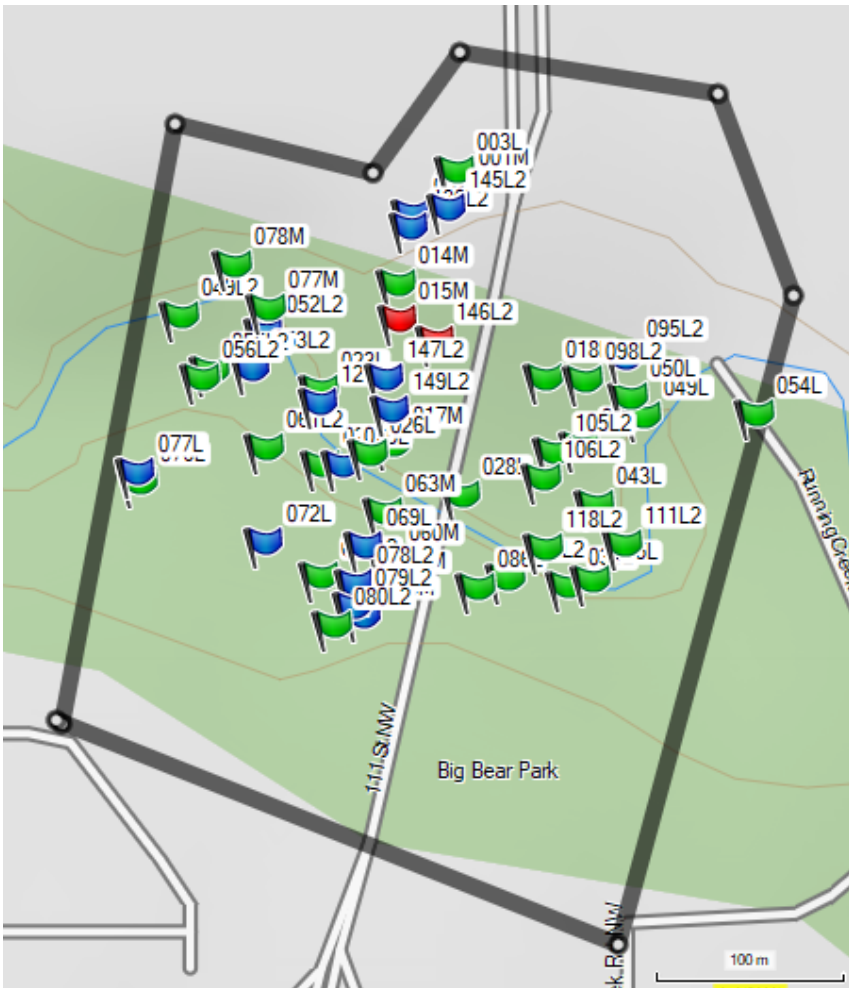


Figure 8: Small mammal (mouse, vole, and shrew) presence within the study area. Red flags indicate the highest concentration where more than five (5) tracks or sign were observed. Blue flags represent moderate concentration of 2-4 sign. Green flags represent single sign observations.

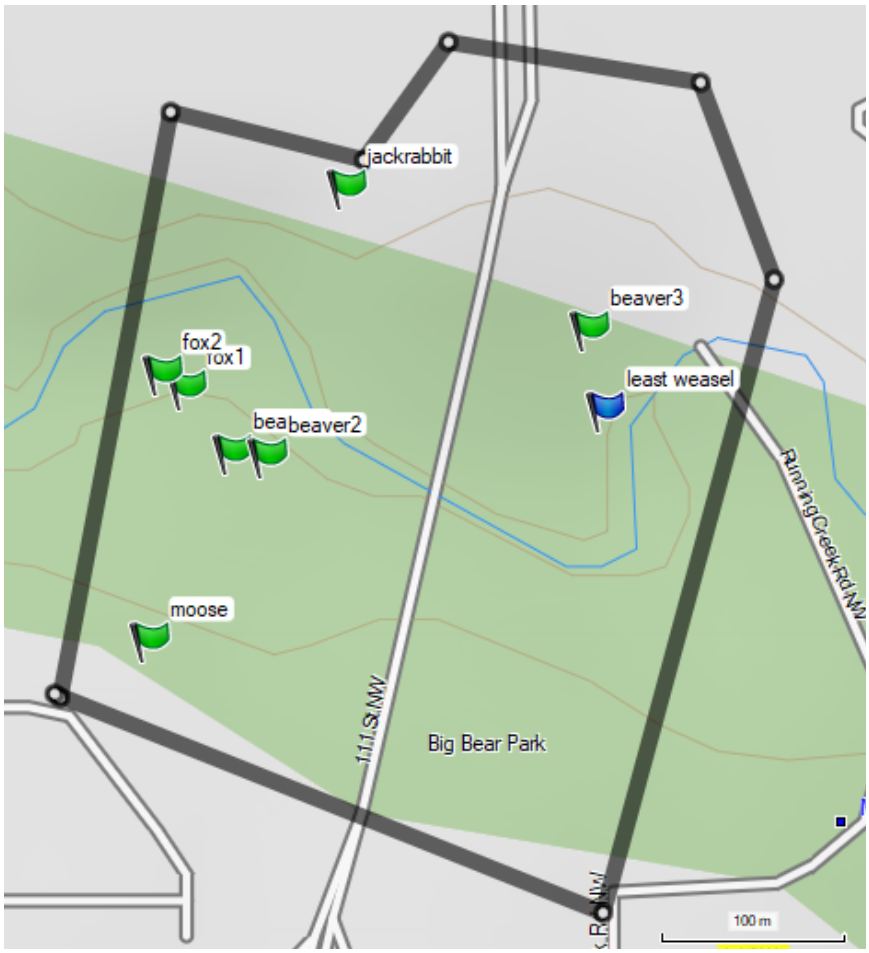


Figure 9: Other mammals present in small numbers within the study area. Blue flags represent moderate concentration of 2-4 sign. Green flags represent single sign observations.

Figure 10: High-use trails by coyote and white-tailed deer. The deer symbol represents the location with the highest risk of conflict.

SUGGESTED MITIGATION

1) Minimize activity directly in the ravine, especially in the treed and shrubby areas.
2) Minimize construction activity at night. Excess noise and light may be detrimental to the presence and movement of nocturnal or crepuscular animals such as deer, moose, and coyote.
3) Avoid constructing on high-use trails, especially on the west side of 111 Street, or using these areas to store equipment or building material.
4) Keep all equipment and material out of the creek and prevent runoff of silt and pollutants into the creek.
5) Restrict tree and vegetation removal to months outside of birthing and nesting season (mid-April to mid-August) (Migratory Birds Convention Act 1994, and Wildlife Act 2000). If vegetation must be removed during this period, a nest search of the area by a biologist is strongly recommended.
6) Continue to monitor animal presence during and post construction.

Deer tracks

LITERATURE CITED

Government of Alberta. 2017. Alberta Environment and Parks. Online: aep.alberta.ca/

Government of Canada. 2018. Past Weather and Climate - Historical Data. Online: http://climate.weather.gc.ca/historical_data/search_historic_data_e.html.

Migratory Birds Convention Act, 1994. 1994. Minister of Justice, Canada. Online: http://laws-lois.justice.gc.ca/eng/acts/M-7.01/.

Wildlife Act. 2000. Province of Alberta. Alberta Queen's Printer, Edmonton, AB. Online: http://www.qp.alberta.ca/documents/Acts/W10.pdf.

CLOSURE

STRIX Ecological Consulting (STRIX Environmental Consulting Ltd., hereafter STRIX) prepared this report for Associated Engineering. This report reflects the professional opinion of STRIX based on information provided by Associated Engineering and otherwise available at the time of writing. This report is not intended for general circulation or publication. STRIX will not assume or otherwise accept responsibility or liability for losses incurred by the city or other parties as a result of the circulation, publication, reproduction, use of or reliance on this report contrary to the provisions discussed in this paragraph.

STRIX would like to thank Associated Engineering for the opportunity to work on this project. If there are any questions or if further clarifications are required, please contact the undersigned by telephone at 780-662-4909 or email info@STRIXeco.ca.

Sincerely,

_____

Chuck Priestley, M.Sc., P.Biol.
Principal, STRIX Ecological Consulting

ADDITIONAL PHOTOS

White-tailed deer print

Coyote print

Long-tailed weasel track

Red squirrel track

White-breasted Nuthatch

Red fox print

Black-capped Chickadee

Pileated Woodpecker

Snowshoe hare tracks

Appendix E - Site Photographs

Photo 1
Blackmud Creek facing east under existing bridges

Photo 2
Blackmud Creek flowing southeast from northwest part of site

Photo 3
Maintained grass and non-maintained grass site type on northwest side of site

Photo 4
Existing bridge and walking trail along northwest side of site

Photo 5
Forested vegetation community on northeast side of existing bridges

Appendix F - **Geotechnical Investigation**

PRELIMINARY GEOTECHNICAL REPORT
SLRT - PROPOSED BRIDGE OVER BLACKMUD CREEK
EDMONTON, ALBERTA

Submitted To:

AECOM
EDMONTON, ALBERTA

Submitted By:

AMEC EARTH & ENVIRONMENTAL
EDMONTON, ALBERTA

28 January 2010

File No. EG09681.BMC

TABLE OF CONTENTS

PAGE

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Appendix A

1.0 INTRODUCTION

1.1 GENERAL

AMEC Earth and Environmental was retained by AECOM to carry out geotechnical investigations for the preliminary engineering phase of the South Extension of the Edmonton Light Rail Transit (LRT) project which extended from Century Park to Ellerslie Road. The purpose of the investigations was to assess the soil and groundwater conditions and provide preliminary geotechnical recommendations for the design and construction of the proposed extension.

This report addresses the proposed LRT Bridge over Blackmud Creek that is to be located immediately west of the existing northbound and southbound 111th Street roadway bridges in south Edmonton. Other geotechnical components of the South LRT project have been (or will be) addressed under separate cover.

1.2 OVERALL PROJECT DESCRIPTION

It is understood that the overall project comprises the extension of the Edmonton LRT from Century Park Station (just north of 23rd Avenue on 111th Street), southward and westward to Ellerslie Road. The alignment of the proposed South LRT extension was based on the 'Century Park to South City Limit Integrated South LRT Corridor Development Conceptual Planning Study' approved by the City of Edmonton (the City) in July 2008. The proposed southwest LRT extension includes an underpass at 23rd Avenue, a bridge over Blackmud Creek, an overpass across Anthony Henday Drive, an Operations and Maintenance Facility, a permanent Park-N-Ride facility, and an LRT Station at the Ellerslie Road terminus.

1.3 BLACKMUD CREEK CROSSING

At the proposed LRT Bridge crossing of Blackmud Creek, the uplands on either side of the valley are fairly flat-lying with the ground dropping off very gently in the north-westerly direction. The Blackmud Creek valley is approximately 20 metres deep along the proposed LRT alignment and is generally quite broad in relation to the size of the creek channel. The width from valley crest to valley crest is approximately 300 m. The north and south valley slopes typically ranged from 3H:1V to 5H:1V with some steeper sections standing near vertical.

The major part of the bedrock profile exposed along the creek valley walls consisted of clay shale with poorly cemented sandstone often being observed at creek level. Some bentonitic layers were also observed during the previous geotechnical investigation for the existing 111th Street Bridge in 1980 by Hardy Associates (1978) Limited[1]. Within the valley of Blackmud Creek, the vegetation consisted of mainly black poplar, black spruce and willow near creek

[1] Hardy Associates (1978) Limited is a predecessor company of AMEC Earth & Environmental

level, with white poplar and white spruce on the slopes in better drained upper areas. The undergrowth consisted of low bushes and grasses.

1.4 EXISTING 111TH STREET BRIDGES

At present, a pair of bridges adjacent to one another carry northbound and southbound 111th Street traffic over Blackmud Creek between Saddleback Road (19th Avenue) and 12th Avenue in south Edmonton as shown on Figure 1. These two structures (referred to herein as the West and East Bridges) were constructed in 1994 and 2007, respectively for vehicular traffic. The pier and abutment foundations for both bridges were completed in 1994 during the construction of the West Bridge.

The existing bridges over Blackmud Creek are both 3-span concrete girder bridges, each with a length of 96 m (36 m between both piers and 30 m between the abutments and piers). The bridge piers were supported on spread footings bearing on bedrock; whereas the abutments were supported on steel H-piles driven into the bedrock. The north approach abutment was built on fill of up to 9 m thickness, while the south approach abutment was built on a cut surface about 6 m below the original grade.

1.5 PROPOSED BRIDGE STRUCTURE

The proposed bridge structure for the LRT extension is to be located on the west side of the two existing vehicular bridges. According to the latest design configuration (December 18, 2009), the bridge would be a 3-span concrete girder bridge about 108 m long and 15 m wide.

The proposed LRT Bridge would have a vertical profile similar to that of the two existing bridges. The LRT Bridge will also accommodate a multi-use walkway/trail immediately along its west side. Based on this bridge concept, the abutments of the proposed LRT Bridge will be positioned on the lower portion of the valley slopes at about 2 to 6 m above the existing ground. It is understood that two types of abutment configurations are under consideration including:

- A concrete wing-wall (i.e. open box abutment) structure on piles with no fill behind the wall.
- A bridge abutment supported on piles with MSE walls to retain fill behind the abutments.

Besides the two options mentioned above, consideration was also given to lengthening the bridge structure to reduce the size of the abutments. This will require less fill for the MSE option; therefore, reduce the impact on the stability of the valley wall. For the wing-wall abutment option, the length of the abutment could be reduced.

Outside of the abutment area, the LRT alignment will be in cuts generally less than 3 m in height. Reinforced slopes or retaining walls may be required at either side of the LRT alignment beyond the abutments if stable cut slopes cannot be achieved due to space limitations in the cut area.

2.0 FIELD AND LABORATORY PROGRAMS

2.1 PREVIOUS INVESTIGATIONS

Geotechnical information (boreholes, laboratory test data, etc.) from previous investigations along the alignment of the proposed SLRT extension was assembled and discussed in a Desktop Study[2] prepared by AMEC. Previous boreholes located in the vicinity of the Blackmud Creek crossing are summarized in Table A-1 in Appendix A, together with boreholes from the current investigation. Logs of these boreholes are also included in Appendix A.

2.2 CURRENT GEOTECHNICAL PROGRAM

2.2.1 Field Investigation

As part of the 2009 investigation, four boreholes (BH09-9 to BH09-12) were drilled in the vicinity of the proposed LRT Bridge at the locations shown on Figure 1. The locations of the boreholes were selected in plan by AMEC and were surveyed by Stantec shortly after drilling completion. Locations of these boreholes were selected before the bridge configuration was known. In addition, no boreholes were planned for the bridge piers. Boreholes from the previous and current investigations are considered sufficient for the preliminary assessment. However, site specific confirmatory borings should be advanced at the pier and abutment locations in detailed design stage.

Boreholes BH09-09 and BH09-12 were both drilled to depths of 8.8 m on the north and south valley uplands, respectively, along the LRT alignment and approximately 150 m back from the valley crest. Boreholes BH09-10 and BH09-11 were drilled near the valley crest on both sides of the valley to depths of 17.6 m. The four boreholes were advanced using a truck-mounted M5 drill equipped with 150 mm diameter solid-stem augers.

An AMEC technologist supervised the drilling and soil sampling, and logged the various soil strata. AECOM had a representative on site to retrieve environmental samples for environmental baseline testing. After drilling completion, the boreholes were backfilled with the drill cuttings and capped with bentonite chips at the ground surface. The borehole logs are presented in Appendix A. All soil samples and auger cuttings were classified in accordance with the modified Unified Soil Classification System (USCS), which is also described in Appendix A.

The soil sampling and testing sequences are shown on the borehole logs. In general, soil sampling and testing consisted of:

- Disturbed auger samples for moisture content determinations and soil index tests;

[2] AMEC Earth & Environmental, *South LRT Extension (Century Park to Ellerslie Station) Preliminary Engineering Phase: Desktop Factual Study of Existing Geotechnical Information*, File No. EG09681, May 29, 2009

- Standard Penetration Tests (SPTs) typically at 1.5 m intervals. The number of blows required to drive the SPT split-spoon sampler 300 mm into the soil (after an initial 150 mm seating drive) were noted and plotted on the borehole logs as the SPT 'N' values. The Standard Penetration Test is described on the Explanation Sheets contained in Appendix A.
- 'Undisturbed' Shelby Tubes samples for soil strength testing.

Groundwater seepage and sloughing conditions were monitored during drilling and at drilling completion. In addition, 25 mm diameter PVC slotted standpipes were installed in Boreholes BH09-10 and BH09-11 for the monitoring of longer-term groundwater levels. The standpipe installation details and the measured water levels are noted on the borehole logs in Appendix A. Groundwater levels in the standpipes were measured by AMEC personnel twice (2 weeks and 7 weeks) after drilling completion.

2.2.2 Laboratory Testing

In addition to routine moisture content determinations, four sets of Atterberg Liquid and Plastic Limits were performed on samples of the near-surface clay and clay till soils. Also, two unconfined compressive strength tests were performed on samples of glacio-lacustrine clay and clay till. The results of laboratory testing from both current and previous investigations are shown on the borehole logs and summarized in Table A-2 in Appendix A.

3.0 SUBSURFACE CONDITIONS

3.1 GENERALIZED STRATIGRAPHY

In general, the soil stratigraphy on the uplands of the valley consisted of organic topsoil overlying clay fill and lacustrine clay underlain by clay till followed by bedrock of Edmonton Formation (interbedded clay shale and sandstone). Within the clay till deposit, random discontinuous sand layers and lenses were encountered at various depths. At the bottom of the Blackmud Creek valley, the general stratigraphy consisted of thin alluvial deposits over shallow bedrock, typically at 1.5 to 2.5 m below the ground surface.

A ground profile illustrating the soil stratigraphy along the proposed LRT bridge alignment is presented on Figure 2. Detailed descriptions of major soil units are presented in the following subsections.

3.1.1 Fill

Fill was encountered in all current boreholes and in 7 previous boreholes at ground surface and extended to depths between 0.5 and 2.5 m. The fill was primarily clay with the upper 0.2 to 0.3 m consisted of organic topsoil. Topsoil fill over 1 m thick was observed in Borehole 92-3. The clay fill was likely originating from the local lacustrine clay or clay till. In Borehole 92-1, about 0.5 m of sand fill was encountered beneath the clay fill.

The clay fill was observed as silty, medium to high plastic, light brown to grey and contained varying silt pockets, sand inclusions, gravel and organics. As shown on Figure 3, Atterberg liquid limits of 44 to 67 percent with corresponding plastic limits of 13 to 22 percent were measured on samples of fill and are indicative of medium to high plasticity. Moisture contents measured in the clay fill ranged between 19 and 37 percent with most values between 20 and 25 percent. Comparing to its plastic limit, the moisture content of the fill was generally at 0 to 8 percent wet of the Optimum Moisture Content.

SPT 'N' values in the fill varied from 5 to 24 blows per 0.3 m penetration, with most values over 10 blows per 0.3 m, which is indicative of a stiff to very stiff state of consistency. Moisture contents and SPT 'N' values of the fill were plotted versus elevation on Figure 4.

3.1.2 Lacustrine Clay

Glacio-lacustrine clay was encountered beneath the clay fill and/or topsoil in all test borings located on the uplands commencing at depths varying between 0.3 and 2.5 m. The clay extended to depths between 3 and 7 m in deeper boreholes and to the depths of exploration in five shallower boreholes.

The clay was generally silty, medium to high plastic, with consistencies varying from stiff to very stiff. Random sand and silt lenses, gravel pockets, sulphate crystals, and rusty nodules, were observed in the clay deposits. SPT 'N' values in the clay varied from 5 to 35 blows per 0.3 m penetration with a majority of values in the range between 10 and 20 blows per 0.3 m, which is indicative of a stiff to very stiff state of consistency. Unconfined compressive strengths of 90 to 175 kPa were measured on four clay samples.

Ten (10) sets of Atterberg Limits tests on the clay samples showed liquid limits from 42 to 67 percent with plastic limits from 20 to 24 percent, as shown on Figure 3. The test results generally indicated that the clay was of medium to high plasticity. Moisture contents of the clay ranged from 12 to 42 percent with most values between 25 to 35 percent. Compared to its Atterberg plastic limits, the natural moisture contents of the majority of the clay was generally in excess of 5 percent wet of its Optimum Moisture Content. Moisture contents and SPT 'N' values in the lacustrine clay were also plotted on Figure 4.

3.1.3 Clay Till

Clay till was encountered beneath the glacio-lacustrine clay in most of the deeper borings positioned on the uplands commencing at depths between 4 and 7 m below surface. Where encountered, clay till extended to the depths of exploration in shallower boreholes and to depths between 8 and 13 m in deeper boreholes.

The clay till was a silty, sandy clay matrix interspersed with random small pebbles, sand lenses and partings. Coal pieces, gypsum crystals and sandstone nodules were also encountered at

varying depths. Common in till deposits are randomly scattered cobbles and boulders. The till was generally of low to medium plasticity with Atterberg liquid limits of 26 to 50 percent and corresponding plastic limits of 13 to 20 percent (see Figure 3).

As shown on Figure 4, the moisture content of the till varied from 12 to 25 percent, with a majority of values between 16 and 22 percent. SPT 'N' values in the till ranged from 12 to 70 blows per 0.3 m penetration, which is indicative of a stiff to hard consistency. This was also confirmed by unconfined compressive strengths of 260 to 560 kPa, measured on seven till samples.

Sand and silt pockets, layers, and lenses were encountered within or immediately above the clay till at varying depths. The thickness of these sand deposits varied between 0.5 and 2.2 m. The sand was generally fine grained, silty, and in a compact to dense state of relative density. One grain size analysis conducted on the 'sand and silt' layer in BH09-10 showed 34 percent sand, 52 percent silt and 14 percent clay.

3.1.4 Alluvial Sediments

Alluvial sediments were encountered in the four boreholes previously drilled at the bottom of the Blackmud Creek valley for the 111th Street bridges. The alluvial sediments consisted of particle sizes varying from sand to clay depending on the depositional environment. Tree branches, rootlets, and other organic debris were also commonly found in the alluvial sediments. At the borehole locations, the alluvial sediments were generally silty sand with clay interbeds and were in a compact state of relative density. The thicknesses of the alluvial sediments ranged between 1.5 and 2.5 m at the borehole locations; however, the thickness could vary considerably at the valley bottom.

3.1.5 Edmonton Formation Bedrock

Bedrock of the Edmonton Formation was encountered in the 4 boreholes at the bottom of the Blackmud Creek valley, and in 7 deeper borings located on the uplands. At the bottom of the valley, the top of bedrock encountered at the borehole locations was at depths of 1.5 to 2.5 m, corresponding to elevations varying from 655.5 to 657.5 m. On the upland and valley wall, the top of bedrock was encountered at 8 to 12.5 m below surface, corresponding to elevations varying from 663.5 to 669.5 m. The difference in bedrock surface elevation between the valley bottom and the upland suggests that the bedrock within the valley has been eroded to its current elevation and has been covered with alluvial sediments.

The bedrock consisted of interbedded sandstone and clay shale with random coal and bentonite seams. The sandstone observed at borehole locations was generally poorly-cemented fine grained sand with various clay contents. At shallow depths, the sandstone had undergone considerable weathering and was typically considered 'hard soil' rather than 'weak rock'. SPT 'N' values measured in the sandstone were generally greater than 50 blows per 0.3 m penetration. It should be noted that the strength of sandstone could vary considerably over

quite short distances depending on the degree of cementation. Well-cemented sandstones typically have high strength and are quite resistant to erosion by running water. Weakly-cemented sandstones, which usually have low clay content, usually soften very quickly upon contact with water.

The clay shale was highly weathered, high plastic, and in a hard state of consistency (in termd of soil classification). As shown on Figure 3, the Atterberg liquid limits of the shale were generally over 80 percent, which was indicative of high plasticity. The bonding between the clay particles in the clay shale is physical, rather than chemical, which leads to rapid breakdown upon exposure. The clay shale usually disintegrates very rapidly when unconfined and subjected to wetting and drying cycles.

During the current investigation, coal seams up to 0.4 m in thickness were encountered on top of bedrock in Boreholes BH09-10 and 11. The coal seams are water bearing zones and commonly observed along the valley wall of Blackmud Creek.

Bentonite seams approximately 0.2 m thick were noted in two previous boreholes (93-1 and 93-2), interbedded in the bedrock. The bentonite seams are the principal weak plane of the local bedrock and usually governing the instability of the valley slope in the region. However, the consistency of the bentonite seams and its continuity were not known.

3.2 GROUNDWATER OBSERVATIONS

In general, groundwater on the upland tends to discharge into the valley of Blackmud Creek. As a result, groundwater levels monitored in the boreholes are highly dependent on the location of the borehole relative to the valley profile.

At the valley bottom, relatively shallow groundwater was expected and the groundwater level was considered to be close to the water level in the creek. This was confirmed by shallow water level (2 m below surface 9 days after completion) measured in Borehole TH-2(1980). In this case, the groundwater was contained in the alluvial deposits above the bedrock.

The groundwater level was relatively deep on the valley wall, about 8 to 10 m below the ground surface measured at the borehole locations. Over the upland away from the valley wall, the groundwater level was generally at 2 to 3 m from the ground surface.

The measured groundwater levels at the borehole locations are summarized in Table A-1.

3.3 WATER SOLUBLE SULPHATES (SO_4)

Five water-soluble sulphate tests were performed on selected soil samples from both previous and current investigations. The results indicated concentrations of water soluble sulphates from less than 0.03 to 0.7 percent, expressed as weight of sulphates to dry weight of soil. The higher

reported concentration is considered to be indicative of 'severe' potential of sulphate attack on subsurface concrete. The test results are summarised in Table A-2.

4.0 GEOTECHNICAL EVALUATIONS

It is understood that the shallow foundations used to support the existing bridge piers have performed satisfactorily to date. Based on a review of the subsurface conditions at the bridge crossing and the performance of the existing pier foundations, the recommended foundation type for supporting bridge piers constructed near the valley bottom is shallow footings on bedrock, similar to the two existing bridges. Pile foundations could also be considered for bridge piers. Due to the presence of very hard sandstone layers at shallow depths, the most appropriate type of pile foundations would be rock socket cast-in-place concrete piles. Recommendations for pile foundations for bridge piers could be provided on request.

Pile foundations are recommended at the bridge abutments, and both driven steel 'H' piles and cast-in-place concrete piles (including conventional drilled shaft and CFA piles) may be considered as appropriate pile types. Due to the random presence of water bearing sand lenses and pockets in the clay till, temporary casings may be required for the installation of conventional drilled shafts. Driven open-end pipe piles could also be considered; however, heavy pipe section (i.e. thick wall) and higher grades of steel may be required to limit pile damage and to attain the required penetration into the bedrock.

Significant cut and fill was undertaken during the previous development of the two roadway bridges, which resulted in relatively flat valley slopes at the location of the proposed LRT Bridge crossing. The bridge abutments will be positioned on the lower portion of the valley slope at about 2 to 6 m above the existing groundline. It is understood that two abutment configurations were being considered, including:

- A concrete wing-wall structure on piles with no fill behind the wall (unfilled structural box abutment). A similar configuration has been used for the two existing 111th Street bridges across Blackmud Creek. Since no additional fill is required, this configuration will have minimal impact on the stability of the valley walls. A major disadvantage of this configuration is that long side walls (~ 60 m) would be required for both abutments.

- A smaller abutment on piles with MSE walls to retain the abutment fill. This configuration eliminates the need for a long abutment and, therefore, requires a shorter length of structurally supported trackway. However, MSE fill placed on top of the valley wall will reduce the stability of the existing valley slope. The potential for deep-seated failures (i.e. failures through weathered bentonite or coal seams in the bedrock) of the valley slope needs to be considered for this configuration. In addition, MSE walls will require further excavation and levelling of the existing ground to achieve sufficient embedment of reinforcing strips within the reinforced zone of the walls.

Outside the abutment area (north of Station 411+820 and south of Station 412+000), permanent cuts up to 3 m in height will be required on both sides of the alignment where the existing

ground is higher than the proposed gradeline. In areas where excavation of side slopes to stable slope angles is not feasible due to space limitations, reinforced slopes or MSE walls will be required. Concrete soldier pile walls using drilled cast-in-place concrete piles or CFA piles as recommended in Subsection 5.4.2 could also be considered. The soldier pile wall should be designed for lateral earth pressure presented in Subsection 5.5.1. Conventional concrete gravity walls may not be feasible since large embedment will be required to resist frost action.

5.0 GEOTECHNICAL RECOMMENDATIONS

5.1 CUT SLOPES

Permanent excavations will be required to attain the design gradeline at locations north of Stn 411+820 and south of Stn 412+000. It is expected that the majority of permanent cuts will be less than 3 m depth. Based on the observed subsurface conditions, the cut will be primarily in fill and native clay. To minimize the risk of slope failures, permanent cuts should be made at inclinations no steeper than 3H:1V. Flatter cut slope angles may be required if the cut is made in sloping ground or if significant seepage and groundwater flows are encountered at the face of the cut slope.

Following the completion of construction, permanent cut slopes should be covered with topsoil and vegetated to provide protection against erosion by surface water runoff, and to maintain a stable slope.

In areas where space limitations prevent the recommended slope angles from being attained, the slope may be steepened through the use of reinforcement, such as reinforced slope or MSE walls. The size of the reinforced zone required for steep cut is governed by various factors including foundation conditions, height of cut, and the inclination of ground surface up slope of the cut. For preliminary design, the width of the reinforced zone can be conservatively taken as the height of the cut slope. Further evaluations, including stability analyses, should be undertaken during detail design when additional information is available (e.g. geometry of the cut, subsurface conditions at the cut location etc.). Recommendations for MSE walls are provided in Subsection 5.5.2.

Unsupported temporary cut slopes through native clay or compacted clay fill less than 3 m vertical height could be made at inclinations no steeper than 1H:1V. Flatter slope may be needed if tension cracks or other signs of instability are observed during construction. Stockpiles of materials, excavated soil, and heavy equipment should be kept away from the crest of the excavation slopes by a distance greater than the depth of excavation. Light wheel loads should be kept back at least 1 m from the crest of any excavations. All excavation work should be in conformance with the Occupational Health and Safety Act.

5.2 EXISTING VALLEY SLOPE

At the proposed LRT Bridge crossing, the valley wall had previously undergone significant cut and fill during the development of the two existing roadway bridges. The abutments of the proposed new LRT bridge would be situated on the lower portion of the valley wall,

approximately 12 m above the valley bottom. Below the abutment, the overall slope of the creek valley was about 5H:1V, with steeper portions at an inclination up to 3H:1V. Valley walls outside of the bridge crossing have much steeper slopes.

The addition of abutment fill (i.e. MSE wall option) may decrease stability of the existing valley slope and may potentially induce deep-seated slope failure through the bedrock. However, the likelihood of deep-seated failure due to the MSE fill is considered low based on the proposed abutment configuration, because:

- Aerial photo studies indicated that the existing banks of the Blackmud Creek are generally stable with no signs of deep-seated failure, although surficial slumping was evidenced at the bend locations where erosion had undercut the valley wall and over steepened the slopes.
- The creek valley is relatively shallow and the abutment fills will be constructed on the lower portion of the valley slope.
- At the proposed bridge crossing, the existing valley slopes have been flattened and further cut will be undertaken on the valley walls.

Preliminary stability analyses showed about 15 percent reduction in factor of safety (from 1.6 to 1.35) of the valley slope against deep-seated failure due to the addition of abutment fill. The analyses were based on subsurface conditions inferred from boreholes in the general area of the bridge crossing and may not be representative for the valley slopes. Additional investigation will be required during the detailed design to delineate the subsurface conditions at the abutment locations on the valley slopes for more refined stability evaluation.

At the bridge abutments, measures should be taken to protect the existing valley slopes against erosion. If conventional fill slopes are used (rather than MSE fills) to raise the existing grade at the abutments, the fill should be placed at an inclination no steeper than 2.5H:1V. Erosion protection is also required for the fill slope. Prior to fill placement, all organic and compressible topsoil should be removed from the surface of the valley wall.

Local low to medium plastic clay and clay till are considered suitable fill materials. However, drying may be required since the local soils were generally in relatively wet condition for compaction (over 5 percent wet of optimum). After moisture conditioning to within 2 percent of the Optimum Moisture Content, the fill should be placed in loose lifts not exceeding 200 mm, with each lift compacted to a minimum of 95 percent of the Standard Proctor maximum dry density.

5.3 SHALLOW FOUNDATIONS

Similar to the existing bridges, bridge piers constructed at the bottom of the creek valley may be supported by footings founded on competent clay shale or sandstone bedrock. The footings should be embedded to a minimum depth of 2.5 m below ground surface for frost protection. Deeper embedment may be required for protection against scour action, or if alluvial deposits or highly weathered bedrock are present at the base of the footing excavation.

For shallow footings founded on competent clay shale or sandstone bedrock, the Ultimate Limit States (ULS) factored bearing resistance should be taken as 1000 kPa. A resistance factor of $\Phi = 0.5$ was included in the factored bearing resistance determination.

Settlement of shallow footings founded on competent bedrock is typically low. For strip footings of 3 to 4 m width, the estimated settlement is between 15 and 25 mm under a load intensity of 500 kPa (expected approximate factored load at the Serviceability Limit State).

The resistance of a footing against sliding can be determined by multiplying the factored vertical load acting at the base of the footing times a friction coefficient of 0.30. Only dead loads with a load factor of 0.85 should be used to calculate the vertical load at the footing base. A resistance factor of $\Phi = 0.8$ should be used to determine the factored resistance against sliding. No passive soil resistance along the sides of the footing should be included in the calculation of sliding resistance, since gaps may be formed between the footing and surrounding soils due to freeze thaw action and desiccation. Furthermore, large lateral movement is needed to mobilize the passive resistance.

Shallow footings for bridge piers should be founded on competent bedrock. On completion of excavation for pier foundations, the bottom of the excavation should be thoroughly cleaned of all loosened and disturbed material and inspected by qualified geotechnical personnel. A lean concrete mud slab should be placed to protect the bearing surface from further disturbance during the period between completion of excavation and casting of the footings. The soil beneath the shallow foundations should not be allowed to freeze, both prior to and after the pouring of concrete.

5.4 PILE FOUNDATIONS

5.4.1 Driven Steel Piles

Steel H-piles or open-end pipe piles could be used to support bridge abutments. Based on the borehole logs, it is expected that H-piles driven with an appropriately sized pile driving hammer would typically penetrate about 4 to 5 m into the bedrock before reaching practical refusal. The depth of penetration into bedrock at refusal would vary depending on a number of factors including variations in soil conditions, the weight of the pile section used, and the energy of the pile-driving hammer used. Hammer selection and termination criteria should be conducted prior to pile installation using Wave Equation Analysis (GRLWEAP).

For steel piles driven to practical refusal into bedrock, the factored compressive resistance could be taken as $0.3F_yA_s$, where F_y is the yield strength of steel, and A_s is the cross-sectional area of steel in the pile. The factored resistance determined using the above expression assumes a resistance factor $\Phi = 0.4$ for piles loaded in axial compression. Dynamic tests using

PDA[3] and CAPWAP[4] during pile installation are recommended to confirm the pile resistance. In addition, higher resistance factor $\Phi = 0.5$ could be used with dynamic tests on a representative number of piles (say 4 to 6 piles for the proposed bridge).

The minimum recommended centre-to-centre pile spacing should be 3 pile diameters or greater for driven steel piles. Preferably, the pile spacing should be increased to that which is practically feasible.

5.4.2 Cast-in-Place Concrete Piles

Conventional drilled cast-in-place concrete piles or CFA piles may be considered for this project. Due to the presence of random water bearing sand lenses or layers in the till deposit, temporary steel casing may be required for the installation of conventional drilled cast-in-place piles. For the design of cast-in-place concrete piles, unfactored unit shaft resistance provided in Table 1 should be used.

Table 1 - Unfactored Unit Shaft Resistances for Cast-in-Place Concrete Piles

Elevation (m)	Major Soil Type	Unfactored Unit Shaft Resistance (kPa)
Above669	Clay / Fill	0[(a)]
669 to 663	Clay Till	60
Below 663	Clay Shale / Sandstone	150

Note: [a] Negative skin friction should be considered where piles are installed at locations where fill thickness is greater than 1.5 m.

Since the bases of conventional straight-shaft friction piles contain disturbed soil generated by the augering process and the bases of such piles are rarely cleaned, the end-bearing resistance is typically ignored. If end-bearing resistance is to be included in the design for conventionally drilled straight shaft piles, the method of cleaning the pile base will need to be approved by the geotechnical engineer. For CFA piles installed in clay till or clay shale bedrock, unfactored unit end-bearing resistances of 1000 and 2000 kPa, respectively, could be included in the pile resistance calculation.

To determine the ULS factored compressive resistance of the pile, a resistance factor of $\Phi = 0.4$ should be applied to the unfactored geotechnical compressive resistance. The resistance of piles to uplift loads will be provided solely by shaft resistance. To determine the ULS factored uplift resistance of a pile, a resistance factor of $\Phi = 0.3$ should be applied to the unfactored uplift resistance. The design of piles for external uplifts loads should be separate from the design for

[3] PDA: *Pile Driving Analyzer*, equipment that monitors pile stress and acceleration during pile driving and interprets pile capacity, driving energy etc.

[4] CAPWAP: *Case Pile Wave Equation Analysis Program*, a computer program used to analyze PDA data for better estimate of pile resistance and its distribution

upward frost jacking forces. The rationale for this is that the adfreeze bond over the frost penetration depth will resist the external loads.

The minimum centre-to-centre spacing for cast-in-place concrete piles should be at least 2.5 pile diameters. Lightly loaded piles should be embedded at a minimum 6.5 m below the ground surface against frost action. Full reinforcement is required over the 6.5 m length.

5.4.3 Negative Skin Friction

Fill placement at abutment locations will result in settlement of the fill (existing and new) and of any underlying lacustrine clay. Settlement of soil relative to the pile will result in the development of negative skin friction along the sections of the pile shafts in contact with the lacustrine clay and fill. Drag loads that develop as a result of this settlement induced negative skin friction must be accounted for in the design of pile foundations.

The unfactored drag load may be estimated assuming the negative skin friction to be 3***z*** kPa within both the fill and lacustrine clay, where z is the total thickness of the compressible layers in metre. If all or a portion of the pile length through the fill is sleeved (such as for piles through MSE fills), negative skin friction may be neglected along the sleeved section of the piles, provided that the annulus between the pile and the sleeve is filled with a low strength material such as polystyrene chips, that would transfer minimal friction between the sleeve and the pile. The drag load should be considered on the loading side rather than the resistance side of the limit states equation, using a load factor (α) of 1.25.

From a geotechnical perspective, negative skin friction is generally a settlement problem in that the drag load diminishes once settlement of the pile tip occurs, and therefore only the structural resistance would need to be checked. However, since the pile tips are to be founded in a non-yielding bearing stratum, the factored drag load would be additive to the factored dead and factored live load for comparison to the factored structural resistance and the factored geotechnical resistance of the pile.

5.4.4 Settlement of Single Piles

The settlement of a single pile would depend on the applied load, strength-deformation properties of the foundation soils, and on the relative proportions of the loads carried by shaft friction and end-bearing. In estimating the settlement of a single pile, it is assumed that the load on the pile in Serviceability Limit State will be 60 to 70 percent of the factored geotechnical resistance of the pile.

For steel piles driven into bedrock, the predicted settlement would be in the range 0.5 to 1 percent of the pile width (or diameter) plus the elastic shortening of the pile. Similar settlement is expected for conventional cast-in-placed piles which develop their vertical resistances by shaft friction only. For CFA piles with end bearing resistance allowed, the predicted settlement would be in the range 1 to 2 percent of the pile diameter plus the elastic shortening of the pile.

Better estimates of predicted settlement could be provided once the loads, pile type and the relative locations of the piles on the site are known.

5.4.5 Lateral Load Resistance of Single Pile

Preferably, the lateral load resistance of a single pile should be analyzed using the computer program *LPILE*, which is based on the method of p-y curves. The program takes into account the effect of layered soils, non-linear characteristics of soils, sloping ground surface, etc., with outputs for a given lateral load including deflections, shear forces, bending moments, and soil reactions at frequent depth increments along the pile shaft. Lateral loads on complex pile group configurations can also be readily analyzed using GROUP software, which is also based on the method of p-y curves. LPILE and/or GROUP analyses should be undertaken during the detail design stage once the pile type, size, loads, and the site-specific foundation soils conditions at the pile locations are known.

For preliminary design, the resistance of piles against lateral loads and moments may be calculated using the Method of Broms[5]. The following is a list of symbols and descriptions of the symbols applicable in the lateral capacity calculations using the Broms Method:

k	=	Unfactored Modulus of Subgrade Reaction (See Table 2)
D	=	Pile Diameter (m)
E_{pile}	=	Elastic Modulus of the pile (kPa)
I_{pile}	=	Moment of Inertia of the pile section (m^4)
y_o	=	Lateral Deflection (m)
L	=	Pile Length (m)
P	=	Unfactored Lateral Load (kN)
C_u	=	undrained shear strength (use C_u = 60 kPa)
e	=	height of load application above the ground line (m)

The recommended values for the Modulus of Subgrade Reaction, k, are given in Table 2. These values are applicable for the expected near-surface soils.

Table 2 - Modulus of Subgrade Reaction for Lateral Loaded Piles

Loading Condition	Unfactored Modulus of Subgrade Reaction (MN/m^3)
For sustained lateral loads	(6/D*)
For cyclic lateral loads	(4/D*)
For transient lateral loads	(8/D*)

*D = Pile Diameter (m)

In order to maintain the soil response within the elastic range, the lateral capacity of piles should be limited by a deflection criterion of 6 mm or less. To determine the lateral load, the chart

[5] Broms, B., (1964). *lateral resistance of piles in cohesive soils.* Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineering, Vol. 90, SM 2, March, pp. 27-63

developed by Broms, as illustrated on the Figure 5 may be used. The use of the chart requires the calculation of a dimensionless length βL, where:

$$\beta = \sqrt[4]{\frac{kD}{4E_{pile}I_{pile}}}$$

The y axis of the chart is given in terms of a dimensionless lateral deflection value (y_okDL/P). In the calculation for the maximum positive moment for a free-head pile, the point of fixity (f) below surface may be determined using the following equation:

$$f = \frac{P}{9c_u D}$$

The maximum positive moment acting on the free-head pile may be determined by the following:

M_{max} = $P(e+ 1.5B + 0.5f)$

5.4.6 Pile Group Effects

For piles installed into the bedrock or close to the bedrock surface, no pile group effect needs to be considered for both vertical load resistance and vertical settlement. The vertical load resistance of a pile group can be taken as the sum of the resistance of individual piles, and the settlement of pile group could be taken as the settlement of an individual pile subjected to the average single pile loading.

Pile group effects need to be considered for laterally loaded piles if the center-to-center spacing between piles is less than 3 diameters in the direction normal to loading (side-by-side), or less than 6 diameters in the direction parallel to loading (in-line). In this case, group reduction factors as given in Table 3 should be used.

The group reduction factor is the ratio of lateral resistance of the pile group to the sum of lateral resistances of individual piles, as expressed by:

$$\eta = \frac{R_g}{n \cdot R_s}$$

where η = reduction factor for lateral loaded pile group
R_g = lateral resistance of a pile group
R_s = lateral resistance of a single pile in a pile group
n = number of piles in a pile group

Table 3 - Group Reduction Factors for Laterally Loaded Pile Groups

Pile Group	Load Direction	Pile Center-to-Center Spacing (s)	
		3 Diameters	5 Diameters
1 x 5	Parallel to long side	0.70	0.90
	Perpendicular to long side	0.90	1.00
2 x 5	Parallel to long side	0.65	0.90
	Perpendicular to long side	0.70	0.95
3 x 5	Parallel to long side	0.60	0.90
	Perpendicular to long side	0.65	0.95
1 x 10	Parallel to long side	0.70	0.90
	Perpendicular to long side	0.90	1.00
2 x 10	Parallel to long side	0.60	0.90
	Perpendicular to long side	0.70	0.95
3 x 10	Parallel to long side	0.55	0.90
	Perpendicular to long side	0.65	0.95

The lateral resistance of a pile group can be estimated by multiplying the sum of lateral resistance of individual piles in the group times the group reduction factor. The reduction factors should be applied equally to all piles within the group regardless of an individual pile's relative location within the group. It is recommended that pile group analyses be performed for structures once the details regarding location of the structure, geometry of the pile group, loading information and pile head fixity have been established.

5.4.7 Frost Design Considerations

The depth of frost penetration should be taken as 2.5 m. The undersides of pile caps, if above the depth of frost penetration, may be subject to frost heaving forces, and foundation components that are in contact with the soil, including pile shafts and the sides of buried components, may be subject to adfreeze pressures.

Frost heave forces on the undersides of pile caps could potentially exceed 200 kPa. Where the undersides of pile caps are located within the depth of frost penetration, the pile caps should be designed to reduce the effects of frost heaving by placing a compressible material or by forming a void below the underside of the pile cap. A void-forming product is recommended. The minimum thickness of the void should be 50 mm. If compressible material were used as an alternative, the uplift pressure acting on the underside of the pile cap may be taken as the crushing strength of the compressible medium. The finished grade adjacent to each pile cap should be capped with well-compacted clay and sloped away from the pile cap such that surface water runoff is not allowed to infiltrate and collect in the void space or in the compressible medium. If water is allowed to accumulate in the void space or if the compressible medium becomes saturated, the beneficial effect will be negated and frost-heaving pressures will occur on the underside of the pile cap.

Adfreeze pressures may be generated along the sides of buried concrete components and the shafts of piles within the depth of frost penetration. An unfactored adfreeze stress of 60 kPa should be assumed where clay soils are in contact with the sides of buried structural components, including the shafts of piles located within the depth of frost penetration. For well-drained, dry granular soil above the groundwater surface, the adfreeze pressures will be negligible. Resistance to adfreeze stresses on pile shafts will be provided by the skin friction below the depth of frost penetration and by sustained vertical loads.

Frost effects on foundations may be further reduced by installing piles and pile caps below the predicted depth of frost penetration (2.5 m) or through the use of rigid polystyrene insulation. Insulation designs could be provided once the desired foundation configurations have been established.

5.5 RETAINING WALLS

5.5.1 Lateral Earth Pressures

Vertical abutment walls and wing walls at the abutment locations will be subjected to horizontal forces due to lateral earth pressures from retained embankments. Table 4 below provides the recommended earth pressure coefficients, unit weights, and friction angles for various soil types.

Table 4 - Earth Pressure Coefficients, Soil Unit Weights and Wall Friction Angles

Soil Type	Earth Pressure Coefficient			Soil Unit Weight kN/m^3		Friction Angle, Φ (degrees)	
	K_a	K_o	K_p	Total γ	Buoyant γ'	Between Soil and Concrete	Soil
Well Compacted[(1)] Gravel Fill	0.27	0.43	3.7	21.5	11.7	25	35
Lightly to Moderately Compacted[(2)] Gravel or Sand Fill	0.33	0.50	3.0	19.5	9.7	21	30
Native Clay and Clay Fill	0.45	0.63	2.2	19.0	9.2	15	22
Clay Till	0.35	0.52	2.8	20.5	10.7	20	29

Notes: (1) > 95 percent of the SPMDD
(2) 90 to 95 percent of the SPMDD

The earth pressure coefficients in Table 4 are based on the assumption of flat ground on top of the retaining wall and do not include wall friction angles in the calculations.

To reduce the potential of lateral hydrostatic or frost forces developing due to accumulation of water behind the wall, it is recommended that a free-draining, non-frost susceptible granular soil be used as backfill behind the walls and that positive discharge of water accumulations be provided. Granular backfill should be provided behind the wall in a wedge-shaped zone

delineated by projecting a 45 degree line to the ground surface from a point located 0.5 m into the soil from the base of the wall. The backfill should be brought up evenly along the entire length of the wall to avoid differential lateral pressures. Alberta Transportation Designation 6, Class 80 gravel, with not more than 5 percent of particles by mass passing the 80 micron sieve size would be a suitable granular fill material behind the wall. A non-woven geotextile fabric, acting as filter, should be utilized to separate granular backfill from the adjacent clay backfill.

The "at rest" (K_o) earth pressure should be used in the case of non-yielding walls. To attain active earth pressure (K_a) conditions, the displacement at the top of the wall should be at least 0.01 times the height of the wall. In the case of non-yielding walls exposed to frost penetration it is recommended that K_o = 1.0, be used to account for lateral frost pressures. However, this higher K_o value need not be applied for the calculation of lateral stresses induced by compaction.

For granular backfill compacted to at least 95 percent of the Standard Proctor maximum dry density, a combined trapezoidal/triangular earth pressure distribution as shown on Figure 6 should be used to account for the induced lateral pressures due to compaction. Figure 6 also provides the relationships to be used in the calculation of the compaction induced earth pressures, and the loads (P) generated by typical compactors. The earth pressure coefficients to be used in the calculation of the lateral pressures should be those applicable to the backfill types given in Table 4 above.

The lateral earth pressures due to surcharge loads should be determined using the relationships given in Figure 7. In the case of uniformly distributed surcharge loads, such as those acting on the surface of the retained soil, the induced lateral earth pressure may be determined by multiplying the surcharge load by the appropriate earth pressure coefficient.

In addition, earthquakes will also induce additional pressures on retaining walls. The magnitude and distribution of earthquake induced loads can be determined using Figure 8 for both 'yielding' and 'rigid' walls with horizontal backfill.

5.5.2 MSE Wall

Based on the latest configuration, MSE walls up to 6 m in height may be required at the bridge abutment locations. Analyses indicated that a minimum 6 m wide reinforcement zone would be required for a 6 m high abutment wall. This was based on the assumption that the reinforced zone was strong enough such that potential failure surfaces will pass below, rather than through the reinforced zones. Steel strips or wire mesh reinforcement are recommended. Along the sides of the abutments, the heights of MSE walls will vary and the minimum widths of reinforcement zones can be taken as the height of the MSE wall for preliminary design. The design of reinforcement within the reinforced zone and associated internal stability assessments should be carried out by the MSE wall vendor.

MSE walls should be founded on native clay till at a minimum depth of 0.5 m below the existing grade. Vegetation, organic topsoil, and other deleterious materials should be removed from below the base of the MSE wall. Excessively wet, softened soils on the exposed subgrade surface should be also removed and replaced with well compacted gravel fill. The subgrade should be adequately inspected by a qualified geotechnical engineer to confirm the suitability of the bearing soil. Where competent subgrades have been achieved, the exposed subgrade should be scarified to a minimum depth of 150 mm and compacted to a minimum of 98 percent Standard Proctor maximum dry density.

The fill material used in the reinforced zone should comprise well graded sand and gravel conforming to the following requirements:

- Granular backfill material used in the MSE walls should be free from organic or other deleterious materials and should conform to the gradation limits shown in Table 5.
- Friction angle equal to or greater than 35 degrees
- Plasticity index less than 6 percent
- Moisture content at time of compaction at or below 2 percent dry of Optimum

Table 5 - Gradation of Granular Backfill for Reinforced Zone of MSE Walls

Sieve Size	Percent Passing (by weight)
100 mm (4 inch)	100
0.425 mm (No. 40)	0 – 60
0.075 mm (No. 200)	0 – 10

Other requirements with regard to fill materials, such as chemical concentrations, specified by the MSE wall supplier should also be met. To minimize the potential for differential settlement, the same fill material should be used under the trackway as is used for the reinforced zones of the MSE walls.

To minimize the long term settlement of the trackway, fill within the reinforcement zone of MSE wall and under the trackway should be placed in lifts not exceeding 200 mm thickness after compaction and compacted to a minimum of 100 percent of the Standard Proctor maximum dry density. In areas where no subgrade support is required (such as along the side of cut slope), the fill should be compacted to at least 95 percent of the Standard Proctor maximum dry density.

Total settlement of the ground surface at the MSE wall location comprises the self-weight settlement of the fill material, and the settlement of the underlying foundation soil. For free-draining, properly compacted granular material used as MSE fill, the self-weight settlement is expected to be small and would be nearly complete at the end of the construction. For MSE walls up to 6 m in height, the long-term settlement due to compression foundation soil would be expected to be in the range of 20 to 50 mm.

5.5.3 MSE Wall Drainage

The provision of good drainage is a key requirement for long term MSE wall performance. To reduce the potential of hydrostatic or frost forces developing due to accumulation of water, it is recommended that the base of the reinforced soil zone be graded at inclination no flatter than two percent to provide positive flow of seepage water towards the face of the MSE walls. Perforated seepage collector pipes enclosed within a geotextile sock, surrounded by a 150 mm annular bed of sand having a gradation comparable to that of concrete sand (as specified by *CSA Specification A.23.1-00, Section 5.3.2.1, Table 4*) should be installed within the reinforced soil zone. Outtake pipes must be provided to allow free discharge of collected seepage water from within the reinforced soil zone.

5.6 CEMENT TYPE FOR SUBSURFACE CONCRETE

The results of water-soluble sulphate tests on soil samples collected from the site indicate that the degree of exposure to sulphate attack for subsurface concrete could be as high as 'severe' as per CAN/CSA-A23.1-04. However, the high sulphate concentrations are typically scattered in isolated zones, and the potential of sulphate hazard is generally considered 'moderate'. It is recommended that foundation concrete be manufactured using MS or MSb Portland Cement. The maximum water/cementing ratio should not exceed 0.50 and the minimum 28-day compressive strength should be 30 MPa. Calcium chloride or any other admixture containing chlorides should not be used since the sulphate resisting property of the cement would be reduced.

To enhance durability, an appropriate quantity of entrained air as per CSA specification CAN/CSA-A23.1-04, Clause 14.3, is recommended for all concrete exposed to freezing and thawing at this site.

5.7 RECOMMENDATIONS FOR FURTHER INVESTIGATIONS

No boreholes were advanced within the creek valley during the current investigation. Reliance was placed on existing (i.e. previous) borehole information from within the creek valley for preliminary design of pier foundations. Boreholes advanced during the current investigation were positioned prior to knowing the bridge configuration and thus there are some uncertainties relative to the actual soil and groundwater conditions at the specific pier and abutment locations. Additional site-specific confirmatory borings should be advanced at pier and abutment locations during detailed design stage in order to confirm that subsurface conditions are consistent with those assumed in the preparation of this report. Additional field investigations should include:

- Boreholes at the locations of the piers and abutments for the proposed bridge structure, a minimum of four (4) boreholes will be required, two shallow holes for bridge piers, and two deep holes for bridge abutments.
- Additional four (4) boreholes, two at each abutment area, to characterize the subsurface conditions for assessment of the valley slope stability due to abutment fill.

- Shallow boreholes west of the multi-use trail to delineate the stratigraphy and groundwater conditions at both abutment areas for retaining wall design.

6.0 CLOSURE

This report provides geotechnical recommendations for the preliminary design of the proposed LRT Bridge structure crossing Blackmud Creek. It is based on the subsurface conditions observed in boreholes in the near vicinity of the creek crossing during the current and previous investigations. It should be recognized that the soil and groundwater conditions in the stream bed at each crossing location may be different than those identified in the test borings, and therefore refinements to the recommendations given herein may be required to suit site-specific conditions encountered during subsequent geotechnical investigations and/or during construction.

This report has been prepared for the exclusive use of AECOM and the City of Edmonton and their agents for specific application to the project described in this report. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Respectfully submitted,

AMEC Earth & Environmental

PERMIT TO PRACTICE
AMEC Earth & Environmental
a Division of AMEC Americas Limited
Signature
Date 28 Jan 2010
PERMIT NUMBER: P-04546
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

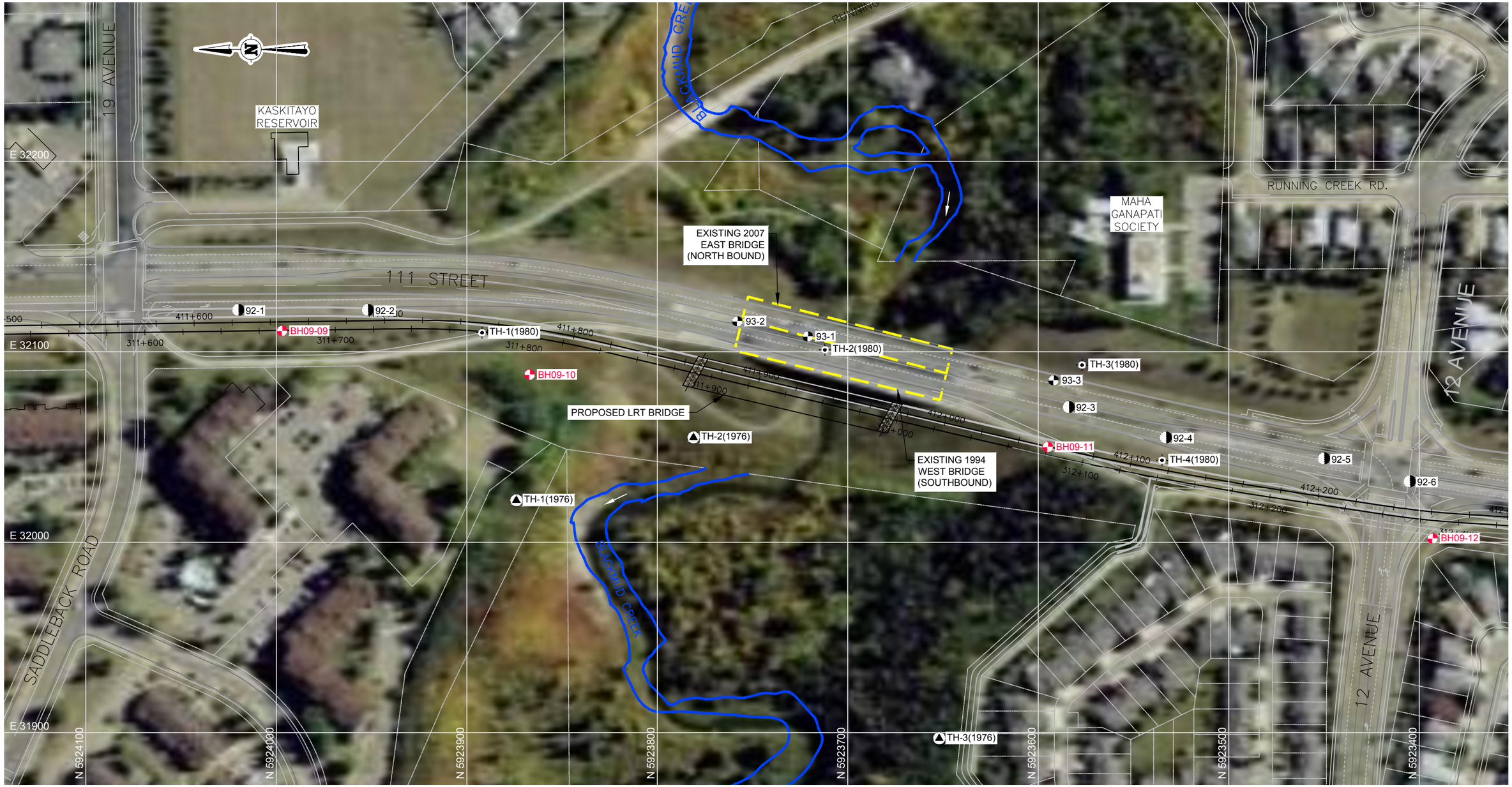
PROFESSIONAL ENGINEER ALBERTA
XITENG LIU

Xiteng Liu, M.Sc., P.Eng.
Senior Geotechnical Engineer

PROFESSIONAL ENGINEER ALBERTA
David J. Walter
28 Jan 2010

David J. Walter, Ph. D., P. Eng.
Senior Associate Geotechnical Engineer

Reviewed by:
M.J. (Marv) Cherniawski, P. Eng.
Senior Associate Geotechnical Engineer



REFERENCE: THIS DRAWING IS MODIFIED FROM s04_pm_civ_ext.dwg PROVIDED BY AECOM.

LEGEND:

- 1976 BOREHOLE
- 1980 BOREHOLE
- 1992 BOREHOLE
- 1993 BOREHOLE
- 2009 BOREHOLE

0m 20 40 60 80

1 : 2000

CLIENT: AECOM

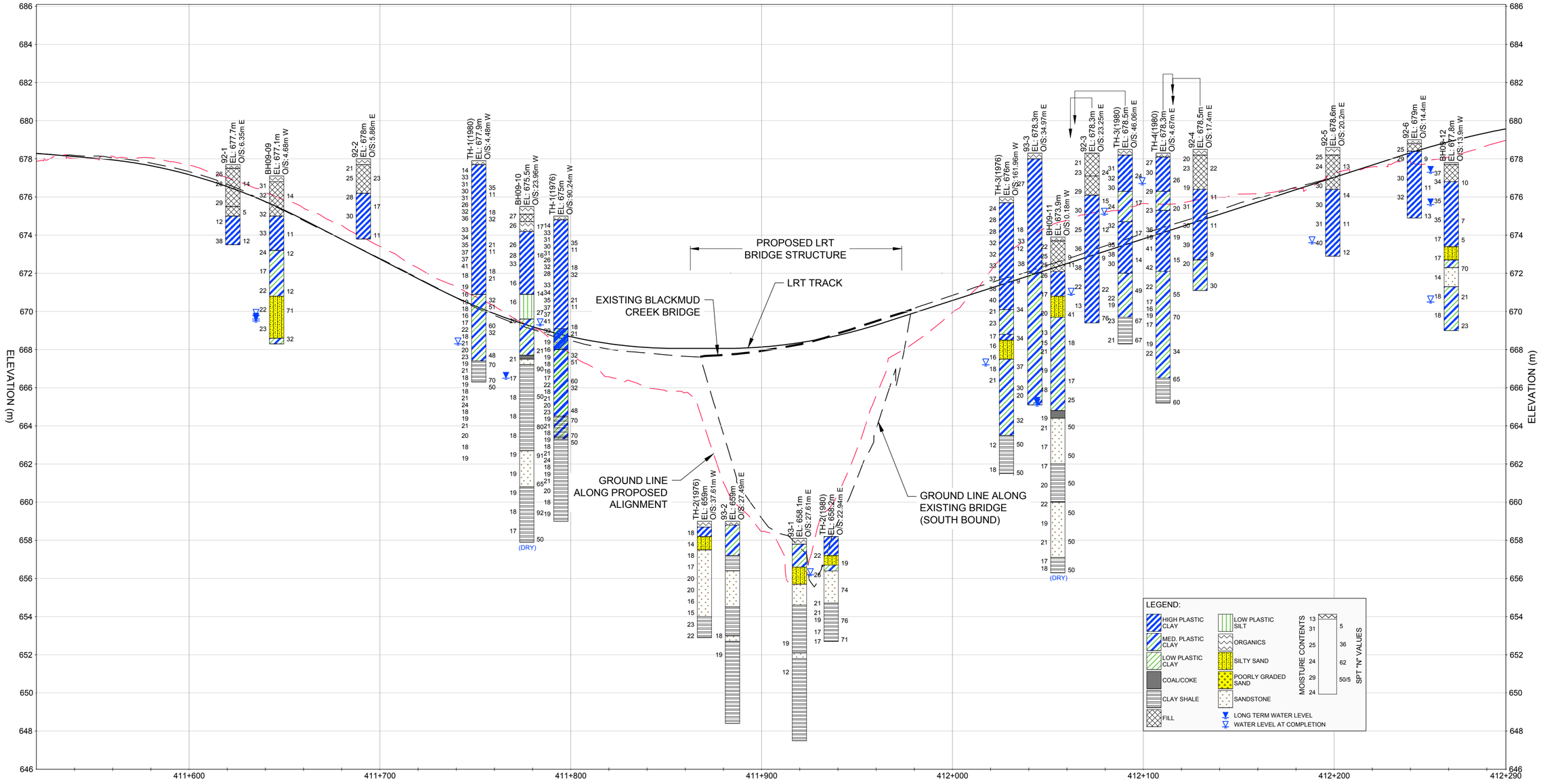
AMEC Earth & Environmental
5681-70 STREET, EDMONTON, ALBERTA, T6B 3P6
PHONE 780-436-2152, FAX 780-435-8425

DWN BY:	RDJ
CHK'D BY:	XL
DATUM:	NAD83
PROJECTION:	3TM - 114
SCALE:	1:2000

PROJECT: SOUTH LRT EXTENSION PHASE 4
(CENTURY PARK TO ELLERSLIE STATION)
PRELIMINARY ENGINEERING STAGE

TITLE: BLACKMUD CREEK CROSSING (111 ST.)
BOREHOLE LOCATION PLAN

DATE:	JANUARY, 2010
PROJECT No.:	EG09681
REV. No.:	A
FIGURE No.:	FIGURE 1



REV	D	M	Y	ISSUE/REVISION DESCRIPTION	ENG.	APPR.
G						
F						
E						
D						
C						
B						
A						

Client:

AECOM

AMEC Earth & Environmental
5681-70 STREET, EDMONTON, ALBERTA, T6B 3P6
PHONE 780-436-2152, FAX 780-435-8425
amec
www.amec.com/earthandenvironmental

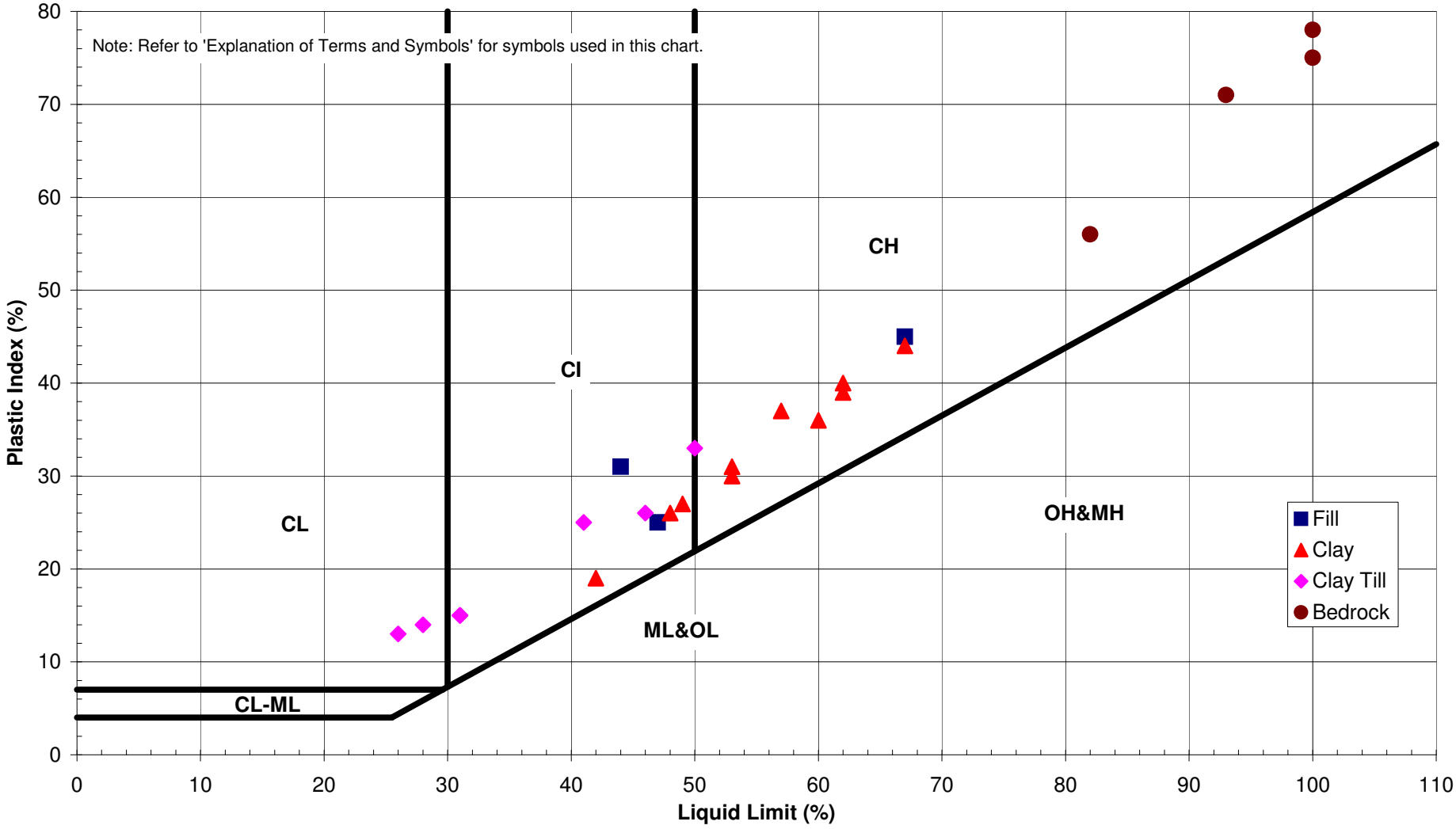
DRAWN BY:	RDJ
REVIEWED BY:	XL
DATUM:	NAD83
PROJECTION:	3TM - 114
SCALE:	AS SHOWN

PROJECT: SOUTH LRT EXTENSION PHASE 4

TITLE: STRARTIGRAPHIC SECTION AT BLACKMUD CREEK CROSSING

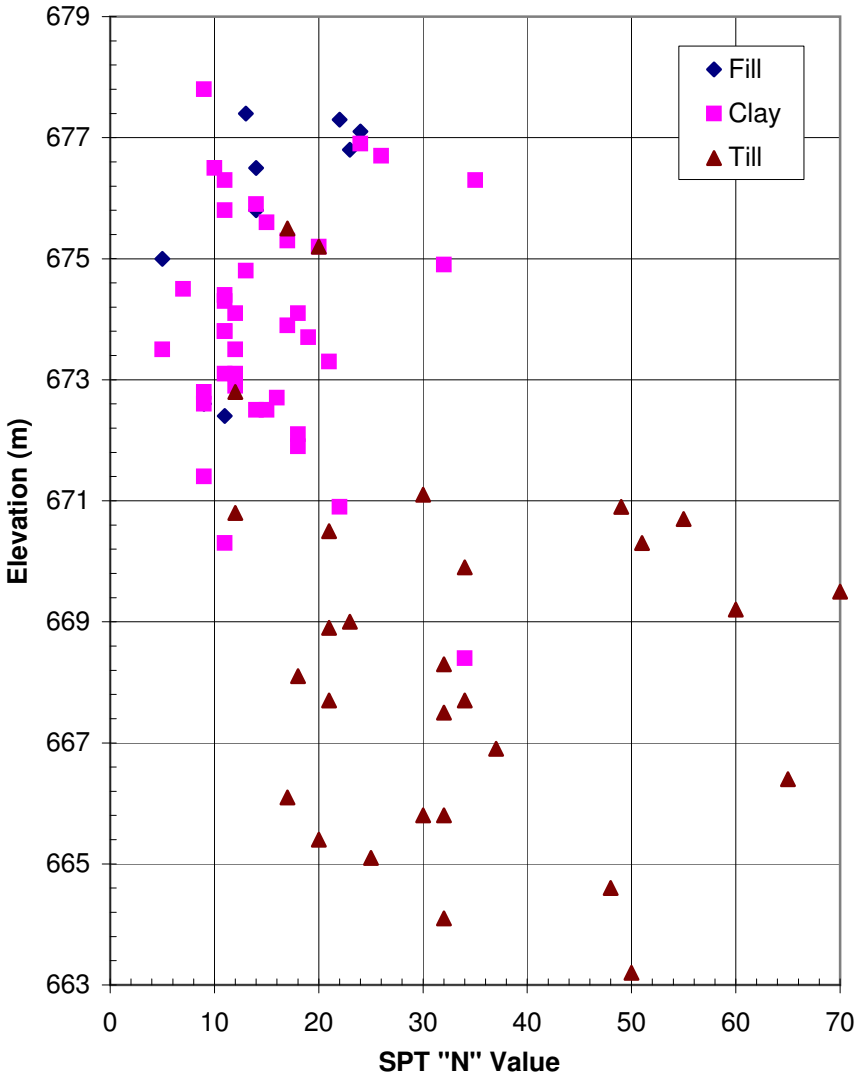
DATE:	JANUARY, 2010
PROJECT No.:	EG09681
FIGURE No.:	FIGURE 2
REV. No.:	A
SHEET No.:	

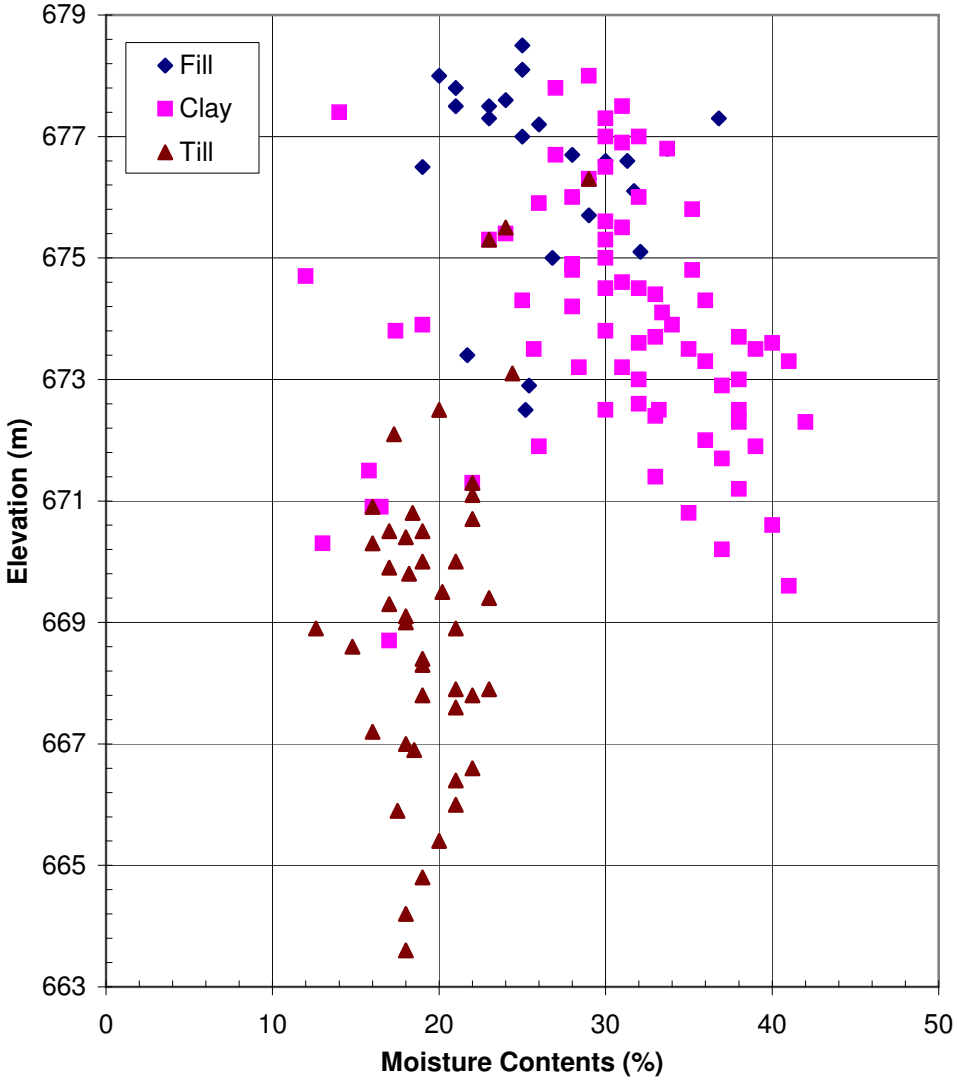
S:\Cad\Civil\EG09600\EG09681\EG09681-006.dwg - Figure 2 BMC - Jan. 27, 2010 5:16 PM - rahul jairath



CLIENT: AECOM	MADE BY: XL	**SLRT - Century Park to Ellerslie** **Blackmud Creek Bridge**	PROJECT NO: **EG09681**
	CHKD BY: DJW		REV. NO:
AMEC Earth & Environmental	SCALE: N.T.S	**Plasticity Chart**	**FIGURE 3**
	DATE: DEC. 2009		

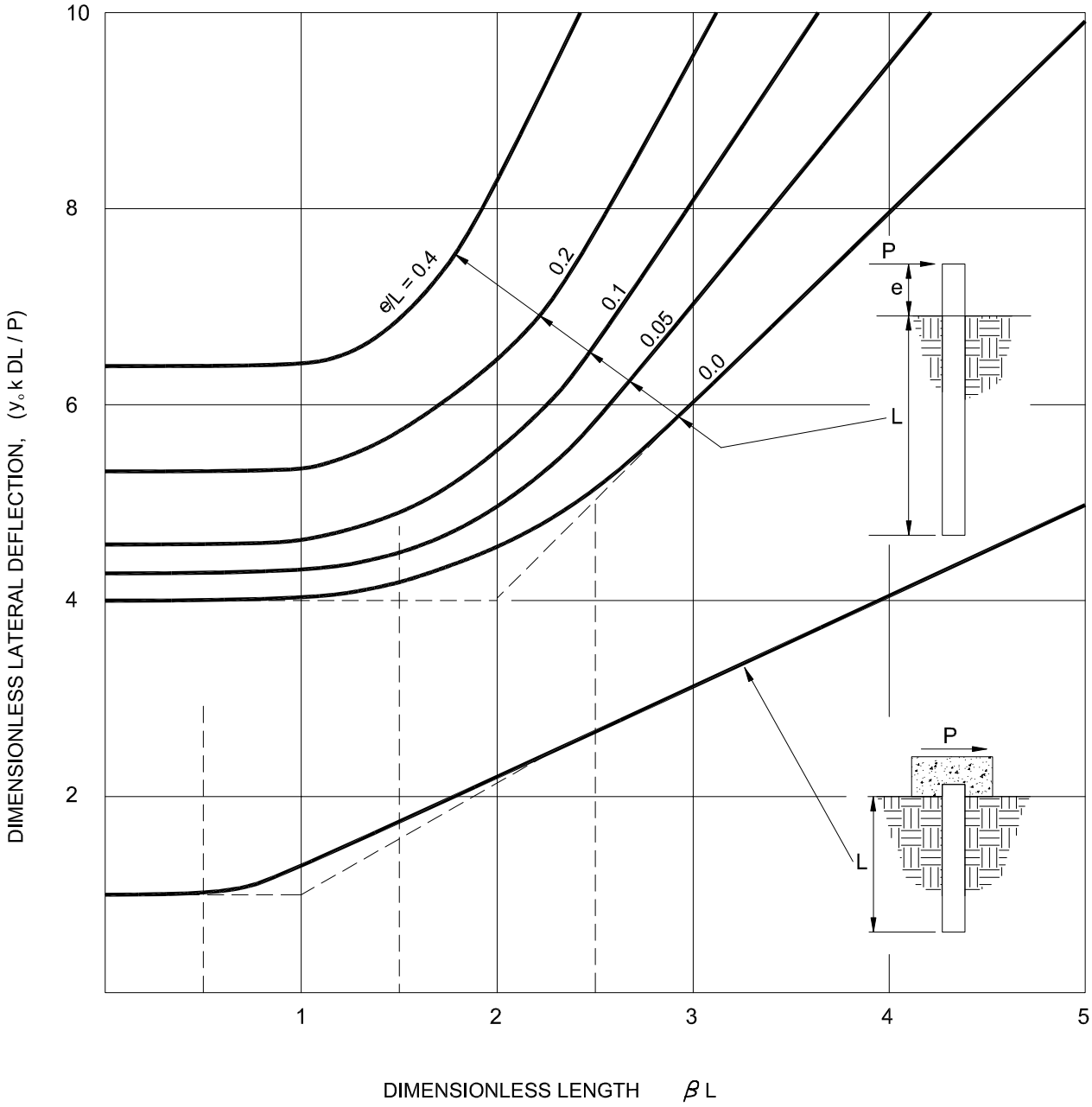
\\EDM4-FS1\edm-projects\GEO\PROJECTS\9650\EG09681 SLRT Preliminary Design\Blackmud Creek Bridge\Lab Summary.xls/Plot Limits





CLIENT: AECOM	MADE BY: XL	SLRT - Century Park to Ellerslie Blackmud Creek Bridge	PROJECT NO: **EG09681**
	CHKD BY: DJW		REV. NO: -
AMEC Earth & Environmental	SCALE: N.T.S	**Moisture Contents and SPT 'N' Values of Surficial Soils**	**FIGURE 4**
	DATE: DEC. 2009		

\\EDM4-FS1\edm-projects\GEO\PROJECTS\9650\EG09681 SLRT Preliminary Design\Blackmud Creek Bridge\MC and SPT.xls/Plot_elev

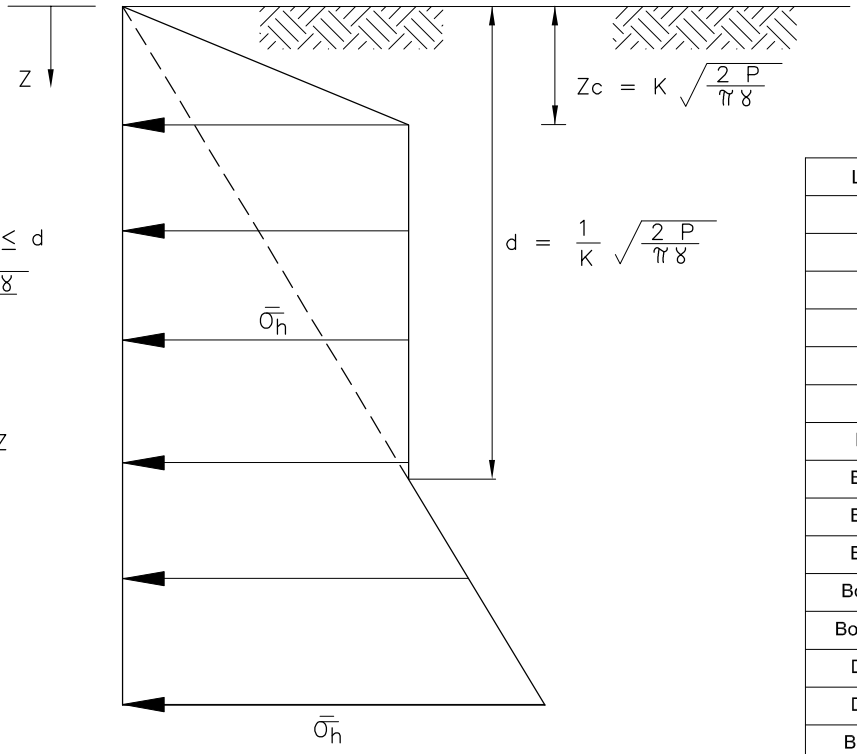


FOR LATERALLY LOADED PILES

(AFTER BROMS, 1964)

CLIENT: AECOM	DWN BY: BGR CHK'D BY: DJW	PROJECT: SOUTH LRT EXTENSION PHASE 4 LRT BRIDGE OVER BLACKMUD CREEK	DATE: DECEMBER, 2009 PROJECT No.: EG09681
amec AMEC Earth & Environmental 5681-70 STREET, EDMONTON, ALBERTA, T6B 3P6 PHONE 780-436-2152, FAX 780-435-8425	DATUM: - PROJECTION: - SCALE: N.T.S.	TITLE: DEFLECTION OF PILES AT GROUND SURFACE IN COHESIVE SOILS DUE TO LATERAL LOADS	REV. No.: R1 FIGURE No.: FIGURE 5

S:\Cadd\Geo\EG09600\EG09681\EG09681-Fig8.dwg - FIGURE 7 - 1/25/2010 4:57:06 PM - xlteng.llu



FOR $Zc \leq Z \leq d$

$$\bar{\sigma}_h = \sqrt{\frac{2P\gamma}{\pi}}$$

FOR $Z > d$

$$\bar{\sigma}_h = K \cdot \gamma \cdot Z$$

LOADS FROM COMMON COMPACTORS	
COMPACTOR	LOAD (P) kN/m
Bowmag TSE	31.3
Bowmag 60S	31.8
Bowmag 65S	22.7
Bowmag 75S	32.5
Bowmag 90S	39.3
Bowmag 75AD	19.6
Bowmag 100AD	20.3
Bowmag 120AD	33.5
Bowmag 130AD	36.1
Bowmag BW122D	30.4
Bowmag BW122PD	35.8
Dynapac LR100	41.7
Dynapac 2100V	92.9
Bowmag 142PDB	46.6
Bowmag 172PDB	92.9
Dynapac CA121D	53.2
Dynapac CA121PD	53.7
Dynapac CA151	79.9
Dynapac CA151D	80.2
Dynapac CA151PD	96.2

$$P \text{ (ROLLER LOAD)} = \frac{\text{DEAD WT. OF ROLLER} + \text{CENTRIFUGAL FORCE}}{\text{WIDTH OF ROLLER}}$$

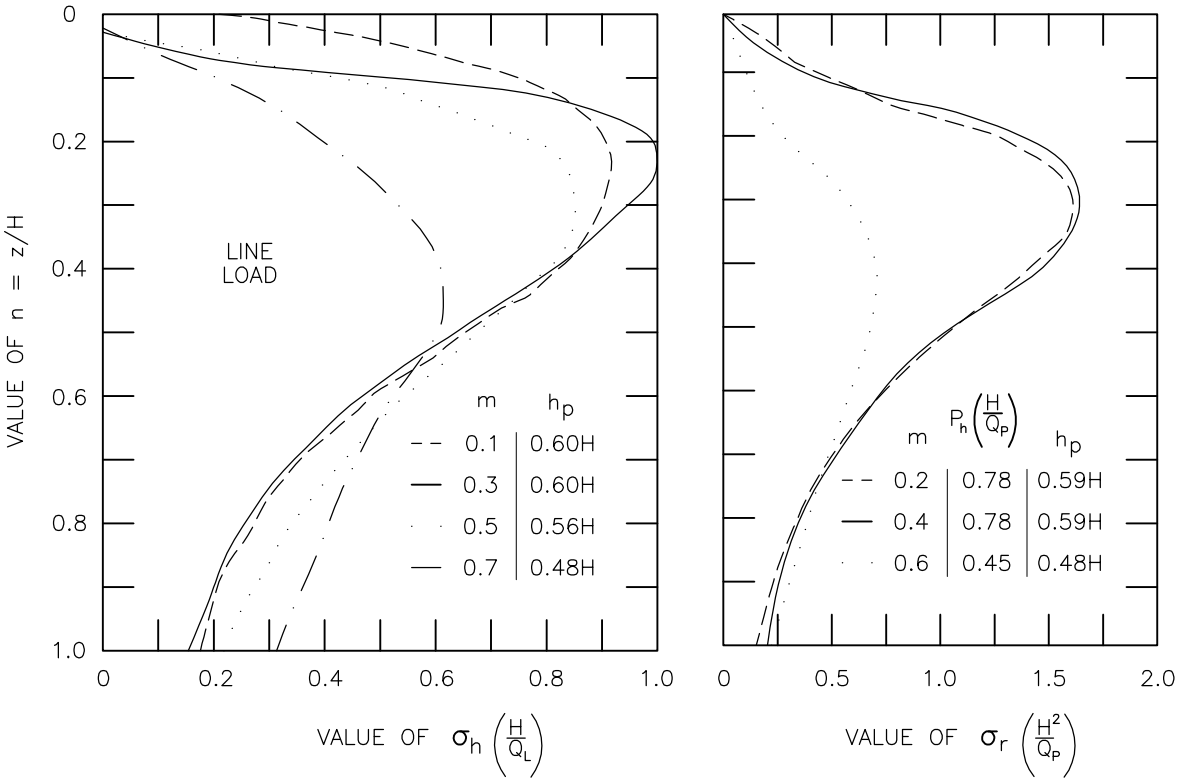
EARTH PRESSURE COEFFICIENT

$K = K_o$ ("AT REST") OR K_a (ACTIVE CASE)
(SEE TEXT OF REPORT)

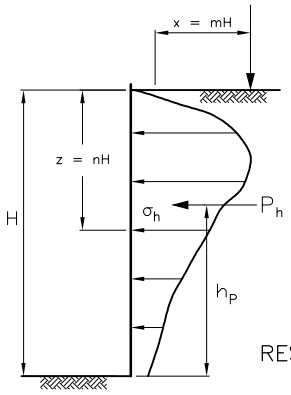
γ = SOIL UNIT WEIGHT
(SEE TEXT OF REPORT)

REFERENCE: INGOLD (1980), INTERNATIONAL CONFERENCE ON COMPACTION

CLIENT: AECOM	DWN BY: BGR	PROJECT: SOUTH LRT EXTENSION PHASE 4 LRT BRIDGE OVER BLACKMUD CREEK	DATE: DECEMBER, 2009
	CHK'D BY: DJW		PROJECT No.: EG09681
amec AMEC Earth & Environmental 5681-70 STREET, EDMONTON, ALBERTA, T6B 3P6 PHONE 780-436-2152, FAX 780-435-8425	DATUM: -	TITLE: LATERAL PRESSURE ON WALLS INDUCED BY COMPACTION	REV. No.: R1
	PROJECTION: -		FIGURE No.: FIGURE 6
	SCALE: N.T.S.		



LINE LOAD Q_L



FOR $m \leq 0.4$:

$$\sigma_h \left(\frac{H}{Q_L}\right) = \frac{0.20n}{(0.16 + n^2)^2}$$

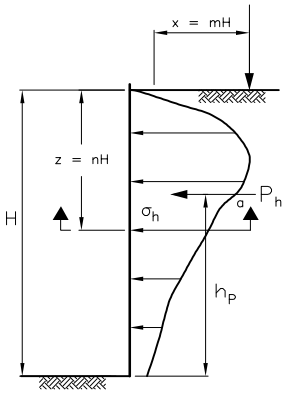
FOR $m > 0.4$:

$$\sigma_h \left(\frac{H}{Q_L}\right) = \frac{1.28m^2n}{(m^2 + n^2)^2}$$

$$\text{RESULTANT } P_h = \frac{0.64\ Q_L}{(m^2 + 1)}$$

PRESSURES FROM LINE LOAD
(BOUSSINESQ EQUATION MODIFIED BY EXPERIMENT)

POINT LOAD Q_P



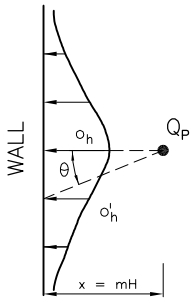
FOR $m \leq 0.4$:

$$\sigma_h \left(\frac{H^2}{Q_P}\right) = \frac{0.28n^2}{(0.16 + n^2)^3}$$

FOR $m > 0.4$:

$$\sigma_h \left(\frac{H^2}{Q_P}\right) = \frac{1.77m^2n^2}{(m^2 + n^2)^3}$$

$$\sigma'_h = \sigma_h \cos^2(1.1\theta)$$



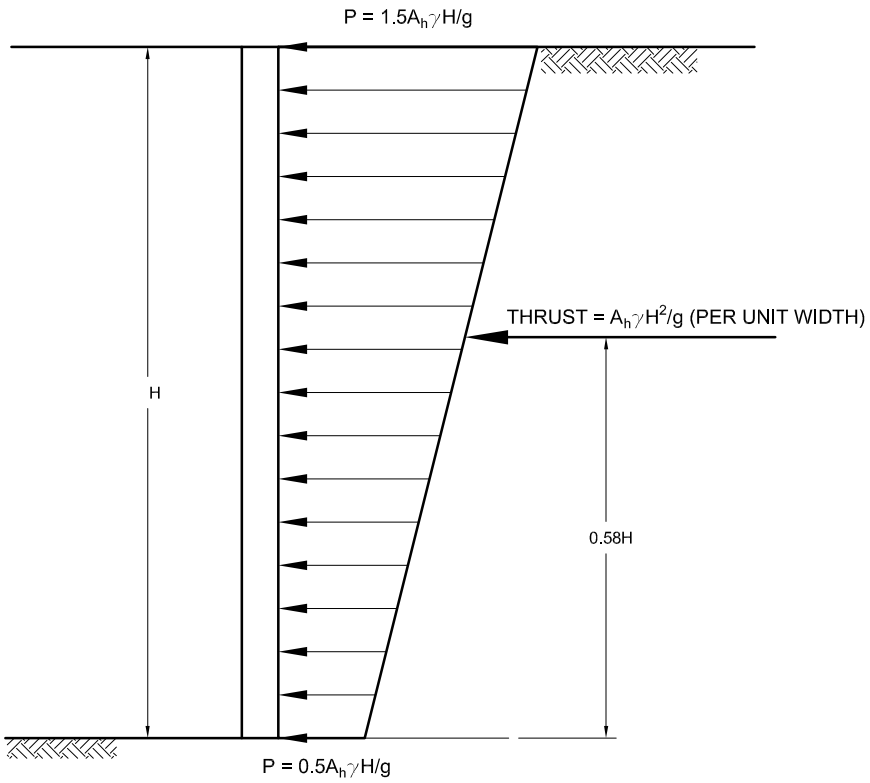
SECTION a–a

PRESSURES FROM POINT LOAD (BOUSSINESQ EQUATION MODIFIED BY EXPERIMENT)

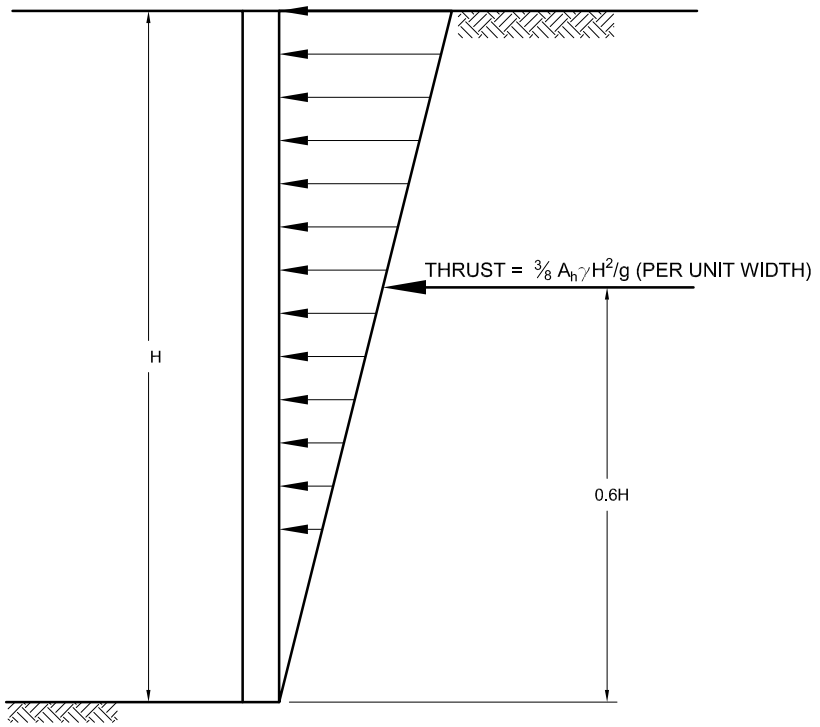
CLIENT: AECOM	DWN BY: BGR	PROJECT: SOUTH LRT EXTENSION PHASE 4 LRT BRIDGE OVER BLACKMUD CREEK	DATE: DECEMBER, 2009
	CHK'D BY: DJW		PROJECT No.: EG09681
amec AMEC Earth & Environmental 5681-70 STREET, EDMONTON, ALBERTA, T6B 3P6 PHONE 780-436-2152, FAX 780-435-8425	DATUM: -	TITLE: LATERAL PRESSURE ON WALLS DUE TO SURCHARGE POINT AND LINE LOADS	REV. No.: R1
	PROJECTION: -		FIGURE No.: FIGURE 7
	SCALE: N.T.S.		

S:\Cadd\Geo\EG09600\EG09681\EG09681-Fig10.dwg - FIGURE 9 - 1/19/2010 2:21:19 PM - rajeev.bhndiganavlly

RIGID WALLS



YIELDING WALLS



A$_h$ = 0.059g
γ = 20kN/m^3

NOTE: THE PEAK HORIZONTAL GROUND ACCELERATION (A $_h$) SHOWN IS RECOMMENDED BY THE GEOLOGICAL SURVEY OF CANADA FOR THE 2005 NATIONAL BUILDING CODE OF CANADA. VALUE TO BE ADJUSTED AS PER PROJECT REQUIREMENTS.

CLIENT: AECOM	DWN BY: BGR CHK'D BY: DJW DATUM: - PROJECTION: - SCALE: N.T.S.	PROJECT: SOUTH LRT EXTENSION PHASE 4 LRT BRIDGE OVER BLACKMUD CREEK	DATE: DECEMBER, 2009 PROJECT No.: EG09681
AMEC Earth & Environmental 5681-70 STREET, EDMONTON, ALBERTA, T6B 3P6 PHONE 780-436-2152, FAX 780-435-8425		TITLE: LATERAL EARTH PRESSURE DIAGRAMS FOR SEISMIC LOADING	REV. No.: R1 FIGURE No.: FIGURE 8

S:\Cadd\Geo\EG09600\EG09681\EG09681-Fig11.dwg - FIGURE 9 - 25/01/2010 4:54:23 PM - xlteng.llu

Appendix A

- Table A-1 Summary of Borehole and Groundwater Information
- Table A-2 Summary of Laboratory Test Results
- Borehole Logs and Laboratory Test Results
- Explanation of Terms and Symbols

Table A-1 Summary of Borehole and Groundwater Information

Project: EG09681 - SLRT Bridge over Blackmud Creek **Date: December 2009**

Borehole	Northing (m)	Easting (m)	Elevation (m)	Depth (m)	Completion	Groundwater Depth (m)	Groundwater Elevation (m)	Time Measured
Current 2009 AMEC Investigation: Proposed South LRT Bridge over Blackmud Creek								
BH09-09	5,923,997	32,111	677.1	8.8	May-09	7.6	669.5	47 days after
BH09-10	5,923,867	32,088	675.5	17.6		9 (dry)	666.5	47 days after
BH09-11	5,923,595	32,050	673.9	17.6		8.7	665.2	47 days after
BH09-12	5,923,393	32,002	677.8	8.8		0.5	677.3	48 days after
Existing 1976 Hardy Investigation: 111th Street Bridge over Blackmud Creek								
TH-1 (1976)	5,923,874	32,022	675	16	Mar-76	9.6	665.4	at completion
TH-2 (1976)	5,923,781	32,055	659	6.1		dry	-	at completion
TH-3 (1976)	5,923,652	31,897	676	14.6		8.8	667.2	at completion
Existing 1980 Hardy Investigation: 111th Street Bridge over Blackmud Creek								
TH-1 (1980)	5,923,892	32,110	677.9	11.6	Sep-80	5.7	672.2	9 days after
TH-2 (1980)	5,923,712	32,101	658.2	5.5		2	656.2	9 days after
TH-3 (1980)	5,923,577	32,093	678.5	10.2		3.4	675.1	9 days after
TH-4 (1980)	5,923,535	32,043	678.3	13.1		1.6	676.7	9 days after
Existing 1992 AGRA Investigation: 111th Street Bridge over Blackmud Creek								
92-1	5,924,020	32,122	677.7	4.2	Aug-92	dry	-	at completion
92-2	5,923,952	32,122	678	4.2		dry	-	at completion
92-3	5,923,584	32,071	678.3	8.9		7.4	670.9	5 days after
92-4	5,923,533	32,055	678.5	7.4		dry	-	at completion
92-5	5,923,450	32,044	678.6	5.7		5	673.6	5 days after
92-6	5,923,405	32,032	679	4.1		dry	-	at completion
Existing 1993 UMA Investigation: 111th Street Bridge over Blackmud Creek								
93-1	5,923,721	32,108	658.1	10.6	Jan-93	-	-	
93-2	5,923,758	32,116	659	10.6		-	-	
93-3	5,923,592	32,085	678.3	13.2		-	-	

Note:

1. Coordinates in 3TM Grid C.M. 114° NAD83.
2. Coordinates and elevations of previous boreholes were estimated based on existing reports/drawings.

TABLE A-2: SUMMARY OF LABORATORY TEST RESULTS

EG09681 SLRT Century Park to Ellerslie - Blackmud Creek Bridge **December, 2009**

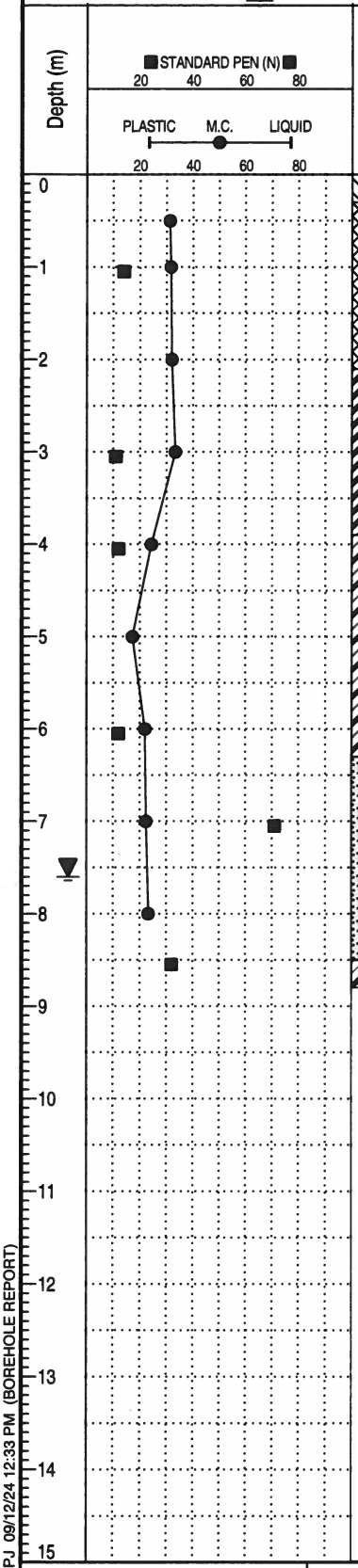
Borehole	Soil Type	Sample Depth (m)		Sample Type	Dry Density	Wet Density	Atterberg Limits		Grain Size Distribution (%)			Unconfined Compression		Sulphate	Standard Proctor Test	
		From	To		ρ_d (kg/m³)	ρ (kg/m³)	wl (%)	wp (%)	Sand	Silt	Clay	q_u (kPa)	ε_f (%)	SO_4 (%)	ρ_{dmax} (kg/m³)	OMC (%)
TH-1(1976)	Clay	5.6	6.0	SPT										0.73		
TH-1(1976)	Clay	5.2	5.6	Tube			48	22								
TH-1(1976)	Clay Till	6.7	7.0	Tube	1745	2080	26	13				258		0.6		
TH-1(1976)	Clay Till	8.6	9.0	SPT										0.1		
TH-1(1976)	Clay Till	9.8	10.2	Tube	1760	2085	41	16				470				
TH-3(1976)	Clay Till	6.7	7.0	Tube	1730	2020	28	14				288				
TH-3(1976)	Clay Till	9.8	10.2	Tube	1635	2000						402				
TH-3(1976)	Clay Till	11.2	11.6	Tube	1700	2035	50	17				402				
TH-1(1980)	Clay	5.3	5.8	Tube		1822						90	1.4			
TH-1(1980)	Clay Till	7.3	7.7	SPT			31	16								
TH-3(1980)	Clay	5.8	6.3	Tube		1786	42	23				105	4.0			
TH-3(1980)	Clay Till	6.8	7.2	Tube			31	16								
92-2	Clay	2.3	2.8	SPT			67	23								
92-3	Clay	3.8	4.3	SPT			53	22								
92-4	Fill	0.8	1.2	SPT			67	22								
92-4	Clay	2.3	2.8	SPT			57	20								
92-5	Fill	0.8	1.3	SPT			44	13								
92-6	Clay	0.8	1.3	SPT			62	23								
93-1	Shale	5.5	5.5	Core			100	25								
93-1	Shale	7	7	Core			82	26								
93-2	Sandstone	6.1	6.1	Core			93	22								
93-2	Shale	7.1	7.1	Core			100	22								
93-3	Clay	1.6	1.6				62	22							15	23.5
93-3	Clay	4.6	4.6				49	22								
93-3	Clay	5.8	5.8				53	23								
BH09-09	Clay	2.3	2.8	Tube								127	2.1			
BH09-10	Clay	2.3	2.8	SPT			60	24								
BH09-10	Clay	3.8	4.3	Tube								175	1.9			
BH09-10	Sand&Silt	5.3	5.8	SPT					34	52	14					
BH09-10	Clay Till	6.9	7.4	Tube								563	7.4			
BH09-10	Shale	11.4	11.9	SPT										0.03		
BH09-11	Fill	0.8	1.3	SPT			47	22								
BH09-11	Clay Till	5.3	5.8	SPT			46	20								
BH09-11	Clay Till	6.9	7.3	Tube								291	12.0			
BH09-11	Clay Till	8.4	8.9	SPT										0.05		

Note: refer to 'explanation of terms and symbols' for symbols used in this table.

AECOM	South LRT Phase 4: Preliminary Engineering Stage	BOREHOLE NO: **BH09-09**
DRILLER: Mobile Augers and Research Ltd.	SITE:Century Park - Ellerslie Road DATUM:	PROJECT NO: EG09681
DRILL/METHOD: M5 Truck Mount (Solid Stem)	LOCATION: Southwest of Saddleback Road & 111 St	ELEVATION: 677.1 m

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

BACKFILL TYPE: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand



SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	ELEVATION (m)
	TOPSOIL organic		G1			677
	FILL: CLAY silty, stiff to very stiff, medium to high plastic, light brown to grey, numerous light grey silt pockets, rare coarse grained sand inclusions, trace organic pockets, moist		D1	14		676
	CLAY silty, firm to stiff, medium to high plastic, laminated, dark brown to light brown, some rust staining, moist		G2			675
			U1		q_u = 127 kPa at 2.1 % Strain	
			D2	11		674
	... below 3.7 m, interbedded clay till		G3			
	CLAY TILL silty, stiff, medium to high plastic, brown, random coal pieces, trace fine gravel, random fine grained sand lenses, moist		D3	12		673
			G4			672
			U2			
			D4	12		671
	SAND fine grained, silty, very dense, brown, damp to moist		B1			
	... from 6.8 to 7.2 m, clean, dark brown to black, random coal pieces, wet		D5	71		670
	... below 7.4 m, clean, light grey				Water level at completion ▽ BH Water level on 05/21/2009 ▽ BH Water level on 06/24/2009	669
	... at 8.4 m, FREE WATER		D6	32		668
	CLAY TILL silty, hard, medium to high plastic, dark grey to black, some fine to coarse grained sand inclusions, rare gypsum crystals, some tan silt pockets, random coal pieces, grey silt stringers/pockets, damp to dry					667
	End of Borehole at 8.8 m Borehole sloughed to 8.3 m at completion Installed 1" PVC standpipe to 8.8 m, slotted from 8.8 to 1.5 m, stickup 0.9 m Borehole backfilled with drill cuttings to 1 m, bentonite to surface Water level at 7.3 m at completion Water level at 7.5 m on May 21, 2009 Water level at 7.6 m on June 24, 2009					666 665 664 663

amec

AMEC Earth & Environmental
5681 - 70 Street NW
Edmonton, Alberta, T6B 3P6

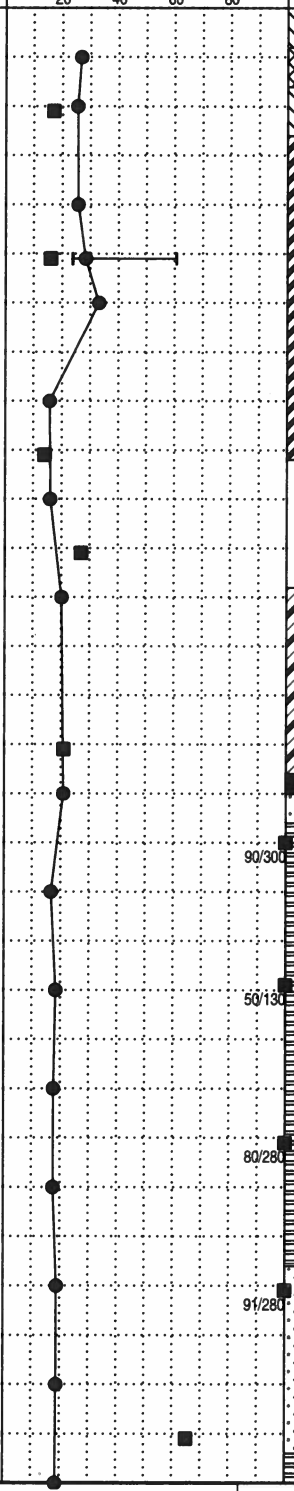
ENTERED BY:	COMPLETION DEPTH: 8.80 m
LOGGED BY: BW/KH	COMPLETION DATE: 7/5/09
REVIEWED BY: XL	Page 1 of 1

EG09681.GPJ 09/12/24 12:33 PM (BOREHOLE REPORT)

AECOM	South LRT Phase 4: Preliminary Engineering Stage	BOREHOLE NO: **BH09-10**
DRILLER: Mobile Augers and Research Ltd.	SITE:Century Park - Ellerslie Road DATUM:	PROJECT NO: EG09681
DRILL/METHOD: M5 Truck Mount (Solid Stem)	LOCATION: North Valley Wall of Blackmud Creek	ELEVATION: 675.5 m

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

BACKFILL TYPE: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand



Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	OTHER TESTS COMMENTS	ELEVATION (m)
0		**TOPSOIL** organic					675
1		**FILL: CLAY** silty, some fine grained sand, stiff, low to medium plastic, light brown, trace organics, moist		D1	17		
		TOPSOIL organic, dry					674
2		**CLAY** silty, some fine grained sand, firm to stiff, medium to high plastic, laminated, light brown, damp to moist		D2	16		673
3		... at 2.3 m, very stiff		G1			
							672
4				U1		q_u = 175 kPa at 1.9 % Strain	
				D3	14		671
5		**SAND AND SILT** some clay, stiff to very stiff, compact, medium plastic, light brown, random gravel sizes, coarse grained sand inclusions, random silt pockets, random coal pieces		G2			
				D4	27	Grain Size Analysis: Sand 34 % Silt = 52 % Clay = 14 %	670
6		... below 5.7 m, random fine grained sand pockets, increased frequency of coal pieces		G3			669
7		**CLAY TILL** silty, very stiff, medium plastic, dark brown, silt pockets, medium to coarse grained sand inclusions, random gravel sizes, random coal pieces, moist		U2		q_u = 563 kPa at 7.4 % Strain	
				D5	21		668
8		... below 7.7 m, silt stringers					
		COAL					
		SANDSTONE highly weathered, poorly cemented, very dense, grey		D6	90		667
9		**CLAY SHALE** slightly weathered, high plastic, hard, dark grey to dark brown, sandstone interbedded, dry				Water level on 05/21/2009	
							666
10				D7	50/130	SPT (D7): pushed through 1 m of slough	
							665
11							
				D8	80/280	SO_4 = 0.03 % SPT (D8): pushed through 1 m of slough	664
12				G4			
							663
13		**SANDSTONE** highly weathered, poorly cemented, very dense, inclusion of clay matrix, some clay shale interbedded, dry		D9	91/280	SPT (D9): pushed through 1.2 m of slough	
							662
14		... at 14.3 m, clay shale laminae					
				D10	65	SPT (D10): pushed through 1 m of slough	661
15		**CLAY SHALE**					

90/300 50/130 80/280 91/280

amec
AMEC Earth & Environmental
5681 - 70 Street NW
Edmonton, Alberta, T6B 3P6

ENTERED BY:	COMPLETION DEPTH: 17.60 m
LOGGED BY: KH	COMPLETION DATE: 7/5/09
REVIEWED BY: XL	Page 1 of 2

AECOM	South LRT Phase 4: Preliminary Engineering Stage	BOREHOLE NO: **BH09-10**
DRILLER: Mobile Augers and Research Ltd.	SITE:Century Park - Ellerslie Road DATUM:	PROJECT NO: EG09681
DRILL/METHOD: M5 Truck Mount (Solid Stem)	LOCATION: North Valley Wall of Blackmud Creek	ELEVATION: 675.5 m

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

BACKFILL TYPE: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

Depth (m)	STANDARD PEN (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	SLOTTED PIEZOMETER	OTHER TESTS COMMENTS	ELEVATION (m)
15			highly weathered, hard, high plastic, dark brown to dark grey, sandstone laminations/crossbedding, dry						660
16	92/300		... at 15.8 m, dark brown, random coal pieces		D11	92		SPT (D11): pushed through 1.2 m of slough	659
17					G5				658
	50/150		**End of Borehole at 17.6 m**		D12	50/150			
18			Borehole dry at completion						657
19			Installed 1" PVC standpipe to 9 m, slotted 9 to 6.3 m, stickup 0.8 m						656
20			Borehole backfilled with drill cuttings, sand, and bentonite (see well installation details)						655
21			Water level at 9 m on May 21, 2009						654
22			Standpipe dry on June 24, 2009						653
23									652
24									651
25									650
26									649
27									648
28									647
29									646
30									

EG09681.GPJ 09/12/24 12:33 PM (BOREHOLE REPORT)

amec

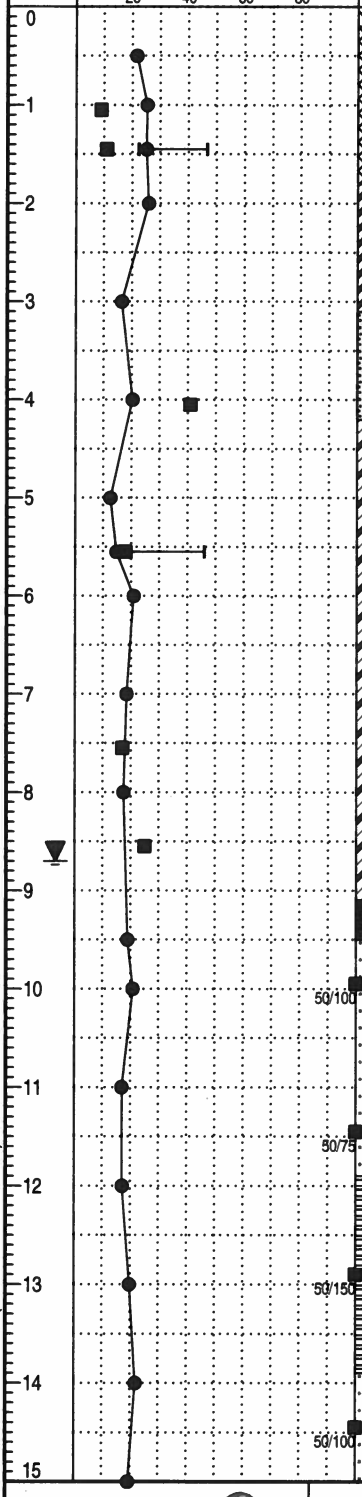
AMEC Earth & Environmental
5681 - 70 Street NW
Edmonton, Alberta, T6B 3P6

ENTERED BY:	COMPLETION DEPTH: 17.60 m
LOGGED BY: KH	COMPLETION DATE: 7/5/09
REVIEWED BY: XL	Page 2 of 2

AECOM	South LRT Phase 4: Preliminary Engineering Stage	BOREHOLE NO: **BH09-11**
DRILLER: Mobile Augers and Research Ltd.	SITE:Century Park - Ellerslie Road DATUM:	PROJECT NO: EG09681
DRILL/METHOD: M5 Truck Mount (Solid Stem)	LOCATION: South Valley Wall of Blackmud Creek	ELEVATION: 673.9 m

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

BACKFILL TYPE: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand



Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	SLOTTED PIEZOMETER	OTHER TESTS COMMENTS	ELEVATION (m)
0	**TOPSOIL** organic, moist		G1				673
1	**FILL: CLAY** silty, stiff, medium plastic, light brown, fine to coarse grained sand inclusions, random gravel sizes, trace organics, rootlets, damp		D1	9			
	... below 1.4 m, silty, tan, rare gravel, rare sand inclusions		D2	11			
2	**CLAY** silty, stiff, high to medium plastic, laminated, tan, moist		G2				672
	... at 2.7 m, sand lense, fine grained						
3	**SAND** silty, some clay, dense to very dense, tan, random gravel sizes (subrounded), moist						671
4			D3	41			670
	CLAY TILL silty, stiff to hard, low to medium plastic, dark brown, fine to coarse grained sand inclusions, trace ironstone, silt stringers/pockets, random gravel sizes, damp to moist						
5	... from 4.8 to 5.6 m, abundant medium to coarse grained sand		G3				669
			D4	18			
6	... at 5.7 m, coal nodule ... below 6.1 m, coal pieces, clay shale nodules						668
7			U1			q_u = 291 kPa at 12.0 % Strain	667
	... at 7.3 m, sandstone pocket		D5	17			
8	... below 7.8 m, sandstone nodules						666
			D6	25		SO_4 = 0.05 % Water level on 06/24/2009 Water level on 05/21/2009	
9	**COAL**						665
10	**SANDSTONE** fine grained, highly weathered, very dense, clay matrix inclusions, grey, dry		G4				664
	... below 9.8 m, interbedded clay shale, dark brown to dark grey		D7	50/100		SPT (D7): pushed through 0.2 m of slough	
11							663
			D8	50/75		SPT (D8): pushed through 0.7 m of slough	
12	... below 11.7 m, dark grey **CLAY SHALE** highly weathered, hard, high plastic, dark brown, some sandstone nodules						662
13	... below 12.6 m, interbedded sandstone		D9	50/150		SPT (D9): pushed through 1.5 m of slough	661
14	... below 13. 8m, greenish grey **SANDSTONE**						660
	highly weathered, very dense, fine grained, clay matrix inclusions, blue to grey, clay shale interbeddings, dry		D10	50/100		SPT (D10): pushed through 0.5 m of slough	
15							659

amec

AMEC Earth & Environmental
5681 - 70 Street NW
Edmonton, Alberta, T6B 3P6

ENTERED BY:	COMPLETION DEPTH: 17.60 m
LOGGED BY: KH	COMPLETION DATE: 7/5/09
REVIEWED BY: XL	Page 1 of 2

AECOM	South LRT Phase 4: Preliminary Engineering Stage	BOREHOLE NO: **BH09-11**
DRILLER: Mobile Augers and Research Ltd.	SITE:Century Park - Ellerslie Road DATUM:	PROJECT NO: EG09681
DRILL/METHOD: M5 Truck Mount (Solid Stem)	LOCATION: South Valley Wall of Blackmud Creek	ELEVATION: 673.9 m

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

BACKFILL TYPE: Bentonite | Pea Gravel | Slough | Grout | Drill Cuttings | Sand

Depth (m)	STANDARD PEN (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	SLOTTED PIEZOMETER	OTHER TESTS COMMENTS	ELEVATION (m)
15									
16	50/130				D11	50/130		SPT (D11): pushed through 0.5 m of slough	658
17			**CLAY SHALE** highly weathered, hard, high plastic, dark brown, some sandstone laminations, dry		D12	50/130		SPT (D12): pushed through 0.5 m of slough	657
	50/130		**End of Borehole at 17.6 m** Sloughed to 15.1 m at completion Borehole dry at completion Installed 1" PVC standpipe to 17.6 m, slotted from 17.6 to 1.5 m, covered with flush-mount traffic box Backfilled with drill cuttings to 1 m, bentonite to surface Water level at 8.8 m on May 21, 2009 Water level at 8.7 m on June 24, 2009						
18									656
19									655
20									654
21									653
22									652
23									651
24									650
25									649
26									648
27									647
28									646
29									645
30									644

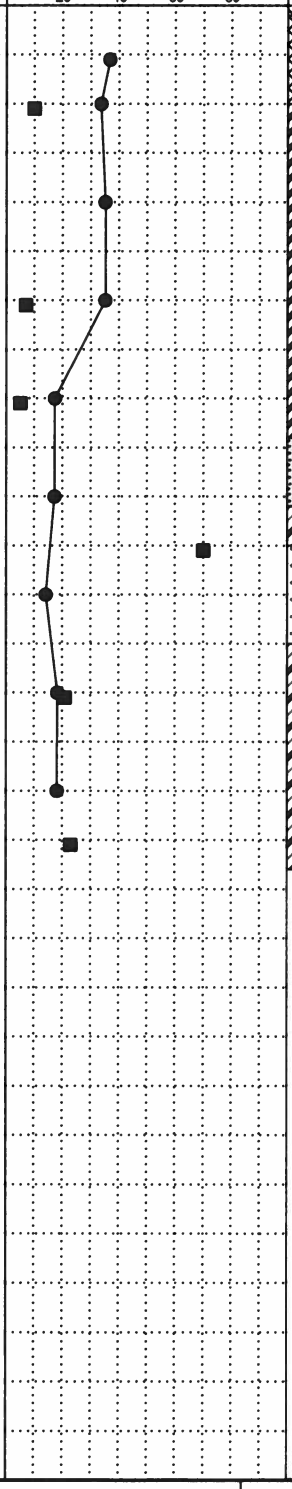
amec
AMEC Earth & Environmental
5681 - 70 Street NW
Edmonton, Alberta, T6B 3P6

ENTERED BY:	COMPLETION DEPTH: 17.60 m
LOGGED BY: KH	COMPLETION DATE: 7/5/09
REVIEWED BY: XL	Page 2 of 2

AECOM	South LRT Phase 4: Preliminary Engineering Stage	BOREHOLE NO: **BH09-12**
DRILLER: Mobile Augers and Research Ltd.	SITE:Century Park - Ellerslie Road DATUM:	PROJECT NO: EG09681
DRILL/METHOD: M5 Truck Mount (Solid Stem)	LOCATION: Southwest of 12 Ave & 111 St	ELEVATION: 677.8 m

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

BACKFILL TYPE: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand



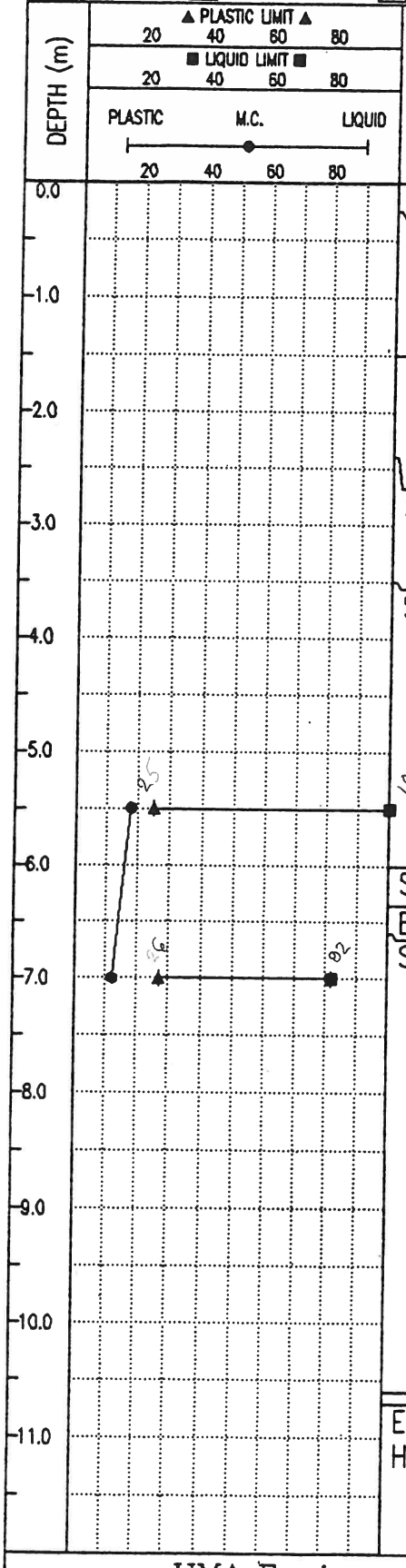
SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	SLOTTED PIEZOMETER	OTHER TESTS COMMENTS	ELEVATION (m)
	TOPSOIL organic, moist		G1			Water level on 06/24/2009	677
	FILL: CLAY silty, medium to high plastic, stiff, light brown to grey, mottled, moist, random gravel sizes, random medium grained sand inclusions		D1	10			
			G2				676
	CLAY silty, firm, medium to high plastic, light brown to grey, moist					Water level on 05/21/2009	
			U1				675
	... below 3.1 m, clayey, increase in silt content		D2	7			
	... below 3.5 m, rust stained silt laminations ... below 3.8 m, dark grey high plastic clay nodules		D3	5			674
	SAND silty, some clay, fine grained, compact to dense, increase gravel clasts close to clay till contact, moist		G3				673
	CLAY TILL sandy, silty, low to medium plastic, very stiff, dark grey, random clay shale nodules, random gravel sizes, medium to coarse grained sand inclusions, random coal nodules, moist		D4	70			672
	SANDSTONE (rafted) fine grained, poorly cemented, highly weathered, clay cemented, light grey, damp		D5	21			671
	CLAY TILL silty, very stiff, medium to high plastic, black to dark gray, random gravel clast sizes, subangular, some fine to medium grained same inclusions, some clay shale nodules, fine grained sand pockets, damp		G4			... below 7.3 m, hard drilling	670
			G5				
	... below 7.3 m, increase abundance of gravel sizes ... below 7.4 m, rare to occasional sandstone inclusions ... below 8.0 m, interbedded fine grained sands ... at 8.8 m, saturated grey to dark grey silt pockets		D6	23			669
	End of Borehole at 8.8 m Borehole open upon completion Installed 1" PVC standpipe to 4.7 m, slotted from 1.7 to 4.7 m, covered with flush-mount traffic box Backfilled with drill cuttings to 0.4 m, bentonite to surface Water at 7.3 m at completion Water level at 2.2 m on May 21, 2009 Water level at 0.5 m on June 24, 2009						668
							667
							666
							665
							664
							663

EG09681.GPJ 09/12/24 12:33 PM (BOREHOLE REPORT)

amec	**AMEC Earth & Environmental** **5681 - 70 Street NW** **Edmonton, Alberta, T6B 3P6**	ENTERED BY:	COMPLETION DEPTH: 8.80 m
		LOGGED BY: BW/KH	COMPLETION DATE: 6/5/09
		REVIEWED BY: XL	Page 1 of 1

CITY of EDMONTON	Project: 111 STREET BRIDGE	TESTHOLE No: 93-1
Driller: Garrity & Baker	NORTH ABUTMENT AND PIER	Project No: 0083-129-00-04
Method: Wet Rotary	STATION: 691.000 OFFSET: C0.00	ELEVATION: 658.100 (m)

SAMPLE TYPE: GRAB | SHELBY TUBE | SPT SAMPLE | A-CASING | NO RECOVERY | CORE



SOIL DESCRIPTION

TOPSOIL

SANDY CLAY TILL
- more sand and gravel with depth

1.5 m

SAND
- some gravel below 1.8 m
- a rock encountered at 1.9 m

2.4 m

SANDSTONE
- grey, weak
- less weathered below 3.0 m

SHALE
- weak rock (hard soil)
- some siltstone layers
- not weathered

SANDSTONE

BENTONITIC SEAM

SHALE
- weak rock (very hard soil)

END OF TESTHOLE AT 10.6 m
HOLE BACKFILLED UPON COMPLETION

REMARKS

START OF CORING
1st CORE 4.9m to 6.0m
Recovery = .76m (69%)
RQD = 34%

2nd CORE 6.0m to 7.6m
Recovery = 1.1m (69%)
RQD = 28%

3rd CORE 7.6m to 9.1m
Recovery = .51m (34%)
RQD = 19%

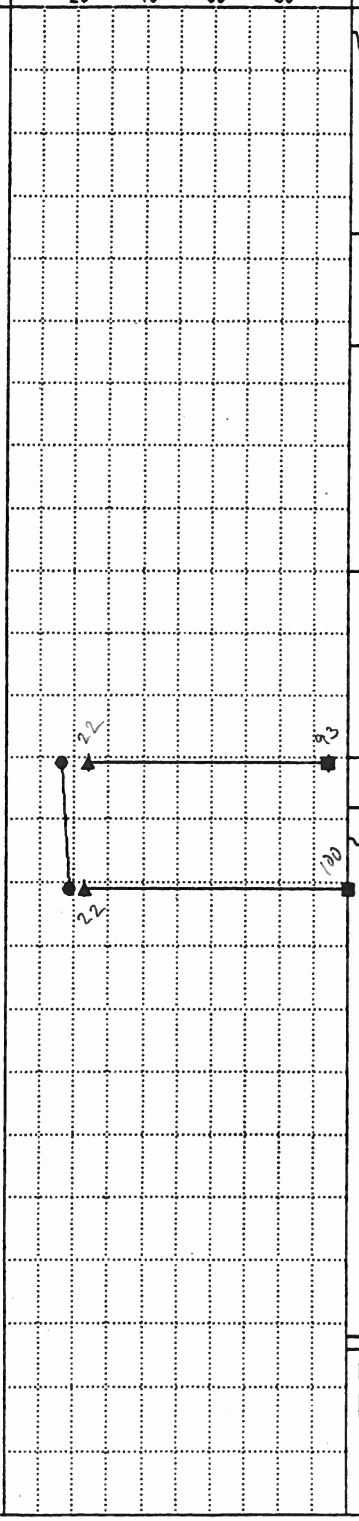
4th CORE 9.1m to 10.6m
Recovery = .76m (51%)
RQD = 42%

ELEVATION(m): 658.1, 657.1, 656.1, 655.1, 654.1, 653.1, 652.1, 651.1, 650.1, 649.1, 648.1, 647.1

UMA Engineering Ltd. Edmonton, Alberta	LOGGED BY: RRM	COMPLETION DEPTH: 10.6 m
	REVIEWED BY: RRM	COMPLETE: 01/28/93
	Fig. No: 1	Page 1 of 1

CITY of EDMONTON	Project: 111 STREET BRIDGE	TESTHOLE No: 93-2
Driller: Garrity & Baker	NORTH ABUTMENT AND PIER	Project No: 0083-129-00-04
Method: Wet Rotary	STATION: 729.000 OFFSET: C0.00	ELEVATION: 659.000 (m)

SAMPLE TYPE: GRAB | SHELBY TUBE | SPT SAMPLE | A-CASING | NO RECOVERY | CORE



SOIL DESCRIPTION

TOPSOIL

CLAY TILL
- some sand and gravel
- rock or gravel layer at 0.9 m

1.8 m

SHALE
- very weak, weathered

SANDSTONE
- very weak, poorly cemented

SHALE
- some siltstone layers
- weak rock (very hard soil)

SANDSTONE

BENTONITIC SEAM

SHALE
- some siltstone layers
- horizontal bedding planes
- more bentonitic zone at 9.8 m

END OF BOREHOLE AT 10.6 m
HOLE BACKFILLED UPON COMPLETION

REMARKS

START OF CORING
1st CORE 4.5m to 6.0m
Recovery = 0.6m (40%)
RQD = 14%

2nd CORE 6.0m to 7.6m
Recovery = 1.2m (80%)
RQD = 31%

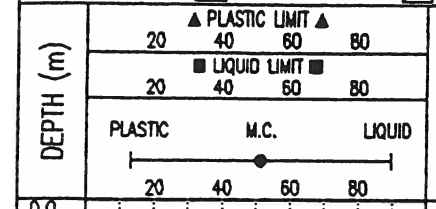
3rd CORE 7.6m to 10.6m
Recovery = 1.7m (57%)
RQD = 26%

ELEVATION(m)
659.0
658.0
657.0
656.0
655.0
654.0
653.0
652.0
651.0
650.0
649.0
648.0

UMA Engineering Ltd. Edmonton, Alberta	LOGGED BY: RRM	COMPLETION DEPTH: 10.6 m
	REVIEWED BY: RRM	COMPLETE: 01/28/93
	Fig. No: 2	Page 1 of 1

CITY of EDMONTON	Project: 111 STREET BRIDGE	TESTHOLE No: 93-3
Driller: Mobile Augers	SOUTH APPROACH	Project No: 0083-129-00-04
Method: Solid Stem Augers	STATION: 560.000 OFFSET: R7.00	ELEVATION: 678.280 (m)

SAMPLE TYPE: GRAB | SHELBY TUBE | SPT SAMPLE | A-CASING | NO RECOVERY | CORE



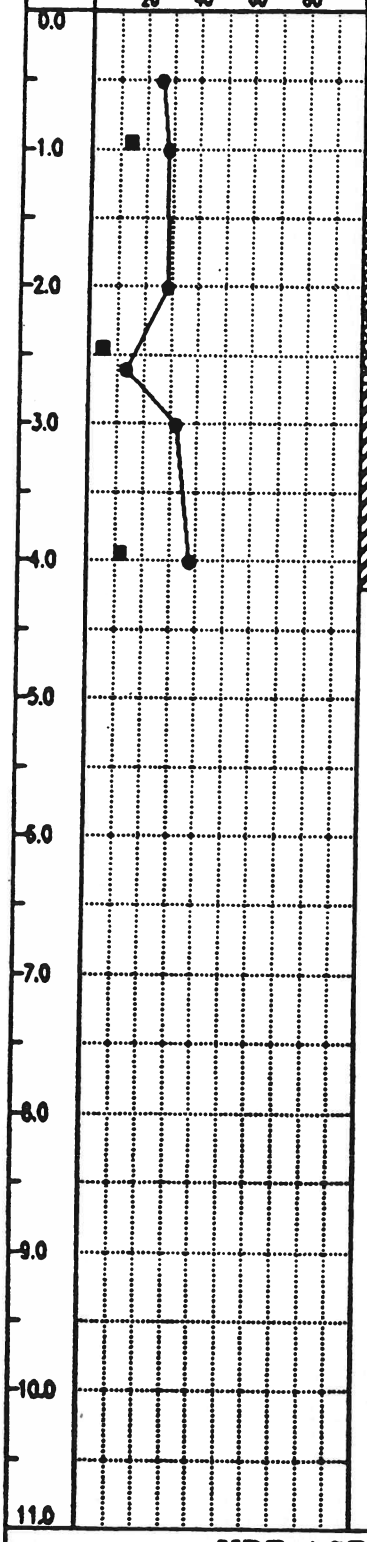
DEPTH (m)	SOIL DESCRIPTION	REMARKS	ELEVATION(m)
0.0	TOPSOIL		678.3
	SILTY CLAY – some sand above 1.5 m – very stiff – layered with occasional silt pockets – medium to highly plastic – moist	STANDARD PROCTOR DENSITY 15.0 kN/m3 OPTIMUM MOISTURE = 23.5% (combined sample 1 to 6m) CONSOLIDATION TEST – see attached lab sheets	
6.3	SANDY SILTY CLAY TILL – moist		
	SATURATED SANDY GRAVEL SEAMS		
	SANDY CLAY TILL – firm, very moist		
10.6	CLAY TILL – grey – hard		
13.2	END OF PROBEHOLE HOLE BACKFILLED WITH AUGER CUTTINGS		

1.0 677.3 | 2.0 676.3 | 3.0 675.3 | 4.0 674.3 | 5.0 673.3 | 6.0 672.3 | 7.0 671.3 | 8.0 670.3 | 9.0 669.3 | 10.0 668.3 | 11.0 667.3 | 12.0 666.3 | 13.0 665.3 | 14.0 664.3

UMA Engineering Ltd. Edmonton, Alberta	LOGGED BY: RRM	COMPLETION DEPTH: 13.2 m
	REVIEWED BY: RRM	COMPLETE: 01/28/93
	Fig. No: 3	Page 1 of 1

UMA ENGINEERING LIMITED	PROPOSED BRIDGE - 111 ST. BLACKMUD CK.	BOREHOLE No: 92-1
EDMONTON, ALBERTA	EDMONTON, ALBERTA	Project No: EG07511
TRUCK MOUNTED B-61 SOLID STEM AUGER	STA 1+928, 9.0 m LEFT OF CENTER LINE	ELEVATION: 677.69 (m)

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

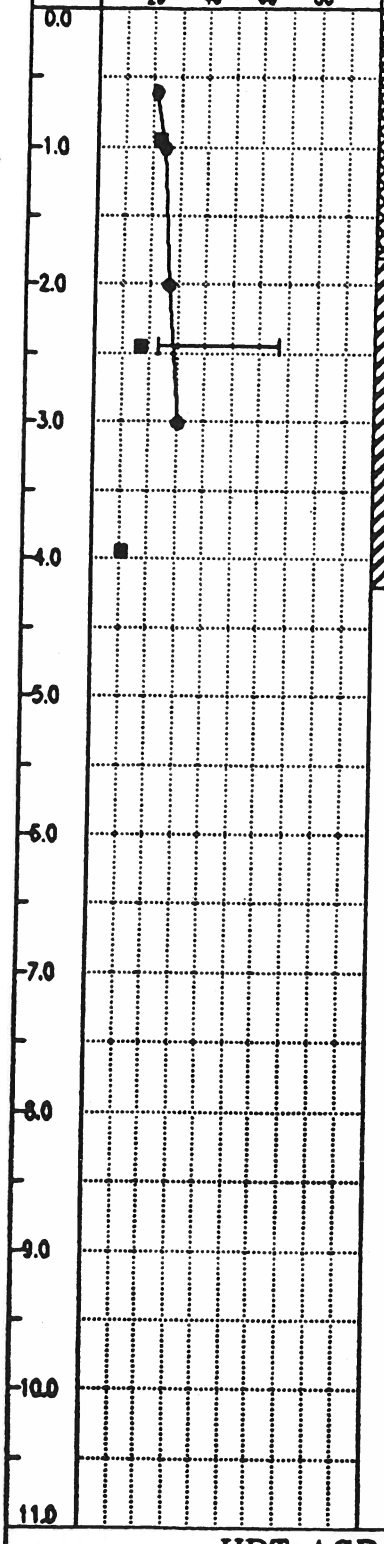


DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	WELL INSTALLATION	OTHER TESTS / COMMENTS	DEPTH (m)
0.0		TOPSOIL FILL, clayey, organic, black, rootlets						0.0
		CLAY FILL, silty, sandy, stiff, medium to high plastic, brown, occasional pebbles, small organic pockets, high plastic clay nodules		G1				
1.0				D1	14			1.0
				G2			pp = 215 kPa	
2.0								2.0
		SAND FILL, silty, fine to medium grained, brown, pebbles, occasional rootlets, TRACE OF FREEWATER at 2.2 m		D2	5			
3.0		CLAY, silty, some fine sand, stiff, high plastic, brown, ironstone nodules, occasional rust stained fissures, occasional grey high plastic clay nodules						3.0
4.0				D3	12		pp = 190 kPa	4.0
		End of Hole at 4.2 m. Backfilled with cuttings to surface. No accumulation of freewater at completion.						
5.0								5.0
6.0								6.0
7.0								7.0
8.0								8.0
9.0								9.0
10.0								10.0
11.0								11.0

HBT AGRA Limited Edmonton, Alberta	LOGGED BY: BL REVIEWED BY: DD Fig. No:	COMPLETION DEPTH: 4.2 m COMPLETE: 92/08/27 Page 1 of 1

UMA ENGINEERING LIMITED	PROPOSED BRIDGE - 111 ST. BLACKMUD CK.	BOREHOLE No: 92-2
EDMONTON, ALBERTA	EDMONTON, ALBERTA	Project No: EG07511
TRUCK MOUNTED B-61 SOLID STEM AUGER	STA 1+870, 9.0 m LEFT OF CENTER LINE	ELEVATION: 677.98 (m)

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



DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER	OTHER TESTS / COMMENTS
0.0		TOPSOIL FILL, organic, black					
		CLAY FILL, silty, some fine sand, very stiff, high plastic, grey to brown, highly weathered, rootlets, occasional pebbles, organic inclusions		D1 C1	23		pp = 390 kPa
2.0		CLAY, silty, trace to some fine sand, very stiff, high plastic, occasional ironstone nodules, occasional grey high plastic clay nodules, rust stains		G2 D2	17		pp = 365 kPa
4.0				D3	11		pp = 340 kPa
		End of Hole at 4.2 m Installed 25mm standpipe with 2.5 m hand slotted section. Backfilled with cuttings to 0.5 m, bentonite to surface. No accumulation of freewater at completion No accumulation of freewater on Sept 1, 92					
11.0							

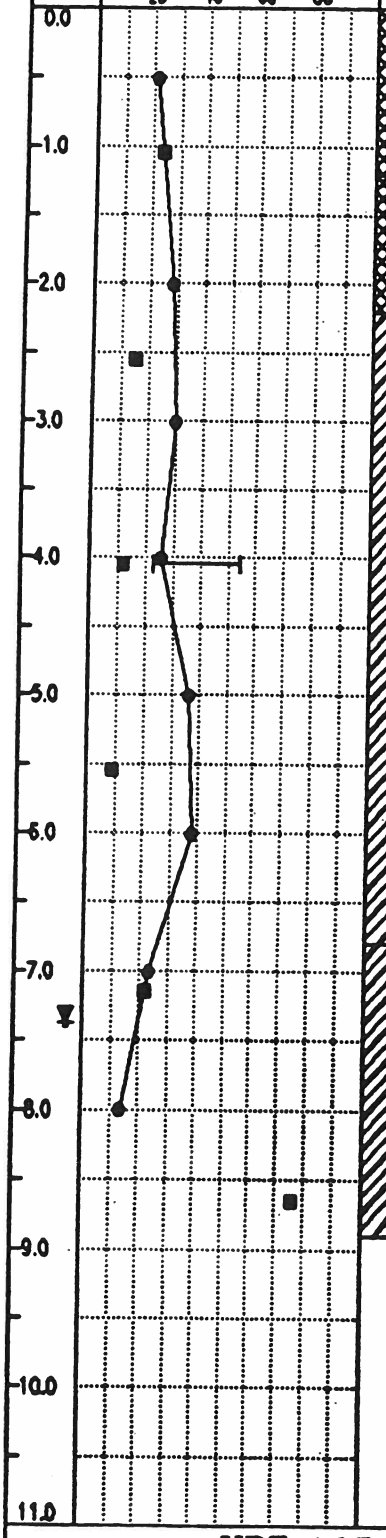
HBT AGRA Limited
Edmonton, Alberta

LOGGED BY: BL
REVIEWED BY: IDO
Fig. No:

COMPLETION DEPTH: 4.2 m
COMPLETE: 92/08/27

UMA ENGINEERING LIMITED	PROPOSED BRIDGE - 111 ST. BLACKMUD CK.	BOREHOLE No: 92-3
EDMONTON, ALBERTA	EDMONTON, ALBERTA	Project No: EG07511
TRUCK MOUNTED B-61 SOLID STEM AUGER	STA 1+478, 3.5 m RIGHT OF CENTER LINE	ELEVATION: 678.28 (m)

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



DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER	OTHER TESTS / COMMENTS
0.0	TOPSOIL FILL, organic, clayey, black to brown, loose, occasional clay lumps					
1.0			D1	24		pp = 315 kPa
	CLAY FILL, silty, sandy, very stiff, medium to high plastic, brown, rootlets, occasional pebbles					
2.0			G2			pp = 315 kPa
	CLAY, silty, fine sandy, stiff, medium plastic, brown, rust stains, high plastic clay nodules		D2	15		
3.0			G3			pp = 195 kPa
4.0	very moist, high plastic inclusions, ironstone nodules		D4	12		pp = 215 kPa
5.0			G5			pp = 125 kPa
			D4	9		
6.0	medium to high plastic		G6			pp < 100 kPa
	many high plastic lenses, brown to grey					
7.0	CLAY, silty, fine sandy, very stiff, medium plastic, brown, occasional coal chips, occasional rust stains pebbles		D5	22		pp = 195 kPa
8.0	FREEWATER at 8.2 m, wet fine sand pockets					
			D6	76		
9.0	till-like, very sandy, sand pockets End of Hole at 8.9 m. Installed 25mm standpipe to 8.4 m with 6.1m hand slotted section. Backfilled with cuttings to 0.5 m, bentonite to surface. Trace of freewater at completion. W.L. at 7.38 m on Sept 1, 92					
10.0						
11.0						

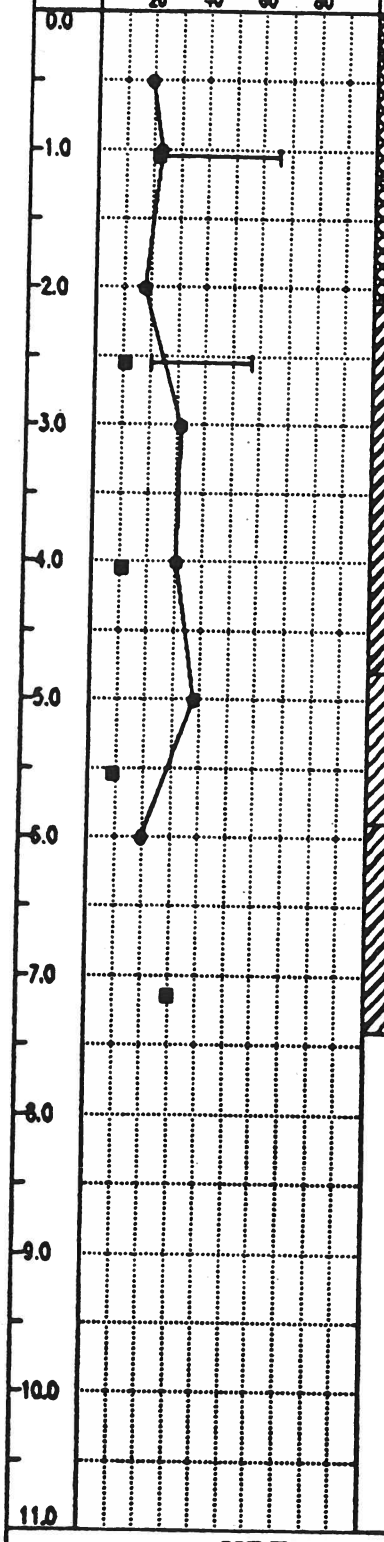
HBT AGRA Limited
Edmonton, Alberta

LOGGED BY: BL
REVIEWED BY: DD
Fig. No:

COMPLETION DEPTH: 8.9 m
COMPLETE: 92/08/27

UMA ENGINEERING LIMITED	PROPOSED BRIDGE - 111 ST. BLACKMUD CK.	BOREHOLE No: 92-4
EDMONTON, ALBERTA	EDMONTON, ALBERTA	Project No: EG07511
TRUCK MOUNTED B-61 SOLID STEM AUGER	STA 1+422, 4.0 m LEFT OF CENTER LINE	ELEVATION: 678.54 (m)

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

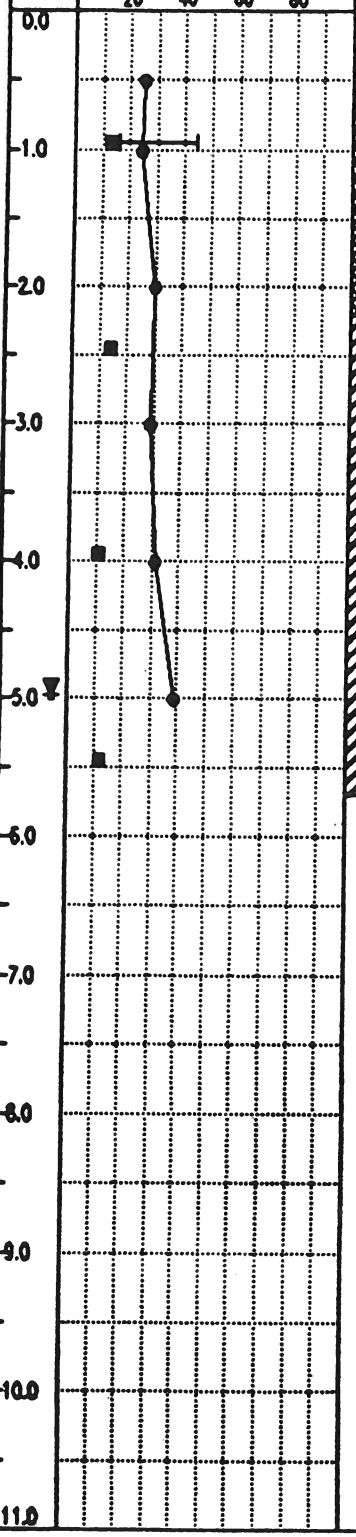


DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	WELL INSTALLATION	OTHER TESTS / COMMENTS	DEPTH (m)
0.0		TOPSOIL FILL, black, organic, roots						0.0
		CLAY FILL, silty, very stiff, high plastic, grey, roots, organic pockets		D1	22		pp > 440 kPa	
1.0								1.0
		CLAY TILL FILL, silty, sandy, stiff, medium plastic, brown, pebbles, coal chips, occasional salts, silt pockets, rust stains		G2			pp > 440 kPa	
2.0								2.0
		CLAY, silty, some fine sand, stiff, medium to high plastic, brown, ironstone nodules, grey high plastic clay nodules, rust stains		D2	11		pp = 195 kPa	
3.0				G3			pp = 170 kPa	3.0
4.0				D3	11		pp = 195 kPa	4.0
5.0		CLAY, very silty, some fine sand, stiff, low to medium plastic, brown, very moist		G5			pp < 100 kPa	5.0
				D4	9			
6.0		CLAY TILL, silty, sandy, very stiff to hard, medium plastic, brown, pebbles, coal chips						6.0
7.0				D5	30			7.0
8.0		End of Hole at 7.4 m. Backfilled with cuttings to surface. No accumulation of freewater at completion						8.0
9.0								9.0
10.0								10.0
11.0								11.0

HBT AGRA Limited Edmonton, Alberta	LOGGED BY: BL REVIEWED BY: IDD Fig. No:	COMPLETION DEPTH: 7.4 m COMPLETE: 92/08/27 Page 1 of 1

UMA ENGINEERING LIMITED	PROPOSED BRIDGE - 111 ST. BLACKMUD CK.	BOREHOLE No: 92-5
EDMONTON, ALBERTA	EDMONTON, ALBERTA	Project No: EG07511
TRUCK MOUNTED B-61 SOLID STEM AUGER	STA 1+360, 3.0 m RIGHT OF CENTER LINE	ELEVATION: 678.60 (m)

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



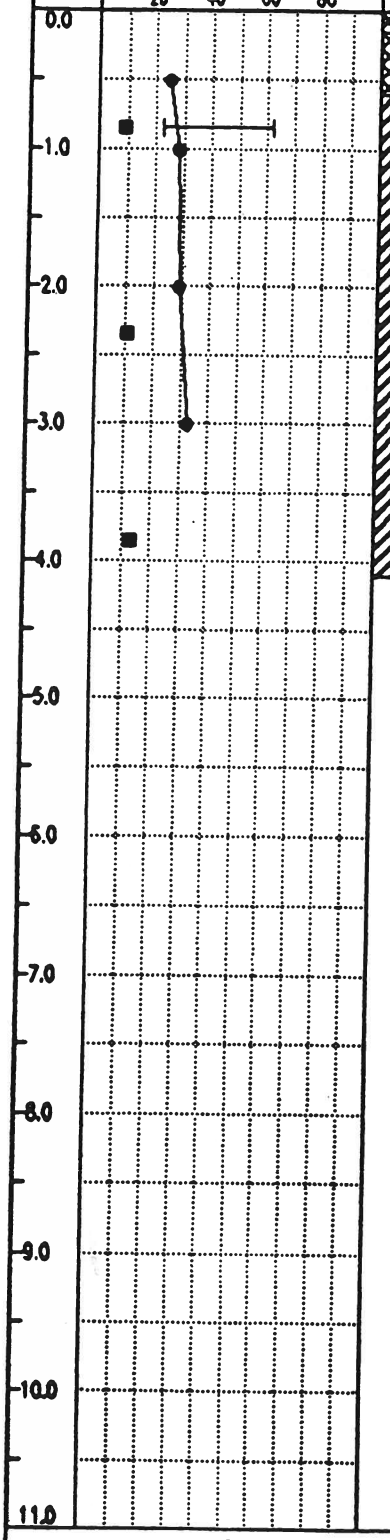
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER	OTHER TESTS / COMMENTS
0.0		TOPSOIL FILL, organic, clayey, black, moist					
		CLAY TILL FILL, silty, sandy, stiff, medium plastic, pebbles, rust stains, coal chips		D1 C1	13		pp = 390 kPa
2.0				G2			pp = 220 kPa
		CLAY, silty, trace to some fine sand, stiff, medium to high plastic, brown, ironstone nodules, high plastic clay nodules, rust stains		D2	14		
3.0				G3			pp = 195 kPa
4.0		rust stained fissures, grey silt pockets		D3	11		pp = 195 kPa
5.0							
		medium plastic		D4	12		
6.0		End of Hole at 5.7 m Installed 25mm standpipe to 5.2 m with 4.5 m hand slotted section. Backfilled with cuttings to 0.5 m, bentonite to surface. No accumulation of freewater at completion W.L. at 4.98 m on Sept 1, 92					
7.0							
8.0							
9.0							
10.0							
11.0							

DEPTH (m) duplicated: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0

HBT AGRA Limited Edmonton, Alberta	LOGGED BY: BL REVIEWED BY: IDD Fig. No:	COMPLETION DEPTH: 5.7 m COMPLETE: 92/08/27 Page 1 of 1

UMA ENGINEERING LIMITED	PROPOSED BRIDGE - 111 ST. BLACKMUD CK.	BOREHOLE No: 92-6
EDMONTON, ALBERTA	EDMONTON, ALBERTA	Project No: EG07511
TRUCK MOUNTED B-61 SOLID STEM AUGER	STA 1+306, 2.5 m LEFT OF CENTER LINE	ELEVATION: 678.96 (m)

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



SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	WELL INSTALLATION	OTHER TESTS / COMMENTS	DEPTH (m)
	TOPSOIL FILL, organic, black						0.0
	CLAY FILL, silty, sandy, stiff, medium plastic, brown to grey, occasional pebbles, rootlets, organic inclusions						
	CLAY, silty, some fine sand, stiff, medium to high plastic, brown, rust stains, high plastic clay nodules		D1	9			1.0
			G1			pp = 170 kPa	
	grey silt pockets, ironstone nodules		G2			pp = 215 kPa	2.0
			D2	11			
	grey, rust stained fissures, many high plastic clay nodules		D3	13			4.0
	End of Hole at 4.1 m. Backfilled with cuttings to surface. No accumulation of freewater at completion						

HBT AGRA Limited Edmonton, Alberta	LOGGED BY: BL REVIEWED BY: IDO Fig. No:	COMPLETION DEPTH: 4.1 m COMPLETE: 92/08/27 Page 1 of 1

HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

BOREHOLE LOG

PROJECT: BLACK MUD CREEK BRIDGE
111 St. and 23 Ave.
EDMONTON, ALBERTA

TH-1 (1980)

LOGGED/DWN.	CKD.	DATE OF INVEST.	JOB NO.	HOLE NO.
DS	WKCM	2 Sept. 1980	B-5081	1

DRILL TYPE: B-61 Solid Auger

WATER CONTENT: W_P - □ W - ○ W_L - △ PERCENT % (10 20 30 40 50 60)

DATUM
SURFACE ELEVATION 677.95 m

DEPTH m	DEPTH ft	SOIL SYMBOL	SOIL DESCRIPTION	CONDITION	TYPE	PENETRATION RESISTANCE	OTHER TESTS
			CLAY(FILL):mixed with construction debris				
			ORGANIC CLAY:silty,black, trace of rootlets		U_1		pp=240kPa
1			CLAY:silty,stiff to very stiff, medium to high plastic,brown, trace of pebbles,trace of crystalline deposits,roothairs		D_1	35	
2	5				U_2		pp>430kPa
					D_2	32	
3	10		--trace of coal chips,oxide spots, sandy lenses				
4					U_3		pp=240kPa
					D_3	21	
5	15		--trace of sand lenses				
					U_4		q_u=90kPa
6					D	18	pp=163kPa Sept.11/80
	20						ε_f=1.4%
							ρ^f=1822kg/m^3
7					U_5		pp=305kPa
			CLAY(TILL):silty,sandy,hard,medium plastic,dark brown,trace of pebbles,coal chips,shale nodules		D_5	51	
8	25						
			←trace of free water seepage		U_6		pp=430kPa
			--very sandy,low plastic,		D_6	60 for 140 mm	@ completion
9	30						Sept.2/80
			-- trace of bentonitic sandstone grey		U_7		pp=430kPa
10					D_7	70 for 200 mm	
	35		CLAY SHALE:carbonaceous,hard, highly plastic,dark brown to black,trace of coal chips				
11					D_8	70 for 220 mm	
			END OF HOLE @ 11.6 m				
12	40		Standpipe installed				
13							

BOREHOLE LOG

HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

PROJECT: BLACK MUD CREEK BRIDGE
111 St. and 23 Ave.
EDMONTON, ALBERTA

TH-2 (1980)

LOGGED/DWN.	CKD.	DATE OF INVEST.	JOB NO.	HOLE NO.
DS	WKCM	2 Sept. 1980	B-5081	2

DRILL TYPE: B-61 Solid Auger

WATER CONTENT: W_P - □ W - ○ W_L - △ PERCENT % (10 20 30 40 50 60)

DATUM

SURFACE ELEVATION 658.186 m

DEPTH m	DEPTH ft	SOIL SYMBOL	SOIL DESCRIPTION	CONDITION	TYPE	PENETRATION RESISTANCE	OTHER TESTS
			CLAY:silty,very sandy,stiff,low plastic,brown				
					U_1		pp=240kPa
1			SAND:compact,medium grained,some silt sized particles		D_1	19	
	5		CLAY(TILL):silty,sandy,very stiff,pebbles,sand lenses				▼Sept. 11/80
2					U_2		pp>430kPa
3	10		SANDSTONE:silty,very dense,fine grained,trace of highly plastic bentonite		D_2	74	
			CLAY SHALE:silty,hard,highly plastic,greyish green,trace of sandstone		U_3		
4					D_3	76	
	15						
5					D_4	71 for 215 mm	
6	20		END OF HOLE @ 5.5 m Standpipe installed No free water @ completion				
7							
	25						
8							
9	30						
10							
	35						
11							
12	40						
13							

BOREHOLE LOG

HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

PROJECT: BLACK MUD CREEK BRIDGE
111 St. & 23 Ave.
EDMONTON, Alberta

TH-3 (1980)

LOGGED/DWN.	CKD.	DATE OF INVEST.	JOB NO.	HOLE NO.
DS	WKCM	2 Sept. 1980	B-5081	3

DRILL TYPE: B-61 Solid Auger

WATER CONTENT: W_P - □ W - ○ W_L - △ PERCENT % (10 20 30 40 50 60)

DATUM

SURFACE ELEVATION 678.44 m

DEPTH m	DEPTH ft	SOIL SYMBOL	SOIL DESCRIPTION	CONDITION	TYPE	PENETRATION RESISTANCE	OTHER TESTS
			TOPSOIL: silty clay, organic, stiff, black, rootlets and decayed matters				
1	5		CLAY: silty, very stiff, high plastic, brown		U_1		pp=210kPa
					D_1	24	
2							
	10		CLAY (TILL): silty, sandy, stiff, medium plastic, brown, trace of pebbles, soft coal fragments, sand lenses		U_2		pp=210kPa
3					D_2	17	
							Sept. 11/80
4	15		CLAY: very silty, stiff, medium plastic, brown, occasional iron-stone, trace of free water		U_3		pp=190kPa
					D_3	17	
5			▽		U_4		pp=210kPa q_u=105kPa ε_f=4% ρ=1786kg/m^3
6	20		-- very silty and very sand		D_4	14	
7			CLAY (TILL): silty, sandy, very stiff, medium plastic, dark brown/grey, pebbles, shale noodles, coal chips		U_5		pp=265kPa
	25				D_5	49	
8			-- frequent sand lenses, medium grained		U_6		pp=380kPa
9	30		CLAY SHALE: hard, highly plastic, trace of sandstone, coal		D_6	67	
			-- sand lenses				
10			-- trace of clay till pocket		U_7	NR	
	35				D_7	67 for 305 mm	
11			END OF HOLE @ 10.2 m Standpipe installed No free water @ completion				
12	40						
13							

HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

BOREHOLE LOG

PROJECT: BLACK MUD CREEK BRIDGE
111 St & 23 Ave.
EDMONTON, Alberta

TH-4 (1980)

LOGGED/DWN.	CKD.	DATE OF INVEST.	JOB NO.	HOLE NO.
DS	WKCM	2 Sept. 1980	B-5081	4

DRILL TYPE: B-61 Solid Auger

WATER CONTENT: Wp - □ W - ○ W_L - △ PERCENT % (10 20 30 40 50 60)

DEPTH m	DEPTH ft	SOIL SYMBOL	SOIL DESCRIPTION (DATUM — SURFACE ELEVATION 678.34 m)	CONDITION	TYPE	PENETRATION RESISTANCE	OTHER TESTS
			TOPSOIL:organics,black,some silty clay				
1	5		CLAY:silty,very stiff,high plastic,brown,trace of crystalline deposits		U_1		pp=305kPa
					D_1	26	Sept. 11/80
2							
			CLAY(TILL):silty,sandy,stiff,low to medium plastic,pebbles,trace of gravel,sandy lenses,trace of water seepage at 2.3 m		U_2		pp=200kPa
3	10				D_2	20	
			CLAY:silty,stiff,high plastic, brown,oxide spots,trace of roothair		U_3		
4					D_3	19	
	15						
5					U_4		pp=140kPa
			very silty		D_4	15	
6	20						
			CLAY(TILL):silty,sandy,hard,medium plastic,brown,trace of pebbles,fine-grained sand lens, shale nodules		U_5		pp=305kPa
7					D_5	55	
	25						
8			sand,medium grained seam		U_6		pp>430kPa
					D_6	70 for	
9	30						
					U_7		pp=315kPa
10					D_7	34	
	35						
11					U_8		pp=380kPa
			CLAY SHALE:carbonaceous,hard, highly plastic,dark brown to black,trace of coal fragments		D_8	65 for 75 mm	
12	40						
13					D_9	60 for 115 mm	
			END OF HOLE @ 13.1 m Standpipe installed No free water @ completion				

HT08 - 79/0

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING & TESTING

SUMMARY OF SAMPLING & LABORATORY TESTS

PROJECT: STANLEY ASSOCIATES LTD. TH-1(1976)
BLACKMUD CREEK BRIDGE

DWN N.W. | CKD | DATE OF INVESTIGATION MAR 23, 1976 | JOB NO E 3491 | HOLE 1

WATER CONTENT — WATER CONTENT - % (w_p - ⊡, w - ⊙, w_L - △); 10 20 30 40 50 60 70

DEPTH FEET	SOIL PROFILE — SOIL DESCRIPTION (DATUM / SURFACE ELEVATION)	SOIL SYMBOL	UNIFIED CLASSIF.	SOIL SAMPLES — CONDITION	TYPE	PENETRATION RESISTANCE	RECOVERY %	OTHER TESTS
	TOPSOIL, CLAYEY, SILTY, BROWN							
1	CLAY, SILTY, BLOCKY, MED. PLASTIC, BROWN.							FROZEN
2								
3								
4	VERY STIFF, HIGH PLASTIC, MOTTLED GREY BROWN, NUGGETY,				U_1			
5	TRACE OF RUST							P.P = 2.7 T.S.F.
6					D	11		PP(AV) 2.4 T.S.F
7	SILTY, LAYERED, MOTTLED BROWN & GREY. TRACE OF FINE SAND.		(CI)					
8					U_2			
9	SILTY, VERY STIFF, LAYERED HIGH PLASTIC, BROWN, TRACE OF RUST & SALTS				D	18		P.P. = 2.7 T.S.F. PP(AV) = 3.0 TSF.
10								
11								
12								
13					U_3			
14	STIFF, MED. PLASTIC RUSTY.				D	11		P.P. = 1.6 T.S.F. PP(AV) = 2.2 T.S.F.
15			(CI)					
16								
17	VERY STIFF, HIGH PLASTIC.		(CH)					
18					U_4			
19	VERY SILTY, STIFF, LAYERED MED. PLASTIC, BROWN THIN SAND LENSES.		CI.		D	21		P.P = 2.5 T.S.F. SO_4 = 0.73%
20	CLAY (TILL) SILTY, SANDY, VERY STIFF, MED PLASTIC, BROWN, SMALL PEBBLES, COAL PIECES		(CI)					
21								
22	SAND LENSES, VERY SANDY TILL, LOW PLASTIC		CL					129 KPa
23					U_5			S = 2.7 KSF γ_d = 109 PCF γ = 130 PCF
24	SILTY, SANDY, HARD MED. PLASTIC, BROWN PEBBLES TO 3/8" Ø		(CI)		D	32		P.P = 2.6 T.S.F. SO_4 = 0.60%
25								
26	VERY SANDY, LOW PLASTIC, SAND		(CL)					
27	LENSES.							
28					U_6			
29	SANDIER LOW PLASTIC ZONES SAND, FINE GRAINED, SILTY,		(CL)		D	32		P.P = 4.5+ T.S.F. SO_4 = 0.10%
30	SILTY, SANDY, HARD, MED. PLASTIC, BROWN, PEBBLES TO 1/2" Ø, COAL SPECKS, TRACE OF SHALE							
31								235 KPa
32	FREE WATER →							S = 4.9 KSF γ_d = 110 PCF γ = 131 PCF
33			(CI)		U_7			
34	GREY				D	48		P.P = 4.5+ T.S.F.
35								

PLATE 2

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING & TESTING

SUMMARY OF SAMPLING & LABORATORY TESTS

PROJECT: STANLEY ASSOCIATES LTD. BLACKMUD CREEK BRIDGE TH1 (1976)

DWN | CK'D | DATE OF INVESTIGATION | JOB NO. E3491 | HOLE 1

WATER CONTENT — WATER CONTENT - % W_p - □ W - ⊙ W_L - △ (10, 20, 30, 40, 50, 60, 70)

DEPTH FEET	SOIL PROFILE: DATUM / SURFACE ELEVATION — SOIL DESCRIPTION	SOIL SYMBOL	UNIFIED CLASSIF.	SOIL SAMPLES: CONDITION	TYPE	PENETRATION RESISTANCE	RECOVERY %	OTHER TESTS
36	CLAY (TILL) (CONT)		(CL)					
37								
38	ABSENCE OF COAL SPECKS NO TRACE OF SHALE			☒	50 FOR 6"			
39	CLAY SHALE, HARD, LAYERED, HIGH PLASTIC, DARK GREY.							
40								
41								
42								
43								
44								
45								
46								
47	GREY.							
48								
49								
50								
51								
52								
53	END OF HOLE @ 52.5' W.L @ COMPLETION 31.5' W.L. 9 HRS LATER 28.5'							
54								
55								
56								
57								
58								
59								
60								
61								
62								
63								
64								
65								
66								
67								
68								
69								
70								

PLATE 3

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING & TESTING

SUMMARY OF SAMPLING & LABORATORY TESTS

PROJECT: STANLEY ASSOCIATES LTD. BLACKMUD CREEK BRIDGE TH-2(197

DWN N.W. | CKD | DATE OF INVESTIGATION MAR 24, 1976 | JOB NO E3491 | HOLE 2

WATER CONTENT

WATER CONTENT - % 10 20 30 w_p - □ 40 w - ○ 50 60 w_L - △ 70

DEPTH FEET	SOIL PROFILE: SOIL DESCRIPTION (DATUM / SURFACE ELEVATION)	SOIL SYMBOL	UNIFIED CLASSIF.	SOIL SAMPLES: CONDITION	TYPE	PENETRATION RESISTANCE	RECOVERY %	OTHER TESTS
	TOPSOIL, CLAYEY, SILTY, SANDY.							FROZEN
1–2	CLAY, SILTY, SANDY, LOW PLASTIC, BROWN, ROOTLETS		(CL)					
3–4	SAND, FINE GRAINED, SILTY, CLAYEY, COMPACT, NON-PLASTIC, BROWN.		(SC)					
5–16	SANDSTONE, BENTONITIC, COMPACT, NON PLASTIC, GREY. DENSE. VERY DENSE.							
17–20	CLAY SHALE, SILTY, TRACE OF FINE SAND, HARD, MED TO HIGH PLASTIC, DARK GREY.							
	END OF HOLE @ 20.0' DRY @ COMPLETION.							

PLATE 4

R.M.HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING & TESTING

SUMMARY OF SAMPLING & LABORATORY TESTS

PROJECT: STANLEY ASSOCIATES LTD. BLACKMUD CREEK BRIDGE TH-3(1976)

DWN N.W | CKD | DATE OF INVESTIGATION | JOB NO E 3491 | HOLE 3

WATER CONTENT — WATER CONTENT - % (10, 20, 30, 40, 50, 60, 70); w_p - ⊡, w - ⊙, w_L - △

DEPTH FEET	SOIL PROFILE: SOIL DESCRIPTION (DATUM / SURFACE ELEVATION)	SOIL SYMBOL	UNIFIED CLASSIF.	SOIL SAMPLES: CONDITION	TYPE	PENETRATION RESISTANCE	RECOVERY %	OTHER TESTS
1	TOPSOIL, CLAYEY, SILTY, ORGANIC, LOW PLASTIC							
2	CLAY, SILTY, BLOCKY, MED. TO HIGH PLASTIC, BROWN.		(CI) TO (CH)					FROZEN.
3								
4								
5	VERY STIFF, ROOTLETS, THIN SANDY MED. PLASTIC LENSES, SALTS.		(CI)	U1	D	18		P.P. = 4.25 T.S.F. P.P.(AV) = 3.3 T.S.F.
6								
7	LAYERED, MOTTLED BROWN & GREY.							
8				U2				
9	SILTY, STIFF, LAYERED, MED. TO HIGH PLASTIC, BROWN & GREY STREAKS RUSTY.		(CI) TO (CH)		D	12		P.P. = 2.4 T.S.F. P.P.(AV) = 2.7 T.S.F.
10								
11								
12	VERY STIFF, HIGH PLASTIC, LIGHT TO DARK BROWN.		(CH)					
13				U3				
14	VERY SILTY, STIFF, LAYERED, LOW PLASTIC BROWN, RUSTY. AT 14' VERY RUSTY.		(CL)		D	9		P.P. = 2.4 T.S.F. P.P.(AV) = 1.6 T.S.F.
15								
16	MED TO HIGH PLASTIC		(CI) TO (CH)					
17	VERY SILTY, FIRM TO STIFF, LOW PLASTIC, HIGH WATER CONTENT.							
18			(CL)	U4				
19	VERY STIFF, LAYERED, BROWN, RUSTY, SANDY LENSES, FREE WATER				D	34		P.P. 2.3, T.S.F.
20	CLAY (TILL) SILTY, VERY SANDY, VERY STIFF TO HARD, LOW PLASTIC, BROWN, COAL PIECES, PEBBLES TO 1/4" Ø							
21			(CL)					
22								S = 3.0 KSF; γ_d = 108 PCF; γ = 129 PCF; P.P. 2.6 TSF.
23				U5				
24	CLAY, SILTY, SANDY, HARD. MED. PLASTIC. BROWN		(CI)		D	34		
25	SAND, VERY FINE, VERY SILTY, DENSE, NON-PLASTIC, BROWN, SOME THIN LOW PLASTIC CLAY TILL LENSES, DRY.							
26			(SM)					
27								
28	CLAY (TILL) SILTY, SANDY, HARD, LOW TO MED. PLASTIC BROWN, PEBBLES TO 1/2" Ø, VERY SILTY SAND LENSES & POCKETS. DRY.			U6				P.P. 4.5+ T.S.F.
29			(CL) TO (CI)		D	37		
30								
31	SAND, FINE GRAINED, SILTY, DENSE, NON-PLASTIC. BROWN, WET & SLOUGHING		(SM)					S = 4.2 KSF; γ_d = 102 PCF; γ = 125 PCF; P.P. 4.5+ TSF
32	CLAY (TILL) SILTY, VERY SANDY, HARD, MEDIUM PLASTIC, GREY & BROWN, PEBBLES TO 1/4" Ø, SOME WEATHERED BENTONITE. AT 32.5' VERY STIFF TO HARD, GREY,							
33				U7	D	30		
34			(CI)		D	20		
35								

PLATE 5

R.M.HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING & TESTING

SUMMARY OF SAMPLING & LABORATORY TESTS

PROJECT: STANLEY ASSOCIATES LTD. BLACKMUD CREEK BRIDGE TH-3(1976)

DWN N.W | CK'D | DATE OF INVESTIGATION | JOB NO E 3491 | HOLE 3

WATER CONTENT — WATER CONTENT - % w_p - □ w - ○ w_L - △ (10 20 30 40 50 60 70)

DEPTH FEET	SOIL PROFILE: DATUM / SURFACE ELEVATION — SOIL DESCRIPTION	SOIL SYMBOL	UNIFIED CLASSIF.	SOIL SAMPLES: CONDITION	TYPE	PENETRATION RESISTANCE	RECOVERY %	OTHER TESTS
36	CLAY (TILL) CONT. AT 33.5' SILTY, SANDY, VERY STIFF, MED PLASTIC, GREY, PEBBLES TO 1/2" Ø							
37								S = 4.2 KSF
38			(CL)		U 8			γd = 106 PCF
39	HARD, MED. PLASTIC, PEBBLES TO 3/8" Ø				D	32		γ = 127 PCF
40								P.P. 3.25 T.S.F.
41								
42	CLAY SHALE, WEATHERED, LAYERED, VERY HARD, HIGH PLASTIC, DARK GREY,				U 9			
43					D	50 FOR 3"		PP 4.5 + T.S.F.
44								
45								
46								
47								
48	TRACE OF COAL				D	50 FOR 4"		
49	END OF HOLE @ 47.9' W.L. @ COMPLETION 29.0'							
50								
51								
52								
53								
54								
55								
56								
57								
58								
59								
60								
61								
62								
63								
64								
65								
66								
67								
68								
69								
70								

PLATE 6

EXPLANATION OF TERMS AND SYMBOLS

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

It should be noted that materials, boundaries and conditions have been established only at the borehole locations at the time of investigation and are not necessarily representative of subsurface conditions elsewhere across the site.

TEST DATA

Data obtained during the field investigation and from laboratory testing are shown at the appropriate depth interval.

Abbreviations, graphic symbols, and relevant test method designations are as follows:

*C	Consolidation Test	TV	Torvane shear strength
D_R	Relative Density	VS	Vane shear strength
*k	Permeability coefficient	w	Natural Moisture Content (ASTM D2216)
*MA	Mechanical grain size analysis and hydrometer test	wl	Liquid Limit (ASTM D 423)
		w_p	Plastic Limited (ASTM D 424)
N	Standard Penetration Test (CSA A119.1-60)	Ef	Unit strain at failure
		γ	Unit weight of soil or rock
N_d	Dynamic cone penetration test	γd	Dry unit weight of soil or rock
NP	Non plastic soil	ρ	Density of soil or rock
Pp	Pocket penetrometer strength	ρd	Dry Density of soil or rock
*q	Triaxial compression test	C_u	Undrained shear strength
q_u	Unconfined compressive strength	$\rightarrow$	Seepage
*SB	Shearbox test	$\underline{\blacktriangledown}$	Observed water level
SO_4	Concentration of water-soluble sulphate	$\underline{\nabla}$	Water level at completion of drilling

* The results of these tests are usually reported separately

Soils are classified and described according to their engineering properties and behaviour.

The soil of each stratum is described using the Unified Soil Classification System[1] modified slightly so that an inorganic clay of “medium plasticity” is recognized.

The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual[2].

Relative Density and Consistency:

Cohensionless Soils		Cohesive Soils		
Relative Density	SPT (N) Value	Consistency	Undrained Shear Strength c_u (kPa)	Approximate SPT (N) Value
Very Loose	0-4	Very Soft	0-12	0-2
Loose	4-10	Soft	12-25	2-4
Compact	10-30	Firm	25-50	4-8
Dense	30-50	Stiff	50-100	8-15
Very Dense	>50	Very Stiff	100-200	15-30
		Hard	>200	>30

Standard Penetration Resistance (“N” value)
The number of blows by a 63.6kg hammer dropped 760mm to drive a 50 mm diameter open sampler attached to “A” drill rods for a distance of 300 mm after an initial penetration of 150 mm.

[1] “Unified Soil Classification System”, Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps Engineers of U.S. Army. Vol. 1 March 1953
[2] “Canadian Foundation Engineering Manual”, 4th Edition, Canadian Geotechnical Society, 2006.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	COLOUR CODE	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75 µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		ORANGE	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			GP		ORANGE	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		ORANGE	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 %	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		ORANGE	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (LITTLE OR NO FINES)	SW		YELLOW-BLACK	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			SP		YELLOW-BLACK	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		YELLOW-BLACK	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 %	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		YELLOW-BLACK	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75 µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	w_L < 50%	ML		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT COMPRESSABILITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW) $I_p = w_L - w_P$ $I_L = \frac{w - w_P}{w_L - w_P} = \frac{w - w_P}{I_p}$ I_p = PLASTICITY INDEX I_L = LIQUIDITY INDEX	
		w_L > 50%	MH		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDS OR SILTY SOILS OF HIGH COMPRESSABILITY		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	w_L < 30%	CL		GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS		
		30% < w_L < 50%	CI		GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		w_L > 50%	CH		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	w_L < 50%	OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY	
		w_L > 50%	OH		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			Pt		PURPLE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBEROUS TEXTURE	

SPECIAL SYMBOLS

LIMESTONE		LEAN OIL SAND / RICH OIL SAND	
SANDSTONE		SHALE	
SILTSTONE		FILL (UNDIFFERENTIATED)	

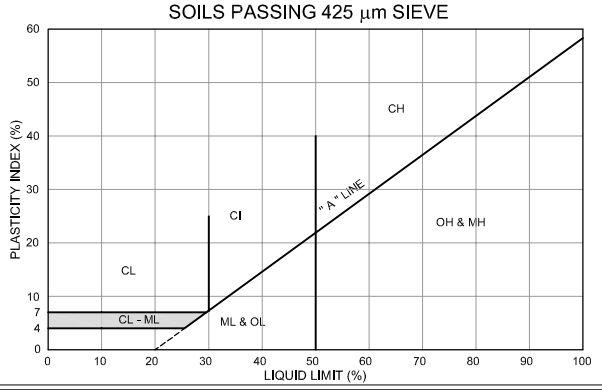
SOIL COMPONENTS

FRACTION	U.S. STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
GRAVEL	PASSING	RETAINED	PERCENT	DESCRIPTOR
COARSE	76mm	19mm	35-50	AND
FINE	19mm	4.75mm		
SAND			20-35	Y/EY
COARSE	4.75mm	2.00mm		
MEDIUM	2.00mm	425µm	10-20	SOME
FINE	425µm	75µm		
FINES (SILT OR CLAY BASED ON PLASTICITY)	75µm		1-10	TRACE

OVERSIZED MATERIAL

ROUNDED OR SUBROUNDED:	NOT ROUNDED:
COBBLES 76mm TO 200mm	ROCK FRAGMENTS > 76mm
BOULDERS > 200mm	ROCKS > 0.76 CUBIC METRE IN VOLUME

PLASTICITY CHART FOR SOILS PASSING 425 µm SIEVE



NOTES:

1. ALL SIEVE SIZES MENTIONED ON THIS CHART ARE U.S. STANDARD A.S.T.M. E.11
2. COARSE GRAIN SOILS WITH 5 TO 12% FINES GIVEN COMBINED GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH CLAY BINDER BETWEEN 5 AND 12% FINES.

AMEC Earth & Environmental
5681 - 70 Street NW
Edmonton, Alberta, T6B 3P6

Appendix G - Plant Species List

Scientific Name (ACIMS)	Common Name (ACIMS)	2015 Rank	Origin (ACIMS)	GRANK
Acer negundo	Manitoba maple	SU	Native	G5
Achillea alpina	many-flowered yarrow	S5	Native	G5?
Actaea rubra	red and white baneberry	S5	Native	G5
Adoxa moschatellina	moschatel	S4	Native	G5
Alnus incana	alder	S5	Native	G5
Amelanchier alnifolia	saskatoon	S5	Native	G5
Anemone canadensis	Canada anemone	S5	Native	G5
Aralia nudicaulis	wild sarsaparilla	S5	Native	G5
Artemisia frigida	pasture sagewort	S5	Native	G5
Betula papyrifera	white birch	S5?	Native	G5
Bromus inermis	smooth brome	SNA	Exotic	G5TNR
Chamerion angustifolium	common fireweed	S5	Native	G5
Cirsium arvense	creeping thistle	SNA	Exotic	GNR
Cornus canadensis	bunchberry	S5	Native	G5
Cornus stolonifera	red-osier dogwood	S5	Native	G5
Elaeagnus commutata	silverberry	S5	Native	G5
Eleocharis palustris	creeping spike-rush	S5	Native	G5
Elymus repens	quackgrass	SNA	Exotic	GNR
Equisetum arvense	common horsetail	S5	Native	G5
Equisetum fluviatile	swamp horsetail	S5	Native	G5
Erigeron philadelphicus	Philadelphia fleabane	S5	Native	G5

Scientific Name (ACIMS)	Common Name (ACIMS)	2015 Rank	Origin (ACIMS)	GRANK
Eurybia conspicua	showy aster	S5	Native	G5
Galium triflorum	sweet-scented bedstraw	S5	Native	G5
Geum aleppicum	yellow avens	S5	Native	G5
Glyceria grandis	common tall manna grass	S5	Native	G5
Glycyrrhiza lepidota	wild licorice	S4	Native	G5
Heracleum maximum	cow parsnip	S5	Native	G5
Hordeum jubatum	foxtail barley	S5	Native	G5
Juncus nodosus	knotted rush	S5	Native	G5
Linaria vulgaris	common toadflax	SNA	Exotic	GNR
Maianthemum stellatum	star-flowered Solomon's-seal	S5	Native	G5
Melilotus alba	white sweet-clover	SNA	Exotic	G5
Melilotus officinalis	yellow sweet-clover	SNA	Exotic	GNR
Picea glauca	white spruce	S5	Native	G5
Plantago major	common plantain	SNA	Exotic	G5
Populus balsamifera	balsam poplar	S5	Native	G5
Populus tremuloides	aspen	S5	Native	G5
Potentilla anserina	silverweed	S5	Native	G5
Prunus virginiana	choke cherry	S5	Native	G5
Ribes americanum	wild black currant	S4	Native	G5
Ribes oxyacanthoides	northern gooseberry	S5	Native	G5

Scientific Name (ACIMS)	Common Name (ACIMS)	2015 Rank	Origin (ACIMS)	GRANK
Rosa acicularis	prickly rose	S5	Native	G5
Rubus idaeus	wild red raspberry	S5	Native	G5
Rubus pubescens	dewberry	S5	Native	G5
Rumex triangulivalvis	narrow-leaved dock	S5	Native	G5
Salix exigua	narrow-leaf willow	S3S4	Native	G5
Schoenoplectus tabernaemontani	common great bulrush	S5	Native	G5
Scirpus microcarpus	small-fruited bulrush	S5	Native	G5
Shepherdia canadensis	Canada buffaloberry	S5	Native	G5
Solidago altissima	tall goldenrod	S5	Native	GNR
Sonchus arvensis	perennial sow-thistle	SNA	Exotic	GNR
Symphoricarpos occidentalis	buckbrush	S5	Native	G5
Taraxacum officinale	common dandelion	SNA	Exotic	G5
Thalictrum venulosum	veiny meadow rue	S5	Native	G5
Tragopogon dubius	common goat's-beard	SNA	Exotic	GNR
Trifolium hybridum	alsike clover	SNA	Exotic	GNR
Tripleurospermum inodorum	scentless chamomile	SNA	Exotic	GNR
Urtica dioica	common nettle	S5	Native	G5
Vicia cracca	tufted vetch	SNA	Exotic	GNR
Viola canadensis	western Canada violet	S5	Native	G5

Appendix H - **EDG Mitigation Measures**

Below is a summary of the mitigation measures which have been incorporated into the current design for each ecological design group as outlined in the Wildlife Passage Engineering Design Guidelines (Stantec 2010).

Ecological Design Group (EDG)	Mitigation Measures Incorporated in Current Design
Large Terrestrial	Clear line of sight through the structure, dry ground on either side, natural substrate, vegetation near the entrance, natural light (high openness ratio)
Medium Terrestrial	Dry ground on either side of crossing, vegetation near the entrance
Small terrestrial	Dry ground on either side of the crossing, overhead cover (shrubs and other vegetation)
Amphibians	Moist environment, natural substrate,
Aquatic	Bridge will not alter the streambed
Water Birds	Diversionary methods
Other birds	Maintain shoreline habitat, avoid planting fruit bearing trees, perform bridge maintenance activities so that they do not interfere with bridge-nesting species.

Appendix I - Follow-Up Tasks

Below is a summary table which outlines the follow-up tasks required for completion prior to construction.

VEC	Follow-up Items
Land use and zoning	Contractor will develop and follow environmental mitigations in the project-specific ECO plan to minimize impacts to Parkland areas, including, but not limited to: equipment maintenance/spill prevention; responsible soil, waste, and debris disposal; restoration of the project's disturbance footprint as per approved landscaping plans. The ECO plan will confirm all terms and conditions from approval under Bylaw 7188 are followed. Trail closures will adhere to the City's Trail Closures Procedures and will be approved through River Valley Operations. Closures to the shared use path and traffic lanes associated with the existing bridges will be managed by the contractor and dependent on City of Edmonton approval. Restoration of the Project Footprint will occur following approved landscaping plans. Contractor will develop a Hazardous Substances and Waste Management Plan.
Blackmud Creek floodplain and channel hydraulics	Design-Build Consultant to conduct an updated hydraulic analysis to verify the HWL, flow rate, and design of the pier structures to be used in final designs.
Topography and soil	Soil nails (steel or fiberglass bars inserted into the ground) or an equivalent and approved option will be incorporated into final designs. Permanent ESC measures will be evaluated and incorporated into the final design, as required. An Erosion and Sediment Control (ESC) Plan will be developed and incorporated into the project-specific ECO Plan. All ESC measures are to follow the City of Edmonton's Erosion and Sedimentation Control Guidelines (City of Edmonton 2005). Temporary ESC measures will be implemented throughout the Project Footprint, as needed, following the specifications of the ESC Plan. Design-Build Contractor to follow the soil handling strategies outlined in the Soils Strategy Report. Detailed information on the handling, storage and disposal of hazardous materials and waste will be incorporated into the project-specific ECO Plan.

VEC	Follow-up Items
Vegetation	Delineating the construction area using flagging, staking, or fencing, prior to construction starting will be required to prevent unnecessary loss of vegetation. Any delineation measures used should allow for wildlife passage. Figure 1-1 shows the proposed location of temporary construction fencing within the project area. Disturbed areas must be addressed in the Restoration Plan. A Tree Protection Plan will be developed and incorporated into the project-specific ECO Plan. A minimum of four weeks prior to the start of construction a meeting with the City's Forestry department will be conducted to review construction and tree protection plans. Conduct early and late season rare plant surveys at least one season prior to vegetation clearing. The contractor will incorporate weed management as part of the project ECO Plan that will follow the Contractors Environmental Responsibility Package, which is part of the City's environmental management program (ENVISO). An Integrated Pest Management Plan will be completed by the contractor and accepted by the City prior to completing any site activities. A Restoration Plan will be completed by the contractor and reviewed and accepted by the City of Edmonton Ecological Planners prior to completing any site activities. A Landscape Plan will be submitted by the contractor to Natural Area Operations and Ecological Planners for review prior to completing any site activities.
Wildlife and movement corridors	ECO Plan will detail mitigation measures, including no feeding instructions to workers, and food waste handling and disposal. Ensure final design allows for spacing between existing bridges and proposed bridge of at least 3.5 m. The current bridge has been designed with a 5.58 m spacing to allow light to enter the corridor and reduce the impact to wildlife movement. This space will allow for light, which will assist in terrestrial movement. Ensure final design allows for appropriate openness ratio, greater than 1.5 m for large terrestrial wildlife (Stantec 2010). The current openness ratio of the bridge is 27 m (10 m x 110 m / 40.4 m). This calculation includes the full width of the existing road/bridge.

VEC	Follow-up Items
	Next phase of designs will be required to include Wildlife Passage Engineering Design Guidelines (Stantec 2010) outlined in Appendix H of this report and incorporate these into all phases of project as applicable. ECO Plan will outline routine monitoring of bird nests within the construction area to confirm no harassment of nesting birds due to construction activities. An environmental professional is to be consulted if clearing activities are to occur within the bird nesting period and pre-construction nest surveys are to be conducted, if needed. Consult an environmental professional if equipment operation and construction activities are to occur adjacent to the existing bridge at Blackmud Creek within the migratory bird nesting window and ensure pre-construction nest surveys are conducted if needed. If active barn swallow nests are discovered during construction period stop work and contact a Canadian Wildlife Service Biologist to discuss mitigation.
Historical resources	Include the Clearance letter in the procurement package.

Appendix J - Reviewer Comments and Response Tables

Associated Environmental

MEMO

Date:	August 30, 2019	**File:**	2017-3959
To:	City of Edmonton	**Page:**	Page 1 of 12
From:	Suzanne Card		
Project:	Capital Line EIA		
Subject:	Response to City of Edmonton Comments		

The tables below summarize comments received from the City of Edmonton and revisions completed by Associated Environmental for the Environmental Impact Assessment developed for the proposed works. Comments on the report were provided by the City of Edmonton via email on June 27, 2019. The table includes a response that outlines the changes made and in some cases, the rationale for change, to facilitate final review of the document.

The draft report submitted on March 8, 2018 included all available information at the time.

Date	No.	Section	Department/Group	Comment/Question/ Clarification Requested by the City of Edmonton	AE Response and Revision in Final Report
June 27, 2019	1		Business Planning and Support (Engineering Services)	However, it should be recognized that additional geotechnical investigation will be required to support detailed design for the proposed development. The report recommendations for further geotechnical investigations should be followed, which would include advancing additional geotechnical boreholes at the pier and abutment locations. It is therefore recommended that the geotechnical consultant shall review the proposed design for the project as well as the current site conditions.	No action required
	2		City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	I would like to have a concordance table that showed the list of our comments with confirmation of response in particular EIA/SLS section. For the items that required follow up, monitoring and reporting requirements, please identify the responsible agency, timeline, scope of the work, review agency and other necessary items if applicable.	Complete See email for table of preliminary review comment responses.

3	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	It is currently unclear how the chosen bridge concept reduces impact to wildlife movement through this area over the other options reviewed. An assessment of each of the bridge options on the openness ratio of the underpass should be completed. Note: this assessment should include: ○ Measurements and calculate openness ratio of the underpass when existing bridge structures are also included in the analysis. ○ Additional methods used to minimize impact to wildlife passage should include: ■ reducing the width of the bridge/MUT ■ incorporation of light into the underpass ■ incorporation of special consideration into a landscaping plan that would hide/vegetate areas in front of the curtain wall ■ incorporate learnings from the snow tracking study (about habitat types local wildlife prefer) into a restoration and landscaping plan ■ Address how to encourage bird movement around this widened passage ■ Suggest enhancements to the areas of high use wildlife trails in order to reduce the identified areas of highest risk of conflict ■ including a map of proposed wildlife fencing	Updates to Section 1.2 updated to clarify that openness ratio the same for all concepts. Table 4-7, under wildlife and movement corridors updated to clarify that existing road/bridge width included in openness calculation. Table 4-7, under Wildlife and movement corridors, wording addresses the planting that will occur under the bridge to accommodate small and medium mammal and songbird passage. Natural light discussed in Table 4-7 under disruption of wildlife movement. Species to be used in Species to be considered for incorporation into the Landscaping and Restoration Plan in Table 4-7 under wildlife and movement corridors and in Table 4-8.

			Table 4-7 under Wildlife and movement corridors updated to provide recommendations for planting to enhance high use trails. Figure 1-1 shows proposed wildlife fencing. Section 1.4.5, 1.4.6, Table 4-7, under Land Use and zoning and Wildlife movement and corridors updated to state that fencing plans will be developed with input from a wildlife specialist.
4	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	Lay down areas are not recommended within the NSRV ARP, please move the lay down area outside of the NSRV ARP o Note: that last sentence in section 1.4.6 seems to suggest that stockpiles, etc., will be allowed in the NSRV ARP. This is not supported.	Complete Text in Section 1.4.6 changed to read "Since this is inside the North Saskatchewan River Valley ARP and near Blackmud Creek, fuels, soil stockpiles, or any leachable or hazardous construction materials will not be permitted for storage at this laydown area. "
5	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	Please note that any change to drainage as a result of draining 23 Avenue underpass into Blackmud Creek is not covered by this EIA and should receive appropriate environmental review and approvals if such a change proceeds	Complete Wording has been updated in Section 1.4.3 to clarify destination of storm drainage. No drainage from the 23 Avenue underpass is planned and this paragraph has been removed.
6	City Planning (Open Space	Please include a map in the EIA that outlines:	Complete

	Network and Assembly, Urban Growth and Open Space Strategy)	o The four high-use wildlife trails that were identified in the project area o The wildlife trails that are to remain open during construction. And a discussion on if the 1:5 year HWL provides enough space for wildlife movement through the construction site? o Map of proposed future MUT alignment that can further reduce its influence on the identified areas of highest risk of conflict o Proposed vegetation protection fencing	The high use wildlife trails are shown on Figure 2-2 in the top right-hand corner and called Wildlife Corridors. Text added to Table 4-7 under Wildlife and movement corridors to address the wildlife trails and limit of construction set above the 1:5 HWL during construction. Text in Table 4-7 under vegetation addresses fencing requirements.
7	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	We note that an amphibian survey has not been completed. Given that in-stream work is not being proposed, this may be acceptable. However, please address the need for appropriate construction buffer width and other mitigation measures in order to protect riparian habitat where amphibian species are likely to occur.	Complete Wording has been added to Table 4-7 under Wildlife and movement corridors. Wording throughout report has changed to clarify that limit of construction will be placed above the 1:5 HWL and Figure 1-1 has been updated to show the boundary.
8	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	As the EIA outlines (page 18), the environmental sensitivity scores in this area range from very high to moderate. Moderate scores indicate areas where "...enhancement of these sites can add to the ecological network" through restoration. Therefore, the project has great opportunity to further mitigate its impacts to the area by improving habitat in the area through the development of a restoration plan that exceeds the requirements outlined in the landscape guidelines. o Please indicate that the Restoration Plan is to be reviewed and approved by City of Edmonton Ecological Planners	Complete Text added in Section 2.2 for further clarification, that states ”Areas scored as moderate have a strong restoration potential which can benefit surrounding ecological assets.” Text updated in Table 4-7 from “A Restoration Plan will be completed by the contractor and accepted by the City prior to completing any site activities.”

			To say, “A Restoration Plan will be completed by the contractor and reviewed and accepted by the City of Edmonton Ecological Planners prior to completing any site activities.”
9	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	Please provide a copy of the March 2019 Noise impact study and outline predicted sensory impacts on wildlife both during construction and operation of the project.	Complete Section 4.1.2.6 updated. Table 4-6 updated to include construction noise. Table 4-7, under Wildlife and Movement corridors, updated to discuss mitigation of piling installation.
10	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	What is the impact of the new piers on the south wildlife passage?	The new pier on the south side of Blackmud Creek is not anticipated to have any impact on wildlife passage as it is in line with the exiting pier and is greater than 15 m south from the wildlife passage within and adjacent to the Creek.
11	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	Please describe what is required to maintain the hand rails? What impact may this have, or not, on the NSRV ARP?	Complete Hand rails was incorrect term. Section 4.1.2.4 has been edited to specify LRT rails and discuss potential impacts.
12	City Planning (Open Space Network and Assembly, Urban	Please provide a mitigation measure for soil compaction (to ensure successful restoration)	Complete Table 4-7, under topography and soils, updated to include statement that Following reapplication subsoils will be

	Growth and Open Space Strategy)		ripped and topsoil disced. Also, vehicle use on reapplied soils will be minimized.
13	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	Please indicate on page 51 that "Maintenance and fueling will occur at least 30m from ..." the top of bank of Blackmud Ravine (not just 30m from the creek)	Complete Text updated in Table 4-7 to say, "Maintenance and fueling will occur at least 30 m from storm / sewer system catch basins and from the top of bank of Blackmud Ravine."
14	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	Please include the following in Table 4-8: Restoration Plan for City Ecological Planners to review	Complete Text added to Table 4-8 to say "Restoration Plan Must be developed by a Restoration Specialist and be submitted to the City of Edmonton's Ecological Planners for review and approval."
15	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	Minor note: Blackmud and Whitemud are in the Strawberry sub-basin of the NSRV	Complete Text added to Section 2.2.2 to say, "Both creeks are located in the Strawberry sub-basin of the North Saskatchewan River Valley."
16	Community and Recreation Facilities (River Valley Parks and Facilities)	For lay down area it states: "Since this is inside the North Saskatchewan River Valley ARP and near Blackmud Creek, fuels, soil stockpiles, or any leachable or hazardous construction materials will be permitted for storage at this laydown area." I believe they are missing the word "NOT" in this statement.	Complete Text changed in Section 1.4.6 to read "Since this is inside the North Saskatchewan River Valley ARP and near Blackmud Creek, fuels, soil stockpiles, or

			any leachable or hazardous construction materials will not be permitted for storage at this laydown area."
17	Community and Recreation Facilities (River Valley Parks and Facilities)	Require trail access plan for pedestrians to move from the west side of the street to the east side, as current trail route underneath the bridge, or if they will have trail open and use overhead hazard mitigation to allow crossing. Would require signage on trails to east, and the north west. Any trail questions/concerns, please contact Braeden Holmstrom.	Complete Text added to Table 4-7 under the Land use and zoning column.
18	Parks and Roads Services (Natural Area Operations)	Please note that a Tree Preservation Plan will be required prior to site mobilization for any trees within 5 meters of construction. - Once the landscape plans have been finalized, please ensure they are circulated to Natural Area Operations for review prior to approval. - Please note there has been an update to the Corporate Tree Management Policy. It is now Corporate Tree Management Policy C456B.	Complete Tree Protection plan discussed in Table 4-8. Wording added to Section 4.3 to specify that landscape plans are to be submitted to Natural Areas Operation and Ecological Planners for review. Text changed in Section 1.5.1.3 to C456B
19	Parks and Roads Services (Resource Planning and Land Development)	1) A pre-construction inspection prior to accessing the site and a post-construction inspection once parkland restoration has occurred will be conducted by Land Development. Email: parkslandscapeinventory@edmonton.ca to request inspections. 2) This project must follow all City Policies and Servicing Agreements 3) Project must be reviewed Natural Areas Operations. 4) The site is in compliance with the site's Natural Area Management Plan. 5) Please follow The City of Edmonton Landscape Design and Construction Standards Volume 5 – Landscaping.	Complete 1) This information is now in Table 4-8. 2) Noted 3) The requirement for review by Natural Areas Operations and Ecological Planners is stated in Section 4.3, in the paragraph directly above Table 4-8.

6) Any damaged turf areas shall be re-sodded or repaired with like grasses/vegetation as required and maintenance (watering and mowing) of restored turf areas will be the responsibility of the proponent until the turf is established. All damages to natural areas must be restored to pre-existing conditions with natural plantings as required and the maintenance (watering) of restored natural areas will be the responsibility of the proponent until the natural area planting material is established. All other damages to parkland inventory (shrub beds, etc) must be restored to pre-existing conditions and COE Construction Standards and City Operations satisfaction.	4) Section 1.5 updated to reference the City-Wide Natural Area Management Plan.
7) Any new trail construction or rehabilitation must have a minimum 1M buffer zone, free of vegetation on either side of the trail.	5) Please refer to text in Table 3-1 which states “Implement planting plan in accordance with Restoration plan and follow guidelines as outlined in the Design and Construction Standards Volume 5 Landscaping (City of Edmonton 2017d).”
8) If tree conflicts (work within 5m of a tree) are anticipated, or arise during construction, or a tree is within 3m of the haul route a site meeting with the City of Edmonton Natural Area Forester will be required. Please be advised that all costs associated with the removal, replacement or transplanting of trees shall be covered by the applicant as per the Corporate Tree Management Policy (C456A). City of Edmonton will schedule and carry out all required tree work involved with this project	6) Text added to Table 4-7 under the vegetation column. 7) Noted; however, there is no new trail construction planned. 8) Corporate Tree Management Policy addressed in Section 1.5.1.3. Tree Protection Plan is addressed in Table 4-7 and Table 4-8.
9) Tree protection is required around existing boulevard trees near the site access points. A minimum 2M protection barrier surrounding each tree is required.	9) Corporate Tree Management Policy addressed in Section 1.5.1.3. Tree Protection Plan is addressed in Table 4-7 and Table 4-8.
10) Site drainage must not be affected by this project.	10) Noted. Drainage described in Section 1.4.3.
11) Please limit the slope of any possible hills or swales to a maximum of 3:1 (i.e. less than 18.0 degrees or 33.3 percent)	11) Design already addresses the requirement that the slope of any

12) Any chain-link fence installed on COE property must have 9 gauge wire, before any plastic coating as per Standard 2.1.2 - Nominal wire diameter: 3.5mm (9-gauge)
13) Please ensure site drainage is not affected by this project and water moves efficiently and quickly and does not allow ponding for several days post rain event.
14) The finished surface of the shared path must be level with the existing turf grade level. 3.7.2 Where sod butt joins surface paving, i.e. manhole, sidewalk or curb, position sod turf crown flush with finished hard surface.
15) There is no dumping or stockpiling on the site.
16) Hard-surface access routes are preferred for large equipment.
17) Any holes must be filled immediately to ensure public safety during project.
18) Weeds must be controlled as per the Weed Act.
19) Use of the area must be managed carefully to prevent any spills or release of contaminants.
20) Erosion and Sedimentation Control Measures must be in place prior to any construction activity to prevent any contaminants from entering Infrastructure or water bodies.
21) Any lay down/staging area must be fenced, with no vehicular or project activity outside of the fenced area.
22) The site is left in an intended state that meets the City's satisfaction.
23) Signage must be posted indicating a project contact person and phone number for inquiries.

possible hills or swales is limited to a maximum of 3:1 (i.e. less than 18.0 degrees or 33.3 percent).
12) Noted
13) Noted. Drainage described in Section 1.4.3.
14) Noted
15) Stockpiling addressed in Section 1.4.6.
16) Noted
17) Noted
18) Weed Control Act described in Section 1.5.2.7. Mitigation measures are described in Table 4-7 under Vegetation.
19) Spills are addressed in Table 4-7 under Topography and soil and Surface water, groundwater and aquatic habitat
20) ESC measures and controls are addressed in Section 1.4.5, Table 3-1, Table 4-7 under Surface water, groundwater, and aquatic habitat and Table 4-8
21) Text added to Section 1.4.6
22) Noted
23) Noted

20	General Conditions Regarding Vegetation Removal	1) Upon approval of the plan, a site meeting with Forestry will be required to review construction plans and tree protection during construction conflicts (construction work within 5 meters). This meeting will need to be scheduled a minimum of four weeks in advance of the construction start date. This is to review access points in and out of the laydown site, placement of all permanent or temporary construction material required for this project, and to determine tree protection requirements within 5 metres of any city tree during the construction work or use of parkland area for the designated lay-down area. Please be advised that all costs associated with the removal, replacement or transplanting of trees shall be covered by the Proponent as per the Corporate Tree Management Policy (C456A). Forestry will schedule and carry out all required tree work involved with this project. Please contact naturalareaoperations@edmonton.ca to arrange this meeting. 2) Any soil damage or compaction compromising the trees root system within the parkland space, boulevard, or within the City's Right-of-Way buffer green space shall be corrected by and at a cost to the proponent/project. Please be advised that all costs associated with soil remediation or with watering, removal, pruning, replacement, transplanting, and protection of trees shall be covered by the proponent as per the Corporate Tree Management Policy (C456A). 3) Prior to construction or lay-down area acceptance, all City of Edmonton trees within 5 meters of the proposed area shall be protected (hoarded) in such a way warranted by the City of Edmonton's Urban Forester. If tree damage occurs, compensation or value will be enforced and shall be covered by the proponent as per the Corporate Tree Management Policy (C456A).	Complete 1) Tree Management Policy described in Section 1.5.1.3. Tree Protection Plan referred to in Table 4-7 under Vegetation and Table 4-8. 2) Tree Management Policy described in Section 1.5.1.3 3) Tree Management Policy described in Section 1.5.1.3 4) Migratory Bird Conventions Act described in Section 1.5.3.2. Mitigation measures described in Table 4-7 under Wildlife and movement corridors.

		4) Please note that the removal of vegetation has the opportunity to impact birds and bird habitat. It is recommended that a nest search is completed a maximum of seven days prior to any disturbance. The nesting period in Edmonton is mid-February to late-August. Protection of migratory and non-migratory birds is legislated federally and provincially and enforceable regardless of whether or not individual environmental reviews conducted in accordance with the River Valley Bylaw include discussions of these topics. The onus is on the individual or company conducting habitat disturbance or construction activities to ensure that due diligence has been exercised to avoid harm to migratory and non-migratory birds. Individuals or companies that do not avoid harm to most wildlife species risk prosecution under the Wildlife Act and, in some cases, the Species at Risk Act. In the case of migratory birds, prosecution under the Migratory Birds Convention Act is also possible.	
21	General Conditions:	1) All mitigation measures and commitments outlined by City reviewers must be incorporated into the construction work plan. 2) The proponent is responsible for seeking approval for any other regulatory permits from provincial and federal agencies. 3) Please contact the Neighbourhood Resource Coordinator Linda Bombardieri 780-944-5783 in the area to ensure appropriate community notification. 4) For potential impacts to City parks and facilities: a) Please ensure restoration of the site occurs and meets existing site conditions. All damages to parkland must be restored to City of Edmonton Construction Standards and City Operations' satisfaction.	Complete 1) Noted 2) Summary of legislative requirements and proponent responsibilities outlined in Table 1-3. 3) Text added to Section 6 – personnel details excluded. 4) Restoration plan referenced in Table 3-1, Table 4-7 under Land use and zoning and Vegetation, and Table 4-8.

b) Noxious weeds shall be managed and controlled as required within any fenced area and should be the responsibility of the contractor/department during construction.
5) All trail closures shall adhere to the City's Trail Closure Procedures. All trail closure activities must be approved through River Valley Operations prior to construction and closure of trails. Please contact Braeden Holmstrom (Team Leader, River Valley & Horticulture) at 587-986-2841 to obtain the necessary trail closure approvals. This shall be done a minimum of two weeks in advance of planned construction.
6) Please attach this letter for any further City of Edmonton approvals.

Weed Control Act described in Section 1.5.2.7. Mitigation measures are described in Table 4-7 under Vegetation.

5) Trail closure requirements are described in Table 4-7 under Land use and Zoning – personnel details excluded.
6) It is anticipated that this report has addressed all outstanding items. Any general conditions stated in these comments and required by the City will be included in the final River Valley EIA sign-off

Suzanne Card

From: Suzanne Card
Sent: Friday, August 30, 2019 9:34 AM
To: Achyut Adhikari
Cc: Kent Eklund; Adonis Dichoso; Sandra Meidinger
Subject: Blackmud Creek EIA - First comment response table

Hi Achyut,
As discussed during our meeting on August 21, please find the comment response table from the first review of the Blackmud Creek EIA completed by Catherine and yourself and submitted to us on October 4, 2018. Edits were incorporated into the EIA report and the SLS, where appropriate.
Thank you
Suzanne

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
October 4, 2018 Achyut Adhikari	**1**	1.4.2, 1.4.3	All proposed infrastructure projects related to the crossing should captured including the utility relocation and related infrastructure for operation related to rail track.	Complete. Section 1.4.2 and 1.4.3 updated to include infrastructure changes.
	2	1.4.3, 1.5.1.2	Stormwater management plan to offset the increased permeability and changed water quality and quantity for both short term (during construction) and long term. Potential LID or bioengineering best practices if suitable for the project	Complete. Section 1.4.3 was updated. Text was added into Section 1.5.1.2.
	3	3.0, 4.1.2.3. Table 4-7	Bank stability related works during construction phase	Complete. Table 3-1 updated. Table 4-7 under Topography and Soil VEC updated.

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
	4	Table 3-1, Section 4 before Table 4-8	Detailed restoration and landscaping plan and timeline (includes landscaping and wildlife consideration in crossing design)	Complete. Table 3-1 updated. Table 4-7 under vegetation and wildlife movement and corridors, Table 4-8 updated.
	5	2.2.1, 4.1.2.1, Table 4-7	Temporary and permanent impact of construction to the recreational (e.g. SUP) in the project area for consideration of alternative mitigation	Complete. Section 2.2.1, Section 4.1.2.1, and Table 4-7 under land use and zoning updated.
	6	N/A	EDC approval if required	No action Edmonton Design Committee (EDC) approval is not required for this project as it is design built.
	7	Table 3-1	Project phases were not clearly identified, need clear description of anticipated activities for site preparation, construction, landscaping/reclamation, operation and maintenance. VEC analysis should identify these phase appropriately while understanding the mitigation measures.	Complete. Table 3-1 updated.
	8	Table 4-8	Construction protection Measures including Waste Management e.g. preparation of ENVISO (role and responsibility of contractor for implementation following the standard)	Complete. Table 4-8 updated.
	9	2.2.3	Phase I and II ESA, Risk Management and consideration for contractor	Complete. Section 2.2.3 updated.
	10	Table 1-3	Applicable federal and provincial regulation during construction	Complete. Summarized in Table 1-3.

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
	11	1.4.7	Project Schedule (Contract award, construction duration, working hours). Detailed construction schedule to be submitted to the City for approval prior to the initiation of any work.	Complete. Section 1.4.7. updated.
	12	1.2	Alternative consideration and selected options for design: relevance to the site specific requirements, geotechnical consideration, river valley ARP implication, visual impact, users' experiences, wildlife crossings	Complete Section 1.2 updated.
	13	4.1.2.1, Table 4-7	Selection of VEC (Social Aspects including land disposition and land use zone, recreational land use, utilities, worker and public safety, etc.). Why these items were not included for discussion in VEC?	Complete. Section 2.2.1, Section 4.1.2.1, and Table 4-7 under land use and zoning updated.
	14	4.1.1., Table 4-1	Impact analysis did not consider impact direction, magnitude, and duration in a detailed level	Complete. Section 4.1.1 and Table 4-1 updated.
	15	6.0	Public engagement at various stages not available	Complete Section 6 updated.
	16	4.1.2.3, 4.3, Table 4-7 and 4-8	Impact analysis section is missing various elements e.g. bank stabilization requirement, soil contamination and handling procedure, potential contamination and plan developed during construction and operation & maintenance.	Complete Section 4.1.2.3., Table 4-3, Section 4.1.2.4, Table 4-4, Table 4-7 under Topography and Soil and Surface water, groundwater and aquatic habitat updated. Table 4-8 updated.

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
	17	4.1.2.4, Table 4-4, 4.1.2.5Table 4-7	Potential river water quality issues during construction related activities, weed invasion and management	Complete Section 4.1.2.4 and Table 4-4 updated. Table 4-7 under surface water, groundwater and aquatic habitat and vegetation updated.
	18	4.1.2.6 and Table 4-7	Will habitat connectivity will be compromised by construction or operation of the Bridge, MUT and rail track and related infrastructures?	Complete. Addressed in Section 4.1.2.6 and Table 4-7 under wildlife and movement corridors.
	19	N/A	How does the land use zoning changes applied?	No action. No land use zoning changes are anticipated for this project as the project is within the municipal road way allowance
	20	4.1.2.1, Table 4-7	Impact to the existing residential land use (e.g. noise impact to the resident, vibration impact during construction, traffic impact, parking and related issues, air pollution etc.)	Complete. Section 2.2.1, Section 4.1.2.1, and Table 4-7 under land use and zoning updated.
	21	2.2.1, 4.1.2.1, Table 4-2 and Table 4-7	The construction will interfere existing recreational use including SUP, impact the visual and aesthetic value of residential area and TOB, construction may compromise users experience for short term and long term.	Complete. Sections 2.2.1 and 4.1.2.1 updated. Text added to Table 4-2 and Table 4-7.
	22	1.4	Related disturbance associated to the relocation or installation of underground/above ground utilities could increase the area of disturbance	Complete The project description (Section 1.4) details all of the components of the bridge construction as well as the storm water upgrades. The storm water upgrades will not increase the area of disturbance footprint.
	23	NA	Workers and Public Safety	Complete

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
				Addressed in Section 1.4.5 and Table 4-7 Land Use and Zoning,
	24	Figure 2-2	Detailed map showing biophysical, wildlife, recreational areas in the project area was not provided	Complete Figure 2-2 updated.
	25	Table 4-7	VEC and Impact analysis on matrix based off various states of project was not provided (e.g. site preparation, demolition, bridge and MUT construction, reclamation, operation etc.)	Complete Table 4-7 updated.
	26	2.2.1, 4.1.2.1, Table 4-2, Table 4-7	Residential impact analysis was not provided in detailed for various criteria e.g. recreational, environmental, wildlife, vegetation, visual , geomorphology, hydrology etc.	Complete. Sections 2.2.1 and 4.1.2.1 updated. Table 4-7 updated.
	27	Table 4-8	List of deliverables required by LRT and applicable for the contractor should be developed to demonstrate adequate consideration and effective control of potential impact (Include construction plan with clear expectation)	Complete. Table 4-8 updated.
	28	Table 4-8	Ensure EMS/ECO/ ESCP and restoration plan	Complete Table 4-8 updated.
	29	Table 4-8	Expectation and conditions for mitigation measures to be delivered by the contractor (e.g. to minimize project footprint, adaptation of stage approach, contamination plan, reclamation plan,	Complete Table 4-8 outlines all plans required by contractor. Table 4-7 discusses mitigation measures for each VEC and stage of project.

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
			ESC) delivery and timeline for monitoring	
Catherine Shier	**30**	N/A	As mentioned earlier, it seems light compared to other EIAs of similar impact.	No action.
	31	1.5.1.1	I note a "pre-scoping meeting" was completed to discuss wildlife connectivity issues, but when will the scoping meeting occur that will include other parties such as geotech, parks, forestry, drainage, transportation, etc."	Complete Section 1.5.1.1 has been updated to include information from 60 and 90% structure review workshops and indication that a formal meeting can be held after submission of this draft.
	32	1.2	There is no discussion on the environmental implications of the alternative bridge length and span configurations. It seems only aesthetics and costs were considered. They should discuss which option had the lowest impact to the creek and ravine. ○ Alternatives to the proposed bridge need to be discussed	Complete Section 1.2 updated.
	33	1.4.6, Figure 1-1	Project area is very wide on the western and eastern side - is this really needed? ○ What is the area of construction impact? I see "Project Footprint" mentioned in text, but I do not see if mapped on a figure. ○ Similarly, where are the lay down areas? They should be outside of the NSRV ARP, but this report states "Locations for lay down areas will be submitted to the City prior to	Complete Figure 1-1 updated. Section 1.4.6 updated.

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
			construction. Previously disturbed areas surrounding the existing bridges will be used to the extent possible." Lay down areas must be outlined	
	34	1.1	Incorrect references to Bylaw 7188 (says 2014 on page 3) and Parks and Biodiversity office	Complete Section 1.1 updated.
	35	Figure 2-2, Table 3-1	The following statement is a huge concern to me: "Project-specific activities associated with site preparation, construction, and landscaping have not yet been confirmed as the project is currently in the Preliminary Design Phase." ○ Best to follow up with Suzanne on how this was dealt with in the other LRT EIA ○ Note on page 35: Landscaping should not be limited to the Design and Construction standards. Areas should be restored and plantings should incorporate wildlife passage design as outlined in the WPEDG ○ Species selected for landscaping/restoration activities should be limited to native plants seen in the immediate area. ○ It would be good to have a weed management section ○ Figure 2-2 outlines Site Types NOT "Vegetation Communities"	Complete Section 3 updated and Table 3-1 updated to describe activities. Table 3-1 updated. Table 3-1 updated. Table 4-7 under vegetation updated. Weed management addressed in Table 4-7 under vegetation. Figure 2-2 edited to say site type and not vegetation community.

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
	36	Table 3-1	Section 3 is inadequate. The statement that "Project-specific activities associated with site preparation, construction, and landscaping have not yet been confirmed as the project is currently in the Preliminary Design Phase." ○ These details should be included in some degree. Refer to existing LRT EIA to ensure consistency	Complete Table 3-1 updated.
	37	4.1.2.4	Will there be any impacts to snow clearing and drainage activities in the NSRV ARP during operation?	Complete. Section 1.4.3 and 4.1.2.4 updated.
	38	6.0	Public Consultation was completed in March 2018? Results should be included/summarized here.	Complete Section 6 updated.
	39	Table 4-2 to 4-6, Table 4-7, 7.0	I see no detailed analysis to support their final conclusion that "The work associated with the construction of the new LRT bridge and MUT is expected to have negligible environmental impacts since it will occur in a previously disturbed area and no instream work is required."	Complete Section 4.1.2 has been edited to include more detail and Tables 4-2 to 4-6 created to support this conclusion.
	40	1.4.5, Table 4-7	They indicate "no worksite isolation is required" because there is no instream work. Surely, they will need to have methods to avoid sedimentation entering the stream?	Complete Section 1.4.5, 4.1.2.2, Table 4-7 under Topography and Soil and Surface water, groundwater and aquatic habitat updated.

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
	41		They should provide more details on "Environmental monitoring is recommended during construction"	Complete. Table 4-7 and Section 5 updated. . Wording has been added in Section 7.0 to reference Table 4-4-7 and Section 5.
	42	2.1.4.,	Re: rare plants ○ Did they do two site visits? I only see one in August mentioned.	Complete Section 2.1.4 updated.
	43	N/A	Re: geotech - I leave that to the Geotech team	No action.
	44	Table 1-3, 4.1.2.6 Table 4-7, Appendix H	Re: wildlife passage: ○ What ways were considered to reduce the width of the passage? Or, to increase light? ○ Attached wildlife report looks good - how (or when) will the recommendations be incorporated into the EIA and on concept or design drawings? ○ What is the width of the bridge and MUT and how does it impact the openness ratio of the passage? It states it is 28m (including the existing bridges), however, the existing bridges are currently 28m. There seems to be some confusion there. ○ What is the impact of the retaining walls, abutments and piles on wildlife passage under the bridge? ○ Will there be any impact to wildlife passage at a 1:100 year event?	Complete Table 4-7, under Wildlife and movement corridors discusses width and light. Recommendations from report incorporated into Table 4-7 under wildlife and movement corridors. Table 4-7, under Wildlife and movement corridors addresses openness ratio. Table 4-7, under Wildlife and movement corridors updated. Limit of construction has been set above 1:5 year HWL. High-use wildlife trail identified runs within Creek and is used during winter. No impacts to wildlife passage anticipated at 1:100 year event. Discussed in Table 4-7 under Wildlife and movement corridors. Table 4-7, under wildlife and movement corridors updated. Table 4-7, under wildlife and movement corridors updated. Table 4-7, under Wildlife and movement corridors updated. Appendix H added. Table 1-3 updated. Figure 2-2 updated. Section 1.4.7 updated.

Date	No.	Section	Comment/Question/Clarification Requested by the City of Edmonton	AE Response and Revision in Final Restoration Plan
			○ What mitigation measures will be included to support the use of the passage by medium and small wildlife that do not like large open areas with limited vegetation? ○ Given the increased width of the road, how will bird passage be facilitated? ○ Speak to mitigation measures for all EDGs outlined in the WPEDG ○ They should mention the migratory bird act under the legislative requirements ○ Figure 2-2 should indicate that the wildlife sensitive zone is the provincial designation. The City of Edmonton considers Blackmud to be equally important to wildlife. ○ Timeline of construction and EIA approval	

Suzanne Card, M.Sc., P.Ag., P.Biol.
Environmental Scientist
Associated Environmental Consultants Inc.
500, 9888 Jasper Avenue, Edmonton, AB T5J 5C6
Tel: 780.451.7666 | Cel: 587-984-3571 | Dir: 587-773-4506

Suzanne Card

From: Suzanne Card
Sent: Thursday, November 14, 2019 1:10 PM
To: Achyut Adhikari; Sandra Meidinger
Cc: adonis.dichoso
Subject: RE: Review comments: EIA and SLS - Blackmud Creek South LRT Extension Crossing - Part 2

Hi Achyut,
Thank you so much for the clarification! Please find below the response table to address the minor comments sent on October 30, 2019.

Date	No.	Section	Department/Group	Comment/Question/Clarification Requested by City of Edmonton	AE Response and Revision in Final Report
30 October 2019	1	Table 4-7	City Planning (Open Space Network and Assembly, Urban Growth and Open Space Strategy)	This table includes reference to "Develop a fence decommissioning schedule that factors in wildlife movement in the Project Area." - Please clarify, I assume this is decommissioning for the temporary construction fence?	Table 4-7 updated to clarify that this statement refers to the temporary construction fence
	2	Table 4-7		This is an incorrect statement: "Light created by this offset with help to facilitate bird passage." This space will allow for light (which will assist in terrestrial movement), and if this space is planted with trees, that will facilitate avian passage.	Table 4-7 updated to say “This space will allow for light, which will assist in terrestrial movement.”
	3	Table 4-7		I am unclear of the reference to "Appendix H" of the WPEDG. Do they perhaps mean Appendix A?	Table 4-7 updated to clarify that Appendix H is in reference to the EIA report.
	4	Comment response Table. Item No. 3		The comments refer to the inclusion of wording that "addresses the planting that will occur under the bridge to accommodate small and medium mammal	This wording is found in Table 4-7 under wildlife movement and corridors and restoration of areas. Statement reads “Plan woody vegetation planting to occur in a network of connected areas or in

					aggregated patches with close proximity to facilitate movement of wildlife in areas that are under cover.”

Please let me know if you have any questions or concerns. If you are satisfied with the incorporation of these edits, will we obtain project sign off as the next step?

Thanks
Suzanne
From: Achyut Adhikari <achyut.adhikari@edmonton.ca>
Sent: Thursday, November 14, 2019 12:58 PM
To: Sandra Meidinger <meidingers@ae.ca>
Cc: Suzanne Card <cards@ae.ca>; adonis.dichoso <adonis.dichoso@edmonton.ca>
Subject: Re: Review comments: EIA and SLS - Blackmud Creek South LRT Extension Crossing - Part 2

Hi Suzanne,
Thank you for the updates. Please see the item 4 below for clarification, apology for sending it incomplete.
"The comments refer to the inclusion of wording that "addresses the planting that will occur under the bridge to accommodate small and medium mammal and songbird passage." However, I do not see this in the section that it is referenced."
I am fine with your approach sending a table with response for review. Let me know once you are ready.
Regards,

Achyut Adhikari
Ecological Planner
URBAN GROWTH AND OPEN SPACE STRATEGY
URBAN FORM AND CORPORATE STRATEGIC DEVELOPMENT | CITY PLANNING

780-442-0695 OFFICE
780-401-7050 FAX

City of Edmonton
Edmonton Tower
7th Floor, 10111 - 104 Avenue NW
Edmonton AB T5J 0J4

On Wed, Oct 30, 2019 at 8:24 AM Achyut Adhikari <achyut.adhikari@edmonton.ca> wrote:

> Good morning Sandra,
> Please see below for remaining minor comments for consideration in your final draft. We should be able to provide project sign off as soon as these comments are incorporated. Thank you for your cooperation.
> Regards,
>
> - Table 4-7:
>
> - This table includes reference to "Develop a fence decommissioning schedule that factors in wildlife movement in the Project Area." - Please clarify, I assume this is decommissioning for the temporary construction fence?
> - This is an incorrect statement: "Light created by this offset with help to facilitate bird passage."
>   - This space will allow for light (which will assist in terrestrial movement), and if this space is planted with trees, that will facilitate avian passage.
> - I am unclear of the reference to "Appendix H" of the WPEDG. Do they perhaps mean Appendix A?
> - The comments refer to the inclusion of wording that "addresses the planting that will occur under the bridge to accommodate small and medium mammal

Achyut Adhikari
Ecological Planner
URBAN GROWTH AND OPEN SPACE STRATEGY
URBAN FORM AND CORPORATE STRATEGIC DEVELOPMENT | CITY PLANNING

780-442-0695 OFFICE
780-401-7050 FAX

City of Edmonton
Edmonton Tower
7th Floor, 10111 - 104 Avenue NW
Edmonton AB T5J 0J4

Appendix K - EIA and SLS Sign Off

Urban Form and Corporate Strategic Development
City Planning

City of Edmonton
7th Floor, 10111 - 104 Avenue NW
Edmonton, AB T5J 0J4

Email: sdrivervalleybylaw@edmonton.ca

December 06, 2019 Reference No. 313069293-001

To: Adonis Dichoso, LRT Extension & Renewal, IIS
Sandra Meidinger and Suzanne Card, Associated Environmental Consultants Inc.

From: Achyut Adhikari, City Planning

Subject: SD19-19 Blackmud Creek South LRT Extension Crossing EIA and SLS- Sign off

---

We have completed our review of the Blackmud Creek South LRT Extension Crossing EIA and SLS project. This letter confirms that Administration has no further concerns with the proposed development under the North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP).

Please note the proposed development meets the definition of a major facility, and as such, City Council must approve the EIA and SLS, and must deem the proposed location in the River Valley as essential, to ensure the policy requirements of the NSRV ARP are satisfied.

Please adhere to the following conditions and advisements provided by reviewers.

Comments from City Planning (Urban Growth and Open Space Strategy):

We understand the project is now at an early stage of construction and the consultant may be unable to address concerns that is more related to construction and restoration.
Please attach a concordance table with the final EIA draft with detailed information on follow up tasks for implementation of mitigation strategy, restoration and monitoring work at the detailed design, construction and operation stages of the project if the detailed was not covered within the Table 4-7 and 4-8 of the EIA report.

Any changes to the proposed mitigation strategy and scope of work moving towards detailed design, construction and operation stages should be considered a new scope and required further review. The restoration plan and monitoring plan once prepared at the next states should be provided for review and comments. We will expect the final outcomes of mitigation, restoration and monitoring activities for follow up since this project is projected likely take a longer project cycle.

If the project construction starts after 5 to 7 years from the date of current assessment, we would like to revisit key environmental parameters for potential review with the current context. Also, please inform us if this project construction is delayed for a long time frame due to any reasons. We should be able to provide most updated contact list for follow up as identified under this memorandum.

Please include all the reviewers comments, follow up response and recommended actions with the final EIA report.

Comments from City Planning (Urban Growth and Open Space Strategy):

Thanks for sending this my way for a final review. Everything is looking good, except, now the EIA is silent on how to improve avian connectivity over or below the bridge.

City of Edmonton
7th Floor, 10111 - 104 Avenue NW
Edmonton, AB T5J 0J4

Email: sdrivervalleybylaw@edmonton.ca

I think the original intent of the following statement "Light created by this offset with help to facilitate bird passage" was to speak to strategies to improve bird passage in the area. However, their clarification now focuses solely on improving terrestrial use ("This space will allow for light, which will assist in terrestrial movement") and excludes any strategies for improving avian use.

Please ensure there is inclusion of plantings to support bird use around the crossing.

Comments from EPCOR Drainage Services (Water and Sewer Servicing):

1423U 111 Street NW and 128 Running Creek Road NW

Our records indicate that water services exist through the area of the proposal directly off Epcor mains.

Comments from Business Planning and Support (Engineering Services):

Engineering Services has reviewed the information provided for the proposed Blackmud Creek South LRT Extension Crossing Project. This information included a Draft Site Location Study (SLS) dated March 8, 2019 and a Draft Environmental Impact Assessment (EIA) dated March 8, 2019, both prepared by Capital Line Partners. The EIA included a project- and site-specific geotechnical report prepared by AMEC Earth & Environmental. (AMEC), File No. EG09681.BMC, dated January 28, 2010.

The SLS provided a generalized description of the proposed project and the rationale for the proposed location, crossing Blackmud Creek along the west side of the existing 111 Street crossing. The SLS did not include any geotechnical information. That said, we would concur with the SLS conclusion that proposed location of the new LRT bridge and multi-use trail (MUT) is the most appropriate site to meet the objectives of the Transportation Master Plan.

It is understood that the proposed design for the project consists of a single 3-span bridge carrying both the LRT and MUT, with 48 m long approach structures leading up to each of the abutments. The approach decks at each of the abutments will be structurally supported on pile foundations and grade beams, with no additional fill to be required at the abutments. Since no additional fill is required, the proposed configuration will likely have minimal impact on the stability of the valley walls.

The EIA included reference to site-specific geotechnical information from the appended AMEC preliminary geotechnical report. The AMEC geotechnical report appended to the EIA appeared to be a comprehensive report that included the requisite information to facilitate the preliminary design of the proposed development. ***However, it should be recognized that additional geotechnical investigation will be required to support detailed design for the proposed development. The report recommendations for further geotechnical investigations should be followed, which would include advancing additional geotechnical boreholes at the pier and abutment locations.***

It is not clear from the information provided for review whether the geotechnical consultant has conducted a review of the proposed design drawings and specifications. Furthermore, changes to site conditions may have occurred since AMEC's preliminary investigation was conducted nearly 10 years ago. ***It is therefore recommended that the geotechnical consultant shall review the proposed design for the project as well as the current site conditions.***

It is anticipated that the geotechnical risk associated with this project can be suitably mitigated through the ongoing involvement of the geotechnical engineering consultant. Provided that the

City of Edmonton
7th Floor, 10111 - 104 Avenue NW
Edmonton, AB T5J 0J4

Email: sdrivervalleybylaw@edmonton.ca

recommendations included in the EIA and appended geotechnical report are adhered to and that the geotechnical engineering consultant is involved in future phases of the development, it would appear that the geotechnical aspects of the project will be addressed accordingly.

If you have any questions regarding these comments, please contact me at (780) 944-7686.

Comments from City Planning (Planning Coordination):
Based on my search, there are no abandoned wells, active high-pressure pipelines, or other oil and gas infrastructure within the study area of Blackmud Creek Crossing.
Therefore, I have no comments on this circulation.

Comments From City Planning Development Engineering and Drawing Review):
no comments to offer on the attached reports. We currently have no record of any pending developer-initiated construction projects near or within the project limits

Comments from Community and Recreation Facilities (Civic Events and Festivals):

No comment.

Comments from Community and Recreation Facilities (Partnership and Event Attraction Strategy):

No comment.

Comments from Community and Recreation Facilities (River Valley Parks and Facilities):

For lay down area it states: "Since this is inside the North Saskatchewan River Valley ARP and near Blackmud Creek, fuels, soil stockpiles, or any leachable or
hazardous construction materials will be permitted for storage at this laydown area." I believe they are missing the word "NOT" in this statement.

Require trail access plan for pedestrians to move from the west side of the street to the east side, as current trail route underneath the bridge, or if they will have trail open and use overhead hazard mitigation to allow crossing. Would require signage on trails to east, and the north west. Any trail questions/concerns, please contact Braeden Holmstrom.

Comments from Parks and Roads Services (Natural Area Operations):

Please note that a Tree Preservation Plan will be required prior to site mobilization for any trees within 5 meters of construction.
- Once the landscape plans have been finalized, please ensure they are circulated to Natural Area Operations for review prior to approval.
- Please note there has been an update to the Corporate Tree Management Policy. It is now Corporate Tree Management Policy C456B.

Comments from Parks and Roads Services (Resource Planning and Land Development):

1) A pre-construction inspection prior to accessing the site and a post-construction inspection once parkland restoration has occurred will be conducted by Land Development. Email: parkslandscapeinventory@edmonton.ca to request inspections.

City of Edmonton
7th Floor, 10111 - 104 Avenue NW
Edmonton, AB T5J 0J4

Email: sdrivervalleybylaw@edmonton.ca

2) This project must follow all City Policies and Servicing Agreements
3) Project must be reviewed Natural Areas Operations.
4) The site is in compliance with the site's Natural Area Management Plan.
5) Please follow The City of Edmonton Landscape Design and Construction Standards Volume 5 – Landscaping.
6) Any damaged turf areas shall be re-sodded or repaired with like grasses/vegetation as required and maintenance (watering and mowing) of restored turf areas will be the responsibility of the proponent until the turf is established. All damages to natural areas must be restored to pre-existing conditions with natural plantings as required and the maintenance (watering) of restored natural areas will be the responsibility of the proponent until the natural area planting material is established. All other damages to parkland inventory (shrub beds, etc) must be restored to pre-existing conditions and COE Construction Standards and City Operations satisfaction.
7) Any new trail construction or rehabilitation must have a minimum 1M buffer zone, free of vegetation on either side of the trail.
8) If tree conflicts (work within 5m of a tree) are anticipated, or arise during construction, or a tree is within 3m of the haul route a site meeting with the City of Edmonton Natural Area Forester will be required. Please be advised that all costs associated with the removal, replacement or transplanting of trees shall be covered by the applicant as per the Corporate Tree Management Policy (C456A). City of Edmonton will schedule and carry out all required tree work involved with this project
9) Tree protection is required around existing boulevard trees near the site access points. A minimum 2M protection barrier surrounding each tree is required.
10) Site drainage must not be affected by this project.
11) Please limit the slope of any possible hills or swales to a maximum of 3:1 (ie less than 18.0 degrees or 33.3 percent)
12) Any chain-link fence installed on COE property must have 9 gauge wire, before any plastic coating as per Standard 2.1.2 - Nominal wire diameter: 3.5mm (9-gauge)
13) Please ensure site drainage is not affected by this project and water moves efficiently and quickly and does not allow ponding for several days post rain event.
14) The finished surface of the shared path must be level with the existing turf grade level. 3.7.2 Where sod butt joins surface paving, i.e. manhole, sidewalk or curb, position sod turf crown flush with finished hard surface.
15) There is no dumping or stockpiling on the site.
16) Hard-surface access routes are preferred for large equipment.
17) Any holes must be filled immediately to ensure public safety during project.
18) Weeds must be controlled as per the Weed Act.
19) Use of the area must be managed carefully to prevent any spills or release of contaminants.
20) Erosion and Sedimentation Control Measures must be in place prior to any construction activity to prevent any contaminants from entering Infrastructure or water bodies.
21) Any lay down/staging area must be fenced, with no vehicular or project activity outside of the fenced area.
22) The site is left in an intended state that meets the City's satisfaction.
23) Signage must be posted indicating a project contact person and phone number for inquiries.

General Conditions Regarding Vegetation Removal:

1) Upon approval of the plan, a site meeting with Forestry will be required to review construction plans and tree protection during construction conflicts (construction work within 5 meters). This meeting will need to be scheduled a minimum of four weeks in advance of the construction start date. This is to review access points in and out of the laydown site, placement of all permanent or temporary construction material required for this project, and to determine tree protection requirements within 5 metres of any city tree during the construction work or use of parkland area for the

City of Edmonton
7th Floor, 10111 - 104 Avenue NW
Edmonton, AB T5J 0J4

Email: sdrivervalleybylaw@edmonton.ca

designated lay-down area. Please be advised that all costs associated with the removal, replacement or transplanting of trees shall be covered by the Proponent as per the Corporate Tree Management Policy (C456A). Forestry will schedule and carry out all required tree work involved with this project. Please contact naturalareaoperations@edmonton.ca to arrange this meeting.

2) Any soil damage or compaction compromising the trees root system within the parkland space, boulevard, or within the City's Right-of-Way buffer green space shall be corrected by and at a cost to the proponent/project. Please be advised that all costs associated with soil remediation or with watering, removal, pruning, replacement, transplanting, and protection of trees shall be covered by the proponent as per the Corporate Tree Management Policy (C456A).
3) Prior to construction or lay-down area acceptance, all City of Edmonton trees within 5 meters of the proposed area shall be protected (hoarded) in such a way warranted by the City of Edmonton's Urban Forester. If tree damage occurs, compensation or value will be enforced and shall be covered by the proponent as per the Corporate Tree Management Policy (C456A).
4) Please note that the removal of vegetation has the opportunity to impact birds and bird habitat. It is recommended that a nest search is completed a maximum of seven days prior to any disturbance. The nesting period in Edmonton is mid-February to late-August. Protection of migratory and non-migratory birds is legislated federally and provincially and enforceable regardless of whether or not individual environmental reviews conducted in accordance with the River Valley Bylaw include discussions of these topics. The onus is on the individual or company conducting habitat disturbance or construction activities to ensure that due diligence has been exercised to avoid harm to migratory and non-migratory birds. Individuals or companies that do not avoid harm to most wildlife species risk prosecution under the *Wildlife Act* and, in some cases, the *Species at Risk Act*. In the case of migratory birds, prosecution under the *Migratory Birds Convention Act* is also possible.

General Conditions:

1) All mitigation measures and commitments outlined by City reviewers must be incorporated into the construction work plan.
2) The proponent is responsible for seeking approval for any other regulatory permits from provincial and federal agencies.
3) Please contact the Neighbourhood Resource Coordinator Linda Bombardieri 780-944-5783 in the area to ensure appropriate community notification.
4) For potential impacts to City parks and facilities:
    a) Please ensure restoration of the site occurs and meets existing site conditions. All damages to parkland must be restored to City of Edmonton Construction Standards and City Operations' satisfaction.
    b) Noxious weeds shall be managed and controlled as required within any fenced area and should be the responsibility of the contractor/department during construction.
5) All trail closures shall adhere to the City's Trail Closure Procedures. All trail closure activities must be approved through River Valley Operations prior to construction and closure of trails. Please contact **Braeden Holmstrom** (Team Leader, River Valley & Horticulture) at **587-986-2841** to obtain the necessary trail closure approvals. This shall be done a minimum of two weeks in advance of planned construction.
6) Please attach this letter for any further City of Edmonton approvals.

Should you have any questions or concerns, please contact me by e-mail or by phone at 780-442-0695.

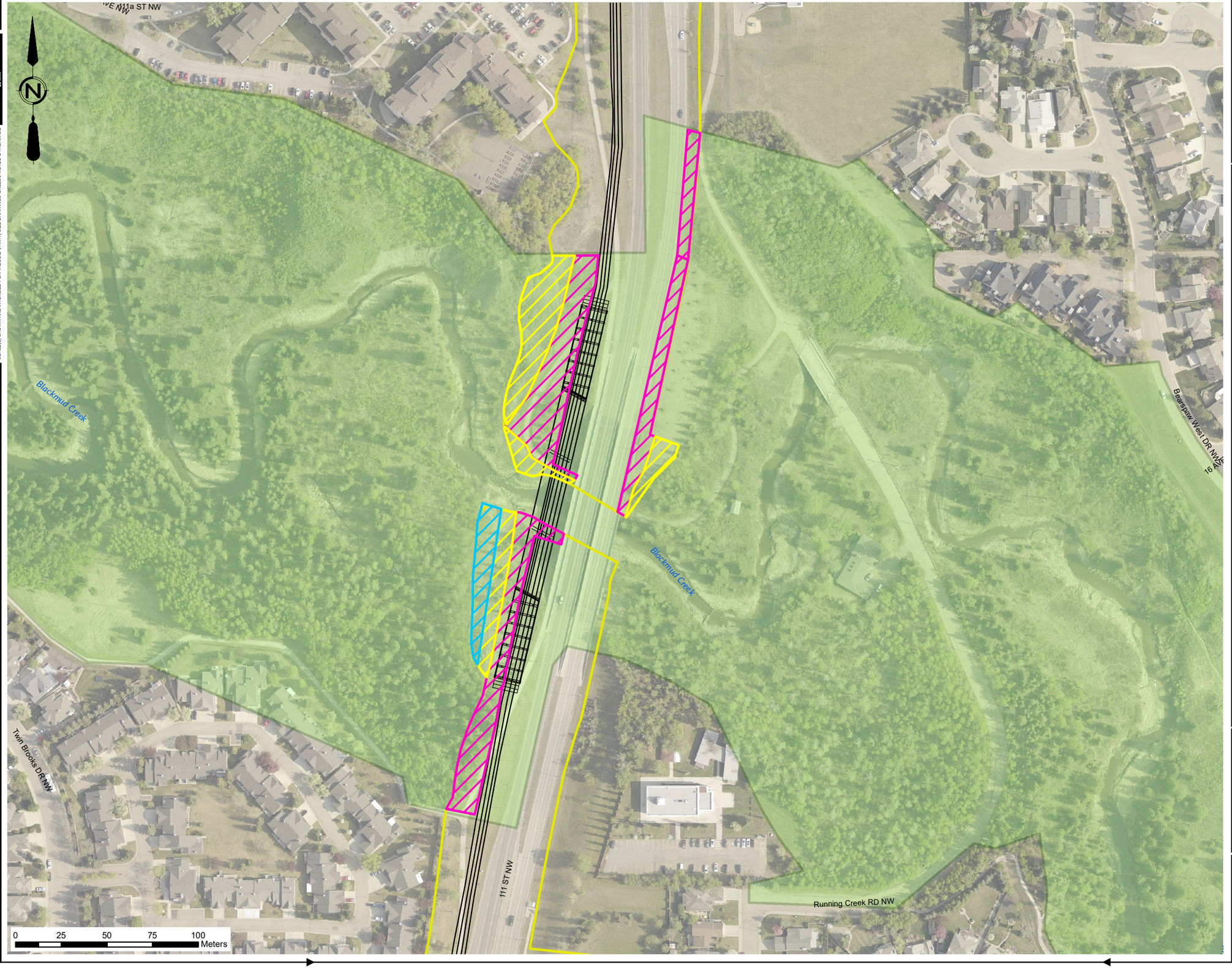
Regards,

Achyut Adhikari

Appendix L – **Naturalization** Figure

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS, UNLESS NOTED OTHERWISE



SAVE DATE: 2/15/2023 9:38:50 AM SAVED BY:
DRAWING PATH: C:\2022-3365_CapitalLineSouthExtension\Schedule10_AppendixA\fig\A3_ClosureNaturalizationAreas.mxd
DATA SOURCE: © OpenStreetMap (and) contributors, CC-BY-SA

CAPITAL LINE PARTNERS
INTEGRATING MOBILITY, COMMUNITIES, AND PEOPLE

Legend:

- Limit of Construction
- Blackmud Creek LRT Bridge
- North Saskatchewan River (NSR) Valley & Ravine System Protection Overlay

Closure Naturalization Areas

- NA-1
- NA-2
- NA-3

THE CITY OF Edmonton

SCHEDULE 10 APPENDIX A, FIGURE 3

CAPITAL LINE SOUTH EXTENSION
PRELIMINARY SOIL ASSESSMENT

CLOSURE NATURALIZATION AREAS

AE PROJECT No.	2022-3365
SCALE	1:2,000
APPROVED	
DATE	2023FEB15
REV	
DESCRIPTION	ISSUED FOR CONTRACT