Attachment 1

Environmental Impact Assessment Pursuant to Bylaw 7188

111 Street and Blackmud Creek Pedestrian Bridge Replacement
Final Report

Prepared for:
City of Edmonton
Integrated Infrastructure Services
Edmonton, Alberta

Project Number EP-861
December 2020

Prepared by:
Spencer Environmental Management Services Ltd.
Edmonton, Alberta

Report: IIS00246

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22 December 2020
File: EP861

Dear Ms. Tatarniak,

Re: AA20-74 - Environmental Impact Assessment Pursuant to Bylaw 7188 for 111 Street and Blackmud Creek Pedestrian Bridge Replacement – FINAL REPORT

As requested, please find enclosed a pdf copy of the above-mentioned final Environmental Impact Assessment (EIA) for your files and for City Planning's files, pursuant to Bylaw 7188. Hard copies of the report will be prepared on request.

A Site Location Study was not required for this project because the new bridge will be located in the footprint of the existing bridge.

Please contact either of the undersigned if you require additional information.

Sincerely,

Spencer Environmental
Management Services Ltd.

Stephanie Jean, M.Sc., P. Biol.
Environmental Scientist

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1.0 INTRODUCTION

The City of Edmonton proposes to replace an aging and deteriorating pedestrian bridge with a section of the Connors Road pedestrian bridge, which was removed as part of Southeast Valley Line LRT construction. The existing Blackmud Creek pedestrian bridge (B128) east of 111 Street is located in Blackmud Creek Ravine within the boundaries of the City of Edmonton's North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188) (Figure 1, Appendix A). This bridge is an extension of Running Creek Road and is no longer used for vehicular traffic. It now provides pedestrian access across Blackmud Creek at the end of Running Creek Road, which runs nearly parallel to 111 Street on its east side.

The pedestrian bridge was constructed in 1971 and was historically used as a vehicle bridge over Blackmud Creek before it was repurposed to a pedestrian bridge in 1994 (BPTEC 2020). The existing bridge is a 30 m long three-span concrete deck bridge supported by a treated timber substructure including instream timber piers (Plates 1.1-1.3). It crosses Blackmud Creek on a 30° right-hand-forward (RHF) skew. A small timber retaining structure is present under the bridge on the north bank. The bridge is currently used as part of the City's shared-use path (SUP) and river valley ravine trail system in and adjacent to Blackmud Creek Ravine (Figure 2, Appendix A). The bridge's condition is deteriorating and requires replacement to maintain safe operation for pedestrian use (BPTEC 2020). Bridge replacement construction is tentatively scheduled for early 2021.

Plate 1.1. View to northeast (upstream) of pedestrian bridge crossing Blackmud Creek (24 July 2019)

Plate 1.2. Upstream view of Blackmud Creek and treated timber pilings under the pedestrian bridge and culvert pipe out of bank (24 July 2019).

Plate 1.3. View to northwest of upstream side of the pedestrian bridge and treated timber pilings structures (24 July 2019)

The pedestrian bridge and adjacent lands needed for replacement activities are wholly located within the boundaries of the City of Edmonton's North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP) (Bylaw 7188) and, therefore, trigger the need for an environmental review pursuant to that Bylaw. An Environmental Impact Assessment (EIA) is the appropriate required level of environmental review for compliance with the

recently revised Bylaw 7188 process, as confirmed in a scoping meeting held with City Planning on 21 June 2019. A separate Site Location Study (SLS) is not required because the replacement bridge will occupy the same footprint as the existing bridge. The EIA will require City Council approval.

This report comprises the Bylaw 7188 EIA prepared for the Blackmud Creek pedestrian bridge replacement project. The EIA format and content follow a project-specific Terms of Reference (ToR), informed by the NSRV ARP Guide to Completing Environmental Impact Assessments Environmental Review ToR and adapted with additional subsections to include all information relating to site plans, the project location and anticipated project activities.

2.0 THE PROPERTY

2.1 Project Area Location, Disposition, Zoning

The pedestrian bridge replacement local study area assessed by this EIA is located in Blackmud Creek Ravine (SW-32-051-24-W4), immediately east of 111 Street (Figure 1, Appendix A). Running Creek Road, a public road, is located immediately south of the bridge and provides access to a private residence located immediately south of the bridge and Blackmud Creek. Figure 1 illustrates the bridge's location in relation to Bylaw 7188 and adjacent lands. The bridge and adjacent lands, with exception of the private residence, are located on City-owned lands and all lands in the local study area are zoned either Agricultural Zone (AG) or Metropolitan Recreation Zone (A) (Figure 3, Appendix A).

Related to flood hazard mapping, the local study area is not shown as mapped in the City's Flood Protection Overlay or by the Government of Alberta's flood hazard mapping.

2.2 Historic Conditions

Historic aerial photograph review was limited to a photograph series spanning 1950 to 2016 that was included in a previously completed EIA for the proposed Capital Line South LRT Expansion (Capital Line Partners 2019) along 111 Street. That series showed the following sequence of development. In 1950, 111 Street was a small rural road crossing through agricultural lands that generally followed the current north-south alignment of 111 Street except it traversed Blackmud Creek Ravine and crossed Blackmud Creek to the east of the current crossing, utilizing the bridge which is now a pedestrian bridge and following the alignment of what is now Running Creek Road. By 1969, a house was built in the ravine bottom south of the current pedestrian bridge and remains at that location to the current day. By 1984, urban development of the tablelands adjacent Blackmud Creek Ravine had begun, starting with the Skyrattler neighbourhood northwest of the Blackmud Creek bridge. By 1993, Keheewin, Bearspaw and Twin Brooks neighbourhoods were constructed north and south of Blackmud Creek Ravine. By 2001, a new vehicle bridge was built over Blackmud Creek west of the original location allowing for a straight connection across the ravine between the existing north and south sections of 111 Street. The old vehicle bridge to the east was repurposed to a pedestrian bridge as part of the City's SUP trail system.

2.3 Summary of Environmental Regulatory Approvals

All typically relevant federal, provincial and municipal environmental legislation, bylaws and policies were reviewed for their application to this project (Appendix B). Because of the presence of instream piers and abutments, federal and provincial permits and approvals will be required to permit temporary and permanent works below the ordinary high-water mark and on the bed and shore of the creek. As is often the case, several provincial and federal statutes prohibiting harm to select resources are relevant to project construction; however, Bylaw 7188 is the only trigger for an environmental assessment. Table 2.1 presents a summary of environmental legislation and bylaws identified as applicable to this project. Additional legislation/bylaw detail is provided in Appendix B.

Several other municipal permits, such as OSCAM, may be required, depending on proponent activity.

Table 2.1. Summary of Applicable Legislation and Bylaws (details in Appendix B)

Legislation or Policy	Regulatory Agency	Authorization/ Approval/ Permit Required	Approval Timeline or Potential Schedule Impact
Municipal			
***North Saskatchewan River Valley Area Redevelopment Plan* (Bylaw 7188)**	City Planning	EIA required and must be approved by City Council.	Completion of an EIA and City Council approval generally takes approximately 6-8 months.
***Corporate Tree Management Policy* (C456C)**	City Forestry	City Integrated Infrastructure Services is collaborating with City Forestry regarding potential impacts to City owned trees and shrubs in the project area.	Proponent responsibility.
***City of Edmonton Parkland* (Bylaw 2202)**	City of Edmonton	Permit required to stage for construction.	Proponent responsibility.
City of Edmonton* (Bylaw 18100) *EPCOR Drainage Services Bylaw	EPCOR	Permit required to use sewage system.	Proponent responsibility.
***Drainage Bylaw* (Bylaw 18093)**	City of Edmonton	No permits/approvals required; compliance only.	Proponent responsibility.
City of Edmonton Community Standards Bylaw (Bylaw 14600)	City of Edmonton	No approval or application; compliance only.	Proponent responsibility.
ENVISO, City Policy C505, City Policy C512	City of Edmonton	Compliance with all aspects of ENVISO required. CoE to complete an Enviso Design Environmental Permit Approval Checklist prior to tender.	Proponent responsibility.
Acts Influencing Construction Methods - Provincial			
Public Lands Act	Alberta Environment and Parks (Land Management Branch)	The bridge is located on Papaschase Surrendered Indian Reserve lands. The province does not claim ownership of the bed and shore within the surrendered reserve. No permission under the *Public Lands Act*	None

Legislation or Policy	Regulatory Agency	Authorization/ Approval/ Permit Required	Approval Timeline or Potential Schedule Impact
		required (*pers. comm.* C. Nahirniak)	
Water Act	Alberta Environment and Parks (Water Approvals Branch)	Code of Practice (CoP) Notification	CoP Notification submission at least 14 days prior to construction commencement. Blackmud Creek is a Class C waterbody with a Restricted Activity Period (RAP) that extends from 16 April to 30 June.
Wildlife Act	Alberta Environment and Parks	No permit required; however, the Act prohibits disturbing prescribed breeding wildlife such as northern flying squirrels or owls.	Proponent responsibility. Vegetation clearing between 15 February and 20 August may result in nest sweep findings that delay clearing.
Historical Resources Act	Alberta Culture, Multiculturalism and Status of Women (ACMSW)	Approval required.	ACMSW granted approval related to archaeological resources and conditional approval related to paleontological resources pending completion of an pHRIA in the form of construction monitoring (see Appendix H).
Acts Influencing Construction Methods - Federal			
Fisheries Act	Fisheries and Oceans Canada (DFO)	Request for Review and/or Authorization.	None. Letter of Advice received from DFO (see Appendix J).
Canadian Navigable Waters Act	Transport Canada	Consultation with Transport Canada to determine if Approval is required.	Approval is required. The Public Notice was posted on 17 December 2020; approval is expected by 01 February 2021.
Migratory Birds Convention Act	Environment and Climate Change Canada	No permit required; however, violation of the *MBCA* may result in penalties.	Proponent responsibility. Vegetation clearing between 15 February and 20 August may result in nest sweep findings that delay clearing.

Legislation or Policy	Regulatory Agency	Authorization/ Approval/ Permit Required	Approval Timeline or Potential Schedule Impact
Species at Risk Act	Environment and Climate Change Canada	No permits required; however, violation of the *SARA* may result in penalties.	Proponent responsibility. Schedule potentially impacted if *SARA* species are found in the area.

2.4 Environmental Site Assessment

Thurber Engineering Ltd. (Thurber) conduced a Limited Phase II Environmental Site Assessment (ESA) in the bridge project area to assess the environmental condition of soil under the bridge and surrounding area based on the assumption that the existing bridge timber piles had been treated with creosote (Thurber 2019a). Thurber's complete Limited Phase II ESA report may be found in Appendix C. A summary of their scope of work and findings is provided below.

Thurber's scope of work included:

- advancement of a total of 12 test holes comprising an initial eight (8) test holes (four on each side of Blackmud Creek) on 10 July 2019 to a depth of 1.5 m, adjacent to the bridge abutments and beneath the existing bridge followed by an additional four (4) test holes on 07 October 2019.
- collection of soil samples at the surface and at approximately 0.5 m intervals to the bottom of the test holes, at locations where the soil strata changed or at locations of visible contaminant staining
- submission of select soil samples for laboratory chemical analyses of polycyclic aromatic hydrocarbons (PAHs) and metals

Thurber submitted fifteen soil samples to the lab for chemical analysis of PAHs and grain size. Seven samples were analyzed for metals and a composite soil sample was submitted for landfill characterization.

Overall, all soil samples met metal guidelines and the landfill characterization sample met the applied Alberta Environment and Parks (AEP) user guide, therefore, the soil cuttings were not considered to be hazardous waste. In terms of grain size, the site was classified as coarse grain.

Not all soil samples met AEP Tier 1 guidelines for PAHs. Specifically, PAHs that did not meet the guidelines included non-carcinogenic anthracene, fluoranthene and pyrene from ground surface to 1.0 m below ground surface on both the north and south creek banks at the bridge crossing. Thurber suggested that anthropogenic and naturally occurring sources may be responsible for these PAHs encountered in the bridge project area and that they are of pyrogenic (fire derived i.e., coal tar, creosote and forest fire residue) origin (Thurber 2019a; Appendix C).

Thurber recommended that the PAHs be risk managed in-situ and that an assessment of risks associated with direct soil contact by human park users will be required during bridge construction activities.

3.0 ENVIRONMENTAL CONTEXT

3.1 Overview of Study Area and Adjacent Lands

The pedestrian bridge crosses Blackmud Creek approximately 5 km upstream from the confluence of Blackmud and Whitemud Creeks in Blackmud Creek Ravine. At this location, Blackmud Creek Ravine is a steep-walled, deeply incised tributary ravine upstream of the pedestrian bridge with a more level floodplain area downstream of the bridge. The ravine is relatively undisturbed in the project area except in the vicinity of 111 Street and the pedestrian bridge (Figures 1 and 2, Appendix A). The dominant developments are 111 Street that crosses the ravine from north to south, west of the pedestrian bridge, and the historical Running Creek Road. A private residence is located in the ravine bottom immediately south of the pedestrian bridge. The City SUP system adjacent 111 Street at the top of the ravine extends into the ravine adjacent and under 111 Street to connect to Running Creek Road. No other formal trail development is present within the ravine. Despite this development, the ravine remains a part of the NSRV system, is mapped as a recognized natural area comprising a natural and functional linkage in Edmonton's ecological network, and, is structurally connected to the NSRV. The steep ravine slopes and ravine bottom remain relatively undisturbed and are mostly well-vegetated with dense trees and shrubs. Some open grassed areas are located adjacent 111 Street and the SUPs. Residential neighbourhoods are located on the adjacent tablelands including Keheewin and Bearspaw neighbourhoods to the north and east, Skyrattler to the northwest and Twin Brooks neighbourhood to the south.

The EIA study area was defined at two scales: local and regional. The local study area comprises the lands within and adjacent to the pedestrian bridge that have potential to be directly affected by proposed construction, permanently or temporarily. The regional study area includes adjacent Blackmud Creek ravine lands to the west and east that are structurally connected bylaw lands and may be indirectly affected. The regional study area was relevant to some resources such as environmental sensitivities and wildlife movement.

3.2 Environmental Sensitivities

3.2.1 Original (2016) Mapping

Figure 4 (Appendix A) shows the results of the City of Edmonton environmental sensitivities analysis and classification mapping (Solstice 2016) in the project vicinity, overlaid with our local study area. The local study area is predominantly mapped as being very high and extremely high value to the City. A small strip of land adjacent to Running Creek Road is mapped as high value, as well as some grassy areas along the SUPs. Areas close to 111 Street are mapped as moderate value. At a regional level, Blackmud Creek Ravine is predominantly mapped as being very high and extremely high value with patches of high value land near the ravine top-of-slope. Blackmud Creek Ravine adjacent 111 Street is mapped as high value with patches of moderate value. The City considers high, very high, and extremely high values as lands suitable for protection or conservation.

3.2.2 Refined Mapping

Methods

Using the 2019 site-specific vegetation data and mapping, we re-analyzed the City of Edmonton's Environmental Sensitivities (2016) GIS layer for the local study area. In particular, we updated the input Ecological Asset scores for the Natural Vegetation ('AVegNat2' attribute), and for the Non-Native Vegetation ('A VegNoNat1' attribute). We reviewed wildlife data and found it to be similar to that used in the 2016 analysis. No other new data were available. Contours are from City of Edmonton open data. Overlay analysis (union function) was used to intersect the 2019 vegetation polygons with the 2016 Environmental Sensitivities polygons. This not only allowed us to update the relevant scores, but it also allowed us to break up larger 2016 mapped polygons to reflect finer scale 2019 mapped polygons. Scores were updated as shown in Table 3.1.

Table 3.1. Sensitivity Analysis Refinement

Where 2019 Vegetation were observed to be…	…the respective Environmental Sensitivities attribute was updated to:
Aspen - Smooth Brome (AW.7)	Natural Vegetation ('AVegNat2' attribute) = 2 score
Balsam Poplar - Mixed Shrubs (PB.1)	Natural Vegetation ('AVegNat2' attribute) = 2 score
Non-Forested Smooth Brome (NF.7)	Non-Native Vegetation ('AVegNoNat1' attribute = 1 score
Riparian (R)	Natural Vegetation ('AVegNat2' attribute) = 2 score

With the scores updated, the Environmental Sensitivities analysis - whereby Assets, Threats and Constraints were summed - was re-run using the model formula as per originally prescribed by Solstice Canada (2016) to produce the new cumulative Environmental Sensitivities layer for the study site. The original final score categorical classes were used to bin the new scores.

Description

The revised Environmental Sensitivities map (Figure 5) shows some changes in mapping within the local study area. The area to the east of the bridge that was formally mapped as extremely high value has expanded to the west of the bridge and now extends further north and south. A small area north of the bridge, and immediately adjacent to the west side of the SUP, has been upgraded from moderate value to high value with a small patch of very high value. A very small patch in this area was also downgraded from high value to moderate value. It should be noted that the footprint of the bridge has not been mapped, as it is developed area.

3.3 Surface Water and Groundwater

3.3.1 Methods

Surface Water

Surface water flows in the proposed project area were described based on examination of topographic maps and field observations. Available literature, environmental assessments and overviews prepared by Spencer Environmental and others were reviewed for additional information.

In addition, BPTEC (2020) undertook a basic desktop hydrotechnical analysis as part of the preliminary engineering report for the proposed bridge replacement project.

Groundwater

Thurber (2019b) installed a standpipe piezometer in test hole TH19-01 on the south side of Blackmud Creek during drilling and site investigations on 9 July 2019. The piezometer was installed flush to the ground surface, backfilled with drill cuttings and capped with bentonite chips near the ground surface. The piezometer was monitored at the time of installation and on 29 July 2019. Thurber's report is provided in Appendix D.

3.3.2 Description

Surface Water

Blackmud Creek is the most significant natural feature in the project area and generally meanders in a northerly direction towards ultimately the North Saskatchewan River. It is the main tributary to Whitemud Creek, entering Whitemud Creek approximately 2 km (straight line distance) downstream of the project area. With the exception of spring run-off flows and during extended rainfall events (including flows from the City's storm sewer and outfall system), Blackmud Creek generally experiences low flows, particularly during late summer, autumn and winter. This is characteristic of similar streams draining into the North Saskatchewan River in the vicinity of Edmonton (Spencer Environmental 2001). Blackmud Creek has a total drainage area of approximately 695 km^2 (BPTEC 2020).

In the project area, the Blackmud Creek channel is relatively narrow (mean width of 10.2 m) with a steep north bank upstream of the bridge (Plate 3.1) (Kingfisher 2020). The remainder of the project area is a relatively level floodplain. There is a stormwater pipe extending out of the steep bank on the upstream side of the bridge (Plate 3.2).

Blackmud Creek is a Class C waterbody with a Restricted Activity Period (RAP) that extends from 16 April to 30 June (AESRD 2012).

Plate 3.1. Steep, bare north cutbank located upstream of the pedestrian bridge (24 July 2019)

Plate 3.2. View upstream under the bridge showing the nearby stormwater pipe (not included in scope of this project)(24 July 2019)

Groundwater

The standpipe piezometer was dry upon installation (Thurber 2019b, Appendix D). On 29 July 2019 the groundwater level was observed at 2.6 m (elevation 657.5 m), which corresponded to approximately 1 m above creek level. Groundwater levels can vary in response to seasonal factors and precipitation.

3.4 Fish and Fish Habitat

3.4.1 Methods

Kingfisher Aquatics Ltd. (Kingfisher) completed a fisheries resources assessment in support of the proposed project including a desktop fisheries information review and field investigations (Kingfisher Aquatics 2020, Appendix E). The field investigations were conducted on 05 September 2019, following standard procedures consistent with the fish habitat assessment methods described in the *Alberta Fish Habitat Manual* (Alberta

Transportation 2009), which were designed to meet requirements of Alberta's *Water Act* and those of Fisheries and Oceans Canada (DFO). The scope of field investigations included:

- habitat inventory of a 387 m study section of Blackmud Creek in the vicinity of the project;
- characterization of the channel profile at seven transects within the study section; and
- in-situ sampling of select water chemistry variables (pH, temperature, dissolved oxygen, conductivity, turbidity) at one location within the study section.

A summary of Kingfisher's findings is provided below. Their complete report is provided in Appendix E of this document.

3.4.2 Description

A search of the Fish and Wildlife Management Information System (FWMIS) (Alberta Environment and Parks 2020) identified six different fish species that are known to inhabit Blackmud Creek: fathead minnow, lake chub, longnose sucker, northern crayfish, white sucker and minnow species. There is no record of sport fish being captured in Blackmud Creek. However, northern pike have been captured in Whitemud Creek, which joins Blackmud Creek approximately 5 km downstream of the pedestrian bridge. Walleye may also use the lower part of Whitemud Creek for spawning. None of the species previously captured from Blackmud Creek are listed under the *Species at Risk Act* and all are considered Secure under the Alberta *Wildlife Act*.

Fish habitat within the study section was predominantly shallow (<0.5 m deep) run habitat, which accounted for approximately two-thirds of the available habitat within the study section. Moderate depth (0.5 m to 1 m deep) run habitat and riffle habitat were less common. Deep (>1 m deep) run habitat was relatively rare. Fines and coarse substrates comprised the majority of the study area. Coarse substrates consisted of gravel and cobbles, with boulders present in limited quantities. Riparian areas were generally well-vegetated. The banks under the bridge were not vegetated, and an exposed unvegetated area was found on the outside bend immediately downstream of the bridge. Overall, fish cover was limited. Woody debris comprised most of the available cover, while overhanging banks and vegetation provided limited cover.

3.5 Geology/Geomorphology

3.5.1 Methods

Thurber conducted a geotechnical investigation in support of the proposed bridge replacement project in summer 2019 comprising a drilling program and laboratory testing of soil samples (Thurber 2019b, Appendix D).

Two test holes were drilled on the north and south sides of the creek at abutment locations on 09 July 2019. Test hole TH19-01 on the south side of the creek was drilled to a depth of 10.4 m (elevation 649.7 m) and test hole TH19-02 on the north side of the creek was

drilled to a depth of 11.9 m (elevation 649.7 m) below the ground surface. Both holes terminated in competent bedrock. The location of test holes was limited to accessible locations on the existing trail/roadway.

Following collection of soil samples, laboratory tests included visual classification and determination of natural moisture content of all recovered soil samples. Atterberg limits, grain size analysis and soluble sulphate tests were performed for selected soil samples (Thurber 2019b, Appendix D).

Thurber (2019b, Appendix D) undertook a slope stability analysis for both north and south abutments in their current configuration using the program SLOPE-W. For this analysis, and due to the limitations of test hole placement noted above, Thurber estimated subsurface conditions between test holes and the creek slopes based on available geological observations.

Thurber's complete report is provided in Appendix D of this document.

3.5.2 Description

Site Geology

Thurber (2019b; Appendix D) noted that site geology was expected to consist of fluvial deposits derived from Blackmud Creek overlying glacial deposits and Cretaceous bedrock. Recent fill materials may overlie some of these glacial units. Colluvium from previous slope movement may also be present on the valley slopes at and above the bridge site. A thin layer of alluvial sediment could also be encountered on the banks of the current water course; however, they are expected to be highly localized and of colluvial origin (Thurber 2019b, Appendix D).

Surficial Conditions

The bridge is located on an outer meander bend, with a lower level river terrace on the south bank and a steeper valley slope on the north bank (Thurber 2019b, Appendix D). The bridge sloped gently (2.2%) from north to south, with a bridge deck elevation ranging from 660 m to 661 m. The creek bed elevation at the bridge site was approximately 657 m.

Subsurface Conditions

Thurber's (2019b, Appendix D) test holes encountered clay till and/or reworked sandstone and sandstone and/or clay shale bedrock. The clay till/reworked sandstone extended to a depth of approximately 3.8 m below existing grade and was generally sandy with trace oxides and coal chips. The sandstone/bedrock was found underlying the clay till/reworked sandstone at depths of approximately 3.6 to 3.8 m. A 600 mm thick pavement structure was encountered in TH19-01, while a thin layer of topsoil was found in TH19-02 at existing grade.

Bedrock

Bedrock was comprised of clay shales and sandstones with scattered coal bentonitic beds of the Horseshoe Canyon Formations of the Edmonton Group (Thurber 2019b, Appendix D). Bedrock materials were weakly cemented, often resembling hard over-consolidated clay, exhibiting many properties associated with soils such as softening and swelling on exposure to weathering. Bedrock was present at approximately elevations of 655 m to 660 m at the Blackmud Creek valley bottom.

Slope Stability

Thurber (2019b, Appendix D) observed no recent signs of instability at either the north or south creekbanks at the existing bridge site. Some evidence of toe erosion was observed at the toe of the north creek bank.

Thurber evaluated two stability cases at each existing pedestrian bridge head slope: an existing shallow failure at the base of the timber abutment retaining wall, and a deeper failure extending below the presumptive tips of the piles. A target factor of safety of 1.5 was desired for head slope stability. The target factors of safety were met for the existing north slope for both shallow and deep failures. At the south bank, the factor of safety for a deep failure exceeded the target factor of safety. However, for a shallow failure the 1.5 target factor of safety was narrowly missed but was met when a modest contribution of the existing pile was taken into consideration (Thurber 2019b, Appendix D). Further slope stability analysis was recommended once the north and south slope configurations are available to check the slope stability of the proposed design.

3.6 Vegetation

3.6.1 Methods

Vegetation in the local study area and immediately adjacent lands was characterized by undertaking the following tasks:

- Preliminary desktop delineation of plant communities using high-resolution remote imagery.
- Classification of plant communities following the Urban Ecological Field Guide for the City of Edmonton, Alberta, Canada (City of Edmonton 2015).
- Search of the Alberta Conservation Information Management System (ACIMS) (AEP 2019) for all records of special status plant species within the project area on 05 September 2019. The area searched consisted of legal section 32-51-24-W4M.
- Plant community inventory and rare plant vegetation survey on 24 July 2019 to characterize communities and identify occurrences of rare plants. A complete species list is available in Appendix F.

3.6.2 Description

The following natural plant communities were mapped in the study area (Figure 6, Appendix A):

- Balsam Poplar – Mixed Shrub Forest (PB.1)
- Aspen – Smooth Brome Forest (AW.7)
- Riparian (R)
- Non-Forested Smooth Brome – Level Slopes (NF.7)

3.6.2.1 Balsam Poplar – Mixed Shrub Forest (PB.1)

In general, this community type is characterized in City of Edmonton (2015) as having considerable tree cover comprising predominantly balsam poplar, with diverse shrubs and forbs occurring in relatively low densities. It tends to occur on sub-hygric/rich soils and shallow slopes.

In the local study area, the balsam poplar – mixed shrub community was observed north of Blackmud Creek (Figure 6, Appendix A). Two distinct forest stands were present; a larger stand occurred on the east side of the existing SUP, while a smaller stand occurred farther west, adjacent to a trail branch that continues under 111 Street. In the study area, this community generally conformed to the description provided above, comprising a canopy dominated by balsam poplar, with a diverse shrub layer (Plate 3.3). Red-osier dogwood, prickly rose and buckbrush were abundant shrubs, while common caragana, an exotic shrub, was frequently observed. The forb and graminoid layer was relatively open compared to the dense shrub layer, with abundant or frequent occurrences of star-flowered Solomon's seal, tall lungwort, common fireweed and smooth brome. Cicer milk vetch was frequently observed near the stand edges.

Plate 3.3. Interior of the balsam poplar – mixed shrub community, demonstrating a diverse shrub layer (24 July 2019)

Overall, 30 species were observed in the balsam poplar – mixed shrub community. Of these, 20 (67%) were native, while the remaining 10 (33%) were exotic or noxious. Two species of noxious weeds were observed in this community: creeping thistle and perennial

sow-thistle. One prohibited noxious weed, common buckthorn, was also observed in this community.

3.6.2.2 Aspen-Smooth Brome Forest (AW.7)

In general, this community type is characterized in City of Edmonton (2015) as having a canopy of aspen and a relatively open understorey dominated by grasses, with few shrubs and forbs. It tends to occur on mesic/rich soils.

In the local study area, the aspen – smooth brome community was observed north of Blackmud Creek on the west side of the existing trail (Figure 6, Appendix A). In the study area, this community generally conformed to the description provided above, comprising a canopy of aspen with occasional Manitoba maple and balsam poplar, and a sparse shrub layer and understorey dominated by smooth brome (Plate 3.4). Frequent shrubs included red-osier dogwood, prickly rose and buckbrush. Frequent to occasional forbs included cicer milk vetch, wild vetch and northern bedstraw. Forbs were relatively sparse, and the understorey comprised abundant smooth brome and quackgrass.

Plate 3.4. Aspen – smooth brome community, demonstrating a relatively open canopy and grass-dominated understorey (24 July 2019)

Overall, 24 species were observed in the aspen – smooth brome community. Of these, 18 (75%) were native, while the remaining six (25%) were exotic or noxious. One species of noxious weed, creeping thistle, was observed in this community. No prohibited noxious weeds were observed.

3.6.2.3 Riparian (R)

Riparian communities are not characterized as part of City of Edmonton (2015). Riparian communities are situated on the banks of watercourses and generally comprise moisture-loving vegetation on moist soils. Within the local study area, riparian communities were situated on the banks of Blackmud Creek and were characterized by wetland-associated vegetation and dense stands of willow (Plate 3.5)(Figure 6, Appendix A). The riparian community was dominated by narrow-leaf willow, with abundant false mountain willow.

In drier areas near the top of the creek banks, smooth brome was abundant, while lower portions of the banks supported abundant reed canary grass and frequent occurrences of bulrush.

Plate 3.5. View to south of Riparian community on the north and south banks of Blackmud Creek, immediately downstream of the existing bridge (24 July 2019)

Overall, 44 species were observed in the riparian community. Of these, 29 (66%) were native, while the remaining 15 (34%) were exotic or noxious. Four species of noxious weeds were observed in this community: creeping thistle, common toadflax, perennial sow-thistle, and common tansy. No prohibited noxious weeds were observed in this community.

3.6.2.4 Non-Forested Smooth Brome – Level Slopes (NF.7)

This community is characterized in City of Edmonton (2015) as being anthropogenic in origin and dominated by species of grasses, particularly the exotic species, smooth brome. This community tends to occur on nutrient rich soils.

In the local study area, the non-forested smooth brome community was patchy but widespread, with the largest areas situated east of the existing trail and north of Blackmud Creek, while smaller patches were located west of the existing trail on both sides of the creek (Plate 3.6) (Figure 6, Appendix A). This community generally conformed to the description provided above and was characterized in the local study area by exotic grass species, such as smooth brome and quackgrass, forming the dominant cover. Abundant and frequent forbs included alsike clover, bird's-foot trefoil, black medick, and wild vetch. Trees and shrubs were infrequent, with occasional occurrences of a small willow seedling, and rare occurrences of white spruce and aspen.

Plate 3.6. Non-forested smooth brome community, looking south toward Blackmud Creek (24 July 2019)

Overall, 21 species were observed in the non-forested –smooth brome community. Of these, nine (43%) were native, while the remaining 12 (57%) were exotic or noxious. Four noxious weed species were observed in this community: creeping thistle, white cockle, perennial sow-thistle and common tansy. No prohibited noxious weeds were observed in this community.

3.6.2.5 Special Status Species

In the City of Edmonton, rare plant species are considered those having an ACIMS conservation rank of S1, S2 or S3. S1 species are known from five or fewer locations in the province. S2 species are known from 6-20 occurrences, and S3 species are known from 21-100 occurrences in the province. A search of ACIMS data conducted on 05 September 2019 returned no records of special status vascular plant species in the immediate project area. A rare plant survey required by City Planning was undertaken on 24 July 2019; one special status species, round-leaved hawthorn (*Crataegus chrysocarpa*; S3), was found scattered throughout the balsam poplar-mixed shrub, aspen-smooth brome, and riparian communities. A description of this species and its occurrences is provided in the following section.

Round-leaved Hawthorn (Crataegus chrysocarpa)

Round-leaved hawthorn is a shrub in the rose family (Rosaceae). It is characterized by broad leaves with doubly-serrate margins and 2-7 cm long thorns on the branches (Plate 3.7) (Moss 1981). Round-leaved hawthorn is typically found in river valleys and open woods and reaches its northern limit in the Central Parkland subregion around Edmonton (Moss 1981). It occurred as approximately 5-10 scattered individuals in the balsam poplar-mixed shrub, aspen-smooth brome and riparian communities within the local study area. Most individuals were observed in the balsam poplar-mixed shrub plant community and no individuals were observed in the riparian community adjacent the pedestrian bridge.

Plate 3.7. Round-leaved hawthorn (*Crataegus chrysocarpa*), showing doubly-serrated leaf margins and long thorns (24 July 2019)

3.6.2.1 Weeds

The Alberta *Weed Control Act* defines two categories of weeds: noxious and prohibited noxious. Noxious weeds are generally those that are currently widespread in the province and are considered difficult to eradicate. Provincial legislation requires those species to be controlled. Prohibited noxious weeds are those that are currently uncommon or absent in the province but have been identified as noxious due to their potential to invade and damage natural and cultivated systems. Alberta law requires that prohibited noxious weeds be *destroyed* where they are found.

Prohibited Noxious Species

Common buckthorn (*Rhamnus cathartica*) was the only prohibited noxious species observed in the proposed project area. It occurred as a single individual in the balsam poplar – mixed shrub community. Seeds of common buckthorn germinate readily in disturbed soils. Common buckthorn can be controlled using herbicides, burning, hand-pulling and flooding (Alberta Invasive Species Council 2014); however, as with many invasive species, control is difficult and may require a multi-year effort.

Noxious Species

Noxious weeds found in the study area included creeping thistle, common toadflax, white cockle, perennial sow-thistle, and common tansy. All of these species are common on disturbed lands in the Edmonton area. Noxious species were widespread in the proposed project area, with each community supporting at least one noxious weed species. Creeping thistle was the most widespread, occurring in each community; it was the only noxious weed observed in the aspen-smooth brome community. The riparian and the non-forested-

smooth brome communities each supported four noxious weed species, although all occurred in relatively low abundances.

3.7 Wildlife

3.7.1 Methods

Wildlife resources in the study area were characterized by undertaking the following tasks:

- Surveys were limited to one breeding bird survey in an expanded study area, conducted on 26 June 2019, at 0615 hours, by a professional biologist experienced in breeding bird surveys. The survey consisted of five, 50 m radius point count stations (Figure 7, Appendix A). All birds seen or heard within an 8-minute period were recorded and estimated bird locations were mapped within the survey area.
- The expanded study area was visually surveyed on 26 June 2019 for the presence of wildlife trees.
- All incidental wildlife and wildlife sign observations during site visits were recorded.
- Available habitat type, condition and quality were assessed through field observations and examination of study area vegetation data and maps.
- A search of FWMIS for all wildlife records for lands within a one km radius of the local study area centre was conducted. FWMIS was accessed on 06 March 2020.
- A search of the eBird database on 21 May 2020 for records of special status bird species in the project area.
- The South LRT expansion EIA (Capital Line Partners 2019) was reviewed for relevant wildlife information in the project area.
- A list of potential wildlife species present, including species status species, was generated by considering all of the above and our knowledge of Edmonton wildlife communities and occurrences.
- Common species names are used throughout the text; scientific names are provided in Appendix G.

3.7.2 Description

3.7.2.1 Available Habitat/Connectivity

The local study area was dominated by natural habitat types including treed and shrubby riparian areas, balsam-poplar and aspen leading forested stands in different stages of succession and open grassy areas. Vegetated areas adjacent the SUP to the north of the pedestrian bridge leading up the hill to 111 Street and on the adjacent residential property southwest of the pedestrian bridge were relatively more disturbed due to previous and current human disturbance. Beaver activity in the area has led to the creation of natural openings in the riparian and forested areas adjacent Blackmud Creek (A. Bismanis *pers. comm.*). No wildlife trees (i.e., trees with visible nests or large trees with cavities) were observed in the local study area, however, there were wildlife trees in the expanded study area upstream and downstream of the pedestrian bridge. Overall, the structural and spatial diversity of these habitat types provided high quality wildlife habitat in the project area for a wide range of avian and mammal species.

Large-, medium- and small-sized urban-adapted wildlife species, such as deer, coyote and weasels, are expected to utilize Blackmud Creek Ravine as a major movement corridor. This is owing to the relatively undisturbed nature of the ravine, the relatively high level of ecological connectivity, the availability of a diversity of habitat types and the relative lack of barriers to movement. Specific to the expanded and local study areas, animals can move unimpeded under the elevated 111 Street bridge along the ravine bottom and along the creek, across Running Creek Road and across the SUP's. Running Creek Road experiences only local traffic primarily associated with the private residence located in the ravine bottom as well as occasional recreationalists using the road and SUP's as part of the City's trail system. It is also possible that some wildlife pass under the existing pedestrian bridge along the creek banks under low water conditions. Two white-tailed deer were observed crossing Running Creek Road from east to west south of the pedestrian bridge during the breeding bird survey conducted for the proposed project in June 2019. This crossing area generally corresponded with a moderate concentration (2-4) of tracks observed during snow tracking conducted in March 2018 (Capital Line Partners 2019). That study documented several high-use deer and coyote trails throughout the expanded study area but not in the local study area adjacent the pedestrian bridge. Wildlife also take advantage of the frozen creek to move throughout the ravine during the winter months (A. Bismanis, *pers. comm.* and Capital Line Partners 2019).

3.7.2.2 Documented and Potential Wildlife

Avifauna

Breeding Bird Survey

The EIA's breeding bird survey provides a snapshot of passerine use of the area. The survey recorded 32 individuals of 15 species across the five, point count stations (station) surveyed (Table 3.2, Figure 7; Appendix A). All species observed are known to commonly breed in Edmonton except for the olive-sided flycatcher, a federal and provincial special status species. While this species may be observed in the Edmonton area, particularly in suitable habitat in river valley ravines such as in Blackmud Creek Ravine, it is not common (see Special Status Species section below for further discussion of this species).

Table 3.2. Summary of Bird Species Observed in the Project Area During the Breeding Bird Survey (June 2019)

Species	Point Count Station (50 m radius)					Total Individuals
	1	2	3	4	5	
American crow	1	1				2
Black-capped chickadee	2	2		1		5
Brown-headed cowbird	1		1			2
Cedar waxwing	1		1	1	1	4
Chipping sparrow	1					1
Clay-colored sparrow	1					1
Dark-eyed junco			1			1
Downy woodpecker		1			2	3
Gray catbird	1		1			2

Species	Point Count Station (50 m radius)					Total Individuals
	1	**2**	**3**	**4**	**5**	
House wren		1				1
Olive-sided flycatcher*****		1				1
Red-eyed vireo	1				1	2
Song sparrow					1	1
White-breasted nuthatch	1	1				2
Yellow warbler	1		1		2	4
Totals (abundance)	**11**	**7**	**5**	**2**	**7**	**32**
Totals (species richness)	**10**	**6**	**5**	**2**	**5**	

*Special status species (federal *Species At Risk Act – Threatened* (Schedule 1), provincial status (2015) - *May Be At Risk*)

Most of the species detected during the breeding bird survey were singing territorially and may have been nesting in the study area. Species abundance ranged from 2 to 11 individuals across all stations. Species richness per station ranged from 2 to 10 species. Highest species richness and abundance were detected at station 1 where there was a combination of mature and structurally complex forested habitat (preferred by red-eyed vireo) and open grassy and shrubby habitats (preferred by chipping sparrow, clay colored sparrow, gray catbird) adjacent Running Creek Road. Lowest species richness and abundance were detected at stations 3 and 4, reflecting the more disturbed and less complex habitat available in the immediate vicinity of the pedestrian bridge and to the north of the bridge. The presence of primary cavity nesting species such as downy woodpecker, black-capped chickadee and white-breasted nuthatch indicated that the project area contained suitable mature trees and snags for excavating cavities. One dark-eyed junco was observed incidentally carrying food and chipping defensively within the vicinity of station 1, indicating the presence of an active nest containing nestlings. Although no evidence of nesting under the bridge was observed in 2019, bridges may be used by passerines such as some species of swallows, phoebes, and American robins as nesting structures.

Mammals

Incidental mammal observations recorded during the breeding bird survey on 26 June 2019 included red squirrel, snowshoe hare, and white-tailed deer. A snowshoe hare was observed on the SUP south of the pedestrian bridge. As noted above, two white-tailed deer were observed crossing Running Creek Road from east to west in the northern half of point count station 1.

Seven additional mammal species were documented in the expanded and local study areas during wildlife snow tracking surveys conducted in Blackmud Creek Ravine in March 2018 including coyote, red fox, long-tailed weasel, least weasel, moose, white-tailed jackrabbit and beaver (Capital Line Partners 2019).

Other undocumented species may use the area as breeding, foraging or year-round habitat. A list of wildlife species potentially occurring in the local study area is provided in Appendix G.

3.7.2.3 Special Status Species

Based on species habitat requirements, an understanding of the available habitat, provincial species distributions, species records in the FWMIS database and field data from this and previous nearby studies, several special status species were identified as having at least some potential to occur in the local study area (Appendix G). The following section discusses the potential occurrence of species that are ranked by the Province as *At Risk* or *May be At Risk*, or, have been federally assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as either *Endangered, Threatened,* or *Special Concern,* and were rated by this study as having at least a moderate likelihood of occurrence within the local study area (Table 3.3). In addition, all species on Schedule 1 of the *Species at Risk Act* (SARA) with ranges that include Edmonton and for which suitable habitat is available in the project area are included for discussion. Species having a provincial status of *Sensitive*, but no federal status, hold no potential to trigger project considerations beyond those applicable to wildlife in general, and, thus, are not discussed, even if their potential for occurrence was considered moderate or high.

The FWMIS search returned records of two special status species observed within 1 km of the project area: pileated woodpecker and eastern phoebe. Both species are provincially ranked as Sensitive with no federal ranking and will not be discussed further here.

Table 3.3. Special Status Wildlife Species with Potential to Occur in the Study Area

Common Name	Provincial Status (General Status of AB Wild Species 2015)	Wildlife Act Designation *	COSEWIC Designation	SARA Designation (Schedule 1)	Observed /Previous Record**	Likelihood of Occurrence	Potential Habitat Use
Little Brown Myotis	May Be At Risk	None given	Endangered	Endangered		High	Roosting, foraging
Northern Myotis	May Be At Risk	Data Deficient	Endangered	Endangered		Low	Roosting, foraging
Olive-sided Flycatcher	May Be At Risk	None given	Special Concern	Threatened	BBS	High	Breeding, foraging
Bank Swallow	Sensitive	None given	Threatened	Threatened		Moderate	Breeding, foraging
Barn Swallow	Sensitive	None given	Threatened	Threatened		Moderate	Breeding, foraging

* Under the *Wildlife Act,* select species carry a designation of Threatened or Endangered; additional species assessed by the Endangered Species Conservation Committee (ESCC) also have these designations
**BBS = observation recorded on 26 June 2019 during breeding bird surveys

Little brown and northern myotis

Based on our understanding of species-habitat associations, the presence of old mature trees in the forested areas in the expanded study area, bridges, and buildings associated with the private residence results in some potential for little brown myotis and northern myotis, two species of bats that are federally listed as *Endangered* (Government of Canada 2019), to use habitat in the project area during the growing season as a roosting site. Little

brown myotis and northern myotis do not hibernate in trees and are not known to overwinter in the Edmonton area. Legal protection currently only extends to overwintering hibernacula and does not cover individual bats. The protection of individual bats and roost sites exists as a best management practice in line with emerging bat conservation efforts.

Little brown myotis utilizes tree crevices (especially old dead or dying trees in mature deciduous forests), buildings and bridges for roosting and maternity roosts during the breeding season. Northern myotis are more dependent on trees for summer roosting and maternity roosts, utilizing a wide range of tree species (deciduous trees preferred) in primarily intact forests (AESRD 2009 and Alberta Community Bat Program 2018). The importance of human made structures, such as buildings, to the northern myotis is unknown (AESRD 2009).

There are large deciduous trees in the expanded study area that would be suitable for roosts. However, the little brown myotis may also roost on the 111 Street Bridge and the Blackmud Creek pedestrian bridge. The likelihood of occurrence in the project area for the little brown myotis was rated as high because of the project area's proximity to Blackmud Creek, a suitable foraging area and water source, and suitable available habitat for roosting in the local study area. The likelihood of occurrence in the project area for the northern myotis was rated as low because this species prefers more intact forest habitats and does not roost in human made structures.

Olive-sided flycatcher

An olive-sided flycatcher was detected singing during the breeding bird survey on 26 June 2019. This flycatcher is provincially listed as *May Be At Risk* and federally listed as *Threatened* in Schedule 1 of the *Species at Risk Act* due to significant population declines across its range (Environment Canada 2016). Olive-sided flycatchers more commonly breed further north in coniferous boreal forest and are most often associated with forest openings, forest edges near natural openings and open to semi-open forest stands (Cornell Lab of Ornithology 2020). In addition, this species is dependent on the availability of snags or residual live trees for foraging and singing perches. Olive-sided flycatchers have been documented in low numbers in the Edmonton area, particularly in the river valley and ravine system, including Blackmud Creek Ravine (Cornell Lab of Ornithology 2019). Suitable habitat for olive-sided flycatchers was present in the expanded study area in the form of open mixedwood forest and forest edge south and west of the pedestrian bridge along Blackmud Creek. Snags and residual live trees were also present. Although breeding was not specifically confirmed during the breeding bird survey, it is assumed that this individual was a male singing on territory rather than a migrating bird due to the advanced stage of the breeding season in late June. Since an olive-sided flycatcher was detected in the expanded study area and suitable breeding habitat was present, the likelihood of occurrence of this species is rated as high.

Bank and barn swallows

No bank or barn swallows were detected during the breeding bird survey, however, there is suitable habitat present in the expanded study area for both species. There is an exposed

steep cutbank upstream of the pedestrian bridge on the north side of Blackmud Creek. This could provide nesting habitat for bank swallows, which often nest in colonies on vertical banks along waterbodies (Cornell Lab of Ornithology 2020). Bank swallows can feed up to 200 m away from their burrow (Garrison 1999), so even if a colony does not occur in the project area, alternative potential nesting habitat lies within foraging range and swallows could still be found foraging around the pedestrian bridge. The likelihood of occurrence is rated as moderate due to the presence of potential habitat for breeding and foraging for this species.

Potential barn swallow habitat is also present in the local and expanded study areas as this species often nests on bridges and buildings. Barn swallows build nests from mud and fasten them to a vertical wall or on a horizontal ledge underneath an overhang (Brown and Brown 2019). Bank swallows have been recorded in Blackmud Creek Ravine (Cornell Lab of Ornithology 2019), but none were detected during the breeding bird survey. The likelihood of occurrence in the project area is thus rated as moderate.

3.8 Historical Resources

3.8.1 Methods

Circle CRM Group Inc. (Circle CRM) conducted a desktop assessment that determined that the pedestrian bridge is located on lands designated with a Historic Resource Value (HRV) of 5 (high potential to contain a historic resource) for archaeology and palaeontology, due to being located within High Archaeological and Palaeontological Resource Sensitivity Zones. Considering this designation, Circle CRM determined that *Historical Resources Act* (HRA) approval is required for the proposed project prior to proceeding with any development activities that include ground excavation.

3.8.1.1 Historical Resources

Circle CRM submitted an application to Alberta Culture, Multiculturalism and Status of Women (ACMSW) on 20 March 2020 recommending approval pursuant to the *Historical Resources Act* due to the presence of previous disturbance in the project footprint and, therefore, the limited potential to significantly impact historic resources. ACMSW agreed with this recommendation and granted project approval pursuant to the HRA relative to archaeological resources on 04 May 2020 (Appendix H).

3.8.1.2 Palaeontological Resources

With respect to palaeontological resources, ACMSW required that a Historical Resources Impact Assessment for palaeontological resources (pHRIA) be completed for the proposed project prior to approval. Sandstone Palaeontology Consulting (Sandstone) conducted a pHRIA on 24 June 2020 (Sandstone 2020; Appendix I). Field investigations were conducted on foot and included examination of areas of high paleontological potential in and near the proposed bridge project footprint. The project footprint was assessed at a local level to determine the geology underlying the existing pedestrian bridge and a broader regional assessment was conducted of six exposures (Z1-Z6; Appendix I) along Blackmud Creek in the project vicinity. Any exposures noted were photographed and a waypoint was

taken. Stratigraphy and sedimentology of the exposures was recorded. All exposures were examined for fossils. If fossils were noted, their significance was determined and a sample collected. If the fossils were not significant or too weathered to be identifiable, they were noted and photographed, but not collected. Data collected on stratigraphy, lithology and the presence or absence of fossils from the regional survey at other exposures surrounding the project footprint were extrapolated to the project footprint to determine if bridge-related excavation would disturb any potentially fossiliferous bedrock or surficial deposits. Sandstone's complete report is provided in Appendix I.

3.8.2 Description

3.8.2.1 Palaeontological Resources

Sandstone's (2020; Appendix I) survey of the Blackmud Creek Valley found bedrock exposures of the fossiliferous Horseshoe Canyon Formation throughout the bridge project area. The bedrock consisted mainly of dark grey crumbly mudstone, with interbedded units of sandstone, coal and ironstone. Of the six exposures assessed in the regional study area, fossils, including coalified plant and wood debris, and dark grey to black fossilized wood with a glassy preservation, were observed at one site (Z5). No other fossils were noted at that site or at any of the other five sites. Bedrock was exposed on the lower part of the valley slope, extending upward from the creek. It was overlain by glaciolacustrine silt and sand, suggesting that the lower part of the valley is underlain by bedrock, with the upper part of the valley underlain by glaciolacustrine deposits of low palaeontological potential (Sandstone 2020; Appendix I). Modern alluvial deposits of silt and sand occurred along Blackmud Creek. A single exposure of Holocene alluvial deposits composed of gravel channel or flood deposits and overbank silt was noted in the project area. It was examined for fossils but none were found.

Although no significant fossils were found during the pHRIA in the project area, the regional area has yielded significant fossils, including a hadrosaur bonebed (Sandstone 2020; Appendix I). Bedrock of the Horseshoe Canyon Formation will be disturbed by bridge construction and the potential of impacts to palaeontological resources is considered high. Sandstone (2020; Appendix I) recommended in their pHRIA, therefore, that the Blackmud Creek pedestrian bridge replacement project be monitored during construction for palaeontological resources. An application with the pHRIA was submitted to ACMSW on 06 August 2020 for their review pursuant to the HRA. Conditional approval related to palaeontological resources was granted by ACMSW on 05 October 2020 (Appendix H). Conditions specified by ACMSW include a pHRIA in the form of a construction monitoring program for all areas of high palaeontological potential. No excavation activities are to take place unless a professional consulting palaeontologist is on site to monitor activities. If significant palaeontological resources are encountered during construction activities the Royal Tyrrell Museum of Palaeontology must be contacted.

3.9 Recreation

The pedestrian bridge forms part of the City's river valley and ravine system's SUP system that extends from the Twin Brooks neighborhood to the Skyrattler and Keheewin

neighbourhoods. The nearby 111 Street bridge over Blackmud Creek accommodates pedestrians and is connected to the same multi-use trail system as the bridge to be replaced.

4.0 THE PROJECT

4.1 Project Description

The City plans to repurpose a span of the Connors Road pedestrian bridge, which was removed for Valley Line Southeast LRT construction, to replace the existing Blackmud Creek pedestrian bridge. The Connors Road pedestrian bridge was built in 1984 and consists of one 42 m steel HSS pony truss span and one 13 m steel girder span (BPTEC 2020; Appendix J). The 42 m truss span of that bridge will be used to replace the Blackmud Creek pedestrian bridge. The existing Connors Road bridge deck does not meet the Canadian Highway Bridge Design Code and, therefore, does not have sufficient capacity to carry City maintenance vehicles. In addition, the existing handrail does not meet the City's height requirement for a bicycle barrier and the paint on the railings contains lead (BPTEC 2020; Appendix J). To meet current safety and environmental standards, the City plans to modify the Connors Road bridge by replacing the deck and handrails prior to placement over Blackmud Creek as the new pedestrian bridge.

The new Blackmud Creek pedestrian bridge will be located within the same footprint as the existing bridge but will be longer and narrower than the existing bridge. The new bridge will have a clear span of 42 m, compared to the existing bridge's 30 m span with instream piers (BPTEC 2020; Appendix J). The new bridge will be supported by two new concrete abutments on H-piles at the top-of-bank on each side of the creek and will have a 2.2% slope. It will be approximately 4 m wide, reducing the width of the bridge footprint compared to the existing bridge, which is approximately 13 m wide. The underside of the new bridge will be at approximately the same elevation as the existing bridge to maintain the existing freeboard. The new bridge superstructure is expected to be approximately 320 mm deeper than the existing girders (underside of truss to top of deck), which will require some grading to tie into the existing SUP. Grading on both banks will require riprap erosion protection including an apron extending into the channel and keyed into the creek bed (BPTEC 2020; Appendix J).

Demolition of the existing bridge will require instream works to remove the existing sub-structure and piers to a depth of 0.6 m below the stream bed. Installation of the new bridge itself is not expected to require instream works, since it will span the entire channel of Blackmud Creek. However, installation of riprap to prevent bank erosion will require instream work.

4.2 Landscaping

Based on discussions with the City, landscaping measures include, but are not limited to (BPTEC 2020):

- Improvement of approach grading to ensure proper transitions onto the paved roadway (Running Creek Road) to the south and the multi-use path to the north.
- Installation of a monument or plaque to commemorate site history and significance of the crossing.
- Beautification of the disturbed area through planting of appropriate vegetation.

It is anticipated that a landscaping plan, produced by a qualified landscape designer, will be required.

4.3 Construction Schedule

Construction is expected to occur in winter 2021. Removal of the existing bridge and installation of the new bridge is expected to take six weeks. Landscaping and paving of the new bridge approaches will take place in the spring of 2021.

4.4 Construction Laydown Area and Access

Construction access will be from 111 Street and 12 Avenue to Running Creek Road on the south side of Blackmud Creek. A laydown area will be located on the roadway at the base of Running Creek Road on the south bridge approach (Figure 2, Appendix A). Due to the length of the new bridge truss and the required turn radius for truck delivery, it will likely be necessary to deliver the new truss directly from 111 Street north of Blackmud Creek and bring the new truss in along the SUP (see below). All work will be within the existing City right-of-way (*pers. comm.* J. Edwards).

4.5 Project Phases and Associated Key Activities

The expected general scope of construction methodology will be as follows (J. Edwards, *pers. comm.*):

- Remove the existing Blackmud Creek pedestrian bridge to about 0.6 m below stream bed in the winter while the creek is frozen.
- Install riprap slope protection after removing existing foundations and backfill excavation with native material.
- Drive steel H-piles at both abutments.
- Install new precast concrete abutments or construct cast-in-place concrete abutments (to be determined).
- Install Connors Road truss on new foundations. Due to the length of the truss, access to the bridge site may not be possible using the south approach road, Running Creek Road. Rig mats may need to be used to bring the truss to the site from the north side along the multi-use path from 111 Street.
- Install new precast concrete deck panels.
- Install new bicycle barriers (may be completed in advance while the truss is being stored in a City maintenance yard).
- Complete landscaping and approach paving in the spring.

5.0 PROJECT IMPACTS AND MITIGATION MEASURES

5.1 Assessing Impacts

5.1.1 Potential Impact Identification and Analysis

Based on the environmental context described in Section 3, the following Valued Ecosystem Components (VECs) were identified for impact assessment: surface water quality, channel hydraulics, fish and fish habitat, creek bank slope stability, vegetation, wildlife and recreation. For each VEC, potential impacts to be examined were identified by overlaying the project drawings on mapped resources, reviewing project activities, conferring with multidisciplinary project team members, reviewing project reports and applying our professional experience with impact assessment and construction performance auditing in other, similar, projects. This process resulted in identification of specific potential impacts that warranted assessment.

In addition, we separately examined the potential for the following select project incidents to occur and impact natural resources:

- Release of hazardous/deleterious substances in or outside of the project area and potential for mitigation off-site.

5.1.2 Impact Characterization

Identified impacts were characterized according to guidance received from the EIA Terms of Reference (Table 5.1). Potential impacts were characterized with respect to nature (positive or negative, direct or indirect), magnitude (negligible, minor, or major), duration and timing (temporary, permanent or seasonal), geographic extent and likelihood. These criteria were defined as shown in Table 5.1:

Table 5.1: Impact Descriptor Definitions.

Nature of Impact	
Positive Impact	An interaction that enhances the quality or abundance of physical features, natural or historical resources.
Negative Impact	An interaction that diminishes the abundance or quality of physical features, natural resources or historical resources.
Direct	An interaction that results in the loss or reduction of a resource/feature.
Indirect	An interaction that results in off-site impacts, such as sedimentation off-site.
Magnitude	
Negligible Impact	An interaction that is determined to have essentially no effect on the resource. (Such impacts are not characterized with respect to direction duration or confidence.)

Minor Impact	An interaction that has a noticeable effect but does not eliminate a local or regional population, physical feature or affect it beyond a defined critical threshold (where that exists).
Major Impact	An interaction that affects a local or regional population, resource, or physical features beyond a defined critical threshold (where that exists) or beyond the normal limits of natural perturbation.
Duration and Timing	
Temporary Impact	A change that does not persist indefinitely.
Permanent Impact	A change that persists indefinitely.
Seasonal Impact	A change that will terminate or diminish significantly after one season.
Geographic Extent	Extent of area affected. Quantify where feasible.
Likelihood	What is the probability that the impact will occur? Is it likely or unlikely?

When applying these descriptors, we considered the project described in Section 4. No additional mitigation measures were applied at the time of potential impact characterization.

5.1.3 Mitigation Development and Residual Impact Assessment

Mitigation measures were developed for all identified negative impacts. Any impact anticipated to remain following mitigation implementation was termed a residual impact. As with potential impacts, residual impacts were characterized with respect to: nature, magnitude, duration and timing, geographic extent and likelihood.

5.2 Impact Assessment Results and Mitigation Measures

5.2.1 Surface Water Quality

Instream and near stream works associated with demolition of the existing pedestrian bridge and construction of the new bridge and associated disturbances to the adjacent riparian areas have potential to create sediments that could enter Blackmud Creek and travel downstream. There is also potential for accidental releases into the creek. Any spills or mobilized sediment on site could enter Blackmud Creek and travel downstream. These types of impact are assessed below in Section 5.2.9.

5.2.1.1 Improved Channel Hydraulics

Impacts

The existing Blackmud Creek pedestrian bridge is located on a relatively tight curve in the channel. There is some minor scouring at the toe of the north bank owing to its location on the outside bend but otherwise there is no evidence of significant erosion or scouring at the bridge site and the creek banks are well vegetated (BPTEC 2020; Appendix J). The existing bridge opening is larger than the natural channel and replacement with the longer Connors Road truss will create an even wider opening. In addition, the existing two instream piers will be removed, further improving flow through the hydraulic opening. The underside of the new bridge truss will be located at approximately the same elevation as the existing bridge to maintain the existing freeboard, which has performed adequately to-date (BPTEC 2020; Appendix J). Based on this information, the new bridge is expected to result in improved creek hydraulics at the bridge crossing location compared to existing conditions and is, therefore, rated as a positive, direct, minor, permanent and likely impact to creek hydraulics.

Mitigation and Residual Impacts

No mitigation measures required. Residual impacts will remain positive, direct, minor, permanent and likely.

5.2.2 Fish and Fish Habitat

Kingfisher (2020) identified the following potential impacts to fish and fish habitat as needing examination:

- Mobilization of sediment
- Release of deleterious substances
- Entrapment, impingement and entrainment of fish
- Change in fish movements
- Invasive species/disease
- At risk species
- Physical changes to fish habitat

See Kingfisher's (2020) full report in Appendix E for comprehensive impacts and mitigation measures for fish and fish habitat. A summary of their identified impacts and mitigation measures are provided in Table 5.2 below.

Table 5.2. Analysis of Potential Effects on Fish and Fish Habitat Associated with the Project.

Impact Pathway			Potential Effect	
Category		Potential Source	Description	Analysis
Water Quality	Mobilization of sediment	➢ In-water construction activities	➢ Alteration of potential fish habitat	Possible negative effect due to:

Impact Pathway			Potential Effect	
Category		**Potential Source**	**Description**	**Analysis**
		➢ Riparian disturbance	➢ Changes to fish habitat suitability ➢ Decreased food production ➢ Reduced fish health and/or increased fish mortality	➢ Instream works associated with demolition of existing structure ➢ Instream works associated with installation/removal of isolation works ➢ Disturbances to the riparian area
	Release of deleterious substances	➢ Operation of heavy equipment in or near water	➢ Reduced fish health and/or increased fish mortality	Possible negative effect due to: ➢ Instream and riparian works will require heavy equipment to be in close proximity to the watercourse
Direct Impacts	Entrapment, impingement, entrainment of fish	➢ In-water construction activities that require isolation ➢ Work site dewatering and/or flow routing with pumps	➢ Fish mortality can occur when fish become stranded in isolation areas ➢ Fish mortality can occur when fish become impinged on screens or entrained in pumps when isolated areas are dewatered	Possible negative effect due to: ➢ Installation of isolation works to facilitate demolition of existing piers ➢ Dewatering and flow management operations that will be required to complete the Project
	Change in fish movements	➢ Installation of isolation works	➢ Isolation works can temporarily block fish movements if structures extend across the entire channel	Possible negative effect due to: ➢ Installation of isolation works to facilitate demolition of existing piers
	Invasive species/disease	➢ In-water construction activities using contaminated equipment	➢ Use of contaminated machinery or materials ➢ Not disposing of contaminated materials appropriately	Possible negative effect due to ➢ Instream and riparian works will require equipment to be in close proximity to the watercourse
	At Risk species	➢ In-water construction activities	➢ Instream work can adversely affect species that are *At Risk* or *Threatened* under Provincial and/or Federal legislation	Not expected: ➢ No *At Risk* species are found in Blackmud Creek.
	Physical changes to fish habitat	➢ Replacement watercourse crossing structure ➢ Temporary isolation works ➢ Riprap protection works	➢ The amount and/or quality of available habitat can be permanently reduced if: o The replacement structure has a larger instream footprint compared to the existing structure o There are disturbances to the near-shore riparian area ➢ The amount of available habitat can be temporarily	Possible positive effect due to: • The existing piers will be removed, and the replacement structure will span the channel (no instream piers). Total increase of available habitat of approximately 20m^2 Neutral effect due to: • Instream isolations (if required) are expected to have a negligible footprint

Impact Pathway			Potential Effect	
Category		Potential Source	Description	Analysis
			reduced due to isolation works	since existing piers are located above (south side) and at (north side) the August 2019 water elevation. In addition, instream isolations (if required) would only need to be in place for a short period of time. Possible negative effect due to: • Riprap protection (approximately 10 m long) will be placed along both streambanks

In general, the potential impacts to fisheries resources from the proposed project can be mitigated through best management practices and specific management/protection plans. With these measures in place the project is not expected to result in the death of fish or the HADD of fish habitat, and residual impacts are anticipated to be negligible (Kingfisher 2020; Appendix E). To that end, Kingfisher submitted a Request for Review to Fisheries and Oceans Canada (DFO) for their review. DFO has determined there will be no contravention of the *Fisheries Act* resulting from the proposed project and has issued a Letter of Advice (Appendix K).

5.2.3 Creek Bank Slope Stability

5.2.3.1 Slope Stability

Impacts

Removal of the existing pedestrian bridge and construction of the new bridge could affect slope stability of the creek banks. Thurber (2019b; Appendix D) observed no recent signs of instability at either the north or south creekbanks at the existing bridge site. Some evidence of toe erosion was observed at the toe of the north creek bank likely owing to being on the outside bend of the creek. In addition, the heavy rock riprap on the north creek bank and timber abutment retaining walls at both head slopes under the existing bridge all appeared to be functioning well (Thurber 2019b; Appendix D). If appropriate measures are not taken to avoid slope destabilization, impacts to slope stability are anticipated to be negative, direct, minor, permanent, local and likely.

Mitigation and Residual Impacts

Thurber (2019b; Appendix D) recommended further stability analyses be undertaken when the new north and south abutment slope configurations are available. Class 1 rip rap is proposed to be installed as part of the new bridge design to prevent erosion of the creek bank slopes and contribute to bank stability (Appendix J). Until there is confirmation that this additional stability analysis has been undertaken and there are no slope stability

concerns, residual impacts to slope stability remain negative, direct, minor, permanent, local and likely.

5.2.4 Vegetation

The following potential impacts to vegetation were identified as needing examination:

- Loss or alteration to native plant communities
- Loss of special status plant species
- Establishment of invasive or weedy species
- Incidental tree damage

5.2.4.1 Loss or Alteration to Native Plant Communities

Impacts

Temporary, direct loss of plant communities will result from demolition and construction of the Blackmud Creek pedestrian bridge. Small, localized clearing of the native riparian plant community will be required prior to demolition of the existing bridge (Figure 6 in Appendix A). Depending on how the Connors Road truss is transported/lifted into place from 111 Street, some localized clearing of the native aspen smooth brome plant community may be required to provide additional clearance. Impacts to native vegetation are rated as negative, direct, minor, temporary, local and likely.

Mitigation and Residual Impacts

In accordance with the City of Edmonton *Corporate Tree Management Policy C456*, all treed areas on city-owned (public) lands in the project area will be assessed for value by the City of Edmonton Forestry department prior to removal. To lessen the potential impact on native plant communities during proposed construction, equipment storage, maintenance and refueling in areas that support native plant communities will be prohibited. Prior to construction, marking the clearing limits with highly-visible flagging will help minimize the extent of vegetation loss. A landscaping plan produced by a qualified landscape designer will be required by the City. Reclamation of disturbed areas through reseeding and planting of appropriate native plants and shrubs will also be required. With these mitigation measures in place, the residual impact to vegetation is rated as negligible.

5.2.4.1 Loss of Special Status Plant Species

Impacts

During the 24 July 2019 rare plant survey one special status plant species, round-leaved hawthorn, was observed in the local study area. Round-leaved hawthorn is ranked as S3 (20-100 occurrences within Alberta), which are not tracked or considered rare by the Province; however, the City of Edmonton does consider S3 species as rare. Round-leaved hawthorn was observed as 5-10 scattered individuals throughout the riparian, aspen-smooth brome and balsam poplar-mixed shrub plant communities, with the majority of the individuals observed in the balsam poplar-mixed plant community. No individuals were observed in the riparian community adjacent the pedestrian bridge. Unmitigated, impacts

to these plants would be negative, minor, temporary, local, direct and likely if plans change and clearing will occur in the balsam poplar-mixed shrub plant community.

Mitigation and Residual Impacts

No clearing in the balsam poplar-mixed shrub plant community is anticipated at this time, therefore, the residual impact is rated as negligible.

5.2.4.2 Establishment of Invasive or Weedy Species

Impacts

Surface disturbance from construction could create ideal conditions for the establishment and spread of noxious weed species. Weeds could become established following construction through the movement of seeds and rhizomes carried on equipment as well as by colonization by seeds transported naturally from adjacent weed populations. Weed establishment in the project area is undesirable, as weeds may then spread to surrounding native plant communities within Blackmud Creek Ravine. Preventing weed establishment in the first place may be the best and most economical opportunity for weed management. In the absence of mitigation, the spread of weedy species within reclaimed areas will likely occur and will have a negative, direct, minor, local, permanent and likely impact.

Mitigation and Residual Impacts

Precautions such as cleaning equipment before moving into the project area will help reduce the potential transfer and spread of weedy species. Cleared areas will be revegetated with topsoil and an appropriate seed mix approved by the City as soon as possible following construction. Some level of weed control will likely be required until desired vegetation becomes established, but the need for such measures can be assessed through monitoring. All short-term weed control measures will be outlined in the contractor's Environmental Construction Operations (ECO) Plan. With proper implementation of these measures, the residual impact will be reduced to negligible.

5.2.4.3 Incidental Tree Damage

Impacts

During delivery of the new bridge along the SUP adjacent trees and shrubs will be vulnerable to limb, trunk and root damage. The potential for additional tree loss as a result is rated as a negative, indirect, minor, permanent, local and likely impact.

Mitigation and Residual Impacts

Compliant with the City's *Corporate Tree Management Policy* (C456) and the *City of Edmonton Tree Preservation Guidelines*, the proponent's contractor will be required to prepare a Tree Protection Plan. That plan will include measures to physically protect individual open space trees within 5 m of the project area and natural tree stands within 10 m of the project area. All trees and shrubs in need of protection will be fenced off with snow fencing and/or hoarded to ensure they are visible. The contractor will be required to

monitor the effectiveness of their tree protection program and record any incidental damage. With these measures in place, the residual impact is rated as negligible.

5.2.5 Wildlife and Wildlife Habitat

The following potential impacts to vegetation were identified as needing examination:

- Loss of terrestrial habitat due to clearing activities
- Habitat alienation during construction
- Breeding wildlife mortality
- Mortality or disturbance of special status wildlife species

5.2.5.1 Loss of Terrestrial Habitat Due to Clearing Activities

Impacts

Any loss of natural vegetation in the project area represents an associated loss of natural habitat. It is expected that relatively small, localized areas of natural riparian habitat will be cleared adjacent the existing bridge prior to demolition. There is also potential that some localized clearing of natural aspen-smooth brome habitat may be required along the SUP to the north of the bridge to accommodate delivery of the Connors Road truss. The remainder of disturbance is expected to be in the anthropogenic non-forested smooth brome plant community, which does provide some wildlife habitat value for nesting, cover and forage. The habitat value of areas to be cleared is moderate to very high, however, as noted in the vegetation discussion, the majority of habitat loss will be temporary. As a result, the anticipated temporary habitat loss is rated as a negative, direct, minor, local in scale, and likely impact.

Mitigation and Residual Impacts

Applying all mitigation measures outlined in the vegetation section will result in establishment of areas of native riparian and aspen-smooth brome plant communities, with a reduced exotic/weedy component and additional smaller naturalized areas supporting native trees and shrubs adjacent the new bridge. This is considered to fully mitigate for the loss, over time. The residual impact is rated as negligible.

5.2.5.2 Habitat Alienation During Construction

Impacts

Activities and noise associated with construction have potential to disrupt wildlife species using adjacent habitat, leading to habitat alienation in those areas. This effectively reduces the amount of usable habitat available to individuals. However, in this case, this potential impact is rated as minor for the following reasons:

- Most wildlife species in the area are likely already adapted to human disturbance.
- Construction disturbance will be periodic over the construction period, and location specific within the project area.
- Construction will typically occur during daylight or early evening hours, leaving adjacent areas relatively undisturbed for nocturnal species.

Considering all the above, the impact of habitat alienation during construction activities is rated as negative, indirect, minor, temporary, local and likely.

Mitigation and Residual Impacts

Few mitigation measures are available. Work crews will be instructed not to harass wildlife and the contractor's ECO plan will include worker/wildlife encounter protocols. The residual impact of habitat alienation during construction activities is, therefore, also rated as negative, indirect, minor, long-term, temporary, local and likely.

5.2.5.3 Breeding Wildlife Mortality

Impacts

Clearing of vegetation can cause wildlife mortality, particularly during the spring and summer breeding season when the mobility of many species is restricted. During those times, adults remain close to nest sites, and young are restricted to nests or not yet able to move long distances. To protect wildlife, and particularly nesting birds protected by the *Migratory Birds Conservation Act* (MBCA) and *Wildlife Act*, current best management practices provided by Environment and Climate Change Canada (ECCC) recommends avoiding vegetation clearing during the period when there is a high probability of nesting activity (i.e., high risk period). This extends to the removal of individual ornamental trees and weedy, grassy areas because commonly occurring species such as the American robin and clay-colored sparrow, which may use those areas for nesting, respectively, are covered by the legislation. When this practice is not adopted and in the absence of other mitigation measures (e.g., nest search), there can be high potential for nest disturbance. Further, owls that occur in Edmonton are protected under the *Wildlife Act* and are early nesters. Clearing during the period 15 February and 20 April without regard of nesting owls can result in owl nest disturbance and nestling mortality. There is some potential for birds to nest on the existing bridge and within the riparian vegetation adjacent the bridge and in nearby trees and shrubs. Destruction of active nests could be in conflict with legislation. Should clearing due diligence not be employed, wildlife mortality resulting from clearing could occur. This would be a negative, direct, major, permanent, local, likely impact. It is rated as major because it represents contravention of the law.

Mitigation and Residual Impacts

In this region, wildlife mortality from vegetation clearing (including brush piles and tall grass) is best avoided by scheduling clearing outside the period 20 April to 20 August. In addition, to respect the possibility of nesting owls, clearing of mature trees during the period 15 February and 20 April should be avoided. Therefore, if possible, this project will avoid any tree and shrub clearing/removal during the period 15 February and 20 August. If clearing/removal must occur during this time period, nest sweeps by a qualified biologist will be required to identify active nests and appropriately buffer them until the nest is no longer active. With these measures in place, wildlife mortality should be avoided, and the residual impact would be negligible.

5.2.5.4 Mortality or Disturbance to Special Status Wildlife Species

Impacts

Four special status wildlife species have the potential to occur in suitable habitat in the project area including little brown myotis, olive-sided flycatcher and bank and barn swallows. All species are migratory and occur in the Edmonton area in the spring and summer (approximately May-September). If bridge demolition and construction occur in early 2021 (winter) as tentatively scheduled, then none of these species would be present and would not be directly impacted by proposed project activities. In that case, impacts to special status wildlife species would be rated negligible.

If demolition and construction occurs in the spring or summer of 2021, then there is potential to adversely affect these species through vegetation clearing and bridge removal as described above in Section 5.2.5.3. Specific to the little brown myotis, it has a high likelihood of occurrence in the project area during the summer months. Suitable foraging and roosting habitat, including maternity roosting colony habitat, is located in nearby deciduous leading habitat areas as well as on the existing Blackmud Creek pedestrian bridge and in nearby buildings. Clearing of natural vegetation and bridge demolition can cause bat mortality. The potential for mortality of individual, solitary bats roosting during daylight hours is low and of limited concern to bat conservation. However, there is also potential for clearing and demolition during the summer months to disturb maternity colonies and result in significant mortality as a result of females and pups exhibiting restricted mobility at these roosts. In this case, as discussed in section 3.7.2, there is a high probability of the presence of little brown myotis maternity roosts within the proposed project area. In this area, pregnant females can occupy maternity roosts as early as early May and there is potential for young flightless and/or dependant bats to be present in maternity roost colonies between late June and late August. Moreover, maternity roosts are sometimes active until mid-September, even after independence of the young (L. Wilkinson, *pers. comm.*). In the absence of mitigation, there is, therefore, potential for the proposed project to result in little brown myotis mortality if vegetation clearing or bridge demolition occurs between early May and mid-September. Should this occur, it would be a direct, negative, major, permanent, local and likely impact. It is rated major because of the species' provincial and federal rankings.

Mitigation and Residual Impacts

Mitigation measures described above in Section 5.2.5.3 apply to vegetation clearing and bridge demolition occurring in the identified restricted clearing/removal periods.

While the project area is not on federal lands and maternity and individual day roosting sites for little brown myotis are not yet identified by SARA as critical habitat nor are they protected by the provincial *Wildlife Act*, best management practices for conservation of this special status species are still warranted, particularly for maternity roost colonies. To that end, schedule vegetation clearing and bridge demolition during the period 16 September to 30 April, inclusive. This will avoid all potential to impact little brown myotis. In the event that the above-noted proactive mitigation is not possible, and clearing and/or demolition is required during the time when maternity roost sites may be active with pregnant females

and/or flightless/dependent young, it is recommended that maternity roost surveys be undertaken at the existing bridge crossing prior to demolition. The survey will be done by qualified personnel using industry accepted survey protocols. If a maternity colony is present, the proponent must consult with AEP and ECCC regarding appropriate protection measures and must provide the City with a record of all correspondence with these agencies including the resulting agency recommendations. Delaying bridge demolition until the fall after the bats have left the maternity roost may be required.

With these measures in place, residual impacts to special status wildlife species are rated as negligible.

5.2.6 Ecological Connectivity/Wildlife Movement

The potential for the project to change ecological connectivity/wildlife movement patterns was examined.

Impacts

Replacement of the pedestrian bridge has potential to result in a slightly improved wildlife permeability under the bridge, in the following ways. While the new bridge will have the same vertical clearance over Blackmud Creek as the existing bridge it will have a slightly longer horizontal clearance over the creek channel (Appendix J). In addition, the existing instream piers will be removed, further improving wildlife passage under the bridge. Riprap erosion protection will be placed on the new abutment slopes, however there will be native fill placed over the toe of the riprap, providing a soft substrate for wildlife passage under the bridge, particularly during low water flows. The width of the new bridge (approximately 4 m) will be narrower than the existing bridge (approximately 13 m), which may create more favourable passage conditions for some wildlife related to a shorter crossing under the bridge and associated improved sight lines to the other side of the bridge. Considering the above, impacts to ecological connectivity/wildlife movement as a result of the replacement bridge are rated as positive, direct, minor, permanent, local and likely. This applies to large-, medium- and small-sized species including deer, coyote, porcupine, snowshoe hare, white-tailed jack rabbit, fox, weasels, voles and mice.

These impacts are rated as minor and not major because at this location wildlife may move unimpeded throughout Blackmud Creek Ravine and are not forced to use passage under the bridge to move from one ecologically connected habitat patch to another. They do, however, have the option to pass under the bridge.

Mitigation and Residual Impacts

No additional mitigation measures are required and residual impacts remain positive, direct, minor, permanent, local and likely.

5.2.7 Historical Resources

The following potential impacts to historical resources were identified as needing examination:

- Disturbance to known and undiscovered historical/archaeological resources
- Disturbance to known and undiscovered paleontological resources

5.2.7.1 Disturbance to Historical/Archaeological Resources

Impacts

Alberta Culture, Multiculturalism and Status of Women (ACMSW) has determined that there are no known historical or archaeological resources at the proposed bridge replacement site and granted conditional approval pursuant to the *Historical Resources Act* relative to archaeological resources (Appendix H) with the understanding that all ground disturbance activities will be confined to the identified project footprint. If final project planning requires the expansion of development activities (including temporary workspace, temporary storage and new access) outside of the approved boundary, then these final plans must be submitted in a new Historic Resources Application prior to the onset of development activities. Impacts to known historical resources are, therefore, expected to be negligible and there is some low potential to encounter unknown archaeological resources. The potential for adverse impact is reduced to an acceptable level by the Province's requirement to comply with Standard Requirements under the "*Historical Resources Act*: Reporting the Discovery of Historic Resources". This includes immediately suspending work and contacting ACMSW should potential historical/archaeological resources be discovered during construction. The potential for the project to adversely affect historical or archaeological resources is, therefore, rated as negligible.

Mitigation Measures and Residual Impacts

In accordance with ACMSW approval requirements, all work will be immediately suspended and ACMSW contacted should potential historical/archaeological resources be discovered during construction (Appendix H). Appropriate follow-up measures would then be implemented. Considering this, the residual impact to historical resources is rated as negligible.

5.2.7.2 Disturbance to Palaeontological Resources

Impacts

Alberta Culture, Multiculturalism and Status of Women (ACMSW) determined that there is potential to adversely impact paleontological resources in the proposed bridge replacement project area. To that end, Sandstone (2020, Appendix I) conducted a pHRIA on 24 June 2020. Although no significant fossils were found during the pHRIA in the project area, the regional area has yielded significant fossils, including a hadrosaur bonebed (Sandstone 2020; Appendix I). Bedrock of the Horseshoe Canyon Formation will be disturbed by bridge construction and the potential for adverse impacts to palaeontological resources is considered high. Impacts to palaeontological resources is, therefore, rated as negative, major, permanent, local to regional and likely.

Mitigation Measures and Residual Impacts

Based on their findings, Sandstone (2020; Appendix I) recommended in their pHRIA that monitoring for the presence of palaeontological resources be conducted during Blackmud Creek pedestrian bridge construction. ACMSW agreed with this recommendation and granted conditional approval pursuant to the HRA related to palaeontological resources on 05 October 2020 (Appendix J). ACMSW requires that a pHRIA in the form of construction monitoring be conducted for all areas of high palaeontological potential and that no excavation activities are to take place unless a professional consulting palaeontologist is on site to monitor activities. If significant palaeontological resources are encountered during construction activities the Royal Tyrrell Museum of Palaeontology must be contacted. With these mitigation measures in place, residual impacts are rated as negligible.

5.2.8 Recreation

The following potential impacts to recreation were identified as needing examination:

- Disturbance to existing recreational use from construction activities
- Improved pedestrian safety

5.2.8.1 Disturbance to Existing Recreational Use from Construction Activities

Impacts

Replacement of the Blackmud Creek pedestrian bridge will require temporary closures of the SUPs in that area. Recreationalists using the SUPs will be temporarily inconvenienced by detours during construction. Deliveries of materials and equipment as well as construction activities also may cause temporary trail and Running Creek Road closures, potentially diminishing recreational use in nearby areas.

Signage throughout the area will provide recreationalists with adequate notification of the timing and duration of construction activities. Temporary fencing will be installed to prevent public access into active construction areas. The potential impacts to recreational use from construction activities are rated as a negative, direct, minor, temporary, local and likely impact.

Mitigation and Residual Impacts

Temporary fencing will be installed around the active construction area. Detour routes will be clearly identified. Signage must be clearly posted indicating a project contact person and prime contractor, and shall include project information, duration and phone number for inquiries. Signage shall be removed within two weeks of construction completion. With these measures in place, residual impacts should be negligible.

5.2.8.2 Improved Recreational Safety

Impacts

Safety for recreational users crossing the new bridge will be improved compared to existing conditions. The new bridge will include a new structure, new surface and new railings.

New bridge railings and deck surfaces will meet current safety requirements. The impacts to recreational safety are expected to be positive, direct, major, permanent, local and likely.

Mitigation and Residual Impacts

No additional mitigation measures are required. The residual impact remains positive, direct, major, permanent, local and likely.

5.2.9 Project Incidents

5.2.9.1 Release of Hazardous/Deleterious Substances On or Off-Site

Impacts

Fuels, lubricants and other hazardous materials are anticipated on-site hazardous materials. Spills or releases can occur during refueling, as a result of equipment failure (e.g., leaking hose), accidents, or improper storage/containment at sites. Spills can cause localized contamination of Blackmud Creek, soils, plant communities, wildlife habitat on and off site and if they enter catch basins, they could travel to Blackmud Creek and ultimately to Whitemud Creek and the North Saskatchewan River. Most spills would likely be small in nature, but if uncontrolled, spills could spread over large areas. Small spills are anticipated at most construction sites. Large spills are more preventable. Spill migration is particularly likely on the relatively steep Blackmud Creek banks. Unprotected catch basins in the project area that lead into the City's storm sewer system have the potential to capture unmitigated releases of deleterious materials and transmit them to downstream water bodies. Catch basins are especially vulnerable where they are situated at the foot of unprotected slopes where long slopes produce higher flow velocities and can capture higher flow volumes that could overwhelm insufficient protective measures

If appropriate plans and practices are not put into place, the impact of a hazardous or deleterious substance spill could be negative, direct, minor to major, permanent, local and likely.

Mitigation and Residual Impacts

The contractor will be required to comply with City of Edmonton's Enviso system. In addition, for the construction period, the contractor will be required to provide a spill prevention and emergency response plan and a hazardous waste management plan. Those plans will include specific measures related to securely protect the creek in the project area. The plans must also include construction monitoring protocols and frequency. With these in place the residual impact should be negligible.

5.2.9.1 Release of Sediment or Other Debris On or Off-site

Impacts

Site preparation during demolition and construction activities will result in the removal of vegetation and exposing of bare soil surfaces, likely for extended periods of time. Demolition and construction activities on exposed soils can result in erosion and loss of top-soils and sub-soils, degradation of top-soil quality, weakened slope stability, or

introduce sediments directly into Blackmud Creek or through the City's storm sewer system. In areas where existing vegetation cover is cleared, exposed soils are susceptible to fluvial (surface water) erosion in wet conditions, and, to a lesser extent, aeolian (wind) erosion in dry conditions. The clearing of vegetation on steep slopes will expose soils that are especially susceptible to erosion resulting from surface runoff given high slope gradients. Eroded soils can accumulate in downslope undisturbed vegetated areas and in the ravine bottom. If mitigation measures (controls and clean-up measures) are not put into practice, the impact on vegetation, habitat and Blackmud Creek would be negative, direct, minor to major, permanent, local and likely.

Mitigation and Residual Impacts

The contractor will be required to comply with City of Edmonton's Enviso system. In addition, for the construction period, the contractor will be required to prepare a site-specific temporary ESC plan, to City of Edmonton specifications, and a site-specific water management plan. These plans will also include monitoring protocols and frequency. With these plans in place the residual impact of sediment or other debris release off site or to the creek should be negligible.

5.3 Cumulative Effects

The cumulative effects assessment study area was defined as Blackmud Creek Ravine extending 300 m up and downstream of the existing pedestrian bridge. The assessment considered past projects, known projects and publicly announced future projects.

5.3.1 Past Projects

Based on aerial photograph analysis, the developed footprint in the cumulative effects study area has remained essentially the same since the early 2000's with realignment of 111 Street and construction of the new 111 Street Bridge over Blackmud Creek around 2001 (Capital Line Partners 2019). The private residence located at the foot of Running Creek Road, approximately 65 m south of the pedestrian bridge, has been at that location since at least 1969 (Capital Line Partners 2019). Aside from the addition of the short sections of SUP extending into the ravine under 111 Street and east of 111 Street to connect to the pedestrian bridge and Running Creek Road, Blackmud Creek Ravine has remained largely undeveloped in this area.

5.3.2 Present Projects

There are no known current projects taking place in this area.

5.3.3 Future Planned Projects

The City of Edmonton's Capital Line South LRT Extension will cross Blackmud Creek on the west side of the 111 Street bridge to extend the track from Century Park to Ellerslie Road. Preliminary design for the project has been completed and future phases of the project will move forward once funding becomes available.

5.3.4 Conclusion

Since the proposed pedestrian bridge replacement project is a stand-alone project and is a replacement of existing infrastructure, it will not act as a catalyst for additional future development in this area. The proposed project, therefore, has no potential to add to the cumulative impact of past projects, nor contribute to cumulative impacts of future projects.

6.0 ENVIRONMENTAL MONITORING

This EIA identifies several monitoring commitments for the City:

- Pursuant to the City of Edmonton's Enviso program, Environmental Construction Operations (ECO) Plan monitoring during site preparation and construction phases of the project must be completed weekly.
- Monitoring is required by the Erosion and Sediment Control Plan, to be undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent.
- A turbidity monitoring program will be developed and implemented by a Qualified Aquatic Environment Specialist (QAES).
- Monitoring of excavation activities by a professional consulting palaeontologist in areas of high palaeontological potential is required by Alberta Culture, Multiculturalism and Status of Women (Appendix H).

7.0 PUBLIC CONSULTATION

During the planning and design phase, it was identified that there are no requirements for public engagement. However, there is one stakeholder, the adjacent private residence, within the study area who will be contacted once there is a better understanding of construction timelines. In addition, there will be a pre-construction open house for the project.

8.0 CONCLUSIONS

8.1 Impact and Sensitivities

This EIA has shown that with the described mitigation measures applied, all but two impacts related to the construction phase of the bridge replacement project can be mitigated such that adverse residual impacts are reduced to negligible.

The key sensitivities identified for the proposed project, therefore, are:

- creek bank slope stability, and
- habitat alienation during construction.

The project has the potential to result in a negative impact to creek bank slope stability. If no appropriate measures are put in place slope destabilization could occur during construction and operation of the new bridge. Thurber (2019b; Appendix D) observed no recent signs of instability at either the north or south creekbanks and the heavy rock riprap on the north creek bank and timber abutment retaining walls at both head slopes under the existing bridge all appeared to be functioning well. However, some evidence of toe erosion was observed at the toe of the north creek bank. Further stability analyses were recommended when the new north and south abutment slope configurations are available (Thurber 2019b; Appendix D). Until there is confirmation that there are no slope stability concerns with new bridge design, residual impacts remain negative, direct, minor, permanent, local and likely.

The project is anticipated to result in one temporary negative residual impact related to wildlife during construction. Construction activities and related noise have the potential to result in wildlife habitat alienation in adjacent areas. Activities and noise associated with construction phases have potential to disrupt wildlife species using adjacent habitat, leading to habitat alienation in those areas. This effectively reduces the amount of usable habitat available to individuals. Few mitigation measures are available, however, work crews will be instructed not to harass wildlife and the contractor's ECO plan will include worker/wildlife encounter protocols.

Considering the above, and that communication with City stakeholders remains open during project development, we are of the opinion that the proposed project does not require additional modifications to proceed responsibly.

8.2 EIA Limitations

This EIA was founded on preliminary design drawings and reports and limited construction methodology information. The EIA was predicated on the knowledge that the City's construction contractor will develop environmental controls intended to induce excellent environmental performance during construction.

8.3 Summary of Key Mitigation Measures

The following represents a list of key mitigation measures selected to itemize important action items for future project stages. All mitigation measures should be included in the Contractor's ECO Plan.

- The City must ensure that the construction contractor adheres to all the mitigation measures listed in Section 5.2.1 and 5.2.2 and distilled here to mitigate potential impacts to surface water and fish and fish habitat and ensure compliance with Provincial and Federal Acts pertaining to water and fish.

    - Prepare a detailed ESC Plan
    - Turbidity monitoring is recommended
    - Follow instream isolation BMPs
    - Construction is to take place outside the RAP
    - Follow decontamination protocols for whirling disease

- The City must ensure that the construction contractor adheres to all the mitigation measures listed in Section 5.2.4 and distilled here to address vegetation loss and ensure compliance with the Corporate Tree Management Policy:

    - Prepare a tree protection plan
    - Revegetate exposed soils promptly
    - Discourage weed establishment
    - Implement weed control and monitoring

- The City must ensure that the construction contractor adheres to all mitigation measures listed in section 5.2.5 to mitigate potential wildlife impacts and ensure compliance with all Provincial and Federal Acts pertaining to wildlife. Note that vegetation clearing and bridge demolition timing are critical issues.

- The City must ensure that the construction contractor adheres to all mitigation measures listed in section 5.2.7. to mitigate potential historical (archaeological and palaeontological) impacts and ensure compliance with the *Historical Resources Act.*

- The City must ensure that the construction contractor adheres to all mitigation measures listed in section 5.2.8 to mitigate potential impacts to recreation and maintain recreationalist safety.

- The City must ensure that the construction contractor adheres to all mitigation measures listed in Section 5.2.9 and distilled here to mitigate impacts to project incidents.

    - Prepare a detailed spill prevention and emergency response plan
    - Water management plan

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9.2 Personal Communications

A. Bismanis. Senior Environmental Scientist, Spencer Environmental Monitoring Services Ltd. Edmonton, Alberta.

J. Edwards. Structural Engineer, BPTEC Engineering Ltd. Edmonton, Alberta

L. Wilkinson, M.Sc., Provincial Bat Specialist. AEP. Communication in 2018 with Andra Bismanis of Spencer Environmental. Edmonton. Alberta.

Appendix A: Figures

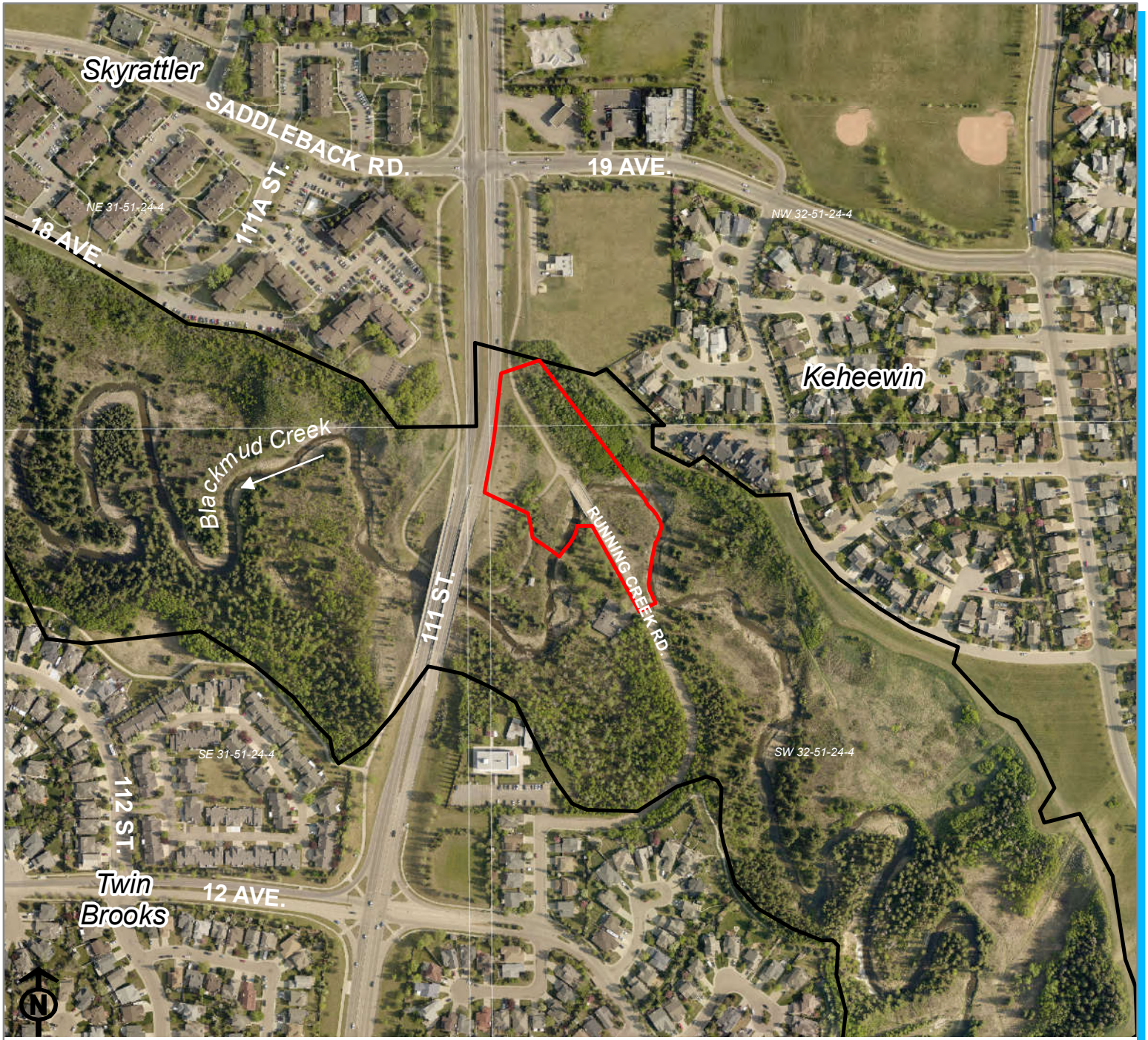
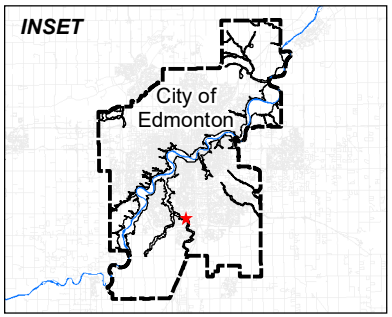


Figure 1.
Project Overview
Blackmud Creek & 111 Street Pedestrian Bridge

Legend

- Local Study Area
- Bylaw 7188 Boundary (COE, 2010)



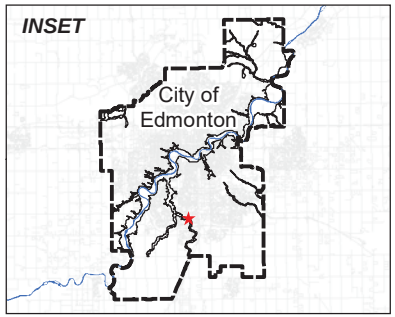
Map Date: 25 May 2020
Mosaic Imagery Date: May-July 2019

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

Figure 2.
Site Overview
Blackmud Creek
& 111 Street
Pedestrian Bridge

Legend

- Proposed Construction Laydown
- Local Study Area
- Total Construction Footprint*
- Bylaw 7188 Boundary (COE, 2010)

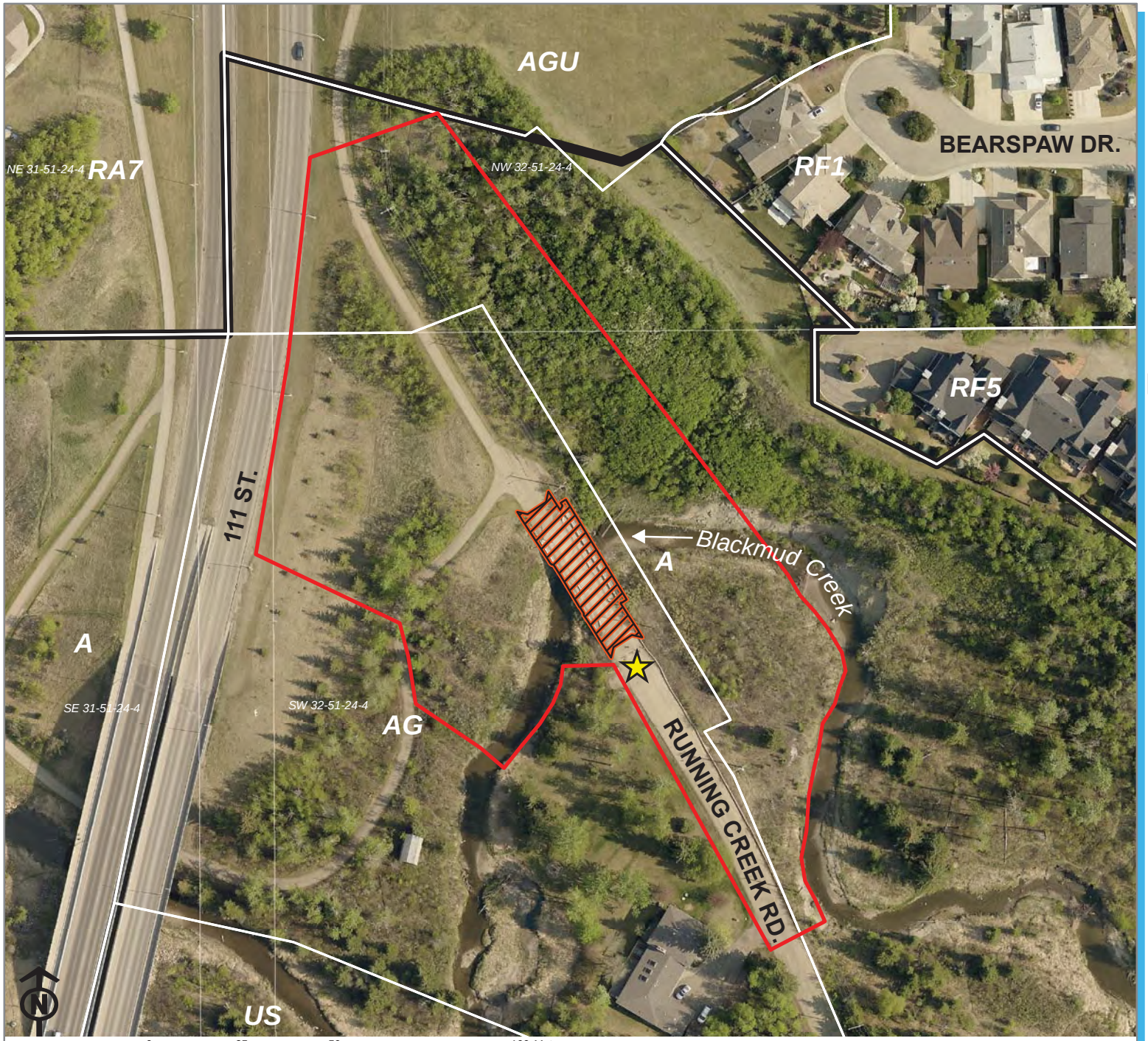


Map Date: 26 March 2020
Mosaic Imagery Date: May-July 2019

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

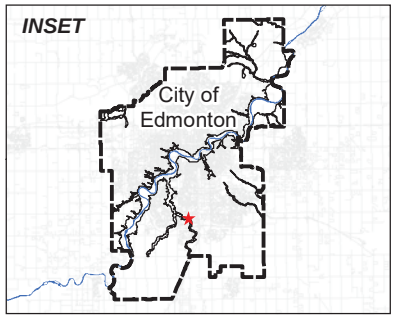
*Conceptual design provided by BPTEC Engineering Ltd. (2020).

Figure 3.
City of Edmonton
Land Use Zoning
Blackmud Creek
& 111 Street
Pedestrian Bridge



Legend

- Proposed Construction Laydown
- Local Study Area
- Total Construction Footprint*
- Bylaw 7188 Boundary (COE, 2010)
- A — Zoning (COE, 2020)



Map Date: 26 March 2020
Mosaic Imagery Date: May-July 2019

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by BPTEC Engineering Ltd. (2020).

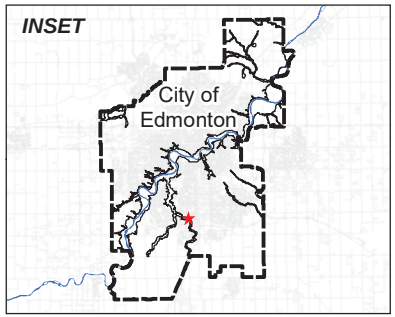
Figure 4.
City of Edmonton Environmental Sensitivities (2016)
Blackmud Creek & 111 Street Pedestrian Bridge

Legend

- Proposed Construction Laydown
- Local Study Area
- Total Construction Footprint*
- Bylaw 7188 Boundary (COE, 2010)
- Contours (COE, 2018)

Environmental Sensitivity**

- Extremely High Value
- Very High Value
- High Value
- Moderate Value



Map Date: 26 March 2020
Mosaic Imagery Date: May-July 2019

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by BPTEC Engineering Ltd. (2020).
**City of Edmonton Environmental Sensitivity Project (Solstice Canada, 2016).

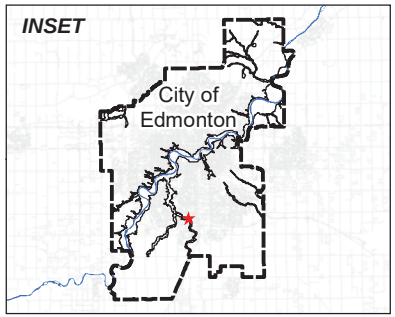
Figure 5.
Updated City of Edmonton Environmental Sensitivities (2020)
Blackmud Creek & 111 Street Pedestrian Bridge

Legend

- Proposed Construction Laydown
- Local Study Area
- Total Construction Footprint*
- Bylaw 7188 Boundary (COE, 2010)
- Contours (COE, 2018)

Environmental Sensitivity**

- Extremely High Value
- Very High Value
- High Value
- Moderate Value



Map Date: 26 March 2020
Mosaic Imagery Date: May-July 2019

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by BPTEC Engineering Ltd. (2020).
**Update of City of Edmonton Environmental Sensitivity Project (Solstice Canada, 2016) data based on site-specific survey data conducted by Spencer Environmental (2019).

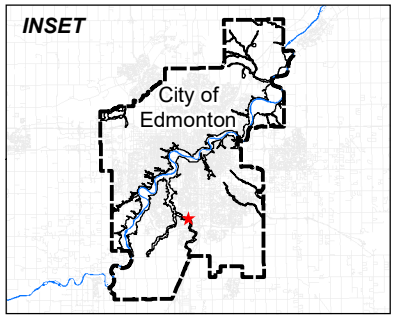
Figure 6. Existing Plant Communities
Blackmud Creek & 111 Street Pedestrian Bridge

Legend

- Proposed Construction Laydown
- Local Study Area
- Total Construction Footprint*
- Bylaw 7188 Boundary (COE, 2010)

Plant Communities (2019)**

- Balsam Poplar – Mixed Shrub Forest (PB.1)
- Aspen – Smooth Brome Forest (AW.7)
- Non-Forested Smooth Brome – Level Slopes (NF.7)
- Riparian (R)



Map Date: 29 May 2020
Mosaic Imagery Date: May-July 2019

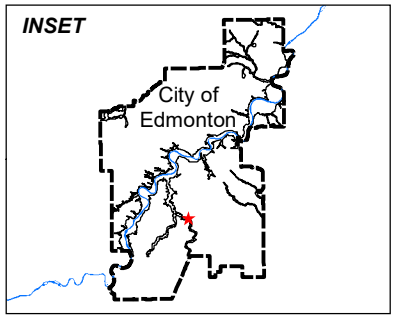
SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by BPTEC Engineering Ltd. (2020).
**Plant community classification follows the Urban Ecological Field Guide for the City of Edmonton, Alberta, Canada (City of Edmonton 2015).

Figure 7.
Breeding Bird Survey Locations
Blackmud Creek & 111 Street Pedestrian Bridge

Legend

- Proposed Construction Laydown
- Local Study Area
- Expanded Study Area
- Total Construction Footprint*
- Bylaw 7188 Boundary (COE, 2010)
- Breeding Bird Survey Location (50m radius)



Map Date: 25 May 2020
Mosaic Imagery Date: May-July 2019

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by BPTEC Engineering Ltd. (2020).

Appendix B: Environmental Approvals Table

Summary of Potential Environmental Approvals for Replacement of the Blackmud Creek and 111 Street Pedestrian Bridge

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
Municipal					
North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188)	City Planning	Bylaw regulates all activities on City lands in the North Saskatchewan River Valley. Blackmud Creek bridge replacement requires an Environmental Impact Assessment (EIA)	EIA must be approved by City Council	EIA to be submitted to City Planning for review and sign off, then to Council Committee and City Council for approval	Committee/Council date anticipated in summer 2020
Corporate Tree Management Policy (C456C)	City Forestry	Policy provides protection for City trees/shrub inventory and a mechanism for monetary compensation for lost canopy. Prior to removal, trees/shrubs are assessed by City's Urban Forestry Department	Aa tree protection plan approved by a CoE urban forester will likely be required and compensation for lost canopy must be arranged with CoE	Meet with City forester to assess project area. A project-specific tree protection plan and compensation program will be developed accordingly, if required.	A forestry assessment of affected trees/shrubs and natural stands must be completed. Compensation to be realized as part of the project as a whole. Contract tender will be responsible for the protection of retained trees.
City of Edmonton (Bylaw 18100) - EPCOR Drainage Services Bylaw	EPCOR	Bylaw regulates the use of the sewer and contractor must consult with EPCOR regarding use of sewer to dewater site. Application for a permit of payment of fees	Permit required to use sewage system	Application for a permit to discharge into the sewer system may be required	Proponent responsibility
Drainage Bylaw (Bylaw 18093)	City of Edmonton	No prohibited, restricted or hazardous waste may be released into the sewage system without written consent from EPCOR	No permits/approvals required; compliance only	None	Proponent responsibility
City of Edmonton Parkland (Bylaw 2202)	City of Edmonton	Bylaw to protect and preserve natural ecosystems for the benefit of all citizens of the City	Approval required to stage construction equipment or other use in park space	Application for a permit to stage for construction	Proponent responsibility
Community Standards Bylaw (Bylaw 14600)	City of Edmonton	Part II establishes construction working periods (07:00-21:00 hours on Monday to Saturday; 09:00-19:00 Sundays and holidays) and acceptable noise levels (not exceeding 65 dBA)	No permits/approvals required; compliance only	None	Proponent responsibility

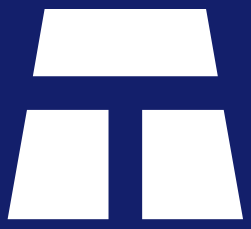
Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
ENVISO, City Policy C505, City Policy C512	City of Edmonton	Based on the ISO 14001 Standard, ENVISO provides a framework for a strong environmental management system aimed at legal/regulatory compliance, pollution prevention and continual improvement (C512). The proponent must be compliant with all aspects of ENVISO	• Proponent must be compliant with all aspects of ENVISO. An Enviso Design Environmental Permit Approval checklist must be completed for all City projects prior to tender. • Review of the Enviso Proponent's Environmental Responsibility Package and City Policy C512. • Signing Proponent's Environmental Acknowledgement Form	• Process must be implemented as project is underway • checklist must be completed prior to tender	Proponent responsibility
Provincial					
Public Lands Act	Alberta Environment and Parks (Land Management Branch)	Use of crown lands, including the bed and shore of all bodies of water, are regulated under this Act. Act requires proponents wishing to work on, alter or occupy Crown land to obtain a disposition or amend existing dispositions	The bridge is located on Papaschase Surrendered Indian Reserve lands. The province does not claim ownership of the bed and shore within the surrendered reserve. No permission under the *Public Lands Act* required (*pers. comm.* C. Nahirniak)	None	None
Water Act	Alberta Environment and Parks (Water Approvals Branch)	Disturbances to the bed and bank of watercourses are covered under the Code of Practice for Watercourse Crossings (2006). Consultation should be undertaken with AEP early to confirm works planned fall within the CoP guidelines and only	Code of Practice Notification	Submit Code of Practice Notification To comply with CoP, a project may also require the specifications and recommendations of a	CoP Notification submission at least 14 days prior to construction commencement

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
		Notification is required. The Water Act also contains provisions to prevent deposition of deleterious substances (including sediment and other contaminants) into watercourses		Qualified Aquatic Environmental Specialist (QAES).	
Wildlife Act	Alberta Environment and Parks	This Act applies to most species of wildlife. The willful molestation, disruption, or destruction of a wildlife nest or den is prohibited by this Act. Special provisions provide for the protection of raptors and their nests/habitats. Project requires clearing of vegetation that may support nesting/denning wildlife. Wildlife may also use the old bridge as a nest site.	Although permitting for clearing is not required under the Act, violations of the Act may result in fines	Avoid vegetation clearing during the period 20 April to 20 August. Contingent approach is to have a qualified biologist undertake a nest sweep of project area to avoid disturbance of active nests and dens. Abide by findings to ensure compliance. In addition, if clearing vegetation after 15 February, undertake a sweep for active owl nests	Not applicable if vegetation clearing is completed before the start of the nesting season (15 February). Nests sweeps undertaken between February 15 and 20 August have potential to result in findings that delay clearing.
Historical Resources Act	Alberta Culture, Multiculturalism and Status of Women (ACMSW)	All projects with potential to disturb historical, archaeological and paleontological resources are regulated under this Act and require approval from ACMSW	Approval required	Submit *Historical Resources Act* application to ACMSW. ACMSW will determine if an Historical Resources Impact Assessment (HRIA) is required	ACMSW granted approval related to archaeological resources and conditional approval related to paleontological resources pending completion of an pHRIA in the form of construction monitoring (see Appendix H).
Federal					
Fisheries Act	Fisheries and Oceans Canada (DFO)	Review and/or authorization is required if a project in or near water has potential to cause death of fish and the harmful alteration, disruption or destruction (HADD) of fish habitat. Permits may be sought for aquatic species at risk.	Request for Review and/or Authorization	It is anticipated that: • A QAES will be required to confirm potential for HADD. If no serious harm to fish is anticipated, then only best management	None. Letter of Advice received from DFO (see Appendix J).

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
				practices required as directed by QAES • Pending the above results, QAES to consult with DFO to confirm if Authorization is required	
Canadian Navigable Waters Act	Transport Canada	The CNWA, brought into force late August 2019, authorizes and regulates interferences with the public right of navigation	Blackmud Creek is occasionally used by canoes and kayaks and is considered navigable. Approval under the Act is required	Consultation with Transport Canada to determine if Approval is required	Approval is required. Public Notice posted on 17 December 2020. Approval expected by 01 February 2021.
Migratory Birds Convention Act	Environment and Climate Change Canada	This Act prohibits the disturbance of nests and individuals of most migratory bird species and prohibits the release of deleterious substances into waters or areas frequented by migratory birds. Project requires clearing of migratory bird nesting habitat	The Act provides guidelines for enforcement only; it is not linked to formal approvals required for construction. Violation of the Act may, however, result in penalties	Avoid vegetation clearing during the period 20 April to 20 August. Contingent approach is to have a qualified biologist undertake a nest sweep of project area and to then avoid disturbance of any noted nesting birds (see related notes for *Wildlife Act*)	Nests sweeps undertaken between February 15 and 20 August have potential to result in findings that delay clearing
Species At Risk Act	Environment and Climate Change Canada	This Act prohibits disturbance to species listed on Schedule 1 of the SARA as endangered, threatened or extirpated and, in some instances, listed species' habitat, on federal lands. On non-federal lands, the Act applies only to disturbance of aquatic species and migratory birds that are listed on Schedule 1 as endangered, threatened or extirpated	Although no approvals or permits are required, violation of the *SARA* may result in penalties	If any federally listed species are identified as present within or adjacent to the project area, best practice is to consider the impact of the project on that species in consultation with Environment and Climate Change Canada	Schedule impacted only if SARA species are found in the area

Appendix C: Limited Phase II Environmental Site Assessment (Thurber 2019a)

LIMITED PHASE II
ENVIRONMENTAL SITE ASSESSMENT
111 STREET PEDESTRIAN BRIDGE PLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA



THURBER ENGINEERING LTD.

THURBER ENGINEERING LTD.

LIMITED PHASE II
ENVIRONMENTAL SITE ASSESSMENT
111 STREET PEDESTRIAN BRIDGE PLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA

Report

to

City of Edmonton

Marcie Kennedy, B.Sc.
Environmental Scientist

Date: November 8, 2019
File: 26388

Neal Fernuik, M.Sc., P.Biol., P. Eng.
Review Principal

THURBER

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THURBER

1. INTRODUCTION

Thurber Engineering Ltd. (Thurber) was retained by the City of Edmonton (CoE) to conduct a Limited Phase II Environmental Site Assessment (ESA) for future replacement of 111 Street Pedestrian Bridge over Blackmud Creek (the "Site") in Edmonton, Alberta.

The Site consists of a pedestrian bridge east of 111 Street crossing Blackmud Creek. The pedestrian bridge currently consists of a double-span concrete deck supported by timber piles, believed to have been treated with creosote. The bridge and surrounding area are shown on Drawing 26388E-1 in Appendix A. The bridge is surrounded by Blackmud Creek vegetated banks and an asphalt pedestrian pathway.

Authorization to carry out the Limited Phase II ESA was provided by Ms. Christina Tatarniuk, P.Eng of CoE. A geotechnical investigation was conducted concurrently with the environmental program and is reported under separate cover.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SCOPE OF WORK

The scope of work, as outlined in Thurber's June 10, 2019 proposal, was to assess the environmental condition of soil under the bridge and surrounding area. Thurber's scope of work generally included the following:

- Advance eight test holes (four per side) to a depth of 1.5 m, or auger refusal, using a hand operated Dutch Auger adjacent to the abutments and beneath the existing bridge
- Collect soil samples at the surface and approximately 0.5 m intervals to the bottom of the test holes, at locations where the soil strata changes or at locations of visible contaminant staining
- Submit selected soil samples for laboratory chemical analyses of polycyclic aromatic hydrocarbons (PAHs) and metals
- Compare analytical results to provincial guidelines and prepare a report.

The scope was expanded to include four additional test holes and submit selected soil samples for PAHs. This expanded scope of work was completed on October 7, 2019.

3. FIELD INVESTIGATION

Prior to initiating drilling activities, Thurber contacted Alberta One Call to arrange public utility locates at the Site.

On July 10, 2019 Thurber advanced eight environmental test holes (TH19E-1 through TH19E-8) to a depth of approximately 1.5 meters with a hand-operated Dutch Auger. Four additional test holes (TH19E-9 through -12) were advanced on October 7, 2019 also by a hand-operated Dutch Auger. The approximate test hole locations are shown on Drawing 26388E-1.

The test holes were visually logged and environmental soil samples collected at intervals as follows: 0-0.15 m, 0.15-0.3 m, 0.5 m, 1.0 m and 1.5 m below ground surface (bgs). Thurber split soil samples into two portions, with one-portion in a glass jar and the remaining portion placed in a plastic bag. The plastic bag portions were field screened for hydrocarbon headspace vapours using an RKI Eagle II organic vapour analyzer (OVA) calibrated to a hexane standard. The field measured parameters for hydrocarbon OVA readings were less than the detection limit of the instrument of 5 ppmv (parts per million vapour).

4. STRATIGRAPHY

Based on the drilling program, soil conditions beneath the Site consist of silty clay at surface, underlain by clay. Topsoil up to 0.05 m bgs was encountered on embankments and was not encountered beneath the bridge. Sporadic coarse sand and gravel were encountered on the east bank between 0.5 m bgs and 1.5 m bgs. Test hole logs are included in Appendix B.

Results from the geotechnical investigation are in general accordance with the environmental program, with deviations attributed to distance from the environmental program. The geotechnical program had asphalt and gravel fill to 0.6 m bgs and then clay and sand to 2.8 m bgs, underlain by clay till to 3.7 m bgs, and clay shale, siltstone and sandstone to 10.4 m bgs, the maximum extent of investigation.

5. REGULATORY GUIDELINES

Based on surrounding and existing land uses, the analytical data was compared to Alberta Environment and Parks (AEP) January 2019 *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* for Parkland Area land use with coarse grained soils. The freshwater aquatic pathway (FAL) could not be removed as Blackmud Creek was within 300 m of the Site.

The landfill classification sample was compared to Alberta Environment and Sustainable Resource Development (AESRD) March 1995 Schedule to the Alberta User Guide for Waste Managers and Alberta Waste Control Regulation (AR 192/1996 and AR 272/2003).

6. SOIL CHEMICAL ANALYSES

Fifteen soil samples were submitted to Element for chemical analyses of PAHs and grain size analyses. Seven samples were analyzed for metals. A composite soil sample was also submitted for landfill characterization. The soil was classified as fine grained to 0.3 m bgs and coarse grained to the maximum extent of investigation. The site was therefore classified as coarse grain. The soil analytical results are presented in Tables 1 and Table 2 in Appendix C. All of the soil samples met metal guidelines. PAH's generally met AEP Tier 1 guidelines, with the following exceptions;

- Anthracene at TH19E-1 (0-0.15 m), TH19E-2 (0.15-0.30 m), TH19E-7 (0.5 m), TH19E-8 (1.0 m), TH19E-11 (1.0 m) and TH19E-12 (0-0.15 m).
- Fluoranthene at TH19E-1 (0-0.15 m), TH19E-2 (0.15 to 0.30 m), and TH19E-5 (0.15-0.3).
- Pyrene at TH19E-8 at 1.0 m.

Table 2 in Appendix C presents ratios of fluoranthene to pyrene and phenanthrene to anthracene for soil samples with detectable PAH concentrations. These ratios assist[1] with the semi-quantitative interpretation/characterization of PAH sources as either petrogenic (derived from petroleum) or pyrogenic (fire derived i.e. coal tar, creosote[2] and forest fire residue[3].)

The landfill characterization sample met the applied Alberta Environment user guide and the soil cuttings are not considered a hazardous waste. Copies of the detailed laboratory reports as provided by Element are included in Appendix D.

6.1 Quality Assurance / Quality Control

Two duplicate soil sample pairs (TH19-E2 at 0.15-0.3 m / Dup A) and (TH19-E10 at 0-0.15m / Dup B) were submitted to Element for metals and PAH analysis as part of Thurber's quality control

[1] Nelson, G. and Garrard, A., 2015. Pyrogenic vs. Petrogenic Source Determination: Diagnostic PAH ratios. AGAT Laboratories.

[2] Although there are variants of creosote that are petrogenically derived, most creosotes are produced by the distillation of coal-tar or wood-tar and are pyrogenic in origin

[3] Vergnoux, A., et al. "Impact of Forest Fires on PAH Level and Distribution in Soils." Environmental Research, Vol. 111, Issue 2 (February 2011): 193-198.

/ quality assurance program. The calculated relative percent difference (RPD) values were less than 30 percent and therefore considered to be within accepted limits.

Copies of the detailed laboratory reports as provided by Element and blind field duplicate data tables are included in Appendix D.

7. ASSESSMENT

PAHs that did not meet AEP Tier 1 guidelines included non-carcinogenic PAHs anthracene, fluoranthene and pyrene from ground surface to 1.0 m bgs on both the 111 Street pedestrian bridge north and south bank. Published research on PAH sources in urban areas suggests[4] that numerous anthropogenic and naturally occurring sources may be responsible for PAHs encountered near the 111 Street pedestrian bridge. Phenanthrene to anthracene ratios are generally less than 10, and fluoranthene to pyrene ratios are generally greater than one for samples with detectable PAH concentrations. These ratios both support the interpretation that PAHs that do not meet AEP Tier 1 guidelines in Blackmud Creek ravine are of pyrogenic origin.

Local anthropogenic sources include particulate deposits from fireplaces, firepits and barbeques in the surrounding residential areas, historical heating of nearby homes as well as motor vehicle exhaust and structural fires. Naturally occurring sources of PAHs in the environment which may contribute to the chemical analyses results in Blackmud Creek ravine include naturally occurring coal deposits, vegetative decay, forest fires and grass fires.

Given the generally undisturbed nature of the ravine, magnitude and topography of the area, Thurber recommends that the PAHs be risk managed in-situ. An assessment of risks associated with direct soil contact by human park users will be required as part of the construction activities.

[4] Vergnoux, A. et al. “Impact of Forest Fires on PAH Level and Distribution in Soils.” Environmental Research, Vol. 111, Issue 2 (February 2011): 193-198.

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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APPENDIX A

Drawings

H:\26000\26388 111th Street Pedestrian Bridge, Edm. AB\Drafting\26388E-1.dwg - 1 - Oct. 29, 2019

N
W E
S

LEGEND

- APPROXIMATE TEST HOLE LOCATION
- DOES NOT MEET AEP TIER 1 2019 PARKLAND USE GUIDELINE

0 2.5 5 7.5 10 12.5 15 m
SCALE 1:250

2017 AIR PHOTO FROM THE CITY OF EDMONTON

THE CITY OF Edmonton

LIMITED PHASE II ENVIRONMENTAL SITE ASSESSMENT
111 STREET PEDESTRIAN BRIDGE REPLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA

SITE PLAN SHOWING APPROXIMATE TEST HOLE LOCATIONS

DWG No. 26388E-1

DRAWN BY	ML
DESIGNED BY	MKK
APPROVED BY	NHF
SCALE	1:250
DATE	OCTOBER 2019
FILE No.	26388

THURBER ENGINEERING LTD.

THURBER

APPENDIX B

Test Hole Logs

CLIENT: CITY OF EDMONTON	PROJECT: LIMITED PHASE II ESA	BOREHOLE NO: **TH19E-1**
DRILLING COMPANY: THURBER	DATE DRILLED: July 10, 2019	PROJECT NO: 26368
DRILL/METHOD: Hand Auger	LOCATION: See Drawing #26368-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	-OVA < 5ppmv	CLAY silty	0
	▥	-OVA < 5ppmv		
	▥	-OVA < 5ppmv		
1	▥	-OVA < 5ppmv		1
	▥	-OVA < 5ppmv		
			END OF TEST HOLE AT 1.5m UPON COMPLETION: Backfilled with drill cuttings and slough	
2				2
3				3
4				4
5				5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 1.5 m
PREPARED BY: MKK	COMPLETION DATE: 7/10/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26368.GPJ THRBR_AB.GDT 8/14/19- LIBRARY-NEW LOGO.GLB

CLIENT: CITY OF EDMONTON	PROJECT: LIMITED PHASE II ESA	BOREHOLE NO: **TH19E-2**
DRILLING COMPANY: THURBER	DATE DRILLED: July 10, 2019	PROJECT NO: 26368
DRILL/METHOD: Hand Auger	LOCATION: See Drawing #26368-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	-OVA < 5ppmv	CLAY silty	0
	▥	-OVA < 5ppmv		
	▥	-OVA < 5ppmv		
1	▥	-OVA < 5ppmv		1
	▥	-OVA < 5ppmv		
			END OF TEST HOLE AT 1.5m UPON COMPLETION: Backfilled with drill cuttings and slough	
2				2
3				3
4				4
5				5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 1.5 m
PREPARED BY: MKK	COMPLETION DATE: 7/10/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26368.GPJ THRBR_AB.GDT 8/14/19- LIBRARY-NEW LOGO.GLB

CLIENT: CITY OF EDMONTON	PROJECT: LIMITED PHASE II ESA	BOREHOLE NO: **TH19E-3**
DRILLING COMPANY: THURBER	DATE DRILLED: July 10, 2019	PROJECT NO: 26368
DRILL/METHOD: Hand Auger	LOCATION: See Drawing #26368-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	-OVA < 5ppmv	CLAY silty	0
	▥	-OVA < 5ppmv		
	▥	-OVA < 5ppmv		
1	▥	-OVA < 5ppmv		1
	▥	-OVA < 5ppmv		
			END OF TEST HOLE AT 1.5m UPON COMPLETION: Backfilled with drill cuttings and slough	
2				2
3				3
4				4
5				5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 1.5 m
PREPARED BY: MKK	COMPLETION DATE: 7/10/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26368.GPJ THRBR_AB.GDT 8/14/19- LIBRARY-NEW LOGO.GLB

CLIENT: CITY OF EDMONTON	PROJECT: LIMITED PHASE II ESA	BOREHOLE NO: **TH19E-4**
DRILLING COMPANY: THURBER	DATE DRILLED: July 10, 2019	PROJECT NO: 26368
DRILL/METHOD: Hand Auger	LOCATION: See Drawing #26368-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	-OVA < 5ppmv	CLAY silty	0
	▥	-OVA < 5ppmv		
	▥	-OVA < 5ppmv		
1	▥	-OVA < 5ppmv		1
	▥	-OVA < 5ppmv		
			END OF TEST HOLE AT 1.5m UPON COMPLETION: Backfilled with drill cuttings and slough	
2				2
3				3
4				4
5				5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 1.5 m
PREPARED BY: MKK	COMPLETION DATE: 7/10/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26368.GPJ THRBR_AB.GDT 8/14/19- LIBRARY-NEW LOGO.GLB

CLIENT: CITY OF EDMONTON	PROJECT: LIMITED PHASE II ESA	BOREHOLE NO: **TH19E-5**
DRILLING COMPANY: THURBER	DATE DRILLED: July 10, 2019	PROJECT NO: 26368
DRILL/METHOD: Hand Auger	LOCATION: See Drawing #26368-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	-OVA < 5ppmv	CLAY silty	0
	▥	-OVA < 5ppmv	AUGER REFUSAL AT 0.5m DUE TO GRAVEL UPON COMPLETION: Backfilled with drill cuttings and slough	
1				1
2				2
3				3
4				4
5				5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 0.5 m
PREPARED BY: MKK	COMPLETION DATE: 7/10/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26368.GPJ THRBR_AB.GDT 8/14/19- LIBRARY-NEW LOGO.GLB

CLIENT: CITY OF EDMONTON	PROJECT: LIMITED PHASE II ESA	BOREHOLE NO: **TH19E-6**
DRILLING COMPANY: THURBER	DATE DRILLED: July 10, 2019	PROJECT NO: 26368
DRILL/METHOD: Hand Auger	LOCATION: See Drawing #26368-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	-OVA < 5ppmv	CLAY silty	0
	▥	-OVA < 5ppmv	AUGER REFUSAL AT 0.5m DUE TO GRAVEL UPON COMPLETION: Backfilled with drill cuttings and slough	
1				1
2				2
3				3
4				4
5				5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 0.5 m
PREPARED BY: MKK	COMPLETION DATE: 7/10/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26368.GPJ THRBR_AB.GDT 8/14/19- LIBRARY-NEW LOGO.GLB

CLIENT: CITY OF EDMONTON	PROJECT: LIMITED PHASE II ESA	BOREHOLE NO: **TH19E-7**
DRILLING COMPANY: THURBER	DATE DRILLED: July 10, 2019	PROJECT NO: 26368
DRILL/METHOD: Hand Auger	LOCATION: See Drawing #26368-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	-OVA < 5ppmv	CLAY silty	0
	▥	-OVA < 5ppmv		
	▥	-OVA < 5ppmv		
	▥	-OVA < 5ppmv		
1			AUGER REFUSAL AT 0.8m DUE TO GRAVEL UPON COMPLETION: Backfilled with drill cuttings and slough	1
2				2
3				3
4				4
5				5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 0.8 m
PREPARED BY: MKK	COMPLETION DATE: 7/10/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26368.GPJ THRBR_AB.GDT 8/14/19- LIBRARY-NEW LOGO.GLB

CLIENT: CITY OF EDMONTON	PROJECT: LIMITED PHASE II ESA	BOREHOLE NO: **TH19E-8**
DRILLING COMPANY: THURBER	DATE DRILLED: July 10, 2019	PROJECT NO: 26368
DRILL/METHOD: Hand Auger	LOCATION: See Drawing #26368-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	-OVA < 5ppmv	CLAY silty	0
	▥	-OVA < 5ppmv		
	▥	-OVA < 5ppmv		
1	▥	-OVA < 5ppmv	AUGER REFUSAL AT 1.0m DUE TO GRAVEL UPON COMPLETION: Backfilled with drill cuttings and slough	1
2				2
3				3
4				4
5				5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 1.0 m
PREPARED BY: MKK	COMPLETION DATE: 7/10/19
REVIEWED BY:	Page 1 of 1

CLIENT: City of Edmonton	PROJECT: 111 STREET PEDESTRIAN BRIDGE REPLACEMENT	BOREHOLE NO: **TH19E-9**
DRILLING COMPANY:	DATE DRILLED: October 7, 2019	PROJECT NO: 26388
DRILL/METHOD:	LOCATION: See Drawing #26388-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	PID (ppmv) 1 2 3 4 / △OVA (ppmv)△ 20 40 60 80	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	△ ●		SAND light brown, fine grained, silty	0
	▥	△ ●			
	▥	△ ●			
1	▥	△ ●		-dark grey - grey	1
				END OF TEST HOLE AT 1.0m	
2					2
3					3
4					4
5					5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 1.0 m
PREPARED BY: MKK	COMPLETION DATE: 10/7/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26388-M-OVA 100 PID TO 5.GPJ THRBR_AB.GDT 10/30/19- LIBRARY-OVA 100 PID TO 5.GLB

CLIENT: City of Edmonton	PROJECT: 111 STREET PEDESTRIAN BRIDGE REPLACEMENT	BOREHOLE NO: **TH19E-10**
DRILLING COMPANY:	DATE DRILLED: October 7, 2019	PROJECT NO: 26388
DRILL/METHOD:	LOCATION: See Drawing #26388-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	PID (ppmv) 1 2 3 4 / △OVA (ppmv)△ 20 40 60 80	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	△ ●		TOPSOIL, dark brown	0
	▥	△ ●		SAND, brown, fine grained, silty	
	▥	△ ●		-coarse grained	
				AUGER REFUSAL AT 0.5m	
1					1
2					2
3					3
4					4
5					5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 0.5 m
PREPARED BY: MKK	COMPLETION DATE: 10/7/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26388-M-OVA 100 PID TO 5.GPJ THRBR_AB.GDT 10/30/19- LIBRARY-OVA 100 PID TO 5.GLB

CLIENT: City of Edmonton	PROJECT: 111 STREET PEDESTRIAN BRIDGE REPLACEMENT	BOREHOLE NO: **TH19E-11**
DRILLING COMPANY:	DATE DRILLED: October 7, 2019	PROJECT NO: 26388
DRILL/METHOD:	LOCATION: See Drawing #26388-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	PID (ppmv) 1 2 3 4 / △OVA (ppmv)△ 20 40 60 80	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	△ ●		SILT, brown, clayey, some fine sand	0
	▥	△ ●		SAND brown, fine grained, silty	
	▥	△ ●			
1	▥	△ ●		END OF TEST HOLE AT 1.0m	1
2					2
3					3
4					4
5					5

THURBER ENGINEERING LTD.

FIELD LOGGED BY:	COMPLETION DEPTH: 1.0 m
PREPARED BY: MKK	COMPLETION DATE: 10/7/19
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26388-M-OVA 100 PID TO 5.GPJ THRBR_AB.GDT 10/30/19- LIBRARY-OVA 100 PID TO 5.GLB

CLIENT: City of Edmonton	PROJECT: 111 STREET PEDESTRIAN BRIDGE REPLACEMENT	BOREHOLE NO: **TH19E-12**
DRILLING COMPANY:	DATE DRILLED: October 7, 2019	PROJECT NO: 26388
DRILL/METHOD:	LOCATION: See Drawing #26388-1	ELEVATION:

SAMPLE TYPE ▥ GRAB SAMPLE

DEPTH (m)	SAMPLE TYPE	PID (ppmv) 1 2 3 4 / △OVA (ppmv)△ 20 40 60 80	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0	▥	△ ●		SILT brown, clayey, some fine sand	0
	▥	△ ●			
				-trace fine to medium sand pockets	
	▥	△ ●			
1				END OF TEST HOLE AT 1.0m	1
2					2
3					3
4					4
5					5

THURBER ENGINEERING LTD.	FIELD LOGGED BY:	COMPLETION DEPTH: 1.0 m
	PREPARED BY: MKK	COMPLETION DATE: 10/7/19
	REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 26388-M-OVA 100 PID TO 5.GPJ THRBR_AB.GDT 10/30/19- LIBRARY-OVA 100 PID TO 5.GLB

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APPENDIX C

Analytical Tables

THURBER

TABLE 1 - SOIL ANALYTICAL RESULTS: METAL PARAMETERS
CITY OF EDMONTON
111 STREET PEDESTRIAN BRIDGE REPLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA

				Metal Parameters																				
Sample Location	**Sample Depth**	**Sample Date**	**Texture**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Boron, Saturated Paste**	**Cadmium**	**Chromium, Total**	**Chromium, Hexavalent**	**Cobalt**	**Copper**	**Lead**	**Mercury**	**Molybdenum**	**Nickel**	**Selenium**	**Silver**	**Thallium**	**Tin**	**Uranium**	**Vanadium**	**Zinc**
	(m bgs)	(dd-mmm-yy)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Tier 1 - Parkland Area[1] - Fine Grained				**20**	**17**	**10,000**	**5**	**3.3**	**10**	**64**	**0.4**	**20**	**63**	**140**	**6.6**	**4**	**45**	**1**	**20**	**1**	**5**	**23**	**130**	**250**
Tier 1 - Parkland Area[1] - Coarse Grained				**20**	**17**	**10,000**	**5**	**3.3**	**10**	**64**	**0.4**	**20**	**63**	**140**	**6.6**	**4**	**45**	**1**	**20**	**1**	**5**	**23**	**130**	**250**
TH19-E1	0.0-0.15	10-Jul-19	Fine	0.5	5.9	801	0.7	<0.5	0.27	13.3	0.1	8.8	17.5	14.8	0.06	<1.0	24.4	<0.3	<0.10	0.16	<1.0	1.3	20.0	63
TH19-E2	0.15-0.3	10-Jul-19	Fine	0.5	4.9	253	0.8	<0.5	0.26	9.2	0.1	8.1	20.6	10.4	<0.05	<1.0	17.5	<0.3	<0.10	0.17	<1.0	1.8	16.5	63
TH19-E3	0.5	10-Jul-19	Coarse	0.5	9.8	114	0.7	0.11	0.24	15.8	0.06	7.6	15.9	21.1	0.06	1	26.1	0.3	<0.10	0.13	<1.0	0.8	21.3	117
TH19-E4	0.5	10-Jul-19	Coarse	0.4	5.8	229	0.7	0.12	0.24	10.2	0.1	9.1	19.6	11.9	<0.05	<1.0	17.9	0.3	<0.10	0.19	<1.0	1.5	18.5	73
TH19-E5	0.15-0.3	10-Jul-19	Fine	0.4	6.5	162	0.5	0.10	0.19	10.5	0.1	7.9	15.1	7.5	<0.05	<1.0	18.9	<0.3	<0.10	0.14	<1.0	0.9	18.8	52
TH19-E7	0.5	10-Jul-19	Coarse	0.3	5.5	124	0.4	<0.05	0.15	6.9	0.09	6.5	11.2	6.0	<0.05	<1.0	14.7	<0.3	<0.10	0.12	<1.0	0.8	12.4	49
TH19-E8	1.0	10-Jul-19	Coarse	0.3	5.0	126	0.5	0.07	0.16	12.2	0.06	5.6	12.7	19.6	0.06	<1.0	20.5	<0.3	<0.10	0.12	<1.0	0.7	17.4	45

Notes:

[1]- Alberta Tier I Soil and Groundwater Remediation Guidelines for Parkland Area Land Use based on Fine-Grained Soils (AEP, 2019).

[2]- Alberta Tier I Soil and Groundwater Remediation Guidelines for Parkland Area Land Use based on Coarse-Grained Soils (AEP, 2019).

--- Parameter not analyzed or no guideline.

BOLD Parameter concentration does not meet applied guideline.

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TABLE 2 - SOIL ANALYTICAL RESULTS: PAH PARAMETERS
CITY OF EDMONTON
111 STREET PEDESTRIAN BRIDGE REPLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA

																						PYROGENIC RATIO[2]	
Sample Location	Sample Depth	Sample Date	Texture	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b+j)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	CB(a)P / TPE	IACR_Coarse	IACR_Fine	Phenanthrene: Anthracene	Fluoranthene: Pyrene
	(m bgs)	(dd-mmm-yy)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		
Tier 1 - Parkland Area[1] - Coarse Grained				**0.017**	**---**	**0.38**	**0.34**	**0.061**	**0.0056**	**0.055**	**0.15**	**---**	**---**	**---**	**---**	**20**	**---**	**---**	**---**	**5.3**	**1.0**	**---**	**< 10**	**> 1**
TH19E-1	0.0-0.15	10-Jul-19	Fine	<0.01	<0.05	<0.05	<0.05	0.06	**0.026**	**0.148**	0.087	0.03	0.1	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	0.032	0.016	0.032	**2.3**	**1.7**
TH19E-2	0.15-0.3	10-Jul-19	Fine	<0.01	<0.05	<0.05	<0.05	0.05	**0.007**	**0.154**	0.107	0.02	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.014	0.004	0.007	**7.1**	**1.4**
TH19E-3	0.5	10-Jul-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	0.005	<0.01	0.012	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.019	0.002	0.003	---	---
TH19E-4	0.5	10-Jul-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	<0.003	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001	---	---
TH19E-5	0.15-0.3	10-Jul-19	Fine	<0.01	<0.05	<0.05	<0.05	0.02	0.005	**0.063**	0.059	0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.016	0.003	0.005	**4.0**	**1.1**
TH19E-7	0.5	10-Jul-19	Coarse	<0.01	<0.05	<0.05	<0.05	0.01	**0.019**	0.019	0.025	0.01	0.14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.026	0.005	0.009	**0.5**	0.8
TH19E-8	1.0	10-Jul-19	Coarse	0.011	<0.05	<0.05	<0.05	0.05	**0.007**	0.021	**0.226**	0.09	0.45	0.26	<0.05	0.60	0.13	0.13	0.37	0.786	0.119	0.232	**7.1**	0.1
TH19E-9	0.15-0.3	7-Oct-19	Fine	<0.01	<0.05	<0.05	<0.05	<0.01	<0.003	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.005	<0.001	<0.001	---	---
TH19E-9	0.5	7-Oct-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	<0.003	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001	---	---
TH19E-10	0-0.15	7-Oct-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	<0.003	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001	---	---
TH19E-10	0.5	7-Oct-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	<0.003	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001	---	---
TH19E-11	0.15-0.3	7-Oct-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	<0.003	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.005	<0.001	<0.001	---	---
TH19E-11	1.0	7-Oct-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	**0.01**	0.035	0.032	0.01	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	0.06	0.035	0.013	0.026	---	**1.1**
TH19E-12	0-0.15	7-Oct-19	Fine	<0.01	<0.05	<0.05	<0.05	0.02	**0.007**	0.039	0.027	<0.01	0.06	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	0.021	0.012	0.024	**2.9**	**1.4**
TH19E-12	1.0	7-Oct-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	<0.003	<0.01	0.010	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001	---	---
Dup A		10-Jul-19	Fine	<0.01	<0.05	<0.05	<0.05	0.02	<0.003	0.015	0.015	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001	---	**1.0**
DupB		7-Oct-19	Coarse	<0.01	<0.05	<0.05	<0.05	<0.01	<0.003	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.005	<0.001	<0.001	---	---

Notes:

[1]- Alberta Tier I Soil and Groundwater Remediation Guidelines for Parkland Area Land Use based on Coarse-Grained Soils (AEP, 2019).

[2] - Pyrogenic vs Petrogenic Source Determination : Diagnostic PAH Ratios. AGAT Laboratories: Gordon Nelson and Andrew Gerrard. (2015)

--- Parameter not analyzed or no guideline.

BOLD Parameter concentration does not meet applied guideline.

BOLD Interpreted as pyrogenic origin

THURBER

TABLE 3 - LANDFILL CHARACTERIZATION
CITY OF EDMONTON
111 STREET PEDESTRIAN BRIDGE REPLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA

Sample	Unit	AESRD 1995 Waste Guidelines[1]	Landfill Classification
LEACHATE INORGANICS			
Antimony	mg/L	500	<0.005
Arsenic	mg/L	5.0	<0.002
Barium	mg/L	100	3.03
Beryllium	mg/L	5.0	0.002
Boron	mg/L	500	<0.2
Cadmium	mg/L	1	0.001
Chromium	mg/L	5	<0.005
Cobalt	mg/L	100	0.049
Copper	mg/L	100	<0.10
Iron	mg/L	1000.0	5
Lead	mg/L	5	<0.050
Mercury	mg/L	0.2	<0.001
Nickel	mg/L	5	0.112
Selenium	mg/L	1	0.002
Silver	mg/L	5	<0.005
Thallium	mg/L	5	0.0008
Uranium	mg/L	2	<0.005
Vanadium	mg/L	100	<0.01
Zinc	mg/L	500	0.13
Zirconium	mg/L	500	<0.01
SOIL ACIDITY			
pH	1:2 Soil: Water	2 to 12.5	9.9
LEACHATE MONO-AROMATIC HYDROCARBONS			
Benzene	mg/L	0.5	<0.01
Toluene	mg/L	0.5	<0.01
Ethylbenzene	mg/L	0.5	<0.01
Total Xylenes (m,p,o)	mg/L	0.5	<0.02
PHYSICAL PROPERTIES			
Paint Filter	---	Solid Waste	Solid Waste
Flash	---	No	No
Flash Point	Degrees C	61	>75

[1]Alberta Environment and Sustainable Resource Development, March 1995. Schedule to the Alberta User Guide for Waste Managers and Alberta Waste Control Regulation (AR 192/1996 and AR 272/2003), pursuant to Alberta Environmental Protection and Enhancement Act

THURBER

APPENDIX D

Analytical Results
Field Duplicate Results

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Analytical Report

Bill To: Thurber Engineering Ltd.
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Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By:
Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Reference Number	1364306-1	1364306-2	1364306-3
Sample Date	Jul 10, 2019	Jul 10, 2019	Jul 10, 2019
Sample Time	NA	NA	NA
Sample Location			
Sample Description	TH19-E1 / 0.0-0.15	TH19-E2 / 0.15-0.3	TH19-E3 / 0.5
Matrix	Soil	Soil	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Metals Strong Acid Digestion						
Boron	Saturated Paste	mg/L	<0.5	<0.5	0.11	0.05
Antimony	Strong Acid Extractable	mg/kg	0.5	0.5	0.5	0.2
Arsenic	Strong Acid Extractable	mg/kg	5.9	4.9	9.8	0.2
Barium	Strong Acid Extractable	mg/kg	801	253	114	1
Beryllium	Strong Acid Extractable	mg/kg	0.7	0.8	0.7	0.1
Cadmium	Strong Acid Extractable	mg/kg	0.27	0.26	0.24	0.01
Chromium	Strong Acid Extractable	mg/kg	13.3	9.2	15.8	0.5
Cobalt	Strong Acid Extractable	mg/kg	8.8	8.1	7.6	0.1
Copper	Strong Acid Extractable	mg/kg	17.5	20.6	15.9	1
Lead	Strong Acid Extractable	mg/kg	14.8	10.4	21.1	0.1
Mercury	Strong Acid Extractable	mg/kg	0.06	<0.05	0.06	0.05
Molybdenum	Strong Acid Extractable	mg/kg	<1.0	<1.0	1.0	1
Nickel	Strong Acid Extractable	mg/kg	24.4	17.5	26.1	0.5
Selenium	Strong Acid Extractable	mg/kg	<0.3	<0.3	0.3	0.3
Silver	Strong Acid Extractable	mg/kg	<0.10	<0.10	<0.10	0.1
Thallium	Strong Acid Extractable	mg/kg	0.16	0.17	0.13	0.05
Tin	Strong Acid Extractable	mg/kg	<1.0	<1.0	<1.0	1
Uranium	Strong Acid Extractable	mg/kg	1.3	1.8	0.8	0.5
Vanadium	Strong Acid Extractable	mg/kg	20.0	16.5	21.3	0.1
Zinc	Strong Acid Extractable	mg/kg	63	63	117	1
Salinity						
% Saturation		%	100	196	59	
Water Soluble Parameters						
Chromium (VI)	Dry Weight	mg/kg	0.1	0.1	0.06	0.05
Polycyclic Aromatic Hydrocarbons - Soil						
Naphthalene	Dry Weight	mg/kg	<0.01	<0.01	<0.01	0.010
Acenaphthylene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Acenaphthene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Fluorene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Phenanthrene	Dry Weight	mg/kg	0.06	0.05	<0.01	0.01
Anthracene	Dry Weight	mg/kg	0.026	0.007	0.005	0.003
Fluoranthene	Dry Weight	mg/kg	0.148	0.154	<0.01	0.010
Pyrene	Dry Weight	mg/kg	0.087	0.107	0.012	0.010
Benzo(a)anthracene	Dry Weight	mg/kg	0.03	0.02	<0.01	0.01
Chrysene	Dry Weight	mg/kg	0.10	0.10	<0.05	0.05
Benzo(b+j)fluoranthene	Dry Weight	mg/kg	0.07	<0.05	<0.05	0.05
Benzo(k)fluoranthene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(a)pyrene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Indeno(1,2,3-c,d)pyrene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05

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Analytical Report

Bill To: Thurber Engineering Ltd.
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Edmonton, AB, Canada
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Attn: Sharon Bunn
Sampled By:
Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Reference Number	1364306-1	1364306-2	1364306-3
Sample Date	Jul 10, 2019	Jul 10, 2019	Jul 10, 2019
Sample Time	NA	NA	NA
Sample Location			
Sample Description	TH19-E1 / 0.0-0.15	TH19-E2 / 0.15-0.3	TH19-E3 / 0.5
Matrix	Soil	Soil	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Polycyclic Aromatic Hydrocarbons - Soil - Continued						
Dibenzo(a,h)anthracene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(g,h,i)perylene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
CB(a)P	B(a)P Total Potency Equivalents	mg/kg	0.032	0.014	0.019	0.001
IACR_Coarse	Index of Additive Cancer Risk		0.016	0.004	0.002	0.001
IACR_Fine	Index of Additive Cancer Risk		0.032	0.007	0.003	0.001
PAH - Soil - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	115	112	93	50-140
2-Fluorobiphenyl	PAH - Surrogate	%	94	88	94	50-140
p-Terphenyl-d14	PAH - Surrogate	%	91	88	91	50-140

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Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Reference Number		1364306-1	1364306-3	1364306-5
Sample Date		Jul 10, 2019	Jul 10, 2019	Jul 10, 2019
Sample Time		NA	NA	NA
Sample Location				
Sample Description		TH19-E1 / 0.0-0.15	TH19-E3 / 0.5	TH19-E5 / 0.15-0.3
Matrix		Soil	Soil	Soil
Analyte	**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Particle Size Analysis - Wet Sieve					
Texture		Fine-Grained	Coarse-Grained	Fine-Grained	
75 micron sieve % Retained	% by weight	37.7	68.7	44.6	0.1

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Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Reference Number	1364306-4	1364306-5	1364306-6
Sample Date	Jul 10, 2019	Jul 10, 2019	Jul 10, 2019
Sample Time	NA	NA	NA
Sample Location			
Sample Description	TH19-E4 / 0.5	TH19-E5 / 0.15-0.3	TH19-E7 / 0.5
Matrix	Soil	Soil	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Metals Strong Acid Digestion						
Boron	Saturated Paste	mg/L	0.12	0.10	<0.05	0.05
Antimony	Strong Acid Extractable	mg/kg	0.4	0.4	0.3	0.2
Arsenic	Strong Acid Extractable	mg/kg	5.8	6.5	5.5	0.2
Barium	Strong Acid Extractable	mg/kg	229	162	124	1
Beryllium	Strong Acid Extractable	mg/kg	0.7	0.5	0.4	0.1
Cadmium	Strong Acid Extractable	mg/kg	0.24	0.19	0.15	0.01
Chromium	Strong Acid Extractable	mg/kg	10.2	10.5	6.9	0.5
Cobalt	Strong Acid Extractable	mg/kg	9.1	7.9	6.5	0.1
Copper	Strong Acid Extractable	mg/kg	19.6	15.1	11.2	1
Lead	Strong Acid Extractable	mg/kg	11.9	7.5	6.0	0.1
Mercury	Strong Acid Extractable	mg/kg	<0.05	<0.05	<0.05	0.05
Molybdenum	Strong Acid Extractable	mg/kg	<1.0	<1.0	<1.0	1
Nickel	Strong Acid Extractable	mg/kg	17.9	18.9	14.7	0.5
Selenium	Strong Acid Extractable	mg/kg	0.3	<0.3	<0.3	0.3
Silver	Strong Acid Extractable	mg/kg	<0.10	<0.10	<0.10	0.1
Thallium	Strong Acid Extractable	mg/kg	0.19	0.14	0.12	0.05
Tin	Strong Acid Extractable	mg/kg	<1.0	<1.0	<1.0	1
Uranium	Strong Acid Extractable	mg/kg	1.5	0.9	0.8	0.5
Vanadium	Strong Acid Extractable	mg/kg	18.5	18.8	12.4	0.1
Zinc	Strong Acid Extractable	mg/kg	73	52	49	1
Salinity						
% Saturation		%	183	75	47	
Water Soluble Parameters						
Chromium (VI)	Dry Weight	mg/kg	0.1	0.1	0.09	0.05
Polycyclic Aromatic Hydrocarbons - Soil						
Naphthalene	Dry Weight	mg/kg	<0.01	<0.01	<0.01	0.010
Acenaphthylene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Acenaphthene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Fluorene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Phenanthrene	Dry Weight	mg/kg	<0.01	0.02	0.01	0.01
Anthracene	Dry Weight	mg/kg	<0.003	0.005	0.019	0.003
Fluoranthene	Dry Weight	mg/kg	<0.01	0.063	0.019	0.010
Pyrene	Dry Weight	mg/kg	<0.01	0.059	0.025	0.010
Benzo(a)anthracene	Dry Weight	mg/kg	<0.01	0.02	0.01	0.01
Chrysene	Dry Weight	mg/kg	<0.05	<0.05	0.14	0.05
Benzo(b+j)fluoranthene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(k)fluoranthene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(a)pyrene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Indeno(1,2,3-c,d)pyrene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05

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Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Reference Number	1364306-4	1364306-5	1364306-6
Sample Date	Jul 10, 2019	Jul 10, 2019	Jul 10, 2019
Sample Time	NA	NA	NA
Sample Location			
Sample Description	TH19-E4 / 0.5	TH19-E5 / 0.15-0.3	TH19-E7 / 0.5
Matrix	Soil	Soil	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Polycyclic Aromatic Hydrocarbons - Soil - Continued						
Dibenzo(a,h)anthracene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(g,h,i)perylene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
CB(a)P	B(a)P Total Potency Equivalents	mg/kg	<0.001	0.016	0.026	0.001
IACR_Coarse	Index of Additive Cancer Risk		<0.001	0.003	0.005	0.001
IACR_Fine	Index of Additive Cancer Risk		<0.001	0.005	0.009	0.001
PAH - Soil - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	103	111	94	50-140
2-Fluorobiphenyl	PAH - Surrogate	%	101	93	79	50-140
p-Terphenyl-d14	PAH - Surrogate	%	91	94	84	50-140

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Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Reference Number	1364306-6
Sample Date	Jul 10, 2019
Sample Time	NA
Sample Location	
Sample Description	TH19-E7 / 0.5
Matrix	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Particle Size Analysis - Wet Sieve						
Texture			Coarse-Grained			
75 micron sieve	% Retained	% by weight	64.8			0.1

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Analytical Report

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By:
Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Reference Number	1364306-7	1364306-8
Sample Date	Jul 10, 2019	Jul 10, 2019
Sample Time	NA	NA
Sample Location		
Sample Description	TH19-E8 / 1	DUP A
Matrix	Soil	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Metals Strong Acid Digestion						
Boron	Saturated Paste	mg/L	0.07	<0.5		0.05
Antimony	Strong Acid Extractable	mg/kg	0.3	0.5		0.2
Arsenic	Strong Acid Extractable	mg/kg	5.0	5.5		0.2
Barium	Strong Acid Extractable	mg/kg	126	263		1
Beryllium	Strong Acid Extractable	mg/kg	0.5	0.7		0.1
Cadmium	Strong Acid Extractable	mg/kg	0.16	0.27		0.01
Chromium	Strong Acid Extractable	mg/kg	12.2	9.6		0.5
Cobalt	Strong Acid Extractable	mg/kg	5.6	8.5		0.1
Copper	Strong Acid Extractable	mg/kg	12.7	21.0		1
Lead	Strong Acid Extractable	mg/kg	19.6	10.7		0.1
Mercury	Strong Acid Extractable	mg/kg	0.06	<0.05		0.05
Molybdenum	Strong Acid Extractable	mg/kg	<1.0	<1.0		1
Nickel	Strong Acid Extractable	mg/kg	20.5	22.7		0.5
Selenium	Strong Acid Extractable	mg/kg	<0.3	<0.3		0.3
Silver	Strong Acid Extractable	mg/kg	<0.10	<0.10		0.1
Thallium	Strong Acid Extractable	mg/kg	0.12	0.18		0.05
Tin	Strong Acid Extractable	mg/kg	<1.0	<1.0		1
Uranium	Strong Acid Extractable	mg/kg	0.7	1.7		0.5
Vanadium	Strong Acid Extractable	mg/kg	17.4	16.4		0.1
Zinc	Strong Acid Extractable	mg/kg	45	64		1
Salinity						
% Saturation		%	49	189		
Water Soluble Parameters						
Chromium (VI)	Dry Weight	mg/kg	0.06	0.1		0.05
Polycyclic Aromatic Hydrocarbons - Soil						
Naphthalene	Dry Weight	mg/kg	0.011	<0.01		0.010
Acenaphthylene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Acenaphthene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Fluorene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Phenanthrene	Dry Weight	mg/kg	0.05	0.02		0.01
Anthracene	Dry Weight	mg/kg	0.007	<0.003		0.003
Fluoranthene	Dry Weight	mg/kg	0.021	0.015		0.010
Pyrene	Dry Weight	mg/kg	0.226	0.015		0.010
Benzo(a)anthracene	Dry Weight	mg/kg	0.09	<0.01		0.01
Chrysene	Dry Weight	mg/kg	0.45	<0.05		0.05
Benzo(b+j)fluoranthene	Dry Weight	mg/kg	0.26	<0.05		0.05
Benzo(k)fluoranthene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Benzo(a)pyrene	Dry Weight	mg/kg	0.60	<0.05		0.05
Indeno(1,2,3-c,d)pyrene	Dry Weight	mg/kg	0.13	<0.05		0.05

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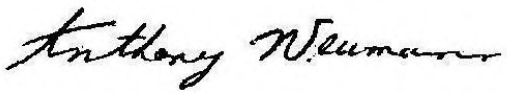
Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Reference Number	1364306-7	1364306-8
Sample Date	Jul 10, 2019	Jul 10, 2019
Sample Time	NA	NA
Sample Location		
Sample Description	TH19-E8 / 1	DUP A
Matrix	Soil	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Polycyclic Aromatic Hydrocarbons - Soil - Continued						
Dibenzo(a,h)anthracene	Dry Weight	mg/kg	0.13	<0.05		0.05
Benzo(g,h,i)perylene	Dry Weight	mg/kg	0.37	<0.05		0.05
CB(a)P	B(a)P Total Potency Equivalents	mg/kg	0.786	<0.001		0.001
IACR_Coarse	Index of Additive Cancer Risk		0.119	<0.001		0.001
IACR_Fine	Index of Additive Cancer Risk		0.232	<0.001		0.001
PAH - Soil - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	104	110		50-140
2-Fluorobiphenyl	PAH - Surrogate	%	79	95		50-140
p-Terphenyl-d14	PAH - Surrogate	%	91	91		50-140

Approved by:



Anthony Neumann, MSc
General Manager

Data have been validated by Analytical Quality Control and Element's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

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P.O.: 26388
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Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Metals Strong Acid Digestion

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Boron	mg/L	-0.0045	-0.05	0.07	yes
Antimony	µg/L	0.00417568	-0.1	0.2	yes
Arsenic	µg/L	0.000125071	-0.2	0.2	yes
Barium	µg/L	0.0356129	-1	1	yes
Beryllium	µg/L	0.00668992	-0.1	0.1	yes
Cadmium	µg/L	0.00105336	-0.01	0.01	yes
Chromium	µg/L	0.0315858	-0.5	0.5	yes
Cobalt	µg/L	0.00273604	-0.1	0.1	yes
Copper	µg/L	0.0189343	-0.6	1.2	yes
Lead	µg/L	0.00213156	-5.0	5.0	yes
Mercury	µg/L	0.00270515	-0.04	0.04	yes
Molybdenum	µg/L	0.00953801	-1.0	1.0	yes
Nickel	µg/L	0.0280949	-0.4	0.7	yes
Selenium	µg/L	0.000342295	-0.3	0.3	yes
Silver	µg/L	-0.000143989	-0.09	0.14	yes
Thallium	µg/L	0.00304956	-0.04	0.04	yes
Tin	µg/L	0.017861	-0.4	0.4	yes
Uranium	µg/L	0.000526313	-0.5	0.5	yes
Vanadium	µg/L	0.0524974	-0.1	0.1	yes
Zinc	µg/L	0.2628	-1	1	yes

Date Acquired: July 18, 2019

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Antimony	mg/kg	0.3	0.3	20	0.4	yes
Arsenic	mg/kg	5.6	5.8	20	0.4	yes
Barium	mg/kg	155	153	20	2	yes
Beryllium	mg/kg	0.5	0.5	20	0.2	yes
Cadmium	mg/kg	0.14	0.14	20	0.02	yes
Chromium	mg/kg	21.5	22.3	20	1.1	yes
Cobalt	mg/kg	6.3	6.7	20	0.2	yes
Copper	mg/kg	16.8	17.4	20	2.2	yes
Lead	mg/kg	7.5	7.8	20	0.2	yes
Mercury	mg/kg	<0.05	<0.05	20	0.05	yes
Molybdenum	mg/kg	<1.0	<1.0	20	2.2	yes
Nickel	mg/kg	21.5	23.2	20	1.1	yes
Selenium	mg/kg	<0.3	<0.3	20	0.7	yes
Silver	mg/kg	<0.10	0.1	20	0.22	yes
Thallium	mg/kg	0.13	0.13	20	0.11	yes
Tin	mg/kg	<1.0	<1.0	20	2.2	yes
Uranium	mg/kg	0.7	0.7	20	1.1	yes
Vanadium	mg/kg	25.2	25.1	20	0.2	yes
Zinc	mg/kg	54	55	20	2	yes

Date Acquired: July 18, 2019

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Antimony	mg/kg	39.4	36.1	43.9	yes

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Quality Control

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Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Metals Strong Acid Digestion - Continued

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Arsenic	mg/kg	39.1	36.3	43.9	yes
Barium	mg/kg	198	183	225	yes
Beryllium	mg/kg	19.2	17.4	22.2	yes
Cadmium	mg/kg	2.06	1.88	2.28	yes
Chromium	mg/kg	96.8	93.6	105.6	yes
Cobalt	mg/kg	19.3	17.0	23.0	yes
Copper	mg/kg	191	183.1	212.7	yes
Lead	mg/kg	19.8	18.3	21.5	yes
Mercury	mg/kg	2.91	2.64	3.36	yes
Molybdenum	mg/kg	206	174.8	234.8	yes
Nickel	mg/kg	96.5	91.6	108.4	yes
Selenium	mg/kg	39.9	34.0	46.0	yes
Silver	mg/kg	19.8	18.20	22.40	yes
Thallium	mg/kg	9.86	8.76	10.74	yes
Tin	mg/kg	200	188.0	218.0	yes
Uranium	mg/kg	98.4	86.0	116.0	yes
Vanadium	mg/kg	19.7	18.0	21.6	yes
Zinc	mg/kg	197	170	230	yes
Date Acquired:	July 18, 2019				
Antimony	mg/kg	3.7	2.3	6.0	yes
Arsenic	mg/kg	3.8	2.6	6.8	yes
Barium	mg/kg	99	58	154	yes
Beryllium	mg/kg	0.3	0.2	0.5	yes
Cadmium	mg/kg	0.90	0.73	1.15	yes
Chromium	mg/kg	79.3	48.8	128.8	yes
Cobalt	mg/kg	6.7	3.9	10.4	yes
Copper	mg/kg	116	76.1	200.5	yes
Lead	mg/kg	238	198.7	305.5	yes
Mercury	mg/kg	0.06	0.05	0.07	yes
Molybdenum	mg/kg	1.1	0.6	1.5	yes
Nickel	mg/kg	26.4	15.8	41.5	yes
Selenium	mg/kg	<0.3	0.1	0.4	yes
Silver	mg/kg	3.8	2.28	6.00	yes
Thallium	mg/kg	0.06	0.04	0.11	yes
Tin	mg/kg	11.0	4.0	16.0	yes
Uranium	mg/kg	<0.5	0.3	0.7	yes
Vanadium	mg/kg	29.2	17.8	46.9	yes
Zinc	mg/kg	294	260	350	yes
Date Acquired:	July 18, 2019				

PAH - Soil - Surrogate Recovery

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Nitrobenzene-d5	%	108.629	50	140	yes
2-Fluorobiphenyl	%	92.276	50	140	yes
p-Terphenyl-d14	%	105.719	50	140	yes

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Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
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PAH - Soil - Surrogate Recovery - Continued

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Date Acquired: July 18, 2019					

Particle Size Analysis - Wet Sieve

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
75 micron sieve	% by weight	40.8	41.9	10	3.0	yes
Date Acquired: July 18, 2019						

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
75 micron sieve	% by weight	19.8	12.2	26.0	yes
Date Acquired: July 18, 2019					

Polycyclic Aromatic Hydrocarbons - Soil

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Naphthalene	ng/mL	0	-0.010	0.010	yes
Acenaphthylene	ng/mL	0	-0.05	0.05	yes
Acenaphthene	ng/mL	0	-0.05	0.05	yes
Fluorene	ng/mL	0	-0.05	0.05	yes
Phenanthrene	ng/mL	0	-0.01	0.01	yes
Anthracene	ng/mL	0	-0.003	0.003	yes
Fluoranthene	ng/mL	0	-0.010	0.010	yes
Pyrene	ng/mL	0	-0.010	0.010	yes
Benzo(a)anthracene	ng/mL	0	-0.01	0.01	yes
Chrysene	ng/mL	0	-0.05	0.05	yes
Benzo(b)fluoranthene	ng/mL	0	-0.05	0.05	yes
Benzo(b+j)fluoranthene	ng/mL	0	-0.05	0.05	yes
Benzo(k)fluoranthene	ng/mL	0	-0.05	0.05	yes
Benzo(a)pyrene	ng/mL	0	-0.05	0.05	yes
Indeno(1,2,3-c,d)pyrene	ng/mL	0	-0.05	0.05	yes
Dibenzo(a,h)anthracene	ng/mL	0	-0.05	0.05	yes
Benzo(g,h,i)perylene	ng/mL	0	-0.05	0.05	yes
Date Acquired: July 18, 2019					

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Naphthalene	ng/mL	102.80	80	120	yes
Acenaphthylene	ng/mL	97.00	80	120	yes
Acenaphthene	ng/mL	100.00	80	120	yes
Fluorene	ng/mL	90.40	80	120	yes
Phenanthrene	ng/mL	89.40	80	120	yes
Anthracene	ng/mL	86.60	80	120	yes
Fluoranthene	ng/mL	89.20	80	120	yes
Pyrene	ng/mL	88.40	80	120	yes
Benzo(a)anthracene	ng/mL	91.00	80	120	yes
Chrysene	ng/mL	101.60	80	120	yes
Benzo(b)fluoranthene	ng/mL	97.00	80	120	yes
Benzo(k)fluoranthene	ng/mL	88.20	80	120	yes

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Polycyclic Aromatic Hydrocarbons - Soil - Continued

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Benzo(a)pyrene	ng/mL	85.00	80	120	yes
Indeno(1,2,3-c,d)pyrene	ng/mL	97.40	80	120	yes
Dibenzo(a,h)anthracene	ng/mL	86.60	80	120	yes
Benzo(g,h,i)perylene	ng/mL	84.60	80	120	yes
Date Acquired: July 18, 2019					

Salinity

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Electrical Conductivity	dS/m	1.02	0.60	1.50	yes
% Saturation	%	54	52	70	yes
Date Acquired: July 22, 2019					
Electrical Conductivity	dS/m	31.9	26.80	35.20	yes
Date Acquired: July 22, 2019					

Water Soluble Parameters

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Chromium (VI)	mg/L	0.001	-0.10	0.10	yes
Date Acquired: July 18, 2019					

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Chromium (VI)	mg/kg	<0.05	<0.05	10	0.01	yes
Date Acquired: July 18, 2019						

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Methodology and Notes

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Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 25, 2019
Report Number: 2424445

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
1:5 Water Soluble Extraction	APHA	*	Colorimetric Method, 3500-Cr B	Jul 18, 2019	Element Edmonton - Roper Road
1:5 Water Soluble Extraction	McKeague	*	Soluble Salts in Extracts of 1:5 Soil:Water Mixtures, 3.23	Jul 18, 2019	Element Edmonton - Roper Road
Metals ICP (Hot Block) in soil	EPA	*	Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements, October 1999, 200.2	Jul 18, 2019	Element Edmonton - Roper Road
Metals ICP (Hot Block) in soil	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	Jul 18, 2019	Element Edmonton - Roper Road
PAH - Soil	AEP		Index of Additive Cancer Risk (IACR), IACR	Jul 18, 2019	Element Calgary
PAH - Soil	US EPA	*	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, 8270	Jul 18, 2019	Element Calgary
Particle Size by Wet Sieve	ASTM	*	Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing, C 117-17	Jul 18, 2019	Element Edmonton - Roper Road
Particle Size by Wet Sieve	Carter	*	Procedure for Particle Size Separation, 55.2.3	Jul 18, 2019	Element Edmonton - Roper Road
Saturated Paste in General Soil	Carter	*	Electrical Conductivity and Soluble Ions, Chapter 15	Jul 22, 2019	Element Edmonton - Roper Road

** Reference Method Modified*

References

AEP	Alberta Tier 1 Soil and Groundwater Remediation Guidelines
APHA	Standard Methods for the Examination of Water and Wastewater
ASTM	Annual Book of ASTM Standards
Carter	Soil Sampling and Methods of Analysis.
EPA	Environmental Protection Agency Test Methods - US
McKeague	Manual on Soil Sampling and Methods of Analysis
US EPA	US Environmental Protection Agency Test Methods

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Project Information

Project ID:	26388
Project Name:	Smith Bridge
Project Location:	Running Creek Bridge
Legal Location:	
PO/AFE#:	26388
Proj. Acct. Code:	
Quote #:	RFP 1310

Invoice To

Company: Thurber Engineering Ltd.
Address: 4127 Roper Road
Edmonton, AB T6E 3S5
Attention: Sharon Bunn
Phone: 780-438-1460
Cell:
Fax:
E-mail: sbunn@thurber.ca
Agreement ID:
Copy of Report: YES / **NO**

Report To

Company: Thurber Engineering Ltd.
Address: 4127 Roper Road NW
Edmonton, AB T6B 3S5
Attention: Marcie Kennedy
Phone: 780-438-1460
Cell: 780-232-0829
Fax: 780-437-7125
E-mail 1: mkennedy@thurber.ca
E-mail 2:
Copy of Invoice: YES / **NO**

Additional Reports to

1) Name:
E-mail:
2) Name:
E-mail:

Sample Custody

Sampled by:
Company: Thurber Engineering Ltd.
I authorize Element to proceed with the work indicated on this form:
Signature:
Date/Time:

RUSH Priority

- ☐ Same Day (200%)
- ☐ Next Day/Two Day (100%)
- ☐ Three or Four Days (50%)
- ☐ 5 to 7 Days (Regular TAT)

Date Required _____

When "ASAP" is requested, turn around will default to a 100% RUSH priority, with pricing and turn around time to match. Please contact the lab prior to submitting RUSH samples. If not all samples require RUSH, please indicate in the special instructions.

Report Results

- ☑ Email ☑ QA/QC
- ☐ Online ☑ PDF
- ☐ Fax ☑ Excel

Requirements

- ☐ HCDWORG ☐ SPIGEC
- ☑ AB Tier 1 ☐ BCCSR

Other (list below)

Special Instructions/Comments (please include contact information including phone number if different from above).

	Site I.D.	Sample Description	Depth start (cm)	Depth end (m)	Date/Time sampled	Matrix	Sampling method	Number of Containers #	MeOH Field Preserved? ✓	CLASS2 (Landfill)	PS24 (Texture)	ABT1SAL-S (Salinity)	ABT1MET-S (Metals)	CCMEC (BTEX, F1-F4)	PAH2 (PAHs)	ABT1VOC-S (VOCs)	GLY2 (Glycols)	ALC2 (Alcohols)	PE1 (Sterilant Screen)	AMILOS-A (Amines)	HOLD
										Enter tests above (✓ relevant samples below)												
1		TH19E-1	0	0.15	10-Jul-19	soil	grab	2			X		X		X						
2		TH19E-2	0.15	0.3	10-Jul-19	soil	grab	2					X		X						
3		TH19E-3		0.5	10-Jul-19	soil	grab	2			X		X		X						
4		TH19E-4		0.5	10-Jul-19	soil	grab	2					X		X						
5		TH19E-5	0.15	0.3	10-Jul-19	soil	grab	2			X		X		X						
6		~~TH19E-6~~	~~0~~	~~0.15~~	~~10-Jul-19~~	~~soil~~	~~grab~~	~~2~~					X		X						
7		TH19E-7		0.5	10-Jul-19	soil	grab	2			X		X		X						
8		TH19E-8		1	10-Jul-19	soil	grab	2					X		X						
9		DUP A		---	10-Jul-19	soil	grab	2					X		X						
10		Landfill Class.		---	9-Jul-19	soil	grab	3		X											
11																					
12																					
13																					
14																					
15																					

Please indicate any potentially hazardous samples

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Page 1 of 1 Control #
ED 120-005

Indicate lot # or affix barcode here

Lot: 1364306 COC

Temp. received: 7.8 °C
Date/Time stamp: JUL 17 AM11:05
Delivery Method: hand
Waybill:
Received by:

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7217 Roper Road NW
Edmonton, Alberta
T6B 3J4, Canada

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Analytical Report

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By: MKK
Company: Thurber

Project ID: 26388.2
Project Name: 111 St Pedestrian Bridge
Project Location:
LSD:
P.O.: 26388.2
Proj. Acct. code: 26388.2

Lot ID: **1384417**
Control Number:
Date Received: Oct 17, 2019
Date Reported: Oct 25, 2019
Report Number: 2452905

Reference Number	1384417-1	1384417-2	1384417-3
Sample Date	Oct 07, 2019	Oct 07, 2019	Oct 07, 2019
Sample Time	NA	NA	NA
Sample Location			
Sample Description	TH19E-9 / 0.15-0.3	TH19E-10 / 0-0.15	TH19E-11 / 0.15-0.3
Matrix	Soil	Soil	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Particle Size Analysis - Wet Sieve						
Texture			Fine-Grained	Coarse-Grained	Coarse-Grained	
75 micron sieve	% Retained	% by weight	48.5	58.5	62.8	0.1
Polycyclic Aromatic Hydrocarbons - Soil						
Naphthalene	Dry Weight	mg/kg	<0.01	<0.01	<0.01	0.010
Acenaphthylene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Acenaphthene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Fluorene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Phenanthrene	Dry Weight	mg/kg	<0.01	<0.01	<0.01	0.01
Anthracene	Dry Weight	mg/kg	<0.003	<0.003	<0.003	0.003
Fluoranthene	Dry Weight	mg/kg	<0.01	<0.01	<0.01	0.010
Pyrene	Dry Weight	mg/kg	<0.01	<0.01	<0.01	0.010
Benzo(a)anthracene	Dry Weight	mg/kg	<0.01	<0.01	<0.01	0.01
Chrysene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(b+j)fluoranthene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(k)fluoranthene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(a)pyrene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Indeno(1,2,3-c,d)pyrene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Dibenzo(a,h)anthracene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
Benzo(g,h,i)perylene	Dry Weight	mg/kg	<0.05	<0.05	<0.05	0.05
CB(a)P	B(a)P Total Potency Equivalents	mg/kg	0.005	<0.001	0.005	0.001
IACR_Coarse	Index of Additive Cancer Risk		<0.001	<0.001	<0.001	0.001
IACR_Fine	Index of Additive Cancer Risk		<0.001	<0.001	<0.001	0.001
PAH - Soil - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	100	98	106	50-140
2-Fluorobiphenyl	PAH - Surrogate	%	83	79	83	50-140
p-Terphenyl-d14	PAH - Surrogate	%	95	88	97	50-140

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Analytical Report

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By: MKK
Company: Thurber

Project ID: 26388.2
Project Name: 111 St Pedestrian Bridge
Project Location:
LSD:
P.O.: 26388.2
Proj. Acct. code: 26388.2

Lot ID: **1384417**
Control Number:
Date Received: Oct 17, 2019
Date Reported: Oct 25, 2019
Report Number: 2452905

Reference Number	1384417-4
Sample Date	Oct 07, 2019
Sample Time	NA
Sample Location	
Sample Description	TH19E-12 / 0-0.15
Matrix	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Particle Size Analysis - Wet Sieve						
Texture			Fine-Grained			
75 micron sieve	% Retained	% by weight	34.1			0.1

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Analytical Report

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By: MKK
Company: Thurber

Project ID: 26388.2
Project Name: 111 St Pedestrian Bridge
Project Location:
LSD:
P.O.: 26388.2
Proj. Acct. code: 26388.2

Lot ID: **1384417**
Control Number:
Date Received: Oct 17, 2019
Date Reported: Oct 25, 2019
Report Number: 2452905

Reference Number	1384417-4	1384417-5
Sample Date	Oct 07, 2019	Oct 07, 2019
Sample Time	NA	NA
Sample Location		
Sample Description	TH19E-12 / 0-0.15	DupB
Matrix	Soil	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Polycyclic Aromatic Hydrocarbons - Soil						
Naphthalene	Dry Weight	mg/kg	<0.01	<0.01		0.010
Acenaphthylene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Acenaphthene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Fluorene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Phenanthrene	Dry Weight	mg/kg	0.02	<0.01		0.01
Anthracene	Dry Weight	mg/kg	0.007	<0.003		0.003
Fluoranthene	Dry Weight	mg/kg	0.039	<0.01		0.010
Pyrene	Dry Weight	mg/kg	0.027	<0.01		0.010
Benzo(a)anthracene	Dry Weight	mg/kg	<0.01	<0.01		0.01
Chrysene	Dry Weight	mg/kg	0.06	<0.05		0.05
Benzo(b+j)fluoranthene	Dry Weight	mg/kg	0.06	<0.05		0.05
Benzo(k)fluoranthene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Benzo(a)pyrene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Indeno(1,2,3-c,d)pyrene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Dibenzo(a,h)anthracene	Dry Weight	mg/kg	<0.05	<0.05		0.05
Benzo(g,h,i)perylene	Dry Weight	mg/kg	<0.05	<0.05		0.05
CB(a)P	B(a)P Total Potency Equivalents	mg/kg	0.021	0.005		0.001
IACR_Coarse	Index of Additive Cancer Risk		0.012	<0.001		0.001
IACR_Fine	Index of Additive Cancer Risk		0.024	<0.001		0.001
PAH - Soil - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	112	108		50-140
2-Fluorobiphenyl	PAH - Surrogate	%	97	82		50-140
p-Terphenyl-d14	PAH - Surrogate	%	103	96		50-140

Approved by:

Darlene Lintott, MSc
Consulting Scientist

Data have been validated by Analytical Quality Control and Element's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

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Quality Control

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By: MKK
Company: Thurber

Project ID: 26388.2
Project Name: 111 St Pedestrian Bridge
Project Location:
LSD:
P.O.: 26388.2
Proj. Acct. code: 26388.2

Lot ID: **1384417**
Control Number:
Date Received: Oct 17, 2019
Date Reported: Oct 25, 2019
Report Number: 2452905

PAH - Soil - Surrogate Recovery

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Nitrobenzene-d5	%	97.1	50	140	yes
2-Fluorobiphenyl	%	86.2	50	140	yes
p-Terphenyl-d14	%	122.66	50	140	yes
Date Acquired:	October 18, 2019				

Particle Size Analysis - Wet Sieve

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
75 micron sieve	% by weight	18.6	12.2	26.0	yes
Date Acquired:	October 18, 2019				
75 micron sieve	% by weight	30.6	24.6	33.4	yes
Date Acquired:	October 18, 2019				

Polycyclic Aromatic Hydrocarbons - Soil

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Naphthalene	ng/mL	0	-0.010	0.010	yes
Acenaphthylene	ng/mL	0	-0.05	0.05	yes
Acenaphthene	ng/mL	0	-0.05	0.05	yes
Fluorene	ng/mL	0	-0.05	0.05	yes
Phenanthrene	ng/mL	0	-0.01	0.01	yes
Anthracene	ng/mL	0	-0.003	0.003	yes
Fluoranthene	ng/mL	0	-0.010	0.010	yes
Pyrene	ng/mL	0	-0.010	0.010	yes
Benzo(a)anthracene	ng/mL	0	-0.01	0.01	yes
Chrysene	ng/mL	0	-0.05	0.05	yes
Benzo(b)fluoranthene	ng/mL	0	-0.05	0.05	yes
Benzo(b+j)fluoranthene	ng/mL	0	-0.05	0.05	yes
Benzo(k)fluoranthene	ng/mL	0	-0.05	0.05	yes
Benzo(a)pyrene	ng/mL	0	-0.05	0.05	yes
Indeno(1,2,3-c,d)pyrene	ng/mL	0	-0.05	0.05	yes
Dibenzo(a,h)anthracene	ng/mL	0	-0.05	0.05	yes
Benzo(g,h,i)perylene	ng/mL	0	-0.05	0.05	yes
Date Acquired:	October 18, 2019				

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Naphthalene	ng/mL	100.20	80	120	yes
Acenaphthylene	ng/mL	107.80	80	120	yes
Acenaphthene	ng/mL	97.80	80	120	yes
Fluorene	ng/mL	98.20	80	120	yes
Phenanthrene	ng/mL	86.00	80	120	yes
Anthracene	ng/mL	97.00	80	120	yes
Fluoranthene	ng/mL	89.00	80	120	yes
Pyrene	ng/mL	85.20	80	120	yes
Benzo(a)anthracene	ng/mL	100.20	80	120	yes
Chrysene	ng/mL	102.60	80	120	yes
Benzo(b)fluoranthene	ng/mL	86.00	80	120	yes

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Quality Control

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By: MKK
Company: Thurber

Project ID: 26388.2
Project Name: 111 St Pedestrian Bridge
Project Location:
LSD:
P.O.: 26388.2
Proj. Acct. code: 26388.2

Lot ID: **1384417**
Control Number:
Date Received: Oct 17, 2019
Date Reported: Oct 25, 2019
Report Number: 2452905

Polycyclic Aromatic Hydrocarbons - Soil - Continued

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Benzo(k)fluoranthene	ng/mL	113.80	80	120	yes
Benzo(a)pyrene	ng/mL	114.40	80	120	yes
Indeno(1,2,3-c,d)pyrene	ng/mL	101.40	80	120	yes
Dibenzo(a,h)anthracene	ng/mL	103.80	80	120	yes
Benzo(g,h,i)perylene	ng/mL	101.20	80	120	yes

Date Acquired: October 18, 2019

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Methodology and Notes

Bill To:	Thurber Engineering Ltd. 4127 Roper Road Edmonton, AB, Canada T6B 3S5	Project ID:	26388.2	Lot ID:	**1384417**
		Project Name:	111 St Pedestrian Bridge	Control Number:	
		Project Location:		Date Received:	Oct 17, 2019
		LSD:		Date Reported:	Oct 25, 2019
Attn:	Sharon Bunn	P.O.:	26388.2	Report Number:	2452905
Sampled By:	MKK	Proj. Acct. code:	26388.2		
Company:	Thurber				

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
PAH - Soil	AEP		Index of Additive Cancer Risk (IACR), IACR	Oct 18, 2019	Element Calgary
PAH - Soil	US EPA	*	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, 8270	Oct 18, 2019	Element Calgary
Particle Size by Wet Sieve	ASTM	*	Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing, C 117-17	Oct 18, 2019	Element Edmonton - Roper Road
Particle Size by Wet Sieve	Carter	*	Procedure for Particle Size Separation, 55.2.3	Oct 18, 2019	Element Edmonton - Roper Road

** Reference Method Modified*

References

AEP	Alberta Tier 1 Soil and Groundwater Remediation Guidelines
ASTM	Annual Book of ASTM Standards
Carter	Soil Sampling and Methods of Analysis.
US EPA	US Environmental Protection Agency Test Methods

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www.Element.com

Project Information

Project ID:	26388
Project Name:	111 St Pedestrian Bridge
Project Location:	
Legal Location:	
PO/AFE#:	26388.2
Proj. Acct. Code:	
Quote #:	RFP 1310

Invoice To

Company:	Thurber Engineering Ltd.
Address:	4127 Roper Road
	Edmonton, AB T6E 3S5
Attention:	Sharon Bunn
Phone:	780-438-1460
Cell:	
Fax:	
E-mail:	sbunn@thurber.ca
Agreement ID:	
Copy of Report:	YES / **NO**

Report To

Company:	Thurber Engineering Ltd.
Address:	4127 Roper Road NW
	Edmonton, AB T6B 3S5
Attention:	Marcie Kennedy
Phone:	780-438-1460
Cell:	780-232-0829
Fax:	780-437-7125
E-mail 1:	mkennedy@thurber.ca
E-mail 2:	
Copy of Invoice:	YES / **NO**

Additional Reports to

1) Name:
E-mail:
2) Name:
E-mail:

Sample Custody

Sampled by: MKK
Company: Thurber Engineering Ltd.
I authorize Element to proceed with the work indicated on this form:
Signature:
Date/Time:

RUSH Priority

- ☐ Same Day (200%)
- ☐ Next Day/Two Day (100%)
- ☐ Three or Four Days (50%)
- ☑ 5 to 7 Days (Regular TAT)

Date Required _____

When "ASAP" is requested, turn around will default to a 100% RUSH priority, with pricing and turn around time to match. Please contact the lab prior to submitting RUSH samples. If not all samples require RUSH, please indicate in the special instructions.

Report Results

- ☑ Email ☑ QA/QC
- ☐ Online ☑ PDF
- ☐ Fax ☑ Excel

Requirements

- ☐ HCDWORG ☐ SPIGEC
- ☑ AB Tier 1 ☐ BCCSR

Other (list below)

Special Instructions/Comments (please include contact information including phone number if different from above).

	Site I.D.	Sample Description	Depth start (cm)	Depth end (m)	Date/Time sampled	Matrix	Sampling method	Number of Containers #	MeOH Field Preserved? ✓	CLASS2 (Landfill)	PS24 (Texture)	ABT1SAL-S (Salinity)	ABT1MET-S (Metals)	CCMEC (BTEX, F1-F4)	PAH2 (PAHs)	ABT1VOC-S (VOCs)	GLY2 (Glycols)	ALC2 (Alcohols)	PE1 (Sterilant Screen)	AMILOS-A (Amines)	HOLD
										Enter tests above (✓ relevant samples below)												
1		TH19E-9	0.15	0.3	7-Oct-19	Soil	Grab	2			X				X						
2		TH19E-10	0	0.15	7-Oct-19	Soil	Grab	2			X				X						
3		TH19E-11	0.15	0.3	7-Oct-19	Soil	Grab	2			X				X						
4		TH19E-12	0	0.15	7-Oct-19	Soil	Grab	2			X				X						
5		Dup B			7-Oct-19	Soil	Grab	4			X				X						
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					

Please indicate any potentially hazardous samples

Submission of this form acknowledges acceptance of Element's Standard of terms and conditions (https://www.element.com/terms/terms-and-conditions)

Page _____ of _____ Control #

ED 120-005

Lot: 1384417 COC

Temp. received: 8.8 °C
Date/Time stamp:
Delivery Method: #hand
Waybill:
Received by: SW

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Report Transmission Cover Page

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By:
Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 19, 2019
Report Number: 2424447

Contact	Company	Address
Marcie Kennedy	**Thurber Engineering Ltd.**	4127 Roper Road Edmonton, AB T6B 3S5 Phone: (780) 438-1460 Fax: (780) 437-7125 Email: mkennedy@thurber.ca

Delivery	Format	Deliverables
Email - Merge Reports	PDF	COC / COA
Email - Merge Reports	PDF	COC / Test Report
Email - Single Report	Legacy Crosstab in CSV	Test Report

Contact	Company	Address
Sharon Bunn	**Thurber Engineering Ltd.**	4127 Roper Road Edmonton, AB T6B 3S5 Phone: (780) 438-1460 Fax: (780) 437-7125 Email: Sbunn@thurber.ca

Delivery	Format	Deliverables
Email - Single Report	PDF	Invoice

Notes To Clients:

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Analytical Report

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By:
Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 19, 2019
Report Number: 2424447

Reference Number	1364306-9
Sample Date	July 09, 2019
Sample Time	NA
Sample Location	
Sample Description	Landfill Class
Sample Matrix	Soil

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Leachate Inorganic - TCLP						
Antimony	TCLP Leachate	mg/L	<0.005	0.005	500	Below Limit
Arsenic	TCLP Leachate	mg/L	<0.002	0.002	5	Below Limit
Barium	TCLP Leachate	mg/L	3.03	0.05	100	Below Limit
Beryllium	TCLP Leachate	mg/L	0.002	0.001	5	Below Limit
Boron	TCLP Leachate	mg/L	<0.2	0.2	500	Below Limit
Cadmium	TCLP Leachate	mg/L	0.001	0.001	1	Below Limit
Chromium	TCLP Leachate	mg/L	<0.005	0.005	5	Below Limit
Cobalt	TCLP Leachate	mg/L	0.049	0.001	100	Below Limit
Copper	TCLP Leachate	mg/L	<0.10	0.1	100	Below Limit
Iron	TCLP Leachate	mg/L	5.0	0.1	1000	Below Limit
Lead	TCLP Leachate	mg/L	<0.050	0.05	5	Below Limit
Mercury	TCLP Leachate	mg/L	<0.001	0.001	0.2	Below Limit
Nickel	TCLP Leachate	mg/L	0.112	0.050	5	Below Limit
Selenium	TCLP Leachate	mg/L	0.002	0.002	1	Below Limit
Silver	TCLP Leachate	mg/L	<0.005	0.05	5	Below Limit
Thallium	TCLP Leachate	mg/L	0.0008	0.0005	5	Below Limit
Uranium	TCLP Leachate	mg/L	<0.005	0.005	2.0	Below Limit
Vanadium	TCLP Leachate	mg/L	<0.01	0.01	100	Below Limit
Zinc	TCLP Leachate	mg/L	0.13	0.1	500	Below Limit
Zirconium	TCLP Leachate	mg/L	<0.01	0.01	500	Below Limit
pH	Initial		10.1			
pH	Final		5.2			
Soil Acidity						
pH	1:1	pH	9.9		2-12.5	Within Limits
Waste Characterization						
Flash Point		°C	>75		61	Within Limit
Flash			No			
Paint Filter	Interpretation		Solid Waste			
Mono-Aromatic Hydrocarbons - Leachate						
Benzene	TCLP Leachate	mg/L	<0.01	0.01	0.5	Below Limit
Toluene	TCLP Leachate	mg/L	<0.01	0.01	0.5	Below Limit
Ethylbenzene	TCLP Leachate	mg/L	<0.01	0.01	0.5	Below Limit
Total Xylenes (m,p,o)	TCLP Leachate	mg/L	<0.02	0.02	0.5	Below Limit

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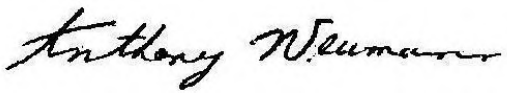
Analytical Report

Bill To:	Thurber Engineering Ltd. 4127 Roper Road Edmonton, AB, Canada T6B 3S5
Attn:	Sharon Bunn
Sampled By:	
Company:	Thurber Engineering Ltd.

Project ID:	26388
Project Name:	Smith Bridge
Project Location:	Running Creek Bridge
LSD:	
P.O.:	26388
Proj. Acct. code:	26388

Lot ID:	**1364306**
Control Number:	
Date Received:	Jul 17, 2019
Date Reported:	Jul 19, 2019
Report Number:	2424447

Approved by:



Anthony Neumann, MSc
General Manager

Data have been validated by Analytical Quality Control and Element's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

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Quality Control

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By:
Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 19, 2019
Report Number: 2424447

Leachate Inorganic - TCLP

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Antimony	µg/L	0.0976591	-0.501	0.501	yes
Arsenic	µg/L	0.00245633	-0.201	0.201	yes
Barium	µg/L	0.103758	-5.01	5.01	yes
Beryllium	µg/L	0.00415806	-0.099	0.099	yes
Boron	µg/L	0.745377	-20.0	20.0	yes
Cadmium	µg/L	0.000839293	-0.0990	0.0990	yes
Chromium	µg/L	0.0900774	-0.501	0.501	yes
Cobalt	µg/L	0.00375887	-0.099	0.099	yes
Copper	µg/L	0.854649	-9.99	9.99	yes
Iron	µg/L	3.31431	-10.0	10.0	yes
Lead	µg/L	0.00766899	-5.010	5.010	yes
Mercury	µg/L	-0.00661388	-0.0990	0.0990	yes
Nickel	µg/L	0.178031	-0.501	0.501	yes
Selenium	µg/L	-0.000831805	-0.201	0.201	yes
Silver	µg/L	0.0102636	-0.501	0.501	yes
Thallium	µg/L	0.000764649	-0.0501	0.0501	yes
Uranium	µg/L	0.00225727	-0.501	0.501	yes
Vanadium	µg/L	0.156456	-1.00	1.00	yes
Zinc	µg/L	1.05315	-9.99	9.99	yes
Zirconium	µg/L	0.0030939	-0.99	0.99	yes
Date Acquired:	July 18, 2019				

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Antimony	mg/L	<0.005	<0.005	20	0.008	yes
Arsenic	mg/L	<0.002	<0.002	20	0.008	yes
Barium	mg/L	0.76	0.71	20	0.04	yes
Beryllium	mg/L	<0.001	<0.001	20	0.004	yes
Boron	mg/L	<0.2	<0.2	20	0.1	yes
Cadmium	mg/L	0.001	<0.001	20	0.0004	yes
Chromium	mg/L	<0.005	<0.005	20	0.020	yes
Cobalt	mg/L	<0.001	<0.001	20	0.004	yes
Copper	mg/L	<0.10	<0.10	20	0.04	yes
Iron	mg/L	<0.1	<0.1	20	0.4	yes
Lead	mg/L	<0.050	<0.050	20	0.004	yes
Nickel	mg/L	<0.050	<0.050	20	0.020	yes
Selenium	mg/L	<0.002	<0.002	20	0.008	yes
Silver	mg/L	<0.005	<0.005	20	0.004	yes
Thallium	mg/L	<0.0005	<0.0005	20	0.0020	yes
Uranium	mg/L	<0.005	<0.005	20	0.020	yes
Vanadium	mg/L	<0.01	<0.01	20	0.00	yes
Zinc	mg/L	<0.10	<0.10	20	0.04	yes
Zirconium	mg/L	<0.01	<0.01	20	0.04	yes
pH		5.2	5.1	0	0.3	yes
Date Acquired:	July 18, 2019					

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC

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Quality Control

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T6B 3S5
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Sampled By:
Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 19, 2019
Report Number: 2424447

Leachate Inorganic - TCLP - Continued

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Antimony	mg/L	0.041	0.036	0.044	yes
Arsenic	mg/L	0.041	0.037	0.043	yes
Barium	mg/L	0.19	0.19	0.21	yes
Beryllium	mg/L	0.019	0.018	0.021	yes
Boron	mg/L	0.4	0.4	0.4	yes
Cadmium	mg/L	0.0021	0.0019	0.0022	yes
Chromium	mg/L	0.102	0.092	0.110	yes
Cobalt	mg/L	0.020	0.018	0.022	yes
Copper	mg/L	0.20	0.19	0.21	yes
Iron	mg/L	4.0	3.7	4.4	yes
Lead	mg/L	0.020	0.015	0.025	yes
Mercury	mg/L	0.0031	0.0027	0.0033	yes
Nickel	mg/L	0.102	0.090	0.110	yes
Selenium	mg/L	0.039	0.035	0.043	yes
Silver	mg/L	0.020	0.017	0.021	yes
Thallium	mg/L	0.0100	0.0088	0.0108	yes
Uranium	mg/L	0.098	0.093	0.109	yes
Vanadium	mg/L	0.02	0.02	0.02	yes
Zinc	mg/L	0.20	0.18	0.22	yes
Zirconium	mg/L	0.20	0.19	0.23	yes

Date Acquired: July 18, 2019

Mono-Aromatic Hydrocarbons - Leachate

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Benzene	ng	0	-9.99	9.99	yes
Toluene	ng	0	-9.99	9.99	yes
Ethylbenzene	ng	0	-9.99	9.99	yes
m,p-Xylene	ng	0	-9.99	9.99	yes
o-Xylene	ng	0	-9.99	9.99	yes

Date Acquired: July 18, 2019

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Benzene	ng	98.01	85	115	yes
Toluene	ng	97.87	85	115	yes
Ethylbenzene	ng	98.85	85	115	yes
m,p-Xylene	ng	101.16	85	115	yes
o-Xylene	ng	104.17	85	115	yes

Date Acquired: July 18, 2019

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Benzene	mg/L	<0.01	<0.01	20	10.00	yes
Toluene	mg/L	<0.01	<0.01	20	10.00	yes
Ethylbenzene	mg/L	<0.01	<0.01	20	10.00	yes
m,p-Xylene	mg/L	<0.01	<0.01	20	10.00	yes
o-Xylene	mg/L	<0.01	<0.01	20	10.00	yes

Date Acquired: July 18, 2019

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Quality Control

Bill To: Thurber Engineering Ltd.
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T6B 3S5
Attn: Sharon Bunn
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Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 19, 2019
Report Number: 2424447

Soil Acidity

Blanks	Units	Measured	Lower Limit	Upper Limit		Passed QC
pH	pH	5.68	5.7	7.3		yes
Date Acquired:	July 18, 2019					
Client Sample Replicates	**Units**	**Replicate 1**	**Replicate 2**	**% RSD Criteria**	**Absolute Criteria**	**Passed QC**
pH	pH	7.8	7.7	0	0.3	yes
Date Acquired:	July 18, 2019					
Control Sample	**Units**	**Measured**	**Lower Limit**	**Upper Limit**		**Passed QC**
pH	pH	6.2	5.4	6.6		yes
Date Acquired:	July 18, 2019					

Waste Characterization

Control Sample	Units	Measured	Lower Limit	Upper Limit		Passed QC
Flash Point	°C	52	50	55		yes
Date Acquired:	July 18, 2019					

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Methodology and Notes

Bill To: Thurber Engineering Ltd.
4127 Roper Road
Edmonton, AB, Canada
T6B 3S5
Attn: Sharon Bunn
Sampled By:
Company: Thurber Engineering Ltd.

Project ID: 26388
Project Name: Smith Bridge
Project Location: Running Creek Bridge
LSD:
P.O.: 26388
Proj. Acct. code: 26388

Lot ID: **1364306**
Control Number:
Date Received: Jul 17, 2019
Date Reported: Jul 19, 2019
Report Number: 2424447

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
Flash Point (Closed cup)	ASTM	*	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester, D 93	Jul 18, 2019	Element Edmonton - Roper Road
Flash Point (Closed cup)	ASTM	*	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester, D 93-16a	Jul 18, 2019	Element Edmonton - Roper Road
Leachate Inorganic (TCLP) ICP-MS	US EPA	*	Toxicity Characteristic Leaching Procedure, SW-846, EPA 1311	Jul 18, 2019	Element Edmonton - Roper Road
Leachate Organic (TCLP-BTEX)	US EPA	*	Toxicity Characteristic Leaching Procedure, SW-846, EPA 1311	Jul 18, 2019	Element Edmonton - Roper Road
Paint Filter Liquids Test	US EPA	*	Paint Filter Liquids Test, 9095B	Jul 19, 2019	Element Edmonton - Roper Road
pH and Conductivity in general soil 1:1	McKeague	*	1:1 Soil:Water Ratio, 4.11	Jul 18, 2019	Element Edmonton - Roper Road

** Reference Method Modified*

References

ASTM	Annual Book of ASTM Standards
McKeague	Manual on Soil Sampling and Methods of Analysis
US EPA	US Environmental Protection Agency Test Methods

Guidelines

Guideline Description	Class 2 Landfill (AB)
Guideline Source	AEP Waste Control Regulation, Alberta Regulation 192/96
Guideline Comments	Limits for analytes that may be required for Class 2 Landfill Acceptance may not be presented in this report. Consult the AENV Waste Control Regulation for hazardous waste limits, and ERCB D058 for dangerous oilfield waste properties.

element
www.Element.com

Project Information

Project ID:	26388
Project Name:	Smith Bridge
Project Location:	Running Creek Bridge
Legal Location:	
PO/AFE#:	26388
Proj. Acct. Code:	
Quote #:	RFP 1310

Invoice To

Company: Thurber Engineering Ltd.
Address: 4127 Roper Road
Edmonton, AB T6E 3S5
Attention: Sharon Bunn
Phone: 780-438-1460
Cell:
Fax:
E-mail: sbunn@thurber.ca
Agreement ID:
Copy of Report: YES / **NO**

Report To

Company: Thurber Engineering Ltd.
Address: 4127 Roper Road NW
Edmonton, AB T6B 3S5
Attention: Marcie Kennedy
Phone: 780-438-1460
Cell: 780-232-0829
Fax: 780-437-7125
E-mail 1: mkennedy@thurber.ca
E-mail 2:
Copy of Invoice: YES / **NO**

Additional Reports to

1) Name:
E-mail:
2) Name:
E-mail:

Sample Custody

Sampled by:
Company: Thurber Engineering Ltd.
I authorize Element to proceed with the work indicated on this form:
Signature:
Date/Time:

RUSH Priority

- ☐ Same Day (200%)
- ☐ Next Day/Two Day (100%)
- ☐ Three or Four Days (50%)
- ☐ 5 to 7 Days (Regular TAT)

Date Required _____

When "ASAP" is requested, turn around will default to a 100% RUSH priority, with pricing and turn around time to match. Please contact the lab prior to submitting RUSH samples. If not all samples require RUSH, please indicate in the special instructions.

Report Results

- ☑ Email ☑ QA/QC
- ☐ Online ☑ PDF
- ☐ Fax ☑ Excel

Requirements

- ☐ HCDWORG ☐ SPIGEC
- ☑ AB Tier 1 ☐ BCCSR

Other (list below)

Special Instructions/Comments (please include contact information including phone number if different from above).

	Site I.D.	Sample Description	Depth start (cm)	Depth end (m)	Date/Time sampled	Matrix	Sampling method	Number of Containers #	MeOH Field Preserved? ✓	CLASS2 (Landfill)	PS24 (Texture)	ABT1SAL-S (Salinity)	ABT1MET-S (Metals)	CCMEC (BTEX, F1-F4)	PAH2 (PAHs)	ABT1VOC-S (VOCs)	GLY2 (Glycols)	ALC2 (Alcohols)	PE1 (Sterilant Screen)	AMILOS-A (Amines)	HOLD
										Enter tests above (✓ relevant samples below)												
1		TH19E-1	0	0.15	10-Jul-19	soil	grab	2			X		X		X						
2		TH19E-2	0.15	0.3	10-Jul-19	soil	grab	2					X		X						
3		TH19E-3		0.5	10-Jul-19	soil	grab	2			X		X		X						
4		TH19E-4		0.5	10-Jul-19	soil	grab	2					X		X						
5		TH19E-5	0.15	0.3	10-Jul-19	soil	grab	2			X		X		X						
6		~~TH19E-6~~	~~0~~	~~0.15~~	~~10-Jul-19~~	~~soil~~	~~grab~~	~~2~~					X		X						
7		TH19E-7		0.5	10-Jul-19	soil	grab	2			X		X		X						
8		TH19E-8		1	10-Jul-19	soil	grab	2					X		X						
9		DUP A		---	10-Jul-19	soil	grab	2					X		X						
10		Landfill Class.		---	9-Jul-19	soil	grab	3		X											
11																					
12																					
13																					
14																					
15																					

Please indicate any potentially hazardous samples

Submission of this form acknowledges acceptance of Element's Standard of terms and conditions (https://www.element.com/terms/terms-and-conditions)

Page 1 of 1 Control #
ED 120-005

Indicate lot # or affix barcode here

Lot: 1364306 COC

Temp. received: 7.8 °C
Date/Time stamp: JUL 17 AM11:05
Delivery Method: hand
Waybill:
Received by:

THURBER

QUALITY ASSURANCE / QUALITY CONTROL - FIELD DUPLICATE RESULTS
CITY OF EDMONTON
111 STREET PEDESTRIAN BRIDGE REPLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA

Sample	Units	Laboratory MDL	TH19E-2 0.15-0.30	DUP A	Calculated RPD	Comments
Metals						
Antimony	mg/kg	0.5	0.5	0.5	<5x MDL	
Arsenic	mg/kg	0.5	4.9	5.5	<5x MDL	
Barium	mg/kg	0.5	253	263	3.9%	
Beryllium	mg/kg	0.5	0.8	0.7	<5x MDL	
Boron, Hot Water Soluble	mg/kg	0.5	<0.5	<0.5	---	
Cadmium	mg/kg	0.5	0.26	0.27	<5x MDL	
Chromium, Total	mg/kg	0.5	9.2	9.6	4.3%	
Chromium, Hexavalent	mg/kg	0.3	0.1	0.1	<5x MDL	
Cobalt	mg/kg	0.5	8.1	8.5	4.8%	
Copper	mg/kg	0.5	20.6	21.0	1.9%	
Lead	mg/kg	0.5	10.4	10.7	2.8%	
Mercury	mg/kg	0.5	<0.05	<0.05	---	
Molybdenum	mg/kg	0.5	<1.0	<1.0	---	
Nickel	mg/kg	0.5	17.5	22.7	25.9%	
Selenium	mg/kg	0.5	<0.3	<0.3	---	
Silver	mg/kg	0.5	<0.10	<0.10	---	
Thallium	mg/kg	0.5	0.17	0.18	<5x MDL	
Tin	mg/kg	0.5	<1.0	<1.0	---	
Uranium	mg/kg	0.5	1.8	1.7	<5x MDL	
Vanadium	mg/kg	0.5	16.5	16.4	0.6%	
Zinc	mg/kg	1	63	64	1.6%	
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg/kg	0.01	<0.01	<0.01	---	
Acenaphthylene	mg/kg	0.05	<0.05	<0.05	---	
Acenaphthene	mg/kg	0.05	<0.05	<0.05	---	
Fluorene	mg/kg	0.05	<0.05	<0.05	---	
Phenanthrene	mg/kg	0.01	0.05	0.02	<5x MDL	
Anthracene	mg/kg	0.003	0.007	<0.003	---	
Fluoranthene	mg/kg	0.01	0.154	0.015	<5x MDL	
Pyrene	mg/kg	0.01	0.107	0.015	<5x MDL	
Benzo(a)anthracene	mg/kg	0.01	0.02	<0.01	---	
Chrysene	mg/kg	0.05	0.1	<0.05	---	
Benzo(b+j)fluoranthene	mg/kg	0.05	<0.05	<0.05	---	
Benzo(k)fluoranthene	mg/kg	0.05	<0.05	<0.05	---	
Benzo(a)pyrene	mg/kg	0.05	<0.05	<0.05	---	
Indeno(1,2,3-c,d)pyrene	mg/kg	0.05	<0.05	<0.05	---	
Dibenzo(a,h)anthracene	mg/kg	0.05	<0.05	<0.05	---	
Benzo(g,h,i)perylene	mg/kg	0.05	<0.05	<0.05	---	
CB(a)P	mg/kg	0.001	0.014	<0.001	---	
IACR_Coarse	---	0.001	0.004	<0.001	---	
IACR_Fine	---	0.001	0.007	<0.001	---	

Notes:

---	Parameter not analyzed or not calculated.
MDL	Method Detection Limit
RPD	Relative Percent Difference

THURBER

QUALITY ASSURANCE / QUALITY CONTROL - FIELD DUPLICATE RESULTS
CITY OF EDMONTON
111 STREET PEDESTRIAN BRIDGE REPLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA

Sample	Units	Laboratory MDL	TH19E-10 @0 - 0.15	DUP B	Calculated RPD	Comments
Polycyclic Aromatic Hydrocarbons						
Naphthalene	mg/kg	0.01	<0.01	<0.01	---	
Acenaphthylene	mg/kg	0.05	<0.05	<0.05	---	
Acenaphthene	mg/kg	0.05	<0.05	<0.05	---	
Fluorene	mg/kg	0.05	<0.05	<0.05	---	
Phenanthrene	mg/kg	0.01	<0.01	<0.01	---	
Anthracene	mg/kg	0.003	<0.003	<0.003	---	
Fluoranthene	mg/kg	0.01	<0.01	<0.01	---	
Pyrene	mg/kg	0.01	<0.01	<0.01	---	
Benzo(a)anthracene	mg/kg	0.01	<0.01	<0.01	---	
Chrysene	mg/kg	0.05	<0.05	<0.05	---	
Benzo(b+j)fluoranthene	mg/kg	0.05	<0.05	<0.05	---	
Benzo(k)fluoranthene	mg/kg	0.05	<0.05	<0.05	---	
Benzo(a)pyrene	mg/kg	0.05	<0.05	<0.05	---	
Indeno(1,2,3-c,d)pyrene	mg/kg	0.05	<0.05	<0.05	---	
Dibenzo(a,h)anthracene	mg/kg	0.05	<0.05	<0.05	---	
Benzo(g,h,i)perylene	mg/kg	0.05	<0.05	<0.05	---	
CB(a)P	mg/kg	0.001	<0.001	0.005	---	
IACR_Coarse	---	0.001	<0.001	<0.001	---	
IACR_Fine	---	0.001	<0.001	<0.001	---	

Notes:

---	Parameter not analyzed or not calculated.
MDL	Method Detection Limit
RPD	Relative Percent Difference

Appendix D: Geotechnical Assessment (Thurber 2019b)

111 STREET PEDESTRIAN BRIDGE REPLACEMENT
GEOTECHNICAL INVESTIGATION

THURBER ENGINEERING LTD.

THURBER ENGINEERING LTD.

111 STREET PEDESTRIAN BRIDGE REPLACEMENT GEOTECHNICAL INVESTIGATION

Report
to
City of Edmonton

Graeme Law, M.A.Sc, E.I.T.
Geotechnical Engineer

Date: October 4, 2019
File: 26388

Robin Tweedie, M.Sc., P.Eng.
Review Principal

THURBER

TABLE OF CONTENTS

THURBER

1. INTRODUCTION

This report presents the results of a geotechnical investigation carried out by Thurber Engineering Ltd. (Thurber) for the pedestrian bridge replacement project at the 111th Street Pedestrian Bridge, over Blackmud Creek in Edmonton, Alberta.

The scope of the geotechnical investigation was outlined in our proposal to Ms. Christina Tatarniuk, M.Sc., P.Eng., of the City of Edmonton Engineering Services (COE) on June 10, 2019. Authorization to proceed with the investigation was received from Ms. Christina Tatarniuk via email on June 26th, 2019.

This investigation did not include an assessment of soil or groundwater for environmental contamination purposes.

This report supersedes our draft report dated September 9th, 2019, and addresses the comments received from the COE and the structural engineers, BPTEC Engineering (BPTEC).

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. BACKGROUND

The City of Edmonton (COE) is planning to replace the 111th Street pedestrian bridge located immediately east of the 111th Street roadway crossing of the Blackmud Creek. The pedestrian bridge currently consists of a 30 m long three-span concrete deck supported by two rows of timber piles, and a small retaining structure on the north slope which retains the approach fills. The north pile bent is located within the north side of Blackmud Creek.

It is understood that the preferred foundation type for the new bridge is driven steel piles, which will support pre-cast concrete abutments. An existing truss bridge (from Connor's Hill Pedestrian Bridge) will be refurbished and placed on the new abutments in a single-span alignment and will be about 42 m long. Grade changes will be minimized but the bridge will consist of a shorter, single span structure.

3. METHOD OF INSPECTION

3.1 Field Drilling Program

The field investigation program consisted of drilling one test hole at each abutment location at the locations shown on Drawing No. 26388-1 in Appendix A.

The test holes were drilled on July 9, 2019 using a truck mounted M-5 auger drill rig operated by All Service Drilling Inc. of Nisku, Alberta. Test holes TH19-01 and TH19-02 were drilled to depths of 10.4 m (elevation 649.7 m) and 11.9 m (elevation 649.7 m) below ground surface respectively, with both test holes terminating in competent bedrock.

Prior to commencing the field drilling program, Thurber contacted Alberta One-Call to clear underground utilities at the borehole locations.

Disturbed and undisturbed samples were obtained during drilling and Standard Penetration Tests (SPTs) were carried out at selected depths in the test holes. The undrained shear strength (C_{pen} values) of cohesive soil samples was estimated at select locations using a pocket penetrometer.

Seepage and water levels in the test holes were recorded during and immediately after drilling. A standpipe piezometer was installed in TH19-01 to allow for future monitoring of the groundwater and was backfilled with drill cuttings and capped with bentonite chips near the ground surface. The standpipe piezometers were installed flushed to the ground surface. The standpipe piezometer was monitored at the completion of installation and on July 29, 2019.

The results of the geotechnical drilling and field tests are summarized on the test hole logs included in Appendix B.

3.2 Laboratory Program

Laboratory testing consisted of visual classification and determination of the natural water content of all soil samples. Atterberg limits tests, grain size analyses, and soluble sulphate content tests were performed for selected soil samples. The results of laboratory tests are summarized on the test hole logs in Appendix B.

3.3 Existing Information Review

A previous geotechnical investigation report for the South LRT Extension Phase 4 Creek Crossing (Ref. 1) was provided to Thurber by the COE summarizing geotechnical information available from previous investigations for the 111th Street creek crossing alignment along the existing roadway.

These test hole logs were more than 100 m away (west) from the pedestrian bridge site, but a stratigraphic summary for reference is included in Appendix C. The above information is also supplemented by available geological maps (Ref. 3 and Ref. 4).

4. SITE DESCRIPTION

4.1 Site Geology

The current Blackmud Creek is a tributary to the North Saskatchewan River Valley and is currently cutting through glacial sediments, flowing north-west toward the existing North Saskatchewan River.

The site geology is expected to consist of fluvial deposits derived from the Blackmud Creek overlying glacial deposits, overlying Upper Cretaceous bedrock. Bedrock is comprised of clay shales and sandstones with scattered coal and bentonitic beds of the Horseshoe Canyon Formations of the Edmonton Group (Ref. 3 and Ref. 4). The bedrock materials are weakly cemented, often resembling hard over-consolidated clay, and exhibit many of the properties associated with soils such as softening and swelling on exposure to weathering.

The geology maps indicate that drift thicknesses are about 5 m in the area, and that the bedrock is present at approximately elevations of 655 m to 660 m at the bottom of the Blackmud Creek valley, consistent with the 2019 survey data provided by the COE.

It is expected that recent fill materials may overlie some of these geological units. In addition, colluvium from previous slope movement may be present on the valley slopes at and above the bridge site. A thin veneer of alluvial sediment could also be encountered on the banks of the current water course, however within the valley it is anticipated these deposits would be highly localized and of colluvial origin.

4.2 Surface Conditions

The pedestrian bridge over the Blackmud Creek is located immediately upstream of the 111th Street roadway crossing. The bridge is located on a left meander bend, with a lower level river terrace on the inside bend of the creek and a steeper valley slope beginning on the northern bank (see selected site photographs included in Appendix E).

The north timber bent is directly exposed to flow and adjacent to a surface layer of heavy rip rap on the left-hand meander bend (photograph 3). The south timber pile bent sits on the terrace of the inner meander of the creek (photographs 4 and 6).

Recent topographic surveys at the bridge location completed by the City were provided to Thurber and are illustrated on Drawing No. 26388-1 to 26388-2 in Appendix A. The bridge slopes gently

from northwest to southeast, with a bridge deck elevation ranging from 660 m to 661 m (photographs 1 and 2).

The creek bed elevation at the project site is at about 657 m, hence the bridge deck sits about 4 m above creek bed level (photograph 4). The eroded slope upstream of the existing bridge shows exposed clay shale and recent signs of instability. We understand the replacement of the existing bridge will retain the current alignment, and as a result have not assessed the adjacent observed instability in this investigation.

4.3 Subsurface Conditions

The soil conditions encountered in the test holes are described on the test hole logs in Appendix B, and are shown on the generalized stratigraphic cross-section A-A' on Drawing No. 26288-2 in Appendix A.

The following main strata were encountered in descending order:

- Clay till and/or reworked sandstone (possibly Colluvium); and
- Sandstone and / or clay shale bedrock.

A 600 mm thick pavement structure was encountered at TH19-01, and a thin layer of organic topsoil was in TH19-02 at existing grade. Further descriptions of the soil conditions encountered during drilling are provided in the following sections.

Review of available test hole logs from previous investigations (Ref. 1, Appendix C) and in-house records at the bottom of Blackmud Creek Valley indicate similar soil conditions and depth of surficial soils overlying the bedrock formation.

4.3.1 Clay Till and/or Reworked Sandstone

Clay till and reworked sandstone layers were encountered underlying the organic topsoil in TH19-01 and TH19-02. The reworked material was primarily medium plastic clay or reworked sandstone, likely originating from the valley walls. The strata extended to a depth of about 3.8 m below existing grade and was generally sandy with trace oxides and coal chips.

The natural water content of the clay till and reworked sandstone ranged between 19 and 32 percent, and 20 to 26 percent, respectively. SPT "N" values of 10 and 25 blows per 300 mm penetration was recorded in the clay till and reworked sandstone indicating a stiff to very stiff consistency.

One Atterberg limits test completed on the colluvium indicated the sample yielded a liquid limit of 118 percent and a plastic limit of 21 percent, indicating that the clay sample was very high plastic. A gradation analysis was conducted on a select sample, with sand, silt, and clay contents of 16, 47, and 37 percent respectively. This sample is likely to have originated as bedrock.

Clayey sand was encountered in TH19-01 underlying the clay till and overlying the weathered bedrock deposit. The clayey sand was about 0.9 m thick and had a natural water content of 10 percent.

4.3.2 Bedrock

Clay shale and sandstone bedrock was encountered underlying the fill and/or silty clay layers in both test holes. The depth to bedrock in the test holes along the upper trail ranged from 3.6 m to 3.8 m, with corresponding top of bedrock elevations ranging from about 656.4 m (TH19-01) to 657.8 m (TH19-02). In test hole TH19-02 a weathered sandstone layer about 1 m to 2 m thick was encountered above more competent bedrock.

The clay shale was generally dark grey and contained varying amounts of sand and siltstone. The natural water content of the clay shale ranged between about 16 and 32 percent. SPT “N” values of the clay shale ranged between 82 to over 100 blows per 300 mm penetration, with the lower blow count in the upper weathered portion of the soil layer in TH19-01, indicating a very hard consistency in soil mechanics terminology, and generally increasing in stiffness with depth.

The sandstone was generally grey, fine grained, silty, and contained trace to some amounts of clay shale and coal. The natural water content of the sandstone ranged between about 16 and 37 percent. SPT “N” values of the sandstone ranged between 20 to over 100 blows per 300 mm penetration, with the lower blow count in a thin weathered layer in TH19-02 indicating a compact to very dense state in soil mechanics terminology.

The result of one blenderized Atterberg limits test indicated the clay shale has a liquid limit of 129 percent and a plastic limit of 32 percent, indicating that the clay shale sample was highly plastic.

4.4 Groundwater Conditions

A standpipe piezometer was installed in TH19-01 to allow for future groundwater level monitoring. The groundwater levels were recorded upon completion of the standpipe piezometers installation and July 29, 2019.

The slough and groundwater levels are noted on the test hole logs in Appendix B and are summarized in Table 4.2.

TABLE 4.2
SEEPAGE AND SHORT-TERM GROUNDWATER LEVELS

TEST HOLE	GROUND ELEVATION (m)	STANDPIPE INSTALLATION DEPTH * (m)	WATER TABLE DEPTH* (ELEVATION) (m)	
			Upon Installation	July 29, 2019
TH19-01	660.12	9.9 (650.2)	Dry	2.6 (657.5)

Note: (*) Meters below current grade (Elevation in meters).

Results of the most recent monitoring on July 29, 2019 indicated that the groundwater level was about 657.5 m, which corresponds to about 1 m above creek level. It should be noted that groundwater levels can vary in response to seasonal factors and precipitation. Hence the actual groundwater conditions at the time of construction could vary from those recorded during this investigation.

4.5 Frost Effects

The surficial in-situ soils at this site are considered to have intermediate to high frost susceptibility. The expected depth of frost penetration has been estimated for the in-situ clay materials encountered in the test holes for both the mean annual Air Freezing Index (AFI) of 1400ºC-days, and the 50-year return period AFI of 2200ºC-days. The mean annual depth of frost penetration for the soils and the penetration for a 50-year return period are provided in Table 4.3.

TABLE 4.3
ESTIMATED DEPTH OF FROST PENETRATION

SOIL TYPE	MEAN ANNUAL AFI (1400ºC-days)	50-YEAR RETURN AFI (2200ºC-days)
Clay	2.1	2.5

The frost penetration depths are estimated for a uniform soil type with no insulative cover. If the area is covered with turf or significant snow cover, the depth of frost penetration will be less. The average frost depth may be used during construction with some risk; the 50-year return period depth should be used for design.

5. GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

5.1 General

It is understood that the preferred foundation type for the new bridge is driven steel piles, which will support pre-cast concrete abutments. An existing single-span truss bridge (from Connor's Hill Pedestrian Bridge) will be refurbished and placed on the abutments. Grade changes will be minimized but the bridge will consist of a longer, single span structure. The following sections outline the comments on existing and proposed head slope stability, foundation types, and estimated earth pressures.

5.2 Slope Stability Evaluation

5.2.1 General

No recent signs of instability were observed at either the north or south riverbanks at the existing bridge crossing site. Some evidence of toe erosion was observed at the toe of the north bank where heavy rock rip rap was exposed at the current creek level. Above the rip rap, the river bank slopes upwards to a timber back wall with minimal vegetation. The south bank slopes gently upwards to a timber abutment retaining wall and was well vegetated.

The heavy rock riprap on the north river bank and timber abutment retaining walls at both head slopes under the existing bridge all appear to be functioning well at the present time.

5.2.1.1 North Head Slope

The north head slope incorporates heavy rip rap at the creek edge, and timber abutment retaining wall under the bridge. The river bank slope extends northward at about a 3.7H:1V slope up to the timber retaining wall. No details are available on the existing rip rap or wall design; however, it is assumed that the rip rap was placed sometime in the past to reduce mitigate potential toe erosion.

5.2.1.2 South Head Slope

The south head slope is situated on a low-level terrace on the inside meander bend of the creek. The timber bent sits on the flood plain, then the head slope rises at about a 3H:1V slope to the existing timber backwall.

5.2.2 Stability Analysis

Slope stability analyses were undertaken for both the north and south head slopes and abutments in their current configuration using the program SLOPE-W based on limit equilibrium stability analysis for two separate cases as follows:

It should be recognized that the test holes were limited to accessible locations on the existing trail and hence the subsurface conditions between test holes and particularly on the creek slopes have been estimated based on the available geological observations.

Presumptive soil parameters were chosen based on the results of this investigation and also from comparison of soil parameters on similar soils and bedrock materials from other representative sites in the Edmonton area and are summarized in Table 5.1. Results of the stability analyses are presented in Appendix D and summarized in Table 5.2.

TABLE 5.1
SOIL AND BEDROCK STRENGTH PARAMETERS
USED IN STABILITY ANALYSES

SOIL TYPE	UNIT WEIGHT γ (kN/m^3)	EFFECTIVE FRICTION ANGLE ϕ' (°)	EFFECTIVE COHESION c' (kPa)
Clay Fill	18	23	5
Sand (Clayey)	21	30	2
Clay	18	23	5
Bedrock	21	25	20

Two stability cases were evaluated at each existing head slope, as follows;

- A shallow failure exiting at the base of the timber abutment retaining wall, and
- A deeper failure extending below the presumptive tips of the piles.

A target factor of safety of 1.5 is desired for the head slope stability. Results of the slope stability analyses are presented in Table 5.2 and the stability charts (Figures D1 to D5 are presented in Appendix D.

As noted, the target factors of safety are met for the existing north slope configuration for both shallow and deep failure surfaces, as shown in Figures D1 and D2.

The factor of safety for a shallow failure at the south headslope is slightly less than 1.5 (Figure D3) but exceeds 1.5 when a modest contribution of the existing pile is taken into consideration (Figure D4). The factor of safety for a deep failure exceeds the target factor of safety (Figure D5).

TABLE 5.2
RESULTS OF SLOPE STABILITY ANALYSES

SLOPE	CASE	FOS [1]	FIGURE
North	Existing Slope – Shallow Failure	1.56	D1
North	Existing Slope – Deep Failure	2.44	D2
South	Existing Slope – Shallow Failure	1.46	D3
South	Existing Slope – Shallow failure with restraining shear force of 0.5 kN/lineal m from pile wall	1.50	D4
South	Existing Slope – Deep Failure	2.51	D5

Note: (1) Long term factor of safety; and

It should be noted that the above analyses are for the existing bridge configuration and further stability analyses should be undertaken when the north and south abutment slope configurations are available to check the slope stability.

Where necessary, Class II rip rap (City of Edmonton Construction Specifications Section 02374) could be placed at the toe of the riverbanks to enhance the riverbank erosion protection. However, the erosion protection should be reviewed by a hydrotechnical consultant to evaluate the adequacy and determine if additional riverbank erosion protection is warranted.

5.3 Foundation Types

5.3.1 General

Driven steel piles and cast in place concrete piles are the preferred foundation types for support of the new bridge abutments. It is expected that the final choice of foundation types will depend on load requirements, accessibility of piling equipment, ease of construction, as well as economic and scheduling considerations.

Recommendations for both types of foundations are provided in the following sections. Additional recommended construction procedures are presented in Appendix F.

Continuous flight auger (CFA) piles could also be used to advance the piles into the underlying bedrock and recommendations for these can be provided upon request.

Both pile types may be designed based on a combination of skin friction plus end bearing resistance. The ultimate geotechnical pile capacity for Limit States Design (LSD) is defined as follows:

$$Q_T = Q_B + Q_s \quad (kN)$$

Where:

Q_T = Ultimate static pile capacity (kN)

Q_B = Ultimate end bearing capacity (kN)

Qs = Ultimate skin friction capacity (kN)

The factored ULS pile capacities are based on the product of the estimated ultimate pile capacity and the appropriate geotechnical resistance factors. The geotechnical resistance factors are prescribed in the National Building Code (NBC, 2015) and are dependent on the method used to determine the ultimate pile capacity, as summarized in Table 5.3.

TABLE 5.3
RECOMMENDED GEOTECHNICAL RESISTANCE FACTOR FOR LIMIT STATES DESIGN OF DEEP FOUNDATIONS (NBC 2015)

DESCRIPTION	GRF [1]
(a) Resistance to axial load	
(i) semi-empirical analysis using laboratory and in-situ test data	**0.4**
(ii) analysis using static loading test results	0.6
(iii) analysis using dynamic monitoring results	0.5
(iv) uplift resistance by semi-empirical analysis	**0.3**
(v) uplift resistance using loading test results	0.4
(b) Resistance to horizontal load	0.5

Note: *Bolded values should be used for pile design, unless appropriate pile load tests are conducted; and
(1) Geotechnical Resistance Factor.

The factored ULS geotechnical pile capacity is equal to the ultimate geotechnical pile capacity times a resistance factor. A resistance factor of 0.4 may be used for compression and 0.3 for tension (refer to NBC 2015). The geotechnical resistance factor in compression may be increased to 0.5 if the capacity of driven steel piles is verified by dynamic testing of piles (i.e. PDA tests) during construction.

5.3.2 Cast-in-Place Concrete Piles

The following general recommendations are provided for design and installation of cast-in-place concrete piles.

a) Cast-in-place concrete end bearing piles should be founded at least 2 m into the hard to very hard bedrock (with SPT N values greater than 100) at a suggested minimum basing elevation at about 653 m. It should be noted that a weathered layer exists overlying the competent bedrock, and that the depth of the bedrock varies across the site. The closest test hole should be referred to during design and installation.

b) Cast in place concrete piles founded in the hard bedrock may be designed using the factored ULS design values presented in Table 5.4.

TABLE 5.4
RECOMMENDED ULS SKIN FRICTION AND END BEARING VALUES FOR CAST-IN-PLACE CONCRETE PILES

APPROX. DEPTH B.G.S. (m)	APPROX. ELEVATION (m)	SOIL TYPE	SKIN FRICTION (kPa)			END BEARING (kPa)	
			Ultimate	ULS Factored [2] Compression	ULS Factored[3] Tension	Ultimate	ULS Factored[2]
0 – 2[1]	661 – 659	Colluvium / Fill	0	0	0	IGNORE	IGNORE
2 – 8	659 – 653	Clay/Sand/ Weathered Bedrock	60	24	18	IGNORE	IGNORE
> 8	Below 653	Bedrock	100	40	36	2,500[4]	1,000

Note: (1) Depth of 2.0 m or the thickness of fill, whichever is greater;
(2) Geotechnical Resistance Factor Compression (GRF) = 0.4;
(3) Geotechnical Resistance Factor Tension (GRF) = 0.3; and
(4) For piles based in very hard clay shale or very dense sand stone at minimum basing elevation of 653 m.

c) Shaft adhesion may be included in the design of end bearing piles where necessary. Shaft adhesion should however not be included in the upper 2 m (or depth of new fill) of the pile below final grade to allow for the possibility of soil drying and shrinking away from the pile shaft. Shaft adhesion should also be ignored within the design depth of scour at the pier pile locations.

d) In the case of belled piles, the bell diameter to shaft diameter ratio should not exceed 3:1, and the bell should not be sloped at more than 30^{o} to the vertical.

e) Where belled piles are used, a minimum pile depth of 2.5 times the bell diameter has been assumed in calculating the above bearing capacity. If less cover is provided, the specified bearing capacity should be reviewed.

f) A minimum pile spacing of 3 shaft diameters is recommended for straight shaft and belled concrete piles. In addition, a minimum edge-to-edge spacing of 600 mm is recommended in the case of belled piles to reduce potential construction problems. Piles within 3 shaft diameters for straight shaft piles or 2 bell diameters for belled piles should not be drilled or poured consecutively within the same 24-hour period in order to allow the concrete in the adjacent pile to set.

g) A minimum pile shaft diameter of 400 mm is recommended to prevent voids from forming during pouring of the concrete. Larger diameter piles are generally required for piles subjected to lateral loading and more practical for construction.

h) Longitudinal reinforcement is required through the pile shaft length to resist potential uplift forces on the pile due to frost action and seasonal moisture variations. If piles are designed as tension elements or are left exposed to freezing temperatures, the pile reinforcing should be designed to resist the anticipated uplift stresses.

i) Temporary steel casing(s) will be required to extend the pile holes through the sand and gravel layers, and to retain the ingress of the high groundwater level (Section 4.4) during construction. Where sand or gravel layers are encountered at or above pile basing depth, it will be necessary to provide steel casing and extend the pile bases deeper into self-supporting soil. The temporary steel casings will also be necessary to prevent potential river flow into the pile holes in the event of high water levels in the creek.

j) All pile excavations should be thoroughly cleaned and visually inspected prior to pouring of the concrete to ensure a satisfactory base has been achieved. No slough or disturbed material should be allowed to remain in the pile excavations. Geotechnical inspection is recommended to confirm suitable bearing conditions have been achieved.

k) Concrete should be poured immediately after drilling of the pile hole to reduce the risk of groundwater seepage and sloughing soil.

l) Cobbles and boulders may be present within the clay, clay till, or sand and gravel layers which could hamper augering if encountered in the pile hole.

m) The concrete materials and methods of concrete construction should be as per CSA A23.1:19/A23.2:19.

5.3.3 Driven Steel Piles

5.3.3.1 General

Driven steel H-section or pipe piles are considered feasible to support the proposed structure at this site.

The piles should be driven to the required embedment depth into the bedrock layer. Pile length requirements will depend on the design loads and driving resistance. It is expected that the driving resistance may vary between the north and south abutments, and hence it is important that monitoring of pile driving should be carried out for all piles to verify that the required pile loads have been met.

Based on the available test holes it is anticipated that hard driving will be required to advance the piles through the bedrock. For estimation of pile penetration depths, it is expected that piles may meet practical refusal at about elevation 653 m at the north abutment, and about 652 m at the south abutment; however, the pile penetration depths may vary depending on the driving energy and bedrock conditions at the abutment locations.

The effect of driving vibrations and noise on the existing structures and site operations would also need to be taken into consideration in choosing driven steel piles for foundation support. As a general guideline, construction vibrations should be limited to peak particle velocities of about 25 to 50 mm/s (depending on the condition of the existing structure) to avoid potential damage to existing concrete structures (Ref. 2**).** Vibration propagation generally should not be a problem for structures located greater than about 15 m from the location of pile driving. However, this should be evaluated taking account of the condition of the existing structures and any underground pipelines near the new abutments. Monitoring of construction vibrations should be carried out during pile driving to check the magnitude of construction vibrations and make any modifications to the pile installation methods as necessary.

At the project site no existing structures were observed to be within 15 m of the proposed alignment. As such, vibration monitoring may be unnecessary during pile installation.

5.3.3.2 Vertical Pile Capacity

The driven steel piles may be designed based on the ultimate and factored ULS skin friction and end bearing values provided in Tables 5.5.

TABLE 5.5
RECOMMENDED ULS SKIN FRICTION AND END BEARING VALUES FOR DRIVEN STEEL PILES

APPROX. DEPTH B.G.S. (m)	APPROX. ELEVATION (m)	SOIL TYPE	SKIN FRICTION (kPa)			END BEARING (kPa)	
			Ultimate	ULS Factored [2] Compression	ULS Factored[3] Tension	Ultimate	ULS Factored[2]
0 – 2[1]	661 – 659	Colluvium / Fill	0	0	0	IGNORE	IGNORE
2 – 8	659 – 653	Clay/Sand/ Weathered Bedrock	60	32	24	IGNORE	IGNORE
> 8	Below 653	Bedrock	100	40	36	12,000[4]	4,800

Note: (1) Depth of 2.0 m or the thickness of fill, whichever is greater;
(2) Geotechnical Resistance Factor Compression (GFR) = 0.4;
(3) Geotechnical Resistance Factor Tension (GFR) = 0.3; and
(4) For piles driven to practical refusal in very hard clay shale or very dense sand stone and capacities verified by driving records.

The piles should be driven to a minimum embedment depth of 8 m to provide sufficient resistance to frost heave, without considering dead loads acting on the piles.

Shaft friction should not be included in the upper 2 m below finished grade to allow for the possibility of soil drying and shrinking away from the pile shaft.

5.3.3.3 Pile Driving

Steel piles should be driven with a hammer of appropriate size and rated energy, depending on the pile design load requirements. As a general guideline, the driving energy should be limited to 630 J per square cm of steel cross section area unless the results from WEAP analyses and/or PDA tests indicate that greater energy could be used without damage to the piles.

The minimum energy required will depend on the pile sizes and design loads and should be determined using WEAP analyses when the design sizes and loads are available. Pile driving records should be maintained during driving of all piles and should be reviewed to confirm that the set criteria have been achieved.

The following guidelines should generally be followed for pile driving and approval:

1. Piles should be driven to the specified pile embedment depths and the required set criteria unless the piles meet premature refusal. Practical refusal is typically defined as a blow count of greater than 125 blows per 250 mm (less than 2 mm per blow), however this should be reviewed based on the results of the driving analysis.

2. Where the piles reach the target depths and the required set for long-term conditions is achieved at the end of initial drive (EOID), the piles may be accepted.

3. In the event that the required set is not achieved at EOID for the design pile embedment depths, the piles should be extended deeper until the set criteria are met. Alternatively, the piles may be allowed to set up for a period of at least 7 days (one week). Selected piles should then be re-tapped to determine if the set requirements are met after “set-up”. The “restrike” should consist of not more than 10 blows of the same (or larger) hammer energy and should be conducted on piles that have not been subjected to potential disturbance from driving of adjacent piles within at least 10 m during the “set-up” period.

4. Where necessary, PDA tests may be undertaken on selected to confirm the pile capacity and verify the set criteria for a specific piling hammer.

5. In the event that premature refusal of the piles is met due to encountering dense material above the target depth, the piles should be reviewed by structural and geotechnical engineers to check that they have adequate capacity to resist the design compression and uplift forces.

6. All piles should be checked for plumbness, and potential damage due to driving at the end of the installation. An out-of-plumb tolerance of 2 percent is typically specified for driven steel piles. Care will be required in set-up and driving of the piles to meet these objectives.

7. Heave of adjacent piles is a concern for close pile spacing and should be monitored throughout the driving. All piles indicating heave of greater than about 5 mm should be re-driven to at least the original embedment depths. If necessary, pile heave may be reduced by pre-boring.

8. Pre-boring may be required through the bedrock within the depth of pile installations. Pre-boring may also be required through the frost zone in the event the pile installations are undertaken during winter when the ground is frozen.

11. The pre-boring hole diameter should be limited to 90 percent of the pile diameter/width or less. Where pre-boring is required through the frozen zone in winter operations, it is more common to oversize the pre-bored hole through the frost depth, and to subsequently backfill the annulus between the pile hole and the pile with lean concrete or compacted granular fill.

12. Driving of deep steel piles may cause a void to form near ground surface due to pile "flutter" during driving. When this occurs, the voids should be backfilled with either grout or tamped sand to maintain the contact between the pile and ground in order to provide the required resistance to vertical and horizontal loads. Voids in the surficial fill caused by flutter may also be filled with bentonite slurry to maintain the integrity of the fill. Pile Monitoring During Construction

Pile monitoring should be carried out during the pile installations for the proposed building to confirm that the required pile installation specifications and capacity are met.

There may be considerable variation in the hammer performance achieved during driving that affects the delivered energy to the pile. Thus, the actual pile capacity may be subject to significant variability for a given set.

5.4 Concrete Grade Beams and Pile Caps

Where pile foundations are used, grade beams or pile caps may be required to transfer the structure loads onto the tops of the piles. If the bases of the grade beam and pile caps are located within the design depth of frost penetration, precautions should be taken to prevent heaving of the grade beam and pile cap due to frost penetration or alternatively the piles and pile cap should be designed to resist the resulting uplift pressures.

The recommended construction procedure for preventing heave under the grade beams and pile caps involves placement of a layer of crushable non-degradable void form at least 150 mm thick under the pile cap. The grade beam must be designed in accordance with the crushing strengths of the void form used and the piles must be able to resist the resulting uplift load.

5.5 Retaining Walls

A triangular earth pressure distribution may be utilized for design of low retaining walls and structures resisting earth pressures. The horizontal earth pressure, p_h, at depth, h, may be calculated as follows:

p_h = k x [(W x h) + q) (kPa)

Where:

k = the coefficient of earth pressure (Table 5.6)

W = the bulk unit weight (kN/m^3)

h = the depth below backfill surface (m)

q = surcharge pressure (kPa)

TABLE 5.6
LONG-TERM EARTH PRESSURE COEFFICIENTS FOR VERTICAL RETAINING WALLS ASSUMING A STIFF WALL, GOOD SURFACE DRAINAGE, AND HORIZONTAL BACKSLOPE

SOIL DESCRIPTION	BULK UNIT WEIGHT kN/m^3	COEFFICIENTS OF EARTH PRESSURE		
		k_a ACTIVE	k_o AT-REST	k_p PASSIVE
Clay Backfill - on site clay and clay till (compacted to 95% of SPMDD)	21	0.40	0.58	2.5
Sand Backfill - on site sand (compacted to 95% SPMDD)	20	0.30	0.45	3.4
Pit Run Gravel Compact (compacted to 95% SPMDD)	22	0.27	0.43	3.7

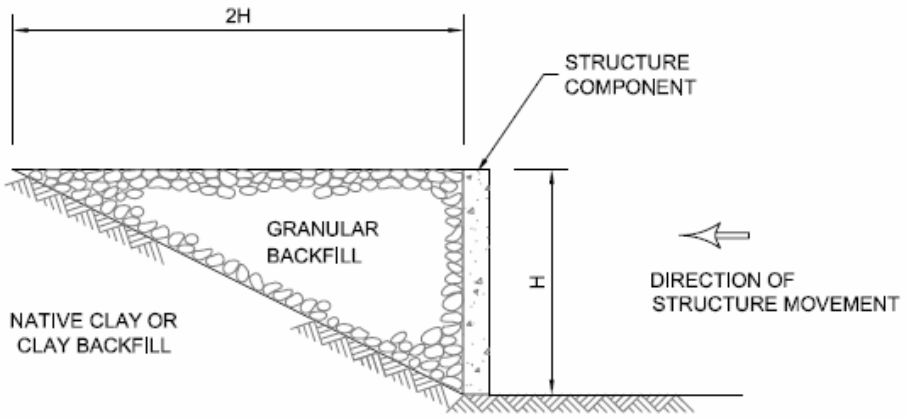
Note: SPMDD = Standard Proctor Maximum Dry Density

Active earth pressure may be used for design of relatively low retaining walls that can be allowed to move laterally at the top of wall a distance of 0.01 times the height of the wall. The passive pressure will be mobilized when the top of the wall has moved into the backfill a distance of 0.02 times the height of the wall. The passive resistance should only be used where there is assurance that the soil in front of the wall will not be displaced in the future either due to scour or excavation.

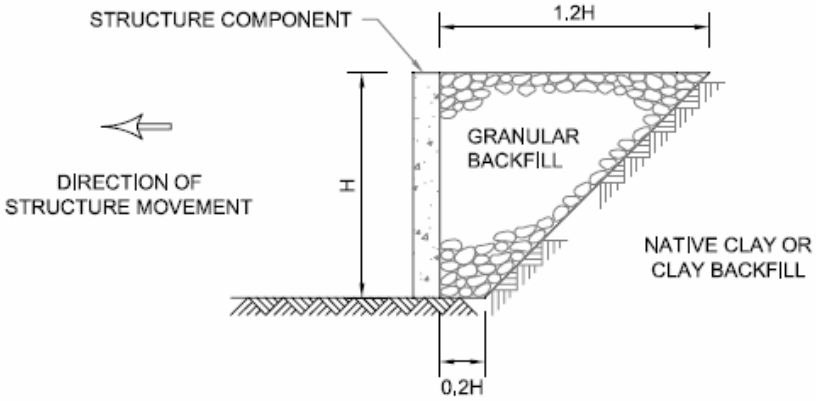
Appropriate load factors should be applied to the lateral earth pressures on retaining walls. A geotechnical resistance factor of 0.5 should be applied to the passive pressure. The global stability of retaining walls on slopes should also be evaluated during detailed design. During detailed design, Thurber should be contacted to review the retaining wall design and to assess the global stability of the slopes retained by the walls.

Where traffic or other live loads may travel or operate near the retaining wall the horizontal pressures due to the live load should be superimposed on the static earth pressures.

The earth pressures are governed by the soil type within a zone of mobilized soil behind the wall. The minimum thickness of backfill required to mobilize the recommended coefficients of earth pressure for gravel is shown in Figure 5.1.



(a) MINIMUM THICKNESS OF GRANULAR BACKFILL TO MOBILIZE PASSIVE EARTH PRESSURES



(b) MINIMUM THICKNESS OF GRANULAR BACKFILL TO MOBILIZE ACTIVE EARTH PRESSURES

MINIMUM THICKNESS OF GRANULAR BACKFILL REQUIRED TO MOBILIZE RECOMMENDED COEFFICIENTS OF EARTH PRESSURES FOR GRAVEL

FIGURE 5.1

Where retaining structures will extend below the water table, either sub-drainage should be provided to maintain the groundwater level below the base of the wall or alternatively the earth pressures should be calculated as follows, assuming full hydrostatic pressures (parameters defined above):

$$p_h = [k \times (W - 9.8) + 9.8] \times h \quad \text{(kPa)}$$

Perimeter drainage, where used, should consist of perforated drains surrounded by washed gravel and enveloped with a non-woven geotextile. Free-draining sand or gravel should be placed against the wall to about 600 mm below the ground surface and an impervious clay cap should be formed at the ground surface. The purpose of the free draining sand is to allow hydraulic flow to the subdrains. The purpose of the 600 mm clay cap is to prevent surface water infiltration into the backfill. Other types of impervious barriers such as geomembranes, concrete slabs or hard surfacing could be used to achieve this objective.

Frost action should also be considered in the design of retaining walls where the backfill is subject to freezing. The recommended approach for preventing horizontal frost pressures on the retaining walls is through the use of frost stable backfill combined with subdrainage where necessary.

Care should be taken not to over compact the backfill, otherwise higher earth pressure will result which may distress the wall.

Gravel fill behind the concrete retaining walls may consist of crushed gravel or pit run gravel meeting City of Edmonton Specifications Class 3, Designation 20 or Class 3, Designation 80 respectively.

5.6 Cement Type

Two water-soluble sulphate ion (SO_4) content tests were conducted on selected soil samples recovered from the upper strata of the test holes. Test results show the presence of less than 0.1 percent of water-soluble sulphate content in the soil samples.

As a result, CSA Type GU (General Use hydraulic cement) may be used in the subsurface concrete at this project site. Results of the sulphate testing is presented on the test hole logs in Appendix B.

The recommendations stated above for the subsurface concrete at this site may require further additions and / or modifications due to structural, durability, service life or other considerations which are beyond the geotechnical scope.

In addition, if imported material is required to be used at the site and will be in contact with concrete, it is recommended that the fill soil be tested for sulphate content to determine whether the above stated recommendations remain valid.

In addition, if imported material is required to be used at the site and will be in contact with concrete, it is recommended that the fill soil be tested for sulphate content to determine whether the above stated recommendations remain valid.

5.7 Seismicity

Hard bedrock was encountered underlying the surficial soils at depths of about 4 m below existing grade. Based on Table 4.1.8.4A of the National Building Code (2010) definitions, the classification for seismic site response is Site Class C.

6. CONSTRUCTION INSPECTION

The performance of the structures will depend upon the quality of workmanship during construction. This is particularly important in regard to foundation installations where variations in soil conditions could occur. Therefore, it is recommended that inspection be provided by qualified geotechnical personnel during foundation installation to confirm that the piles for the are installed in competent bearing material and that the stratigraphy is similar to those that have been assumed for the design.

7. LIMITATIONS AND USE OF REPORT

There is a possibility that this report may form part of the design and construction documents for information purposes. This report was issued before any final design or construction details have been prepared or issued. Therefore, differences may exist between the report recommendations and the final design, in the contract documents, or during construction. In such instances, Thurber Engineering Ltd. should be contacted immediately to address these differences.

Designers and contractors undertaking or bidding the work should examine the factual results of the investigation, satisfy themselves on to the adequacy of the information for design and construction, and make their own interpretation of the data as it may affect their proposed scope of work, cost, schedules, and safety and equipment capabilities.

8. LIST OF REFERENCES

1. AMEC Earth and Environmental, (January 10th, 2010) Preliminary Geotechnical Report: SLRT – Proposed Bridge Over Blackmud Creek, Edmonton, Alberta. File No. RG19681.BMC.

2. Amick H. and Gendreau M, (2000) Construction Vibrations and Their Impact on Vibration Sensitive Facilities, ASCE, DOI 10.1061/40475(278)80.

3. Andriashek, L.D., (1988) Quaternary Stratigraphy of the Edmonton Map Area, NTS 83H, Alberta Research Council Open File Report #198804.

4. Kathol, C.P. and McPherson, R.A. (1975), Urban Geology of Edmonton. Bulletin 32 Alberta Research Council.

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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APPENDIX A

Drawing No. 26388-1 – Overall Site Plan Showing Test Hole Locations
Drawing No. 26388-2 – Stratigraphic Cross-Section at Bridge

H:\26000\26388 111th Street Pedestrian Bridge, Edm, AB\Drafting\26388-1~2.dwg - 1 - Oct. 04, 2019

N
W E
S

LEGEND

TEST HOLE LOCATION

0 2 4 6 8 10 15 20m

SCALE 1:300

2017 AIR PHOTO FROM THE CITY OF EDMONTON

THE CITY OF Edmonton

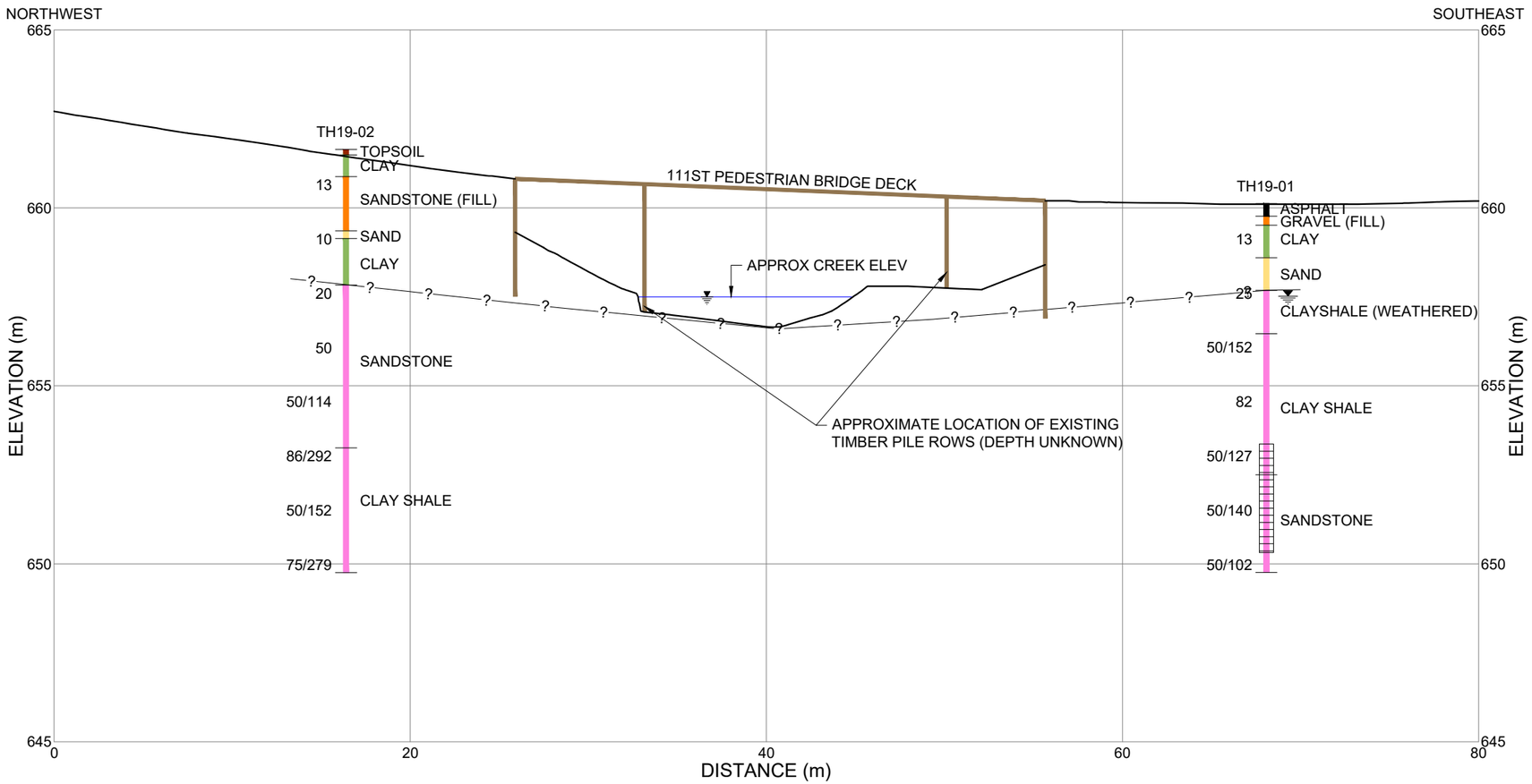
111 STREET PEDESTRIAN BRIDGE REPLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA
GEOTECHNICAL INVESTIGATION

SITE PLAN SHOWING APPROXIMATE TEST HOLE LOCATIONS

DWG No. 26388-1

DRAWN BY	KLW
DESIGNED BY	GL
APPROVED BY	RWT
SCALE	1:300
DATE	AUGUST 2019
FILE No.	26388

THURBER ENGINEERING LTD.



LEGEND

15 SPT N VALUE

WATER LEVEL IN PIEZOMETER

STANDPIPE PIEZOMETER SCREENED INTERVAL

NOTE

DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

THE CITY OF Edmonton

111 STREET PEDESTRIAN BRIDGE REPLACEMENT
BLACKMUD CREEK, EDMONTON, ALBERTA
GEOTECHNICAL INVESTIGATION

CROSS-SECTION A-A'

DWG No. 26388-2

DRAWN BY	KLW
DESIGNED BY	GL
APPROVED BY	RWT
SCALE	H 1:300 V 1:50
DATE	AUGUST 2019
FILE No.	26388

THURBER ENGINEERING LTD.

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APPENDIX B

Symbols and Terms
Modified Unified Soils Classification System
Test Hole Logs

SYMBOLS AND TERMS USED ON TEST HOLE LOGS

1. VISUAL TEXTURAL CLASSIFICATION OF MINERAL SOILS

CLASSIFICATION	APPARENT PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200 mm	Greater than 200 mm
Cobbles	75 mm to 200 mm	75 mm to 200 mm
Gravel	4.75 mm to 75 mm	5 mm to 75 mm
Sand	0.075 mm to 4.75 mm	Visible particles to 5 mm
Silt	0.002 mm to 0.075 mm	Non-Plastic particles, not visible to the naked eye
Clay	Less than 0.002 mm	Plastic particles, not visible to the naked eye

2. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	APPROXIMATE UNDRAINED SHEAR STRENGTH		APPROXIMATE SPT * 'N' VALUE
Very Soft	Less than 10 kPa		Less than 2
Soft	10 - 25 kPa		2 to 4
Firm	25 - 50 kPa		4 to 8
Stiff	50 - 100 kPa		8 to 15
Very Stiff	100 - 200 kPa	Modified from	15 to 30
Hard	200 - 300 kPa	National Building	Greater than 30
Very Hard	Greater than 300 kPa	Code	

* SPT 'N' Value Standard Penetration Test 'N' Value - refers to the number of blows from a 63.5 kg hammer free falling a height of 0.76m to advance a standard 50mm outside diameter split spoon sampler for 0.3m depth into the undrilled portion of the test hole.

3. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	STANDARD PENETRATION TEST (SPT) (Number of Blows per 300 mm)	
Very Loose	0 - 4	
Loose	4 - 10	
Compact	10 - 30	Modified from
Dense	30 - 50	National Building
Very Dense	Over 50	Code

4. LEGEND FOR TEST HOLE LOGS

SYMBOL FOR SAMPLE TYPE

SYMBOLS USED FOR TEST HOLE LOGS

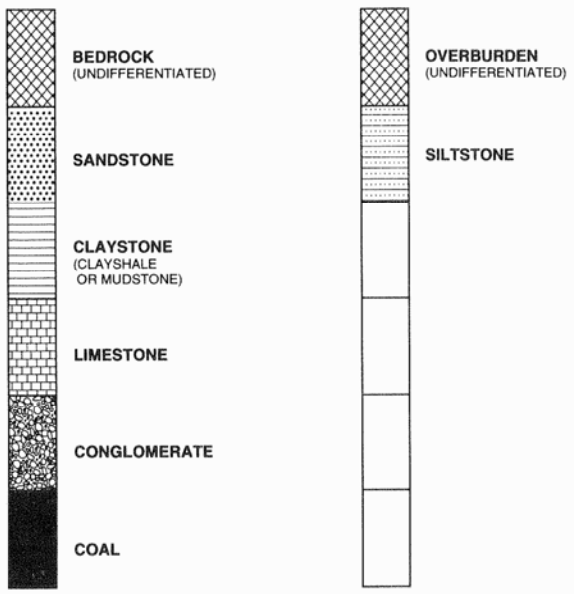
●	WC - Water Content (% by weight) of soil sample
▼	Water Level
■ SPT	Standard Penetration Test 'N' Value (Blows/300mm)
▲ CPen	Shear Strength determined by pocket penetrometer
CVane	Shear Strength determined by pocket vane
Cu	Undrained Shear Strength determined by unconfined compression test
SO_4%	Percent (%) of water soluble sulphate ions

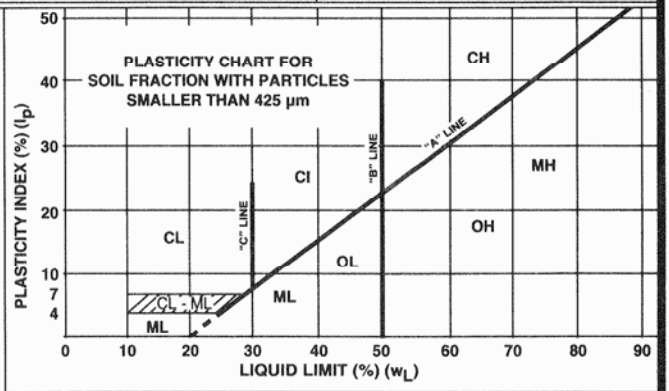
THURBER ENGINEERING LTD.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS
(MODIFIED BY PFRA, 1985)

MAJOR DIVISION			GROUP SYMBOL	THURBER LOG SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN 4.75 mm	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	Determine percentages of gravel and sand from grain size curve. Depending on percentages of fines (fraction smaller than 75µm) coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP; More than 12% GM, GC, SM, SC; 5% to 12% Borderline cases requiring use of dual symbols. $C_U = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR GW
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE I_p LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE I_p MORE THAN 7 — Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols
	SANDS MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW
		SAND WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE I_p LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE I_p MORE THAN 7 — Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$w_L < 50\%$	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (see below)
		$w_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	$w_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	
		$30\% < w_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS	
		$w_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$w_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY	
		$w_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS	
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE

SPECIAL SYMBOLS





THURBER ENGINEERING LTD.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS
(MODIFIED BY PFRA, 1985)

CLIENT: City of Edmonton	PROJECT: 111 STREET PEDESTRIAN BRIDGE REPLACEMENT	BOREHOLE NO: **TH19-01**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: July 9, 2019	PROJECT NO: 26388
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: N5923757.87, E32237.87	ELEVATION: 660.12 (m)

SAMPLE TYPE: GRAB SAMPLE | SPT | NO RECOVERY

BACKFILL TYPE: BENTONITE | DRILL CUTTINGS | SAND | SLOUGH

CPEN (kPa): 50 100 150 200

SPT Blows/300 mm: 10 20 30 40

PLASTIC W.C. LIQUID: 10 20 30 40

DEPTH (m)	SAMPLE TYPE	SPT (N)	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0							ASPHALT	660
					GM		GRAVEL (FILL), dark brown, sand, 20mm size and rounded gravel	
					CI			
1		13	-SO_4 = 0.02%		CI		CLAY (TILL) light grey, silty, some sand, trace gravel and coal chips	659
					SC		SAND dark brown, medium grained, clayey, trace gravel	
2							-brown, some clay	658
		25					CLAY (TILL) grey - brown, sandy, silty, trace oxides and gravel	
3					CH			657
							CLAY SHALE very hard, trace oxides	
4		50/152	>> Cpen > 215kPa		CH			656
					CH		-grey, trace sandstone	
5								655
		82	>> Cpen > 215kPa		CH		-trace siltstone	
6			>> Cpen > 215kPa		CH			654
7		50/127	120 >> Cpen > 215kPa		CH		-trace siltstone lenses	653
					CI-SC		SANDSTONE very dense, grey, some clay shale	
8								652
		50/140	>>		CI-SC		-light grey	
9					CI-SC			651
10								

THURBER ENGINEERING LTD.

FIELD LOGGED BY: LRG	COMPLETION DEPTH: 10.4 m
PREPARED BY: GBL	COMPLETION DATE: 7/9/19
REVIEWED BY:	Page 1 of 2

BOREHOLE LOG 26388.GPJ THRBR_AB.GDT 9/5/19- LIBRARY-NEW LOGO-N E.GLB

CLIENT: City of Edmonton	PROJECT: 111 STREET PEDESTRIAN BRIDGE REPLACEMENT	BOREHOLE NO: **TH19-01**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: July 9, 2019	PROJECT NO: 26388
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: N5923757.87, E32237.87	ELEVATION: 660.12 (m)

SAMPLE TYPE: GRAB SAMPLE | SPT | NO RECOVERY

BACKFILL TYPE: BENTONITE | DRILL CUTTINGS | SAND | SLOUGH

DEPTH (m)	SAMPLE TYPE	SPT (N)	CPEN (kPa) 50 100 150 200 / SPT Blows/300 mm 10 20 30 40 / PLASTIC W.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
10		50/102	>>			CI-SC		SANDSTONE- CONTINUED	650
								END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -Slough at 9.9m -No water Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -July 9, 2019 = Dry -July 29, 2019 = 2.60m	
11									649
12									648
13									647
14									646
15									645
16									644
17									643
18									642
19									641
20									

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FIELD LOGGED BY: LRG	COMPLETION DEPTH: 10.4 m
PREPARED BY: GBL	COMPLETION DATE: 7/9/19
REVIEWED BY:	Page 2 of 2

BOREHOLE LOG 26388.GPJ THRBR_AB.GDT 9/5/19- LIBRARY-NEW LOGO-N E.GLB

CLIENT: City of Edmonton	PROJECT: 111 STREET PEDESTRIAN BRIDGE REPLACEMENT	BOREHOLE NO: **TH19-02**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: July 9, 2019	PROJECT NO: 26388
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: N5923799.95, E32207.7	ELEVATION: 661.64 (m)

SAMPLE TYPE: GRAB SAMPLE | SPT | SHELBY TUBE

DEPTH (m)	SAMPLE TYPE	SPT (N)	CPEN (kPa) 50 100 150 200 / SPT Blows/300 mm 10 20 30 40 / PLASTIC W.C. LIQUID 10 20 30 40	REMARKS	USC	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0				$-SO_4$ = 0.02%	CI		TOPSOIL dark brown, organic, rootlets, some high plastic clay	
					CI-SC		CLAY (FILL), brown, some clay till and sand, trace oxides	661
1		13	118	-Clay = 37% Silt = 47% Sand = 16%	CI-SC		SANDSTONE (REWORKED) compact, brown, silty, trace sand, oxides, and coal chips	
					CI-CH		-trace clay shale	660
2								
					SC		SAND, compact, brown, silt, trace oxides and gravel	
		10			CI		CLAY (TILL) brown, sandy, silty, trace oxides, gravel, and coal chips	659
3					CI			
								658
4		20			CI-SC		SANDSTONE compact, grey, fine grained, trace siltstone lenses and coal	
					CI-SC		-trace clay shale	657
5								
		50			CI-SC		-very dense	656
6					CI-SC			
								655
7		50/114	>>		CI-SC		-some siltstone nodules	
					CI-SC		-some clay shale	654
8								
		86/292	>>	-Seepage -Cpen > 215kPa	CH		CLAY SHALE very hard, dark grey, trace sandstone lenses and coal	653
9					CH			
								652
10								

THURBER ENGINEERING LTD.

FIELD LOGGED BY: LRG	COMPLETION DEPTH: 11.9 m
PREPARED BY: GBL	COMPLETION DATE: 7/9/19
REVIEWED BY:	Page 1 of 2

BOREHOLE LOG 26388.GPJ THRBR_AB.GDT 9/5/19- LIBRARY-NEW LOGO-N E.GLB

CLIENT: City of Edmonton	PROJECT: 111 STREET PEDESTRIAN BRIDGE REPLACEMENT	BOREHOLE NO: **TH19-02**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: July 9, 2019	PROJECT NO: 26388
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: N5923799.95, E32207.7	ELEVATION: 661.64 (m)

SAMPLE TYPE ▯ GRAB SAMPLE ▨ SPT ■ SHELBY TUBE

DEPTH (m)	SAMPLE TYPE	SPT (N)	CPEN (kPa) / SPT Blows/300 mm / PLASTIC W.C. LIQUID	REMARKS	USC	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
10							CLAY SHALE - CONTINUED	
		50/152		>>■ Cpen > 215kPa	CH		-silty, sandy	
				>>▲ Cpen > 215kPa	CH		-dark brown	651
11								
		75/279		>>■ Cpen > 215kPa	CH			650
12							END OF TEST HOLE AT 11.9m UPON COMPLETION: (Below ground surface) -No slough -Water at 8.5m Backfilled with drill cuttings and bentonite chips	649
13								648
14								647
15								646
16								645
17								644
18								643
19								642
20								

THURBER ENGINEERING LTD.

FIELD LOGGED BY: LRG	COMPLETION DEPTH: 11.9 m
PREPARED BY: GBL	COMPLETION DATE: 7/9/19
REVIEWED BY:	Page 2 of 2

BOREHOLE LOG 26388.GPJ THRBR_AB.GDT 9/5/19- LIBRARY-NEW LOGO-N E.GLB

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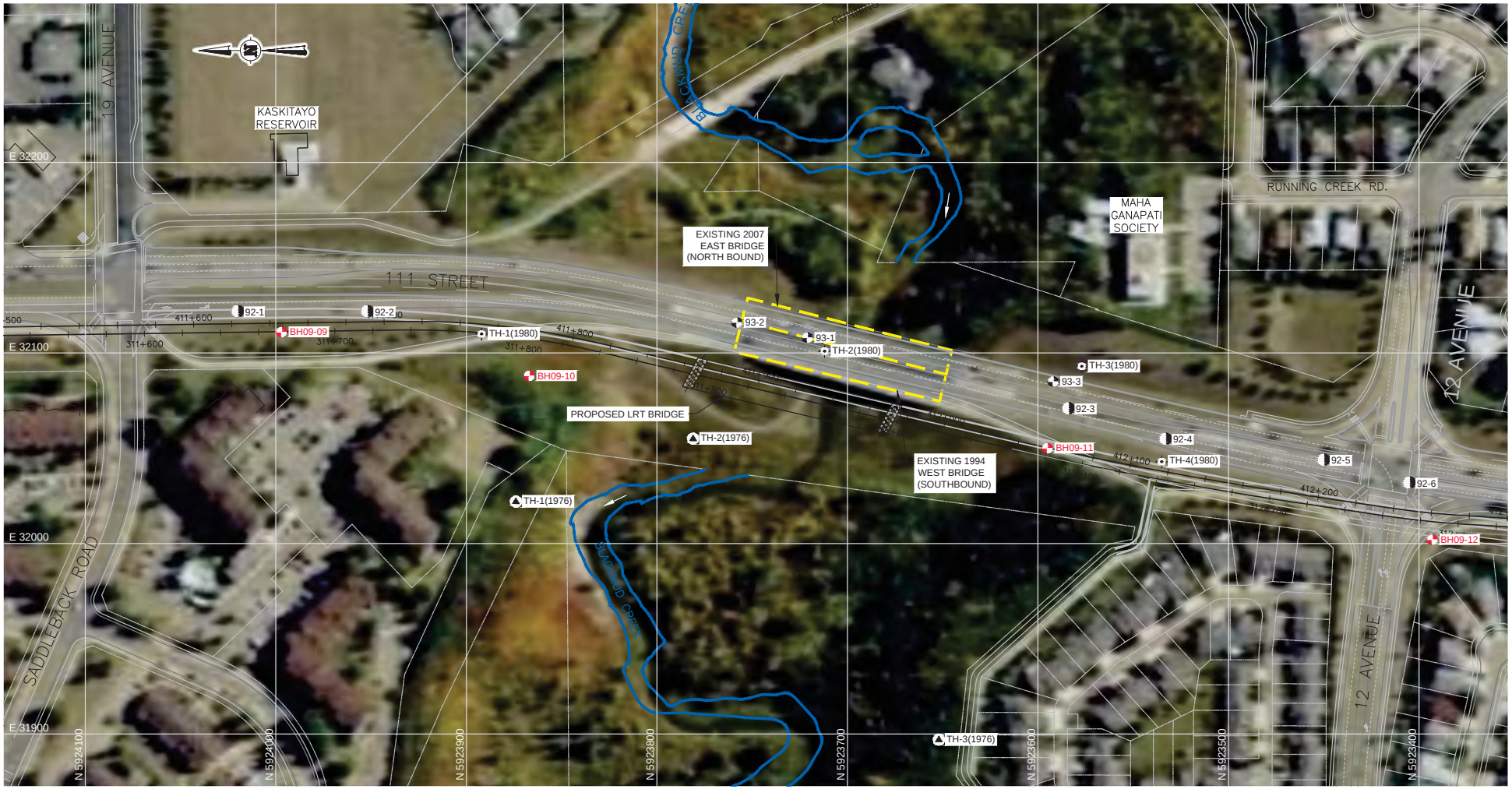
APPENDIX C

Existing Test Hole Logs



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

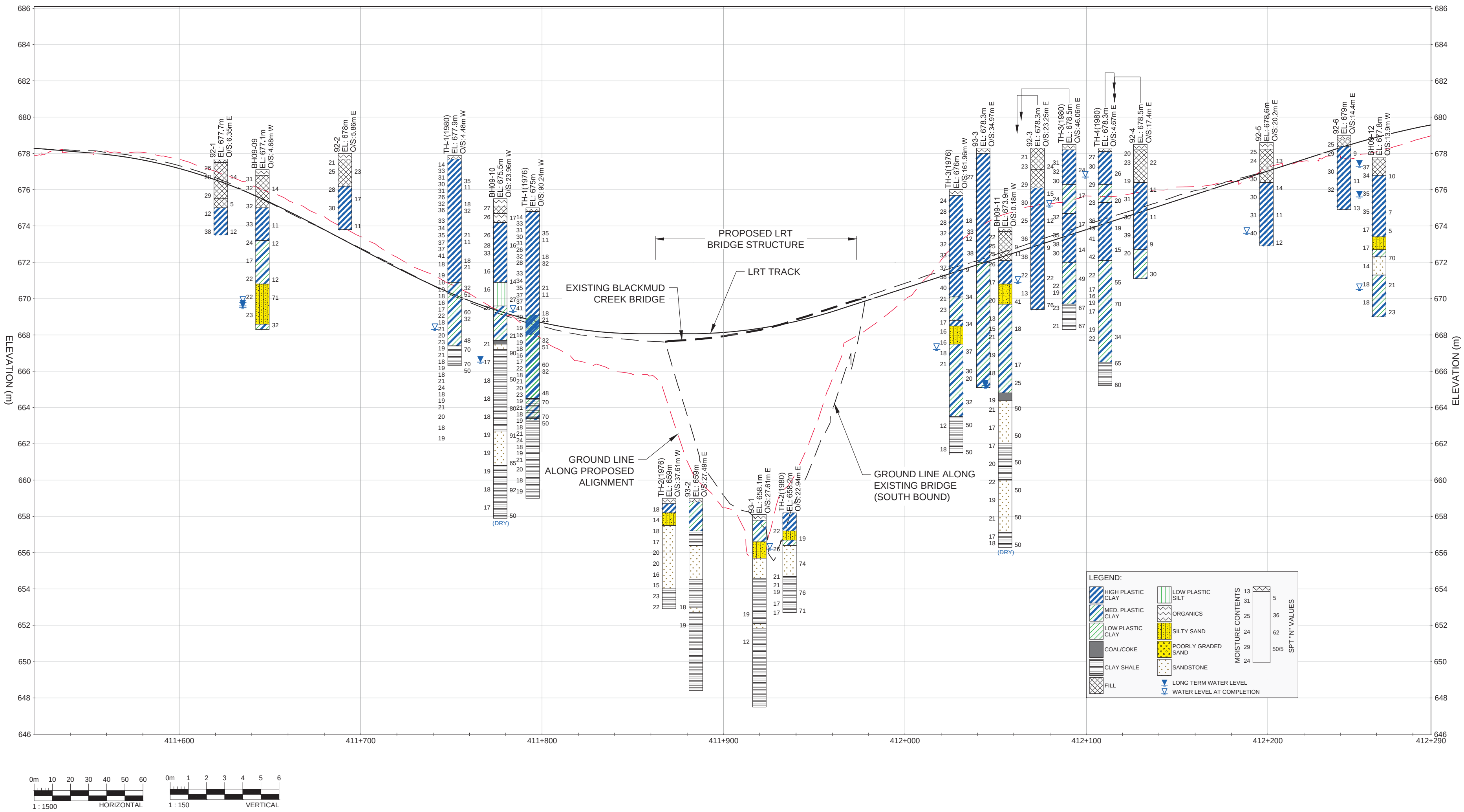
amec

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
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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

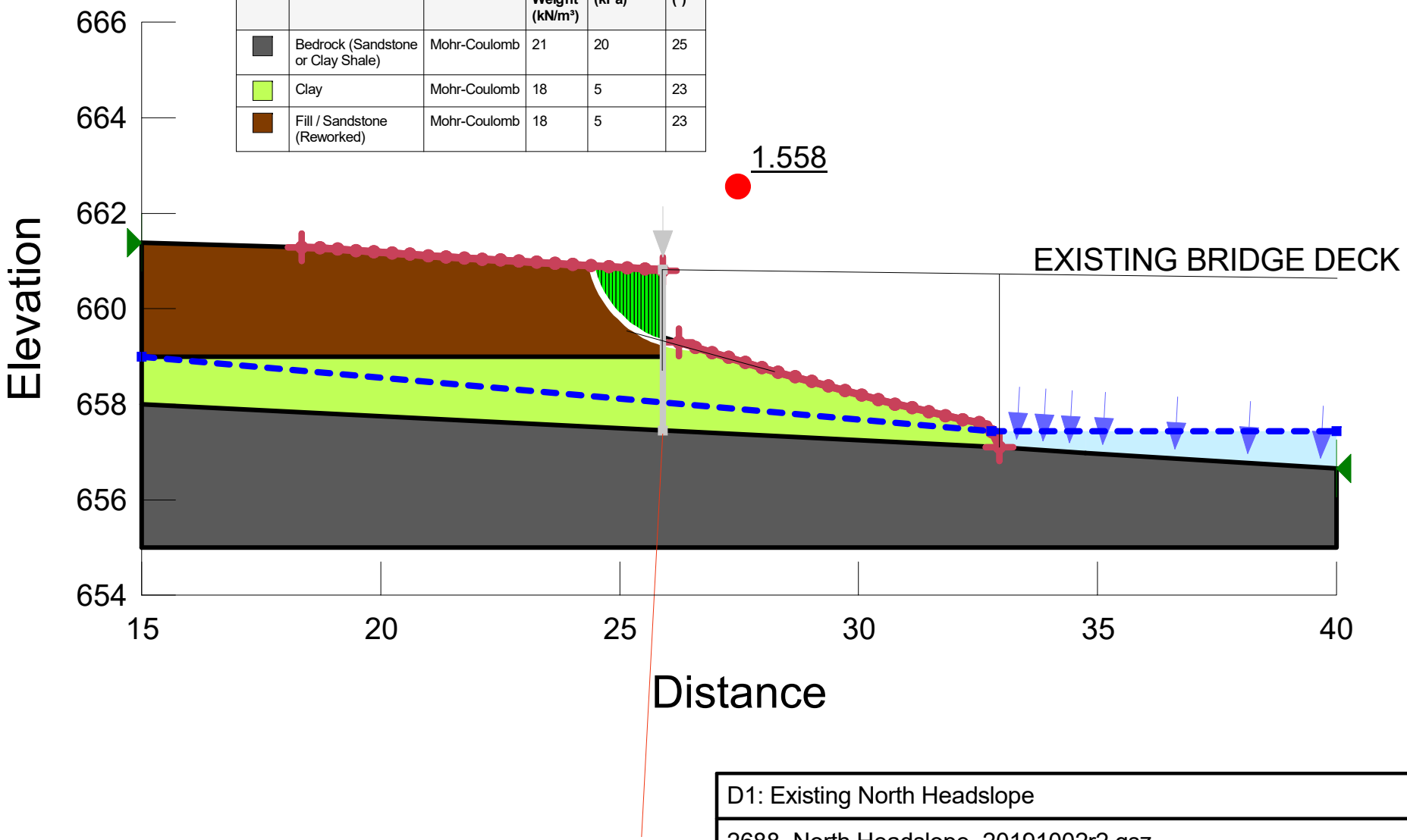
DATE: JANUARY, 2010
PROJECT No.: EG09681
FIGURE No.: FIGURE 2
REV. No.: A
SHEET No.:

THURBER

APPENDIX D

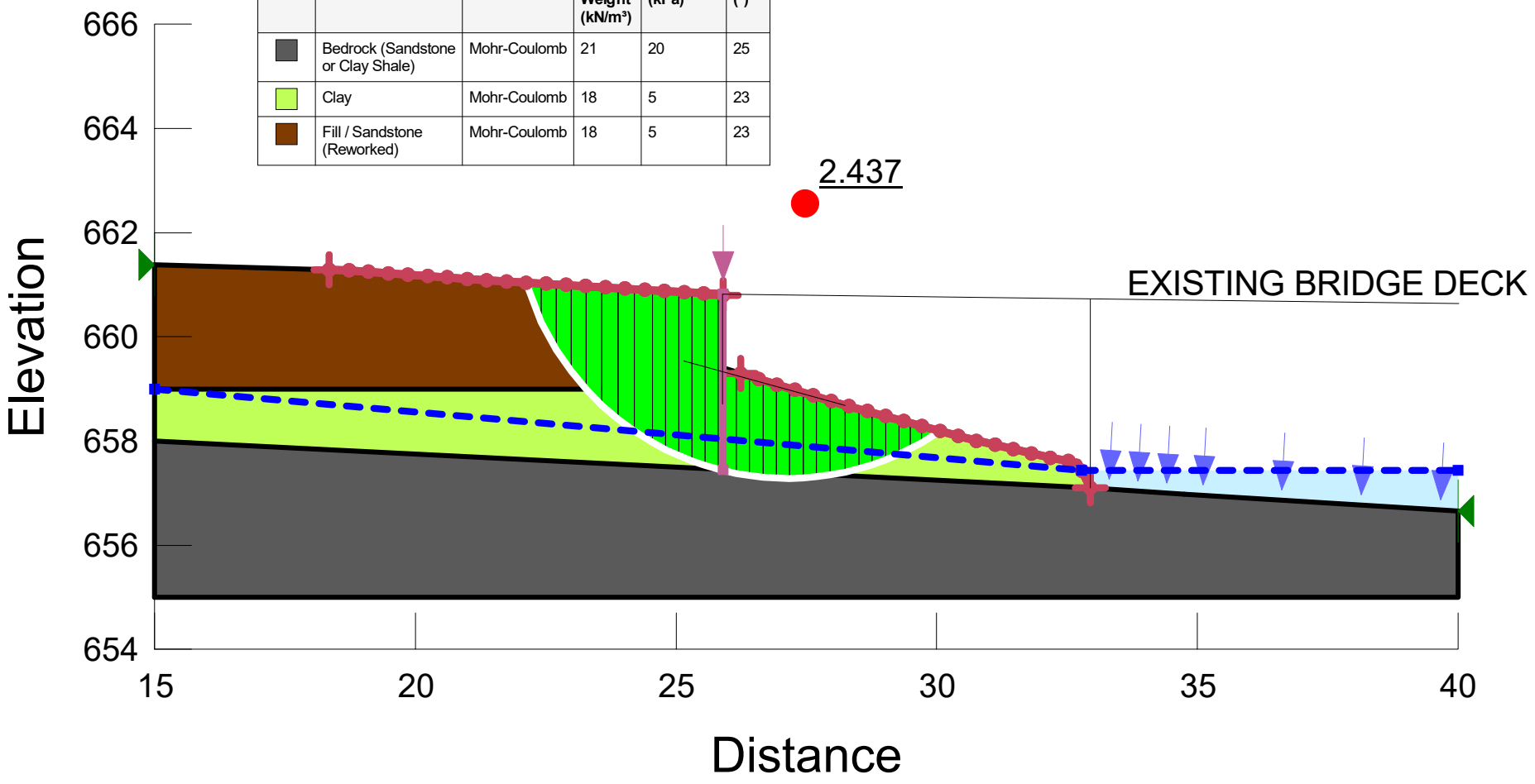
Slope Stability Analyses

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock (Sandstone or Clay Shale)	Mohr-Coulomb	21	20	25
	Clay	Mohr-Coulomb	18	5	23
	Fill / Sandstone (Reworked)	Mohr-Coulomb	18	5	23



D1: Existing North Headslope	
2688_North Headslope_20191002r2.gsz	
2019-10-03	1:120

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock (Sandstone or Clay Shale)	Mohr-Coulomb	21	20	25
	Clay	Mohr-Coulomb	18	5	23
	Fill / Sandstone (Reworked)	Mohr-Coulomb	18	5	23



D2: Existing North Headslope	
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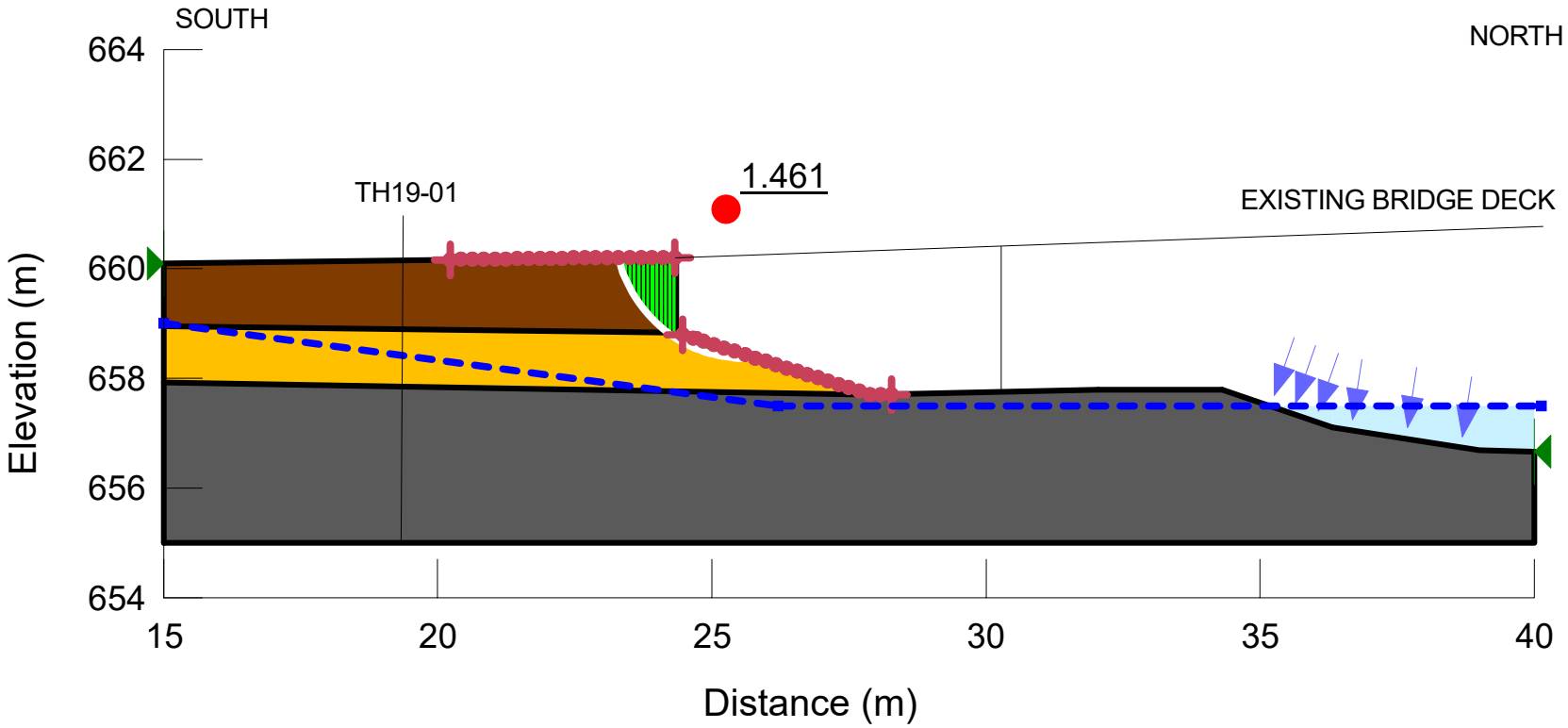
2019-10-03	1:120

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock (Sandstone or Clay Shale)	Mohr-Coulomb	21	20	25
	Clay	Mohr-Coulomb	18	5	23
	Sand (Clayey)	Mohr-Coulomb	20	2	30



D3: Existing South Headslope	
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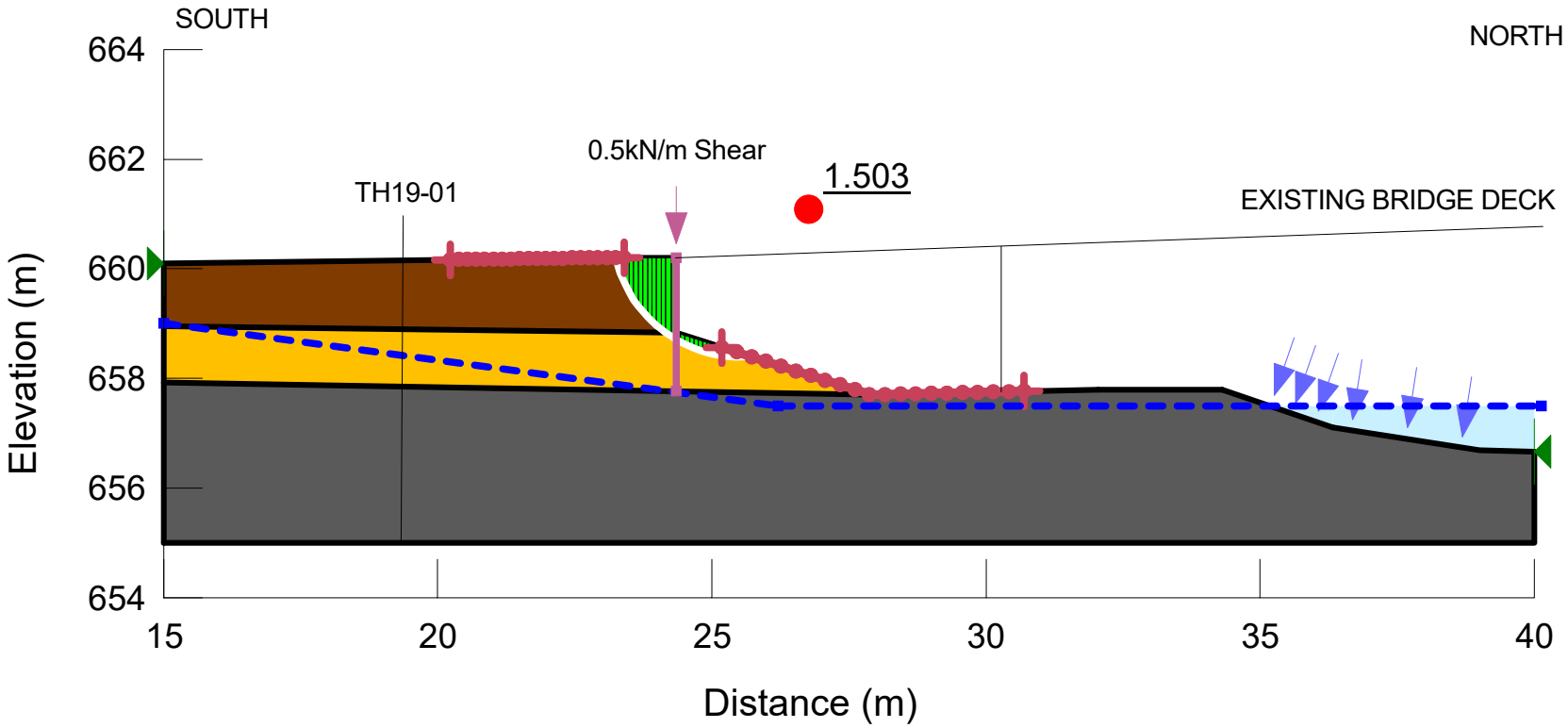
2019-10-02	1:130

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock (Sandstone or Clay Shale)	Mohr-Coulomb	21	20	25
	Clay	Mohr-Coulomb	18	5	23
	Sand (Clayey)	Mohr-Coulomb	20	2	30



D4: Existing South Headslope	
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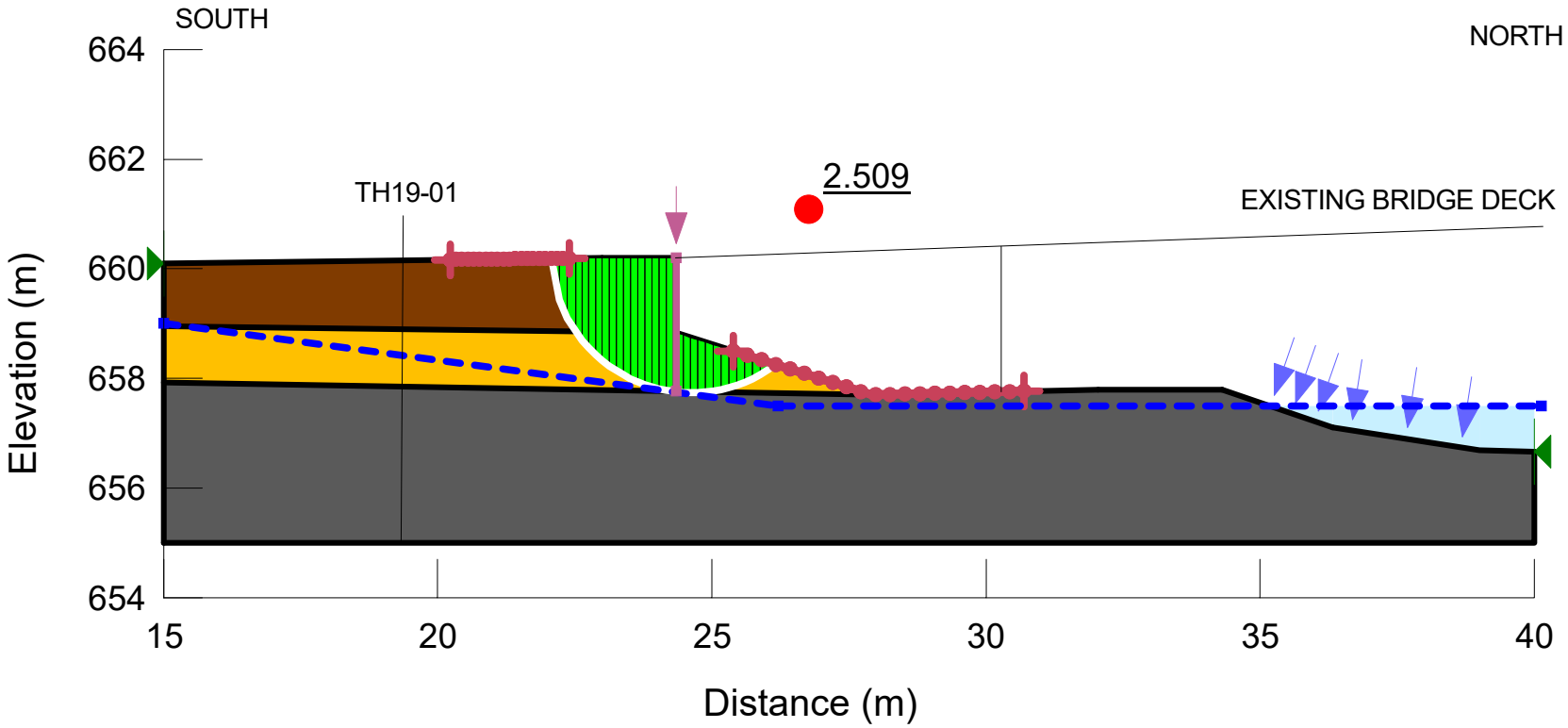
2019-10-02	1:130

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock (Sandstone or Clay Shale)	Mohr-Coulomb	21	20	25
	Clay	Mohr-Coulomb	18	5	23
	Sand (Clayey)	Mohr-Coulomb	20	2	30



D4: Existing South Headslope	
2688_South Headslope_20191002.gsz	
2019-10-02	1:130

THURBER

APPENDIX E

Site Photographs

Photo 1 – View of 111st pedestrian bridge (looking north).

Photo 2 – View of 111st pedestrian bridge (looking south).

Photo 3 – View of existing north timber bent (looking east).

Photo 4 – View of existing timber bents (looking east, upstream).

Photo 5 – View of existing north retaining structure and head slope.

Photo 6 – View of existing south timber bent and low-lying river terrace (looking south-east).

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APPENDIX F

Recommended Construction Procedures

THURBER

RECOMMENDED CONSTRUCTION PROCEDURES

The following construction procedures are considered to represent good practice and are to be read in conjunction with the text of this report.

1. BACKFILLING

1.1 Backfill around foundations should be placed in such a manner so as to prevent settlement and to be relatively impervious near the surface so that water does not pond against foundations nor be allowed to seep into the soil.

1.2 Backfill should not be placed until the structure has sufficient strength to withstand the earth pressures resulting from placement and compaction.

1.3 All backfill around grade beams, foundation walls, etc. must be carefully and uniformly compacted. The backfill should be placed in even layers and no frozen or organic material should be incorporated into the fill. All lumps of material must be broken down or squeezed together during placing and compaction.

1.4 The final grade (allowing for some settlement of the backfill) should shed water away from the structure.

1.5 During construction, precautions should be taken to prevent water ponding in grade beam excavations thereby acting as a source of water to soften the soil under the floor slab area or providing a source of water for frost action if the building is not heated during freezing weather.

2. BORED CAST-IN-PLACE CONCRETE PILES

2.1 If there is evidence of water bearing and/or sloughing soil, casing should be used to seal off the water or prevent the sloughing of the sides of the hole. The concrete and reinforcing steel should be on hand and placed as soon as the pile hole has been completed and approved.

2.2 Pile bells, if used, should be formed entirely in self-supporting soil and it may be necessary in some cases to extend the pile bell if caving occurs at the location of the bell.

2.3 Water should not be left ponded on the pile base and should be removed or dried by the use of dry cement when permitted by the engineer.

2.4 Concrete should be placed without segregation and carefully vibrated throughout the full length of the pile to ensure that voids do not exist in the pile shaft. The concrete slump

should be between 75 and 125 mm with a minimum compressive strength at 28 days of 21 MPa (3000 psi). Higher compressive strengths may be required for structural or durability reasons, and higher slumps may be necessary for closely spaced reinforcing bars or where concrete is to be tremied under water.

2.5 Steel reinforcing should be tied into the grade beam reinforcing steel. This recommendation is important where the soil below grade beam can swell from a change in moisture content or by frost action before the building is heated.

2.6 Piles closer than 2 1/2 diameters should not be drilled and poured consecutively unless permitted by the engineer and depending upon soil conditions. Where the drilling operation might affect the concrete in the adjacent pile, the drilling should not be carried out until the concrete has at least 24 hours to set, or before the concrete has reached its initial set.

3. DRIVEN STEEL PILES

3.1 Piles shall be driven by equipment having a striking weight of not less than one-third of the driven weight of the piles. The driver should be capable of delivering at least 27 kN-metres (20,000 ft-lbs) of energy.

3.2 The number of blows required to drive the pile each foot should be recorded for every pile as an indication of the satisfactory carrying capacity of the pile and as an indicator of potential tip damage.

3.3 The driving energy should be restricted to 6300 kN-metres per square metre (3,000 ft-lbs per square inch) of steel in the pile cross-section

3.4 After each pile is driven to its required depth an elevation should be taken of the pile top or on a suitable mark on the side of the pile. This elevation should be checked periodically to ensure that it is not heaved by the driving of adjacent piles. Piles that are heaved must be redriven.

3.5 For piles, which displace a considerable amount of soil during driving, such as closed-end piles, care must be taken that the driving does not cause damaging horizontal displacement of existing structures or foundations.

3.6 Where piles are designed to gain support by skin friction in the soil, it is essential that the pile have ends and walls free from protrusions, which would cause voids or disturbance of the adjacent soil during driving.

Appendix E: Fisheries Assessment (Kingfisher 2020)

Blackmud Creek 111th St. Pedestrian Bridge

Fisheries Resources Assessment

PREPARED FOR:

Spencer Environmental Management Services Ltd.

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Edmonton, AB
T5K 2J8

PREPARED BY:

Kingfisher Aquatics Ltd.

23 Otterbury Avenue
Red Deer, AB
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March 2020

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Appendices

1.0 INTRODUCTION

The City of Edmonton (the City) is planning to replace an existing pedestrian bridge over Blackmud Creek that is located immediately upstream of the 111th Street road crossing of the creek (the Project). On behalf of the City, Spencer Environmental Management Services Ltd. (Spencer Environmental) has retained Kingfisher Aquatics Ltd. (Kingfisher) to complete a fisheries resources assessment of Blackmud Creek and prepare a fisheries impact assessment for the Project.

This report presents the results of the fisheries resources assessment of Blackmud Creek conducted by Kingfisher on September 5, 2019. The scope of work for the fisheries assessment was developed to provide the City with sufficient fisheries information to satisfy the information requirements of Fisheries and Oceans Canada (DFO) and the Alberta Code of Practice for Watercourse Crossings (AEP 2019a). The primary objectives of the fisheries assessment are described below.

- Characterize the fisheries resources in Blackmud Creek within the vicinity of the Project.
- Assess the potential negative effects to fisheries resources that may occur as a result of the Project.
- Identify strategies to mitigate negative effects to fisheries resources as a result of the project.
- Provide recommendation regarding the need to request a DFO Request for Review.

2.0 PROJECT INFORMATION

2.1 SETTING

The Project is located on Blackmud Creek approximately 5 km upstream from its confluence with Whitemud Creek, which subsequently flows into the North Saskatchewan River (Figure 1). Alberta Environment and Parks (AEP) has designated Blackmud Creek as a Class C waterbody with a restricted activity period (RAP) that extends from April 16 to June 30 (AESRD 2012). Class C waterbodies are considered to be moderately sensitive fish habitat that is broadly distributed and are sensitive enough to be damaged by unconfined or unrestricted instream activities (Alberta Environment 2001). Additional information regarding the location of the Project and the Blackmud Creek drainage is provided in Table 1.

Table 1. Project location and drainage information.

Site Location - NAD 83 UTM (Zn 12)	332831 E 5924766 N
ATS Location	SE 31-51-24 W4M
Natural Region[1]	Central Parkland
Drainage Basins	North Saskatchewan River
Length of drainage upstream to headwaters[2]	~25 km
Length of drainage downstream to Whitemud Creek[2]	~ 5 km
Strahler Order[3]	5

[1] Natural Regions Committee (2006)
[2] FWMIS (AEP 2019b)
[3] Strahler order as reported by FWMIS (AEP 2019b)

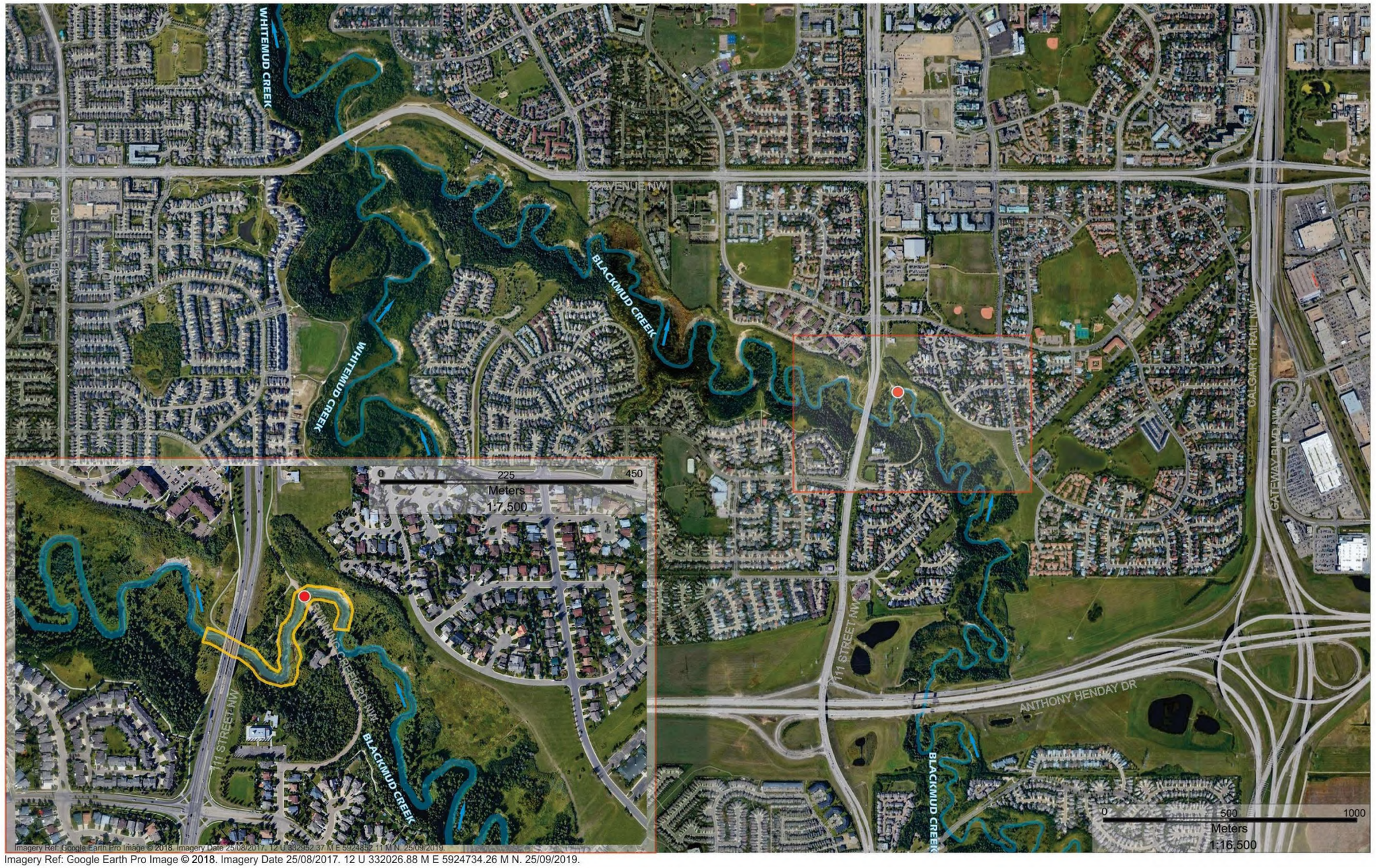


FIGURE 1.
Location Overview

LEGEND

- Watercourses
- Study Area
- Roads
- Pedestrian Bridge Crossing
- Flow Direction

Kingfisher Aquatics

Imagery Ref: Google Earth Pro Image © 2018. Imagery Date 25/08/2017. 12 U 332026.88 M E 5924734.26 M N. 25/09/2019.

2.2 PROJECT DESCRIPTION

Preliminary design information prepared by BPTEC Engineering (BPTEC) is provided in Appendix A. The estimated period for all construction/demolition activities required to replace the bridge is approximately 6 weeks.

The existing crossing is a 3-span (30.3 m total length) bridge consisting of Type HC precast concrete girders on timber caps with driven piles. The proposed replacement structure will be a single-span (42 m length) steel pony truss bridge on precast concrete abutments with driven steel piles. The demolition of the existing structure will require instream works to remove the existing sub-structure and piers. Construction of the new bridge is not expected to require instream works since it will span the entire channel of Blackmud Creek. However, while there is a small amount of existing rock riprap along the toe of the north headslope, BPTEC is recommending additional riprap be placed on both sides of the river (under the bridge) to protect the new structure.

3.0 STUDY SECTION

The study section was established according to Kingfisher's standard procedures for small to medium sized watercourse crossings (Appendix B) and encompassed a 387 m section of Blackmud Creek that extended from 87 m upstream of the existing bridge to 300 m downstream of the bridge. (Figure 1).

4.0 METHODS

4.1 FISHERIES INFORMATION REVIEW

The Fish and Wildlife Management Information System (FWMIS) was queried to produce a Fish and Wildlife Report for Blackmud Creek to identify the fish species that are known to occupy the creek.

4.2 FIELD INVESTIGATION

A field investigation was conducted on September 5, 2019 following Kingfisher's standard procedures for small to medium sized watercourse crossings (Appendix B). These procedures were developed to be consistent with the fish habitat assessment methods described in the Alberta Fish Habitat Manual (AT 2009), which were designed to meet the requirements of the *Water Act* as well as information requirements of Fisheries and Oceans Canada (DFO). The scope of the field investigations included:

- habitat inventory of a 387 m study section of Blackmud Creek in the vicinity of the Project;
- characterization of the channel profile at seven transects within the study section; and
- in-situ sampling of select water chemistry variables (pH, temperature, dissolved oxygen, conductivity, turbidity) at 1 location within the study section.

4.3 DOCUMENTATION

Data collected during the field investigation was recorded on standardized forms. Field data, FWMIS data, and available project information was reviewed and analyzed to assess potential impacts to fisheries resources as a result of the Project. Potential impacts to fisheries resources were identified and mitigation strategies were developed and assessed to determine the potential for the Project to adversely affect fisheries resources.

5.0 EXISTING CONDITIONS

5.1 FISH POPULATIONS

A query of the FWMIS identified 8 different fish species that are known to inhabit Blackmud Creek (Table 2). There is no record of sport fish being captured in Blackmud Creek; however, northern pike (*Esox lucius*) have been captured in Whitemud Creek, and walleye (*Sander vitreus*) may use the lower part of Whitemud Creek for spawning.

None of the fish species previously captured from Blackmud Creek are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or under the Species at Risk Act (SARA) and all are considered to be Secure under the Alberta Wildlife Act (SARA Public Registry 2019, AEP 2019d).

Table 2. Fish species previously captured from Blackmud Creek (from FWMIS (AEP 2019b)).

Common Name	Scientific Name
Minnow Family	*Cyprinidae*
Fathead Minnow	*Pimephales promelas*
Lake Chub	*Couesius plumbeus*
Longnose Sucker	*Catostomus catostomus*
Northern Crayfish	*Oronectes virilis*
White Sucker	*Catostomus commersoni*

5.2 FISH HABITAT

5.2.1 Habitat Inventory

A summary of habitat inventory results is presented in Appendix C and photographs depicting typical conditions at the time of assessment are presented in Appendix D.

The fish habitat within the study section was predominantly shallow (<0.5 m deep) run habitat which accounted for approximately two-thirds of the available habitat within the study section. Moderate depth (0.5 m to 1.0 m deep) run habitat and riffle habitat were lesson common, while deep (>1 m deep) run habitat was relatively rare (Figure B-1, Appendix B). Fines and coarse substrates were present in comparable amounts within the study section. Coarse substrates consisted primarily of gravel and cobbles, while boulders were present in limited quantities. The riparian area was generally well-vegetated with grasses, shrubs, and trees. However, the banks under the bridge were not vegetated and there was an exposed, unvegetated area on the outside of a meander immediately downstream of the bridge. Cover for fish was relatively limited overall. Woody debris provided the majority of cover opportunities while overhanging banks and vegetation were present in limited quantities. Other forms of cover were virtually nonexistent.

5.2.2 Streambank and Channel Characteristics

The channel within the study area had a neutral channel profile overall but was confined in places and exhibited an irregular meander pattern that was typical of a Type E stream channel (as described by Rosgen (1994)). The mean wetted width was 7.8 m while the mean channel width was 10.2 m. Water depths at all transects were relatively shallow (<0.5 m deep). Both streambanks were generally stable and well-vegetated although some minor instability and exposed banks were evident approximately 20 m downstream of the bridge. Clumps of grassy bank that had broken free and slumped down the banks were observed throughout the study section. A record of the streambank and channel measurements obtained at the transects is provided in Table 3.

Table 3. Streambank and channel information for Blackmud Creek at the crossing location.

Location	Transect Number		1	2	3	4	5	6	7
	Distance from Crossing		-25	-15	-5	0	+5	+15	+25
Left Upstream Bank	Bank Height (m)		0.72	0.76	0.92	0.85	0.78	0.75	0.75
	Bank Angle (°)		90	90	90	30	90	80	70
	Bank Cover		OV	OV	OV	NONE	OV	OV	NONE
	Riparian Vegetation		GR	SH	GR	EX	SH	GR	EX
	Bank Stability		S	S	S	S	S	S	U
	Undercut Measurement (m)		0.16	0.27	0.16	0	0.42	0.07	0
	Bank Substrate		Fn	Fn	Fn	Bl	Fn	Fn	Fn
Right Upstream Bank	Bank Height (m)		0.95	0.95	0.8	0.54	0.52	0.92	0.88
	Bank Angle (°)		75	50	30	15	20	90	75
	Bank Cover		OV	NONE	OV	NONE	OV	OV	OV
	Riparian Vegetation		GR	SH	GR	EX	GR	SH	GR
	Bank Stability		Stable	Stable	Stable	Stable	Stable	Stable	Stable
	Undercut Measurement (m)		0.13	0	0	0	0	0	0
	Bank Substrate		FN	FN	FN	FN	FN	FN	FN
Channel	Habitat Type at Transect		R3	R3	R3	R2	r2	rf	r3
	Streambed Substrate	Dominant	FN	GR	GR	GR	GR	CB	GR
		Subdominant	GR	CB	CB	CB	CB	GR	CB
	Instream Cover		None	None	None	None	None	None	None
	Wetted Width (m)		9	7	7	7	8	7	7
	Bankfull Width (m)		9.3	8.5	8.5	11	10	8	8.5
	Depths (m)	left	0.44	0.40	0.28	0.54	0.54	0.23	0.36
		centre	0.37	0.42	0.26	0.62	0.54	0.07	0.16
		right	0.23	0.09	0.18	0.34	0.23	0.08	0.14

5.2.3 Water Quality and Stream Discharge

In situ water quality and stream discharge was measured at a single location within the study section. Results of the analysis are provided in Table 4.

Table 4. In situ water quality and stream discharge for Blackmud Creek at the Project location.

Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)	Temperature (°C)	Specific Conductivity (µS/cm)	Discharge (L/s)
9.26	8.2	16.67	15.9@ 12:00	965	247

5.3 DISCUSSION

Blackmud Creek in known to support a number of forage fish and coarse fish species. There is no record of sport fish occupying the creek; however, it is possible that northern pike occasionally frequent the lower portion of the Blackmud Creek near the confluence with Whitemud Creek.

Forage fish likely utilize Blackmud Creek for all life cycle stages while use by larger bodied coarse fish species (i.e longnose suckers and white suckers) is probably seasonal, due to limited overwintering habitat within the creek. Overall, the capability of the fish habitat within the study section was judged to be low to moderate as described in Table 5.

Table 5. Analysis of fish habitat capability of the Blackmud Creek in the vicinity of the Project.

Evaluation		Rationale	Overall Capability
Criteria	Ranking		
Sensitivity	Low	Habitat is primarily utilized by forage and coarse fish species	Low-Moderate
Utility	Moderate	Habitat is important but not critical for survival of species ➢ Habitat in the study section is expected to be utilized by a number of forage and coarse fish species for a range of life cycle phases. ➢ Regular use of the study section by sport fish section is not expected.	
Rarity	Low	Habitat within the study section appears to be common and widely available within Blackmud Creek.	

6.0 POTENTIAL IMPACTS AND MITIGATION

6.1 POTENTIAL IMPACTS

Assessment of potential impacts to fisheries resources associated with the proposed Project was based on:

- preliminary design information (Appendix A);
- existing site conditions and fish habitat capability ranking; and
- review of the DFO Pathway of Effects Diagrams.

The results of the impact pathways analysis are provided in Table 6.

Table 6. Analysis of potential effects associated with the Project.

Impact Pathway			Potential Effect	
Category		**Potential Source**	**Description**	**Analysis**
Water Quality	Mobilization of sediment	➢ In-water construction activities ➢ Riparian disturbance	➢ Alteration of potential fish habitat ➢ Changes to fish habitat suitability ➢ Decreased food production ➢ Reduced fish health and/or increased fish mortality	Possible negative effect due to: ➢ Instream works associated with demolition of existing structure ➢ Instream works associated with installation/removal of isolation works ➢ Disturbances to the riparian area
	Release of deleterious substances	➢ Operation of heavy equipment in or near water	➢ Reduced fish health and/or increased fish mortality	Possible negative effect due to: ➢ Instream and riparian works will require heavy equipment to be in close proximity to the watercourse
Direct Impacts	Entrapment, impingement, entrainment of fish	➢ In-water construction activities that require isolation ➢ Work site dewatering and/or flow routing with pumps	➢ Fish mortality can occur when fish become stranded in isolation areas ➢ Fish mortality can occur when fish become impinged on screens or entrained in pumps when isolated areas are dewatered	Possible negative effect due to: ➢ Installation of isolation works to facilitate demolition of existing piers ➢ Dewatering and flow management operations that will be required to complete the Project
	Change in fish movements	➢ Installation of isolation works	➢ Isolation works can temporarily block fish movements if structures extend across the entire channel	Possible negative effect due to: ➢ Installation of isolation works to facilitate demolition of existing piers
	Invasive species/disease	➢ In-water construction activities using contaminated equipment	➢ Use of contaminated machinery or materials ➢ Not disposing of contaminated materials appropriately	Possible negative effect due to ➢ Instream and riparian works will require equipment to be in close proximity to the watercourse
	At Risk species	➢ In-water construction activities	➢ Instream work can adversely affect species that are *At Risk* or *Threatened* under Provincial and/or Federal legislation	Not expected: ➢ No *At Risk* species are found in Blackmud Creek.
	Physical changes to fish habitat	➢ Replacement watercourse crossing structure ➢ Temporary isolation works ➢ Riprap protection works	➢ The amount and/or quality of available habitat can be permanently reduced if: o The replacement structure has a larger instream footprint compared to the existing structure o There are disturbances to the near-shore riparian area ➢ The amount of available habitat can be temporarily reduced due to isolation works	Possible positive effect due to: • The existing piers will be removed, and the replacement structure will span the channel (no instream piers). Total increase of available habitat of approximately 20m^2 Neutral effect due to: • Instream isolations (if required) are expected to have a negligible footprint since existing piers are located above (south side) and at (north side) the August 2019 water elevation. In addition, instream isolations (if required) would only need to be in place for a short period of time. Possible negative effect due to: • Riprap protection (approximately 10 m long) will be placed along both streambanks

6.2 MITIGATION AND QAES SPECIFICATIONS AND RECOMMENDATIONS

Potential impacts to fisheries resources as a result of the Project can be mitigated through implementation of best BMP's and specific management/protection plans. The mitigation measures described below should be considered as the Qualified Aquatic Environment Specialist (QAES) Specifications and Recommendations for the Project.

6.2.1 Design Measures

BPTEC has incorporated several mitigation measures into the Project design. Design measures that will assist in mitigating potential impacts to fisheries resources include:

- The replacement of a 3-span bridge with a clear span bridge will result in a net increase in available fish habitat.
- The instream footprint associated with bank protection works will be minimized since the riprap installed below the average high-water mark will be backfilled with native materials.
- The riparian footprint associated with bank protection works will be minimized since the riprap installed on the headslopes will be limited to the area immediately under the bridge (which are largely devoid of vegetation).

6.2.2 General Construction Measures

Standard BMP's described below should be implemented during construction as deemed necessary depending on Project details and local conditions:

- Clearing of riparian vegetation should be kept to a minimum.
- The duration and intensity of instream work should be kept to a minimum.
- Minimize the removal of natural woody debris, rocks, sand or other materials from the banks, or the bed of the watercourse below the ordinary high-water mark.
- Immediately stabilize banks disturbed by any activity associated with the project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site.
- Restore bed and banks of the waterbody to their original contour and gradient. Where original bank form can not be restored due to instability, establish a new gradient that maintains bank stability and does not encroach on fish habitat.
- All construction materials should be removed from the site upon Project completion.
- Implement mitigation measures described in DFO's measures to protect fish and fish habitat (DFO 2019).

6.2.3 Erosion and Sediment Control

- Minimize disturbances to streambanks and riparian vegetation.
- Ensure that an erosion and sediment control plan is developed, implemented and maintained for the duration of the Project.
- BMP's outlined in the City of Edmonton's Erosion and Sediment Control guidelines (2005a) and manual (2005b) should be implemented as required based on site conditions.

6.2.4 Management of Contaminants

- Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds.
- Ensure that equipment used within 100 m of the watercourse is equipped with environmentally-sensitive hydraulic fluids that are non-toxic to aquatic life and that are readily or inherently biodegradable.
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.
- Develop a spill response plan to be implemented immediately in the event of a spill and keep an emergency spill kit on site and accessible at all times.
- The Project is located in the Yellow Decontamination Zone of the Province (AEP 2019c). Where applicable, Alberta Environment and Parks decontamination protocols for whirling disease should be adhered to (AEP 2017).

6.2.5 Scheduling of Works

- Instream construction should be scheduled to avoid periods of high precipitation and high stream flows. If possible, construction should be completed during a low water period (i.e. winter) when the existing piers are above the surface water elevation (i.e. not instream).
- Instream construction should be completed outside of the RAP, which extends from April 16 to June 30th (AESRD 2012).
- Isolation works that block more than 2/3 of the channel width have the potential to restrict fish migration and should not be left in place for more than 14 consecutive days without implementing alternative measures to accommodate fish passage.

6.2.6 Instream Isolation

- Instream construction activities should be isolated from the flowing waters of the waterbody to prevent the mobilization of the sediment into the watercourse and to prevent other deleterious substances from entering the waterbody.
- Instream isolation(s) should be constructed of non-erodible materials that will remain functional throughout duration of instream activities and can be fully removed once instream activities have been completed.
- Instream isolation(s) should adhere to the schedules defined in Section 6.2.5.
- If dewatering is required, all pumps that are used in fish bearing areas should be screened in accordance with the specifications described in Section 6.2.7.
- Water pumped out of an isolated construction area should not be pumped directly into a waterbody. Water should be dewatered into a well-vegetated area in a manner that will not result in erosion, or into a settling tank/pond or geotextile bag to ensure water returning to the watercourse is of equal or better quality than that of water within receiving waterbody.
- When removing isolation works:
    - All construction debris, equipment and non-native streambed material must be removed prior to reintroducing water to the isolated area.
    - All isolation materials must be fully removed from the waterbody.

6.2.7 End-of-Pipe Fish Screens

- If pumping from fish-bearing waters is required, all pumps should be screened in accordance with DFO's interim code of practice: end-of-pipe fish screens (http://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html). Submission of the code of practice Notification Form is not required if a DFO Request for Review is submitted for the Project.

6.2.8 Fish Capture and Release

- In the event that construction activities result in the potential entrapment of fish, a QAES should be retained to complete the following:
    - Prepare a fish capture and release (FC&R) plan.
    - Obtain a Fish Rescue Research Licence from Alberta Environment and Parks.
    - Conduct FC&R operations whereby stranded fish are captured from within isolated areas and relocated to an appropriate release location within Blackmud Creek.

6.2.9 Turbidity Monitoring

- A turbidity monitoring program should be implemented when instream work is being conducted. At a minimum the monitoring program should incorporate the following:
    - An independent QAES should be retained to develop and implement the program.
    - An equation that explains the relationship between turbidity and total suspended solids (TSS) should be developed prior to initiating instream works.
    - The program should outline frequency of monitoring during specific phases of the project.
    - The program should define sample sites and exceedance criteria.
    - The program should define response actions and protocols in the event that an exceedance occurs.

6.2.10 Decontamination Protocols

- The Property is located in the Yellow Decontamination Zone of the Province (high to moderate risk for whirling disease) (AEP 2019b). Care should be given to equipment that has come in contact with other waterbodies in the Alberta Environment and Parks Red and Yellow Decontamination Risk Zones (AEP 2019b). Where applicable, Alberta Environment and Parks decontamination protocols for whirling disease should be adhered to (AEP 2017).

6.3 RESIDUAL EFFECTS

Potential effects to fisheries resources arising from the Project can be mitigated through implementation of established best management practices and specific management/protection plans as described in Section 6.2. A summary of the potential impact assessment, including a determination of the potential for adverse residual effects is provided in Table 7.

Table 7. Description of potential adverse impacts, mitigation, and residual impacts associated with the Project.

Impact Category	Mitigation	Residual Effects
Mobilization of sediment	➢ Implement general construction mitigation measures ➢ Implement erosion and sediment control measures ➢ Implement contaminant control measures ➢ Implement recommended turbidity monitoring	Not expected
Release of contaminants	➢ Implement general construction mitigation measures ➢ Implement contaminant management measures	Not expected
Entrapment, impingement, entrainment of fish	➢ Implement instream isolation measures ➢ Adhere to end of pipe fish screen Code of Practice ➢ Implement fish capture and release	Not expected
Change in fish movements	➢ Adhere to recommended schedules ➢ Implement instream isolation measures	Not expected
Invasive species/disease	➢ Implement decontamination protocols as required	Not expected
Physical changes to fish habitat	➢ Implement design mitigation measures ➢ Adhere to recommended schedules	Not Expected

6.4 DFO REQUEST FOR REVIEW

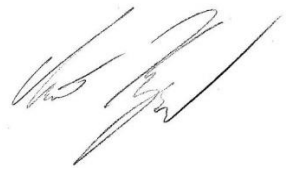
In Canada, projects that will likely result in the death of fish and/or the harmful alteration, disruption, or destruction (HADD) of fish habitat must obtain an authorization from the Minister of Fisheries, Oceans and the Canadian Coast Guard as per the Canadian *Fisheries Act Regulations*.

As described in Table 7, no residual effects to fisheries resources are expected to occur as a result of the Project assuming that it proceeds as described in Section 2.2 and provided that all mitigation measures outlined in Section 6.2 are implemented. Based on this analysis, the Project is considered unlikely to result in the death of fish and/or HADD of fish habitat. However, it is recommended that a Request for Review be submitted to DFO since the Project will involve instream work.

7.0 CLOSURE

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

Kingfisher Aquatics Ltd.



Scott Holroyd, P.Biol.
Senior Fisheries Biologist
Project Biologist

Erik Stemo, P.Biol
Senior Fisheries Biologist
Project Director

8.0 REFERENCES

Alberta Environment. 2001. Guide to the Code of Practice for Watercourse Crossings Including Guidelines for Complying with the Code of Practice (made under the Water Act and the Water (Ministerial) Regulation). Queen's Printer for Alberta. Edmonton, Alberta.

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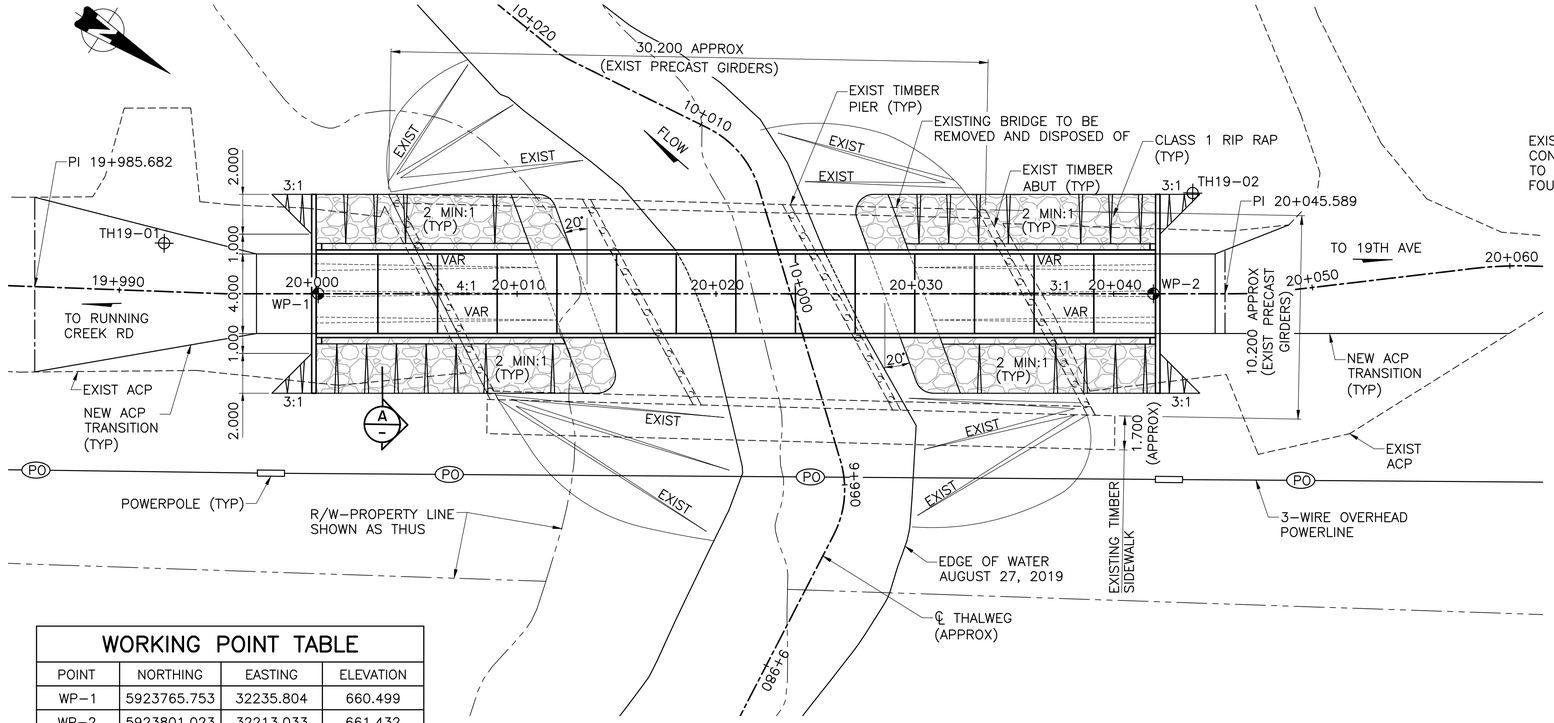
Appendix A

Preliminary Design Information



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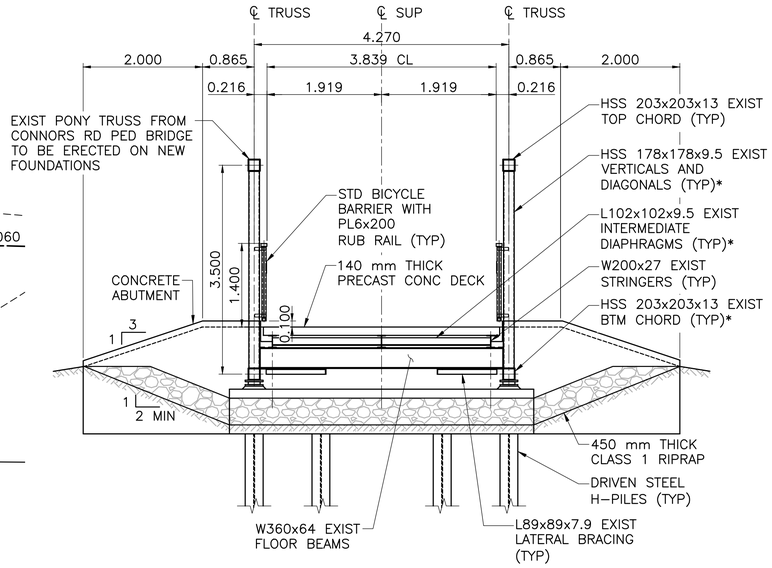
WP-2	5923801.023	32213.033	661.432

NOTE:
WORKING POINTS ARE ℄ BRG ABUTMENTS AT
℄ TOP OF FINISHED DECK



* NOTE:
SOME SECTION SIZES VARY FROM AS-BUILT TRUSS
DRAWINGS BASED ON FIELD MEASUREMENTS

A
SECTION
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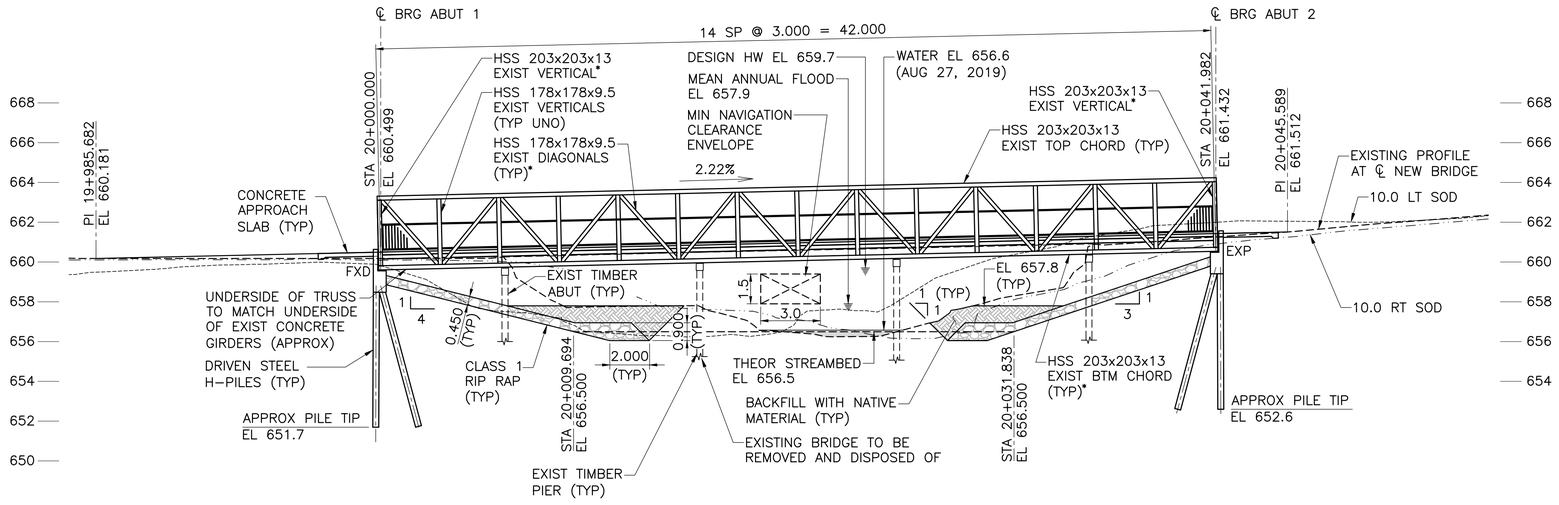

ELEVATION
LOOKING WEST 1:150

*NOTE:
SOME SECTION SIZES VARY FROM AS-BUILT TRUSS
DRAWINGS BASED ON FIELD MEASUREMENTS

REFERENCE DRAWINGS	
CONNORS RD PEDESTRIAN BRIDGE – REINFORCING SCHEDULE	CD13-84-01
CONNORS RD PEDESTRIAN BRIDGE – MISCELLANEOUS DETAILS	CD12-84-01
CONNORS RD PEDESTRIAN BRIDGE – HANDRAIL DETAILS	CD11-84-01
CONNORS RD PEDESTRIAN BRIDGE – DECK LAYOUT & DETAILS	CD10-84-01
CONNORS RD PEDESTRIAN BRIDGE – TRUSS & GIRDER DETAILS	CD09-84-01
CONNORS RD PEDESTRIAN BRIDGE – TRUSS & GIRDER LAYOUT	CD08-84-01
CONNORS RD PEDESTRIAN BRIDGE – BEARING DETAILS	CD07-84-01
CONNORS RD PEDESTRIAN BRIDGE – BENT DETAILS	CD06-84-01
CONNORS RD PEDESTRIAN BRIDGE – NORTH & SOUTH ABUTMENTS – REINF	CD05-84-01
CONNORS RD PEDESTRIAN BRIDGE – NORTH & SOUTH ABUTMENT DETAILS	CD04-84-01
CONNORS RD PEDESTRIAN BRIDGE – GENERAL ARRANGEMENT	CD03-84-01
CONNORS RD PEDESTRIAN BRIDGE – BRIDGE APPROACHES & DETAILS	CD02-84-01
CONNORS RD PEDESTRIAN BRIDGE – SITE PLAN	CD01-84-01
PRECAST CONCRETE 33 FT SPAN TYPE "HC" CURB STRINGER	S-785
PRECAST CONCRETE 33 FT SPAN TYPE "HC" INTERIOR STRINGER	S-784
DESCRIPTION	DRAWING

INDEX

3	INFORMATION – SHEET 2	BLAC 210 S03
2	INFORMATION – SHEET 1	BLAC 210 S02
1	GENERAL LAYOUT	BLAC 210 S01
SHEET	DESCRIPTION	DRAWING

1

NO.	REVISIONS	BY	DATE	APP'D
7				
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1	UPDATED DRAWING INDEX	JE	2020-03-16	KJG

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1	TENDER AWARD DATE		

PROGRAM NO.
CONTRACT NO.

CONSTRUCTION RETURN
CONTRACTOR
SURVEYOR
DATE
FILE NUMBER
CONSTRUCTION ENGINEER DATE
GENERAL SUPERVISOR DATE

BPTEC ENGINEERING
Suite 200, 4220-98 Street NW (780) 436-5376
Edmonton, AB T6E 6A1 www.bptec.ca 521-035.7

PERMIT TO PRACTICE
BPTEC ENGINEERING LTD.
ORIGINAL SIGNED BY KEN GALM
ON MARCH 16, 2020
PERMIT NUMBER: P0132
The Association of Professional
Engineers and Geoscientists of Alberta

APPROVED FOR CONSTRUCTION
DATE

PROFESSIONAL ENGINEER ALBERTA
ORIGINAL STAMPED AND SIGNED
BY: Jesse Edwards
ON: Mar. 16, 2020

DEPARTMENT / BRANCH	APPROVAL	DATE

TRANSPORTATION INFRASTRUCTURE DELIVERY DATE

SURVEY
JOB NO. 521-035.4
SCALE AS NOTED
HOR
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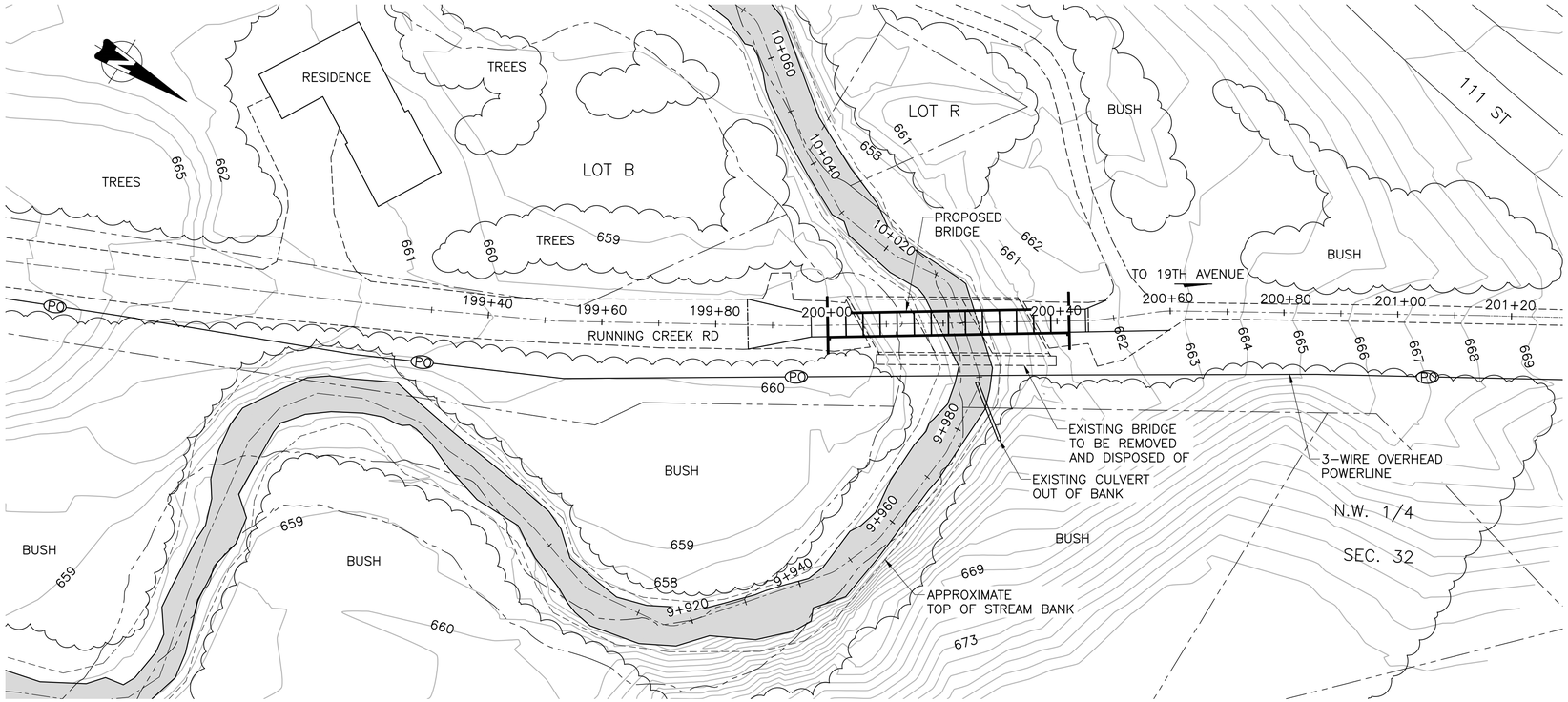
DRAWN AD DATE 2020-03-12
DESIGNED JE DATE 2020-03-12
CHECKED KJG DATE 2020-03-12

THE CITY OF Edmonton
INTEGRATED INFRASTRUCTURE SERVICES
INFRASTRUCTURE PLANNING AND DESIGN BRANCH

PROJECT
111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT
GENERAL LAYOUT

DRAWING
BLAC 210 S01



SITE PLAN

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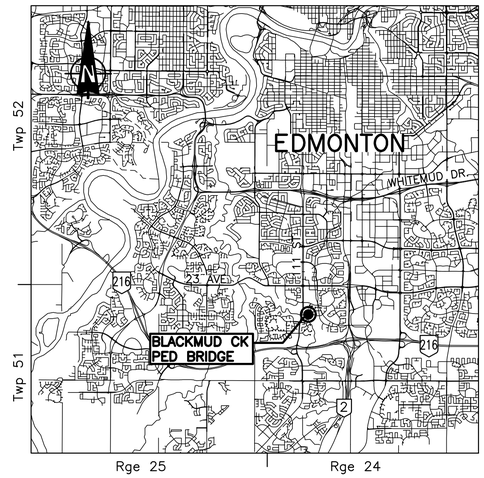

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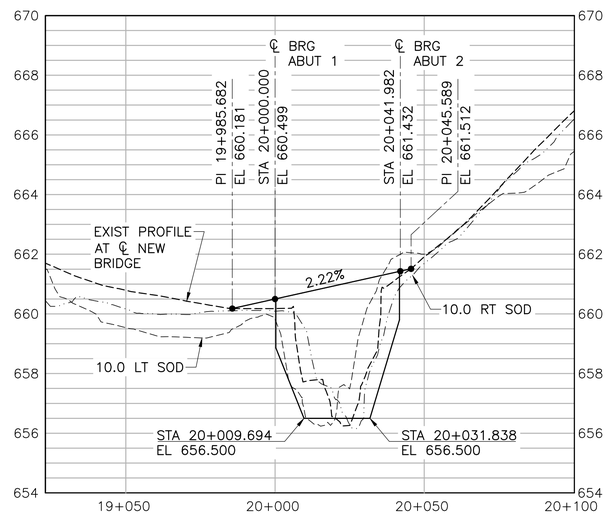

TRAIL PROFILE

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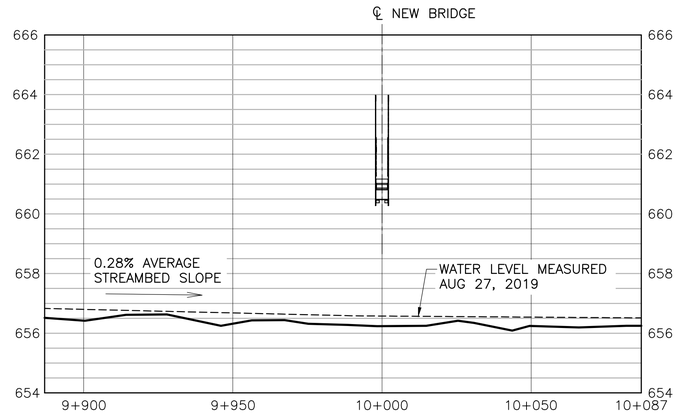

STREAMBED PROFILE

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VERT 1:100

GENERAL NOTES

- DIMENSIONS OF EXISTING BRIDGE ELEMENTS ARE BASED ON AVAILABLE INSPECTION INFORMATION AND HISTORICAL RECORDS. ACTUAL DIMENSIONS MAY VARY DUE TO ORIGINAL CONSTRUCTION TOLERANCES. THE CONTRACTOR SHALL CONFIRM ALL DIMENSIONS IN ADVANCE OF COMMENCING THE RELATED WORK.
- ALL DIMENSIONS SHOWN ON THE GENERAL LAYOUT AND INFORMATION SHEETS ARE GIVEN IN METRES UNLESS NOTED OTHERWISE. ALL OTHER DRAWINGS ARE DIMENSIONED IN MILLIMETRES, UNLESS NOTED OTHERWISE.

SURVEY INFORMATION

- SURVEY INFORMATION PROVIDED BY THE CITY OF EDMONTON (COMPLETED JULY 9, 2019) AND BPTEC ENGINEERING (COMPLETED AUGUST 27, 2019)
- SOME SITE FEATURES INCLUDING TOP OF BANK, EDGE OF WATER, TREELINES DIGITIZED FROM 2017 AERIAL PHOTOGRAPH. SUPPLEMENTAL TOPOGRAPHY BEYOND SURVEY LIMITS FROM FROM CITY OF EDMONTON DTM
- THE COORDINATES AND STATIONING ARE BASED ON NAD83 DATUM USING THE 3TM GRID PROJECTION, CENTRAL MERIDIAN 114. A COMBINED SCALE FACTOR (CSF) OF 0.999807 HAS BEEN ADOPTED FOR THIS PROJECT
- ALL DIMENSIONS INDICATED ON THESE DRAWINGS ARE GROUND DISTANCES. GRID DISTANCE = GROUND DISTANCE x 0.999807

HYDROTECHNICAL SUMMARY

- DRAINAGE AREA = 695 km^2
- DESIGN HIGH WATER: Y = 3.2 m, V = 2.1 m/s, Q = 103 m^3/s
- MEAN ANNUAL FLOOD: Y_2 = 1.4 m, V_2 = 1.2 m/s, Q_2 = 18 m^3/s

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PROGRAM NO.

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BPTEC ENGINEERING
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Edmonton, AB T6E 6A1 www.bptec.ca 521-035.7

PERMIT TO PRACTICE
BPTEC ENGINEERING LTD.
ORIGINAL SIGNED BY KEN GALM ON MARCH 12, 2020
PERMIT NUMBER: P0132
The Association of Professional Engineers and Geoscientists of Alberta

APPROVED FOR CONSTRUCTION

DATE

PROFESSIONAL ENGINEER ALBERTA
ORIGINAL STAMPED AND SIGNED
BY: Jesse Edwards
ON: Mar. 12, 2020

DEPARTMENT / BRANCH	APPROVAL	DATE

TRANSPORTATION INFRASTRUCTURE DELIVERY DATE

SURVEY
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SCALE AS NOTED
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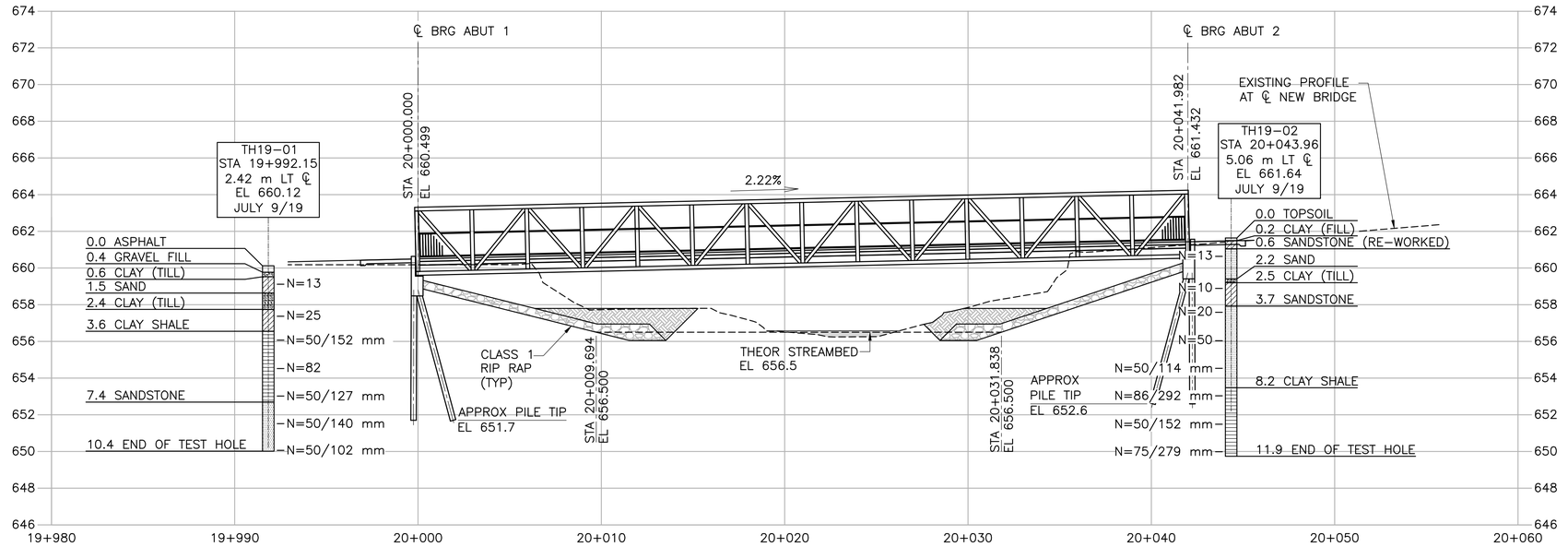
THE CITY OF Edmonton
INTEGRATED INFRASTRUCTURE SERVICES
INFRASTRUCTURE PLANNING AND DESIGN BRANCH

PROJECT
111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT
INFORMATION SHEET 1

DRAWING
BLAC 210 S02



ELEVATION

LOOKING WEST 1:150

GEOTECHNICAL

- ALL GEOTECHNICAL INFORMATION PROVIDED FOR THIS PROJECT HAS BEEN COMPILED FOR DESIGN PURPOSES ONLY. WHILE IT IS BELIEVED TO CORRECTLY REPRODUCE OR SUMMARIZE OBSERVATIONS MADE DURING TESTING, IT IS VALID ONLY FOR THE PRECISE LOCATION(S) SHOWN AND IS NOT TO BE CONSTRUED AS GUARANTEEING THE ACTUAL MATERIAL AND CONDITIONS EXISTING THROUGHOUT THE SITE. THE TESTING METHODS USED MAY NOT HAVE DETERMINED THE PRESENCE, ABSENCE OR EXTENT OF HEAVY ROCK RIPRAP, BOULDERS, HARD OR SOFT FORMATIONS, WATER TABLES, ARTESIAN CONDITIONS OR OTHER VARIABLES. IT IS THE RESPONSIBILITY OF OTHERS USING THIS INFORMATION TO ENSURE THAT IT IS ADEQUATE FOR THEIR PURPOSES, OR TO SUPPLEMENT IT WITH ADDITIONAL INFORMATION.
- TEST HOLE LOGS BY THURBER ENGINEERING LTD. A COMPLETE DESCRIPTION OF SOIL LOGS IS PRESENTED IN THURBER ENGINEERING LTD. REPORT ENTITLED "111 STREET PEDESTRIAN BRIDGE REPLACEMENT", DATED SEPTEMBER 9, 2019.

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THE CITY OF Edmonton
INTEGRATED INFRASTRUCTURE SERVICES
INFRASTRUCTURE PLANNING AND DESIGN BRANCH

PROJECT

111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT

INFORMATION SHEET 2

DRAWING

BLAC 210 S03

Appendix B

Assessment Methods

Kingfisher Aquatics Ltd. (Kingfisher) Standard Procedures for Watercourse Crossings in Alberta have been developed to meet the information requirements of provincial and federal regulators for most instream activities associated with watercourse crossing construction or other similar sized projects that require instream works. These procedures may be utilized in combination with other assessment methods that do not strictly align with this document. In these instances, any modifications to the methodology described in this document will be described and rationalized in the main body of the report.

The Guide to the Code of Practice for Watercourse Crossings Including Guidelines for Complying with the Code of Practice (the Guide to the Code of Practice), Section B: Aquatic and Biological Site Assessments (Alberta Environment 2001) served as the primary reference and outline for these standard procedures.

A) ASSESSMENT PREPARATION

In order to determine assessment requirements; all available project information will be reviewed prior to initiation of the field assessment activities to aid in the determination of:

1) potential streambed, streambank and riparian disturbance;
2) anticipated potential effects on the aquatic environment; and
3) the estimated zone of impact resulting from potential effects.

Background topography and drainage information will be collected through the review of available maps, satellite imagery and air imagery. Historical fisheries information will be collected through:

1) Querying the provincial database known as the Fish and Wildlife Management Information System that is accessed through the Fish and Wildlife Internet Mapping Tool maintained by Alberta Environment and Parks; and
2) Reviewing available literature including articles from peer-reviewed journals, governments, private firms, non-government organizations, and aboriginal organization sources.

B) FIELD ASSESSMENT

A field assessment will be conducted when existing fish and/or fish habitat information is deemed to be insufficient to support an assessment of the potential effects of the project on the aquatic environment.

1) Study Area

Field assessments conducted for watercourse crossings require at a minimum:

- one 100 m or longer study section established upstream of the watercourse crossing or proposed watercourse crossing right of way; and
- one 300 m or larger study section located downstream of the watercourse crossing or proposed watercourse crossing right of way. The downstream study section must encompass the entire zone of impact. Additional study sections may be required to determine potential fish species that could be affected by the project.

2) Determining the Zone of Impact

The Guide to the Code of Practice (Alberta Environment 2001) defines the zone of impact as:

- the area of streambed and streambanks of the water body that will be altered or disrupted as a result of the works; and
- the area where 90% of the sediment discharged as a result of the works would be deposited.

FISH COLLECTION

When there is insufficient fisheries information available to evaluate potential project effects on the aquatic environment Kingfisher will conduct fish sampling to the extent required to meet the specific information requirements of the project.

1) Permitting

All fish sampling conducted by Kingfisher will be done so under licence from the Province of Alberta and, when applicable, the Government of Canada. The follow permits may be required to conduct fish sampling depending on the method used, the location of the waterbody being sampled, and the potential fish species present:

- Alberta Environment and Parks issued Research Licence
- Department of Fisheries and Oceans Canada issued Species at Risk Act Permit
- Parks Canada issued Research and Collection Permit

2) Fish Collection Data

In accordance with the Guide to the Code of Practice (Alberta Environment 2001) data collected from fish capture will include at a minimum:

- the length of the study section;
- the type of equipment used, and the electrofishing effort made (seconds) and catch per unit effort (other active and passive fish capture methods may be used to augment electrofishing where required);
- all fish species captured, the number of each species and the location or habitat types where fish were captured;
- the fork length and weight of all sportfish species captured;
- the gender and maturity of sportfish species if externally determinable;
- the spawning potential; and
- during restricted activity periods, any evidence of spawning activity (redds, fish on redds, etc.) and determine where possible the presence of fish and fry at the crossing site.

Alberta Fisheries Management Branch (AFMB) Standard for Sampling of Small Streams in Alberta (2013[a]) provides additional guidelines for minimum information requirements for both general fish sampling and specific sampling methods. Information requirements for specific fish sampling methods are provided in Section 3. Kingfisher will collect all information to meet the AFMB Standards for general fish sampling information as outlined below:

Sample Site Descriptors:

- Waterbody Name
- Waterbody ID
- Activity Date
- Crew Initials
- Starting Universal Transverse Mercator (UTM) coordinates
- Site Location Notes
- Project Site Number
- Water Temperature
- Conductivity
- Stream Stage (Dry, Low, Moderate, High, Flood)
- Wetted Width
- Maximum Depth

Fisheries Descriptors:

- Capture Method
- Sample Number
- Species
- Fork Length (mm)
- Total Body Weight (g)
- Injury Comments
- General Fisheries Comments

3) Fish Collection Methods

Selection of fish sampling gears is initially based of the following key points (Portt et al. 2006):

- the study question(s) that the investigators wish to answer;
- the habitats that are being investigated;
- the fish species that are being investigated; and
- the time of year when investigations will take place.

In addition to the key points listed above, Kingfisher also considers the catchability, efficiency, and lethality of fish sampling gear. In general, Kingfisher selects fish sampling gear that maximizes catchability and efficiency of sampling efforts while minimizing the potential for fish mortality.

Standard Kingfisher fish collection methods, application information, and guidance documents are provided in Table C.1.

Table C.1. Standard Fish Collection Methods, Application Information, and Guidance Documents.

Fish Collection Method	Habitat Type	Water Depths	Fish species	Guidance Documents
Angling (A)	Lotic or lentic habitats	>0.1 m	Medium to large-bodied sport fish and some coarse fish	Vancouver Island University. 2010. Electrofishing: Theory, Safety and Uses Version 6.0; AFMB. 2004. Electrofishing Policy Respecting Injuries to Fish.; BCMELP. 1997. Fish Collection Methods and Standards Version 4.0; AFMB. 2013[a].Standards for sampling of small streams in Alberta; AFMB. 2013[a].Standards for sampling of small-bodied fish in Alberta; AFMB. 2013[c].Standards for the ethical use of fishes in Alberta; AESRD. 2015. Fish Research Licence Application – Fish Rescue Best Practices. BCMFLNRO. Freshwater Fishing Regulation. Alberta Government. Sportfishing Regulations. Portt et al. 2006. A review of fish sampling methods commonly used in Canadian freshwater habitats. Alberta Transportation. 2009. Fish Habitat Manual.
Backpack Electrofishing (A)	Primarily lotic	Between 0.1 m and 0.5 m	Most species and sizes	
Boat Electrofishing (A)	Primarily lotic	Between 0.5 m and 2.0 m	Most species and sizes	
Gillnetting (P)	Lentic	>0.5 m	Medium to large bodied sport and course fish	
Minnow Trapping (P)	Primarily lentic	>0.3 m	Small bodied forage fish species and some sport fish	
Seine netting (A)	Primarily lentic	<1.0 m	Most species and sizes	

(A)=Active Technique
(P)=Passive Technique

Angling

Angling equipment and rigging are usually geared toward specific fish species or groups of fish species. This allows angling efforts to be very effective at targeting specific fish species with minimal bi-catch. In most presence/absence sampling scenarios it is ideal to utilize gear that maximizes catchability, such as electrofishing or seine netting that is capable of catching a wide variety of fish species. As such, angling is typically used for assessments that require sampling for a specific fish species that may not effectively be captured by other methods (i.e. Lake Sturgeon).

Angling is conducted in crews of two or more to maximize sampling effort. When multiple anglers are sampling a waterbody for multiple species anglers will use alternate rigging methods in an effort to expand the number of fish species and/or life stages of fish angling efforts could capture. Angling methods will largely rely on the experience of the crew members; however, all angling methods will comply with provincial sport fishing regulations.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) required angling specific information:

- Number of Anglers,
- Hours Fished per Angler

Backpack Electrofishing

Electrofishing is the technique of passing electric current through the water to attract and immobilize fish for capture. It is most efficiently used in contained areas of small rivers and streams that are difficult to sample using nets or traps (BCMELP 1997).

Backpack electrofishing is conducted by a two-person crew. One of the two crew members will be a certified electrofishing crew leader who will operate the backpack electrofisher. The second crew member will capture immobilized fish with a fine mesh nylon or rubber net. Electrofishing is conducted by sweeping the anode pole of the electrofisher across the channel and downstream towards the cathode tail and netter. The crew progresses upstream through the study area moving back and forth across the stream in a zigzagging pattern. Sampling effort is evenly distributed throughout the sample section. Captured fish are collected and temporarily held in a water-filled pail (carried by the second crew member) or in a live-well. Electrofishing can only effectively be completed when crew members are able to readily spot immobilized fish. Therefore, electrofishing surveys are not conducted when turbidity levels are elevated or when the sample area is frozen.

Boat Electrofishing

Boat electrofishing is conducted following the same principles as backpack electrofishing but is used on larger streams and shallow lakes where water depths prevent wading. Two types of boats are used, drift boats (passive) or jet boats (active), the former is typically used on small rivers that may not accommodate a power boat and the latter is used on larger rivers where the operation of a large power boat is more feasible. The basic components of the shocking system include a power supply, voltage and current regulator, cathode, anode, and safety circuits. Boats used for electrofishing are large enough to hold all the equipment and provide a safe and adequate work space for the crew. The power is supplied to the boat electrofisher via a gas-powered generator. The cathodes are suspended from the sides of the boats and the anodes are normally one or two booms protruding from the front of the boat (BCMELP 1997).

Boat electrofishing is conducted with a crew of 3 to 4 members when the boat electrofishing set up utilizes a movable anode. When the boat electrofishing set-up utilized a fixed anode, a crew of 2 to 3 members can operate the system effectively. The use of fixed or moveable anodes depends on the fish sampling objectives of the assessment. Movable anodes typically allow for greater control of the habitat sampled, and as such are considered optimal for presence/absence sampling.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) which stipulates collection of the following information:

- Electrofishing on-time
- Distance electrofished – 300 m or 40x the mean wetted width will be considered the minimum electrofishing survey distance
- Electrofisher Pulse Width
- Electrofisher Frequency
- Electrofisher Voltage

Gillnetting

Gillnets are suspended in the water column at different depths depending on the fish species type (pelagic, benthic, etc.) being targeted. Fish are captured when they swim into the mesh of the net and the maxillary or operculum area, teeth, spines, girth, or scales are caught on the mesh of the net as they attempt to pass through or free themselves from the mesh.

Net set times are dependent on whether the project requires non-lethal or lethal sampling. Gill nets are typically used when the sacrifice of fish is either necessary and/or where the risk (of gillnetting) to local fish populations is considered low. The length of the net set is a large factor in the amount of fish mortality observed. If deployed in lotic waterbodies they should be checked and cleared frequently (every two hours or less, particularly where non-lethal sampling is an objective). If deployed in lentic waterbodies they should be set overnight for no greater than 24 hours (AFMB 2013[b])

Gillnetting is conducted as per the B.C. standard procedure for gillnetting that has been developed for the use of gill nets in lakes for reconnaissance level inventories. The net consists of six nets or panels, 15.2 m long and of different mesh sizes, that are strung together in a "gang" to form a net 91.2 m long and 2.4 m deep. The mesh size is measured from knot to knot of a single, diagonally stretched mesh. Each mesh size is selective for a certain size fish (Table C.2), therefore, the individual panels used in the net have been chosen so the net is capable of catching a wide range of fish. The following is the standard order of the panels based on mesh size, the corresponding filament size used in the construction of the net and the mean fork length of the fish caught by each of the mesh sizes (BCMELP 1997; based on Hamley 1972):

Table C.2. Order, Mesh Size and Filament Size Standards relative to Fish Mean Fork Length (BCMELP 1997).

Order	Mesh Size (mm)	Filament Size (mm)	Fish Fork Length (mm)
1	25	0.20	114
2	76	0.25	345
3	51	0.20	228
4	89	0.30	380
5	38	0.20	178
6	64	0.25	280

Most gillnetting sampling requires the use of watercraft. As such, a minimum crew size of two is used during gillnetting. Crew size and number of watercraft employed for gillnet fish sampling is dependent on project objectives, the size and number of nets set, and the project time frame.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) which stipulates collection of the following information:

- Date and time of net(s) set
- Date and time of net(s) lifted
- Mesh Size (mm)
- Length of net(s) set (m)
- Depth of net(s) set (m)

Minnow Trapping (Gee Trapping)

Minnow traps or Gee-minnow traps are used to target small-bodied fish in moderate to deep (>0.5 m) habitat where electrofishing becomes less effective, particularly on small-bodied fish. Due to the small size and ease of deployment of minnow traps, minnow trapping can be conduct by a single crew member (Portt et al. 2006); however, fish processing requirements typically dictate a minimum crew size of two.

Minnow traps usually consist of two wire baskets held together by a clip and attached to a marker float. The baskets are interlocked, and the clip is inserted to hold the two halves together. The float line is attached and the trap is positioned on the bottom or suspended at a particular depth. The position of the trap is marked by the float attached to the line. Traps can be set with or without bait. Fish swim inside the traps through funnel shaped openings that guide them from a large opening near the outside of the trap to the narrow opening close to the centre of the trap. Once inside it is difficult for the fish to locate the opening and escape (BCMELP 1997).

Kingfisher will complete minnow trapping in accordance with AFMB Standards for Sampling Small-bodied Fish in Alberta (2013[b]). When bait is used, the type and amount will be recorded. Traps will be set for a minimum of 18 (trapping) hours (trapping hours = # traps x hours of set time) and all traps will be checked at least once every 2 hours and cleared of fish.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) required trap netting specific information:

- Date and time of trap(s) set
- Date and time of trap(s) lifted
- Trap type
- Number of traps

Seine Netting

Seine netting can be conducted by boat or by wading and can be an effective passive capture method. However, the effectiveness of seine netting can be limited by coarse substrates and/or fish cover (aquatic vegetation, woody debris, and overhanging bank) that can foul the net, interrupt net pulls, and allow fish to escape.

In lentic habitat, seine netting is conducted parallel to shore. The off-shore seiner walks in advance of the on-shore seiner. After the seine pull is completed the off-shore seiner brings their end of the seine net to shore and the seine is pulled in while making sure that the leadline remains in contact with the bottom and the floatline is in contact with the surface (AFMB 2013[b]). In lotic habitat, seine pulls vary depending on the local conditions.

The configuration of seine nets can vary depending on the application of the net and the target species. Most nets have a braided leadline or rolled lead weights to weigh the bottom of the net while the top of the net is typically supported by a floating corkline (BCMELP 1997). Kingfisher typically utilizes seines ranging from 3.3 m to 30 m long and 1.2 m to 1.8 m deep with mesh sizes 0.125 mm to 2.5 mm.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) required seine haul specific information:

- *Net and mesh dimensions (m and mm)
- Area Sampled
- *Number of net pulls per area

*derived requirements based on AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) and Standards for Sampling Small-bodied Fish in Alberta (2013[b])

C) FISH HABITAT ASSESSMENT

1) Habitat Inventory/Habitat Mapping

Fish habitat data collection is conducted by Kingfisher crews traversing study area(s), typically from downstream to upstream either by boat (Large River Fish Habitat Assessments) or by wading (Small Stream Fish Habitat Assessments). Information is collected in a sequentially ordered and spatially referenced manner that allows for the data to be presented as a habitat map or in a habitat inventory catalogue, depending on project requirements.

Small Stream Fish Habitat

Kingfisher standard methods for small stream fish habitat assessment are adapted from R.L.& L. (1994) and Hawkins et al. (1993) that are outlined in the Alberta Transportation Fish Habitat Manual (2009). Habitat is classified into discrete units based on water depth, velocity, and substrate. The dimensions of each unit are measured and fish cover type(s), substrate composition, riparian vegetation types, and bank stability are quantified and recorded. Definitions of habitat units are provided in Table D.1 and classifications based on water depth are provided in Table D.2. Fish cover types, streambed substrates, and riparian vegetation types are presented in Table D.3 while other in-channels are described in Table D.4.

Table D.1. Small Stream Fish Habitat Units, Symbols and Descriptions.

Habitat Unit	Symbol	Description
Cascade	CA	Extremely high gradient and velocity; extremely turbulent with entire water surface broken; may have short vertical sections, but overall is passable to fish; armoured substrate, may be associated with chutes and rapids
Chute	CH	Area of channel constriction, usually due to bedrock intrusions; associated with channel deepening and increase velocity
Rapids	RA	Extremely high velocity; deeper then riffle; substrate extremely coarse (large cobble/boulder); instream cover in pocket eddies and associated with substrate
Riffle	RF	High velocity/gradient relative to run habitat; surface broken due to submerged or exposed bed material, shallow relative to other channel units; coarse substrate; usually limited instream or overhead cover for juvenile or adult fish (generally ≤ 0.5 m deep).
Run (glide)	R1, R2, R3	Moderate to high velocity; surface largely unbroken; usually deeper than RF; substrate size dependent on hydraulics
Flat	F1, F2, F3	Area characterized by low velocity and near-uniform flow; differentiated from pool habitat by high channel uniformity; more depositional than R3 habitat
Pool	P1, P2, P3	Discrete portion of channel featuring increased depth and reduced velocity relative to riffle/run habitats; formed by channel scour.
*Backwater, snye, and impoundment habitat types have been removed because the functionality and form of these habitat types can be recorded through a combination of the listed habitat types and habitat in-channel features		

Table D.2. Small Stream Depth Classifications, Definitions, and Applicable Habitat.

Class	Definition	Applicable Habitat
1	Class 1 water depths range from 1 m to 1.5 m	Run (glide), Flat, Pool
2	Class 2 water depths range from 0.5 m to 1.0 m	
3	Class 3 water depths range from 0.1 m to 0.5 m	

Table D.3. Substrate, Fish Cover and Riparian Vegetation Classifications, Symbols and Descriptions.

Classification	Symbol	Description
Fish Cover		
Woody Debris	WD	Submerged branches, logs, or tree roots
Overhanging Bank	OB	Undercut bank
Overhanging Vegetation	OV	Terrestrial vegetation hanging over or into the waterbody
Aquatic Vegetation	AV	Vegetation rooted below the waters surface
Boulder	BL	Coarse substrate either capable of providing slack water or with interstitial spaces large enough to provide cover for the fish species present
Substrate		
Fines*	FN	<2 mm
Gravel (small & large gravels)*	GR	2 – 64 mm
Cobble*	CB	65 – 256 mm
Boulder*	BL	>256 mm
Bedrock	BR	Single large unit of substrate or single large aggregated unit of substrate
Riparian Vegetation		
Grass/bryophytes	Gr	Herbaceous, or bryophytic, low, non-woody plants
Shrubs	Sh	Multiple woody stemmed low to medium height plants including sapling trees
Tress	Tr	Single large woody stemmed plants
Exposed Bank	Ex	Unvegetated bank substrate composed of soil or aggregate material
Armoured Bank	Ar	Unvegetated bank substrate composed of bedrock or boulder armouring (i.e. riprap)

*defined by Overton et al 1997.

Table D.4. Small Stream In-Channel Features, Symbols, and Descriptions

Type	Symbol	Description
Substrate Ledge	SL	Area of bedrock, clay, or aggregated smaller streambed substrates intruding into the channel; often associated with chute or plunge pool habitat, may have a vertical drop affecting fish passage
Log Ledge	LL	An area where large woody debris has fallen perpendicular to stream flow and has backed up streamflow and loose substrate on the upstream side, commonly associated with a plunge pool habitat on the downstream side
Debris Pile	DP	Debris pile (e.g., log jam) which influences instream habitat; including effects on fish cover
Beaver Dam	BD	Partial or complete beaver constructed impoundments
Anthropogenic Feature	AF	Human-made structure that protrudes into a waterbody, effecting either fish habitat or stream geomorphology
Falls	FA	Highest water velocity; involves water falling over a vertical drop; impassable to fish
Discontinuous Channel	DC	Portions of the study section where channel definition is lost, or channel is lost underground. Assumes the unit width of the last defined unit downstream of the discontinuous channel.

Large River Fish Habitat

Kingfisher standard methods for large river fish habitat assessment are adapted from R.L. & L. (1994) and are outlined in the Alberta Transportation Fish Habitat Manual (2009). Large river habitat classification methodology is intended for use on large watercourses that do not consistently exhibit specific habitat units such as pools, runs, and riffles. With this methodology, habitat is characterized based on general channel form, shoreline features, as well as the presence of specific microhabitat features. A description of large river habitat classifications is presented in Table D.5 and D.6.

Table D.5. Large River Fish Habitat Components, Symbols and Descriptions

Type	Symbol	Description
Major Habitat Types		
Unobstructed Channel	U	Single main channel, no permanent island, side bars occasionally present, limited development of exposed mid-channel bars at low flow
Singular Island	S	Two channels around single, permanent island, side and mid-channel bars often present at low flow
Multiple Island	M	More than two channels and permanent islands, generally extensive side and midchannel bars at low flow
Bank Habitat Types		
Armoured/Stable	A1	Largely stable and at repose; cobble/small boulder/gravel predominant; uniform shoreline configuration; bank velocities low-moderate; instream/overhead cover limited to substrate and turbidity
	A2	Cobble/large boulder predominant; irregular shoreline due to cobble/boulder outcrops producing BW habitats; bank velocity low (BW)/moderate; instream/overhead cover from depth, substrate and turbidity
	A3	Similar to A2 with more boulder/bedrock; very irregular shoreline; bank velocities moderate-high with low velocity BW/eddy pools providing instream cover; overhead cover from depth/turbidity
	A4	Artificial riprap substrates consisting of angular boulder-sized fill; often associated with high velocity areas; shoreline usually regular; instream cover from substrate; overhead cover from depth/turbulence
Canyon	C1	Banks formed by valley walls; cobble/boulder bedrock; stable at bank-water interface; typically deep/high velocity water offshore; abundant velocity cover from substrate/bank irregularities
	C2	Steep, stable bedrock banks; regular shoreline; moderate-deep/moderate-fast water offshore; occasional velocity cover from bedrock fractures
	C3	Banks formed by valley walls, primarily fines with some gravel/cobble at base; moderately eroded at bank-water interface; moderate-high velocities; no instream cover
Depositional	D1	Low relief, gently sloping bank; shallow/slow offshore; primarily fines; instream cover absent or consisting of shallow depressions or embedded cobble/boulder; generally associated with bars
	D2	Similar to D1 with gravel/cobble substrate; some areas of higher velocities producing riffles; instream/overhead cover provided by substrate/turbulence; often associated with bars/shoals
	D3	Similar to D2 with coarser substrates (cobble/boulder); boulders often imbedded; moderate-high velocities offshore; instream cover abundant from substrate; overhead cover from turbulence
Erosional	E1	High, steep eroded banks with terraced profile; unstable; fines; moderate-high offshore velocity; deep immediately offshore; instream/overhead cover from submerged bank materials/vegetation/depth
	E2	Similar to E1 without the large amount of instream vegetative debris; offshore depths shallower
	E3	High, steep eroding banks; loose till deposits (gravel/cobble/sand); moderate-high velocities and depths; instream cover limited to substrate roughness; overhead cover provided by turbidity
	E4	Steep, eroding/slumping highwall bank; primarily fines; moderate-high depths/velocities; instream cover limited to occasional BW formed by bank irregularities; overhead cover from depth/turbidity
	E5	Low, steep banks, often terraced; fines; low velocity; shallow-moderate; no instream cover; overhead cover from turbidity
	E6	Low slumping/eroding bank; substrate either cobble/gravel or silt with cobble/gravel patches; moderate depths; moderate-high velocities; instream cover from abundant debris/boulder; overhead cover from depth/turbidity/overhanging vegetation

Table D.6. Special Habitat Features, Symbols, and Descriptions.

Type	Symbol	Description
Pool	P	High, steep eroded banks with terraced profile; unstable; fines; moderate-high offshore velocity; deep immediately offshore; instream/overhead cover from submerged bank materials/vegetation/depth
Tributary Confluence	TC	Confluence area of tributary entering mainstem; tributary confluence [sub-classified according to tributary flow and wetted width at mouth at the time of the survey]
	TC1	Intermittent flow, ephemeral stream
	TC2	Flowing, width < 5m
	TC3	Flowing, width 5 - 15m
	TC4	Flowing, width 16 - 30m
	TC5	Flowing, width 31 - 60m
	TC6	Flowing, width > 60m
Shoal	SH	Shallow (< 1m deep), submerged areas in mid-channel or associated with Depositional areas around islands/side bars
	SHC	Submerged area of coarse substrates
	SHF	Submerged area of fine substrates
Backwater	BW	Discrete, localized area exhibiting reverse flow direction and, generally, lower velocity than main current; substrate similar to adjacent channel with more fines
Rapid	RA	Area with turbulent flow, broken surface (standing waves, chutes etc.), high velocity (>1 m/s), armoured substrate (large boulder/bedrock) with low fines
Snye	SN	Discrete section of non-flowing water connected to a flowing channel only at its downstream end, generally formed in a side channel or behind a peninsula (bar)
Slough	SL	Non-flowing water body isolated from flowing waters except during flood events; oxbows
Log Jam	LJ	Accumulation of woody debris; generally located on island tips, heads of side channels, stream meanders; provide excellent instream cover

2) Streambank Assessment

Kingfisher standard procedures for streambank assessment are derived from the guidelines for complying with the Code of Practice for Watercourse Crossings Section B Physical Assessment Components (Alberta Environment 2001). At a minimum, five transects will be established within the study area perpendicular to stream flow. Table D.7 provides a description of the parameters that will be assessed along each transect.

Table D.7. Streambank Transect Parameters, Units and Descriptions.

Parameter Components	Parameter Units	Description
Channel Properties		
Wetted Width (m)	Metres	The distance across the wetted surface of the waterbody perpendicular to stream flows
Bankfull Width (m)	Metres	The distance between the LUB and the RUB at level of the 1:2 year highwater mark perpendicular to stream flows
Depth (m)	Metres	The distance from the water surface to a point vertically inline on the streambed
Velocity (m/s or s/m)	Metres per Second, Seconds per Metre	The distance travelled by flowing water per unit of time
Streambed Substrate (FN,GR,CB,BL,BR)	Fines, Gravel, Cobble, Boulder, Bedrock	The material composing the bottom of a stream below the usual water surface
Instream Cover (WD, OV, AV, BL)	Woody Debris, Overhanging Vegetation, Aquatic Vegetation, Boulder	Submerged stream features that are capable of providing shelter for the fish species present within the waterbody
Bank Properties		
Bank Height (m)	Metres	The distance from the water surface to the top of the level of the 1:2 year highwater mark
Bank Angle (°)	Degrees	The angle of the slope of the bank from the waters surface to the 1:2 year highwater
Bank Cover (WD, OB, OV)	Woody Debris, Overhanging Bank, Overhanging Vegetation	Bank features that are capable of providing shelter for the fish species present within the waterbody
Bank Substrate (FN, GR,CB,BL,BR)	Fines, Gravel, Cobble, Boulder, Bedrock	The material composing the streambanks adjacent to the usual water surface
Riparian Vegetation (Gr, Sh, Tr, Ex, Ar)	Grass/Bryophyte, Shrub, Tree, Exposed Bank, Armoured Bank	Vegetation (or the absence of the vegetation) rooted within the riparian area immediately adjacent to the bank
Bank Stability (S or U)	Stable or Unstable	Bank areas displaying slumping, fracturing, or other signs of erosion that would cause bank material to enter the waterbody
Bank Undercut (m)	Metres	Length of bank overhanging into the channel

3) Water Quality

In situ water quality as described in Table D.8 will be measured at one location within the study area.

Table D.8. *In Situ* Water Quality Variables and Units of Measure.

Variable	Parameter Units of Measure
Temperature	Degrees Celsius
pH	Potential of Hydrogen
Dissolved Oxygen	Milligrams per Litre
Conductivity	Micro-Siemens per Centimeter
Turbidity	Nephelometric Turbidity Unit

4) Photographic Documentation

Photographs will be taken to document general site and habitat conditions as well as channel and bank features with the study area. Typical photographic documentation may include the following:

- representative fish habitat and channel form within the study area;
- unique and/or important habitat or channel features;
- the waterbody looking upstream and downstream from the upstream end of the study area;
- the waterbody looking upstream and downstream from the downstream end of the study area;
- the waterbody looking upstream at the proposed right of way; and
- the waterbody looking downstream at the proposed right of way

D) HABITAT EVALUATION

The overall capability of the local habitat within the study section was evaluated based on the sensitivity of species that occupy the habitat, the utility of the habitat (what life processes it supports), and the rarity of the habitat (Table E.1).

Table E.1. Description of Habitat Evaluation and Ranking Criteria.

Evaluation Criteria	Description	Ranking
Sensitivity	What is the sensitivity of species that occupy the habitat?	Low – habitat is primarily utilized by forage and course fish species Moderate – habitat is primarily utilized by forage, coarse, and sport fish species but no highly sensitive species or species of concern are expected to utilize the habitat High – habitat is expected to be utilized by sensitive and/or threatened species.
Utility	For each fish guild (forage, coarse, sport), does the habitat support: • Spawning? • Rearing? • Feeding? • Migration? • Overwintering?	Low – habitat is not a requisite for survival of species Moderate – habitat is important but not critical for survival of species High – habitat is critical for survival of species
Habitat Rarity	How rare is the habitat within the study section and the within the general vicinity of the project?	Low - the habitat is common and available in large quantities Moderate - the habitat is not common and has limited distribution High - the habitat is in unique and only present in small quantities

E) LITERATURE CITED

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Appendix C

Habitat Inventory Results

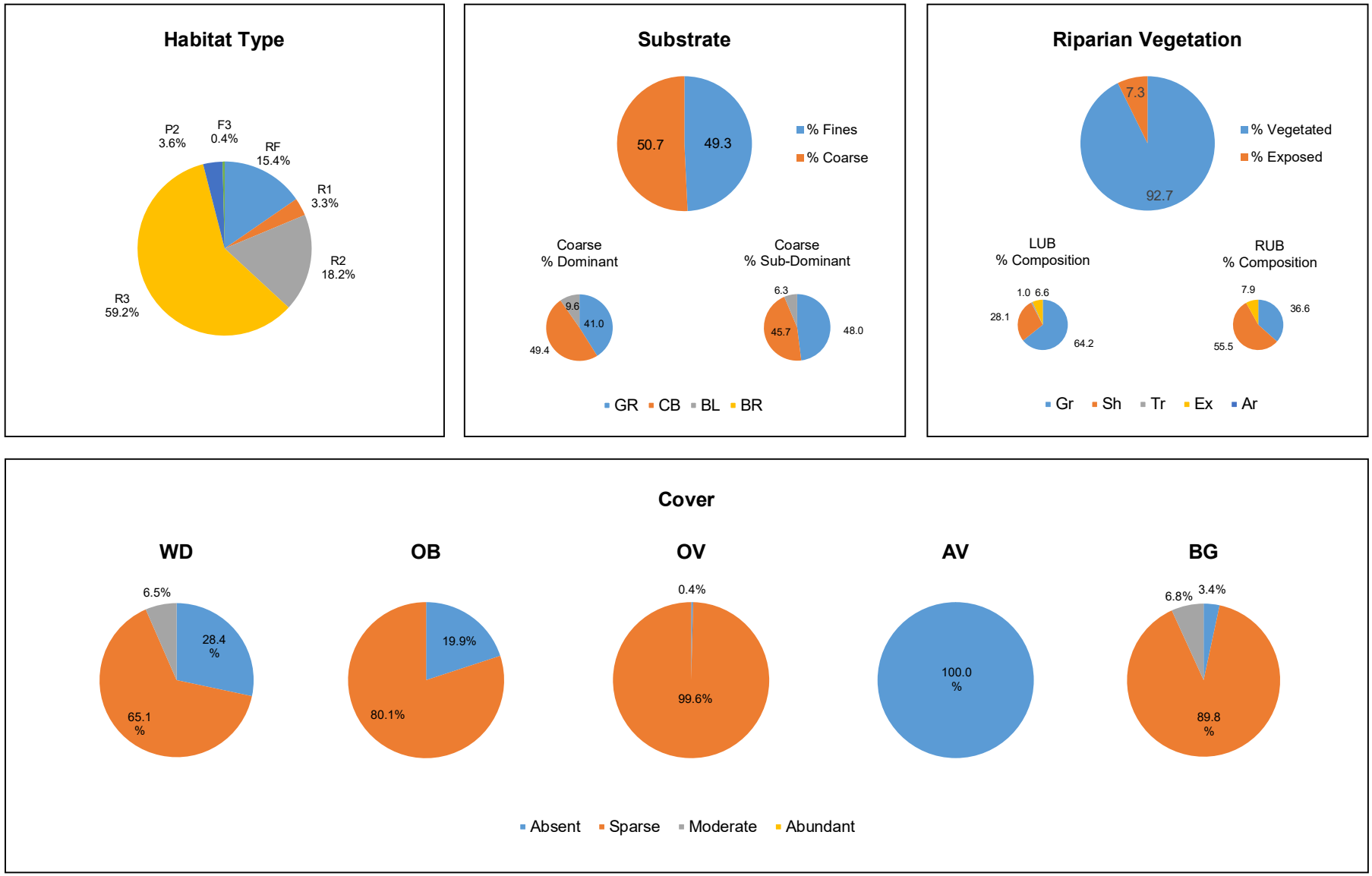

Figure B-1. Summary results for habitat inventory on Blackmud Creek adjacent to the 111 St. Pedestrian Bridge.

Appendix D

Photographs

Plate 1: Looking upstream from the upstream end of the study section.

Plate 2: Looking upstream from 100 m upstream of the bridge.

Plate 3: Looking downstream at the RUB bank under the bridge.

Plate 4: Looking downstream at the LUB bank under the bridge.

Plate 5: Looking upstream from approximately 50 m downstream of the bridge.

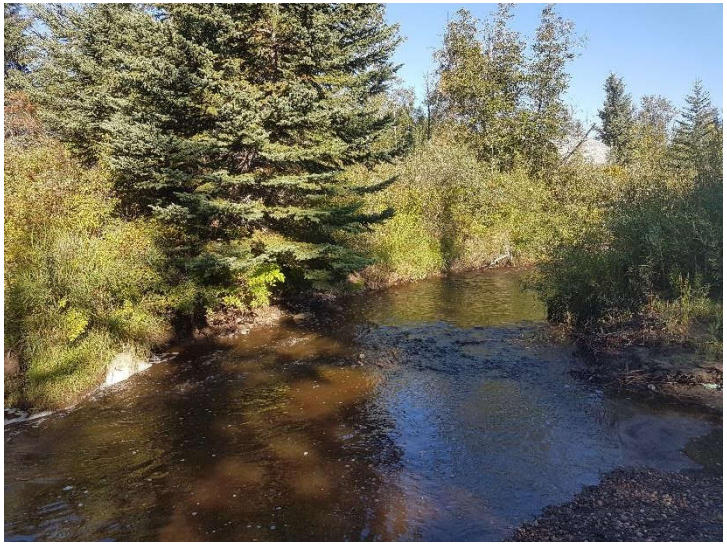

Plate 6: Looking upstream from approximately 150 m downstream of the bridge.

Plate 7: Looking upstream from the 111 St NW bridge crossing at the downstream end of the study section.

Plate 8: Looking downstream from the 111 St NW bridge crossing at the downstream end of the study section.

Appendix F: Plant Survey Species List

111 Street and Blackmud Creek Pedestrian Bridge Plant Species Inventory by Plant Community (24 July 2019)

Species*				Community**			
Scientific Name	**Common Name**	**ACIMS Rank**	**Origin**	**Riparian (R)**	**Balsam Poplar-Mixed Shrub Forest (PB.1)**	**Aspen-Smooth Brome Forest (AW.7)**	**Non-Forested Smooth Brome (NF.7)**
Tree							
Acer negundo	Manitoba maple	native	SU	O		F	
Betula papyrifera	white birch	native	S5?	R			
Picea glauca	white spruce	native	S5	R			R
Populus balsamifera	balsam poplar	native	S5	O	D	F	
Populus tremuloides	aspen	native	S5	R	F	D	R
Quercus macrocarpa	burr oak	exotic	SNA		R		
Shrub							
Alnus incana ssp. *tenuifolia*	river alder	native	S5	F			
Amelanchier alnifolia	saskatoon	native	S5		F	O	
Caragana arborescens	common caragana	exotic	SNA	F	F	O	
Cornus stolonifera	red-osier dogwood	native	S5	O	A	F	
Crataegus chrysocarpa	round-leafed hawthorn	native	S3	R	R	R	
Elaeagnus commutata	silverberry	native	S5	O	O	O	
Rhamnus catharticus	common buckthorn	prohibited noxious	SNA		R		
Ribes americanum	wild black currant	native	S4		O		
Ribes hudsonianum	northern black currant	native	S5		O		
Ribes oxyacanthoides	northern gooseberry	native	S5		O	O	
Ribes triste	wild red currant	native	S5			R	
Rosa acicularis	prickly rose	native	S5	O	A	F	
Rubus idaeus	wild red raspberry	native	S5	F	F		
Salix exigua	narrow-leaf willow	native	S3S4	D			
Salix petiolaris	basket willow	native	S5			O	
Salix pseudomonticola	false mountain willow	native	S4	A			
Salix sp.	willow seedling	native					O

Species*				Community**			
Scientific Name	**Common Name**	**ACIMS Rank**	**Origin**	**Riparian (R)**	**Balsam Poplar-Mixed Shrub Forest (PB.1)**	**Aspen-Smooth Brome Forest (AW.7)**	**Non-Forested Smooth Brome (NF.7)**
Shepherdia canadensis	Canada buffaloberry	native	S5		R		
Symphoricarpos occidentalis	buckbrush	native	S5	R	A	F	
Syringa sp.	lilac	exotic	SNA	R			
Forb							
Achillea millefolium	common yarrow	native	S5	O			R
Achillea sibirica	many-flowered yarrow	native	S5	R			
Actaea rubra	red and white baneberry	native	S5		O	O	
Astragalus cicer	cicer milk vetch	exotic	SNA	F	F	F	
Chamerion angustifolium	common fireweed	native	S5		F		
Cirsium arvense	creeping thistle	noxious	SNA	O	O	O	O
Equisetum arvensis	common horsetail	native	S5				O
Equisetum sylvaticum	woodland horsetail	native	S5	O			
Erigeron sp.	fleabane	native		R			
Galium boreale	northern bedstraw	native	S5	O		O	O
Geum aleppicum	yellow avens	native	S5	R			
Heracleum maximum	cow parsnip	native	S5		R		
Lathyrus venosus	purple peavine	native	S4		O		
Linaria vulgaris	common toadflax	noxious	SNA	O			
Lotus corniculatus	bird's-foot trefoil	exotic	SNA	O			F
Maianthemum canadense	wild lily-of-the-valley	native	S5			R	
Maianthemum stellatum	star-flowered Solomon's-seal	native	S5		F		
Matricaria discoidea	pineappleweed	exotic	SNA	O			
Medicago lupulina	black medick	exotic	SNA	F			F
Medicago sativa	alfalfa	exotic	SNA	F	O		
Melilotus officinalis	yellow sweet-clover	exotic	SNA				O
Mertensia paniculata	tall lungwort	native	S5		F		
Oenothera biennis	yellow evening-primrose	native	S5	R			

Species*				Community**			
Scientific Name	**Common Name**	**ACIMS Rank**	**Origin**	**Riparian (R)**	**Balsam Poplar-Mixed Shrub Forest (PB.1)**	**Aspen-Smooth Brome Forest (AW.7)**	**Non-Forested Smooth Brome (NF.7)**
Potentilla anserina	silverweed	native	S5	F			
Silene latifolia	white cockle	noxious	SNA				R
Solidago altissima	tall goldenrod	native	S5	O		O	
Sonchus arvensis	perennial sow-thistle	noxious	SNA	O	O		O
Symphyotrichum ciliolatum	Lindley's aster	native	S5	O			
Tanacetum vulgare	common tansy	noxious	SNA	O			O
Taraxacum officinale	common dandelion	exotic	SNA	F	O		
Tragopogon dubius	common goat's-beard	exotic	SNA				R
Trifolium hybridum	alsike clover	exotic	SNA	F			A
Trifolium pratense	red clover	exotic	SNA				O
Vicia americana	wild vetch	native	S5	F		F	F
Vicia cracca	tufted vetch	exotic	SNA			O	
Graminoid							
Bromus inermis	smooth brome	exotic	SNA	A	F	A	D
Carex atherodes	awned sedge	native	S5	F			
Carex sp. 1	sedge	native				R	
Carex sp. 2	sedge	native					O
Elymus repens	quackgrass	exotic	SNA	F	O	F	A
Phalaris arundinacea	reed canary grass	native	S5	A			
Poa pratensis	Kentucky bluegrass	native	S5	O	O		F
Schonoeplectus sp.	bulrush	native	S5	F			
Species Richness				**44**	**30**	**24**	**21**
Native Species Richness				**29**	**20**	**18**	**9**
Exotic Species Richness				**11**	**7**	**25**	**8**
Noxious/Prohibited Noxious Species Richness				**4**	**3**	**1**	**4**

*Scientific nomenclature, common names and ranks follow ACIMS (2019), using vascular plant data updated March 2018

**Species abundance abbreviations per community are as follows: D=dominant, A=abundant, F=frequent, O=occasional, R=rare

Appendix G: Wildlife List

111 Street and Blackmud Creek Pedestrian Bridge Wildlife List (May 2020)

Common Name	Scientific Name*	Provincial Status (General Status of AB Wild Species 2015)	Wildlife Act Designation and New Species Assessed by ESCC	COSEWIC Designation**	SARA Designation (Schedule 1)	Species Recorded in Study Area***	Likelihood of Occurrence	Potential Habitat Use
Common Garter Snake	*Thamnophis sirtalis*	Sensitive	LP Candidate	LP Candidate (SSC)			Low	Foraging/dispersal
Canada Goose	*Branta canadensis*	Secure						
Mallard	*Anas platyrhynchos*	Secure						
Ruby-throated Hummingbird	*Archilochus colubris*	Secure						
Spotted Sandpiper	*Actitis macularius*	Secure						
Solitary Sandpiper	*Tringa solitaria*	Secure						
Franklin's Gull		Secure		LP Candidate (SSC)			Low	Migration
Ring-billed Gull	*Larus delawarensis*	Secure						
Great Blue Heron	*Ardea herodias*	Sensitive					Low	Foraging
Black-crowned Night Heron	*Nycticorax nycticorax*	Sensitive					Low	Foraging
Sharp-shinned Hawk	*Accipiter striatus*	Secure		Not at Risk				
Cooper's Hawk	*Accipiter cooperii*	Secure		Not at Risk				
Northern Goshawk	*Accipiter gentilis atricapillus*	Sensitive		Not at Risk			Low	Breeding/foraging
Red-tailed Hawk	*Buteo jamaicensis*	Secure		Not at Risk				
Great Horned Owl	*Bubo virginianus*	Secure						
Barred Owl	*Strix varia*	Sensitive	Special Concern				Low	Breeding/foraging
Northern Saw-whet Owl	*Aegolius acadicus*	Secure						
Belted Kingfisher	*Megaceryle alcyon*	Secure						
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Secure						
Downy Woodpecker	*Dryobates pubescens*	Secure				BBS, CLP 2019		
Hairy Woodpecker	*Dryobates villosus*	Secure				CLP 2019		
Northern Flicker	*Colaptes auratus*	Secure						
Pileated Woodpecker	*Colaptes pileatus*	Sensitive				FWMIS, CLP 2019	High	Breeding/foraging
Merlin	*Falco columbarius*	Secure		Not at Risk		CLP 2019		
Peregrine Falcon	*Falco peregrinus anatum/tundrius*	At Risk	Threatened	Not at Risk	Special Concern		Low	Foraging
Olive-sided Flycatcher	*Contopus cooperi*	May Be At Risk		Special Concern	Threatened	BBS	High	Breeding/foraging
Western Wood-pewee	*Contopus sordidulus*	May Be At Risk					Low	Breeding/foraging
Least Flycatcher	*Empidonax minimus*	Sensitive		LP Candidate (SSC)			Moderate	Breeding/foraging
Eastern Phoebe	*Sayornis phoebe*	Sensitive				FWMIS	Moderate	Breeding/foraging
Eastern Kingbird	*Tyrannus tyrannus*	Sensitive					Moderate	Breeding/foraging
Northern Shrike	*Lanius excubitor*	Secure						
Blue-headed Vireo	*Vireo solitarius*	Secure						
Warbling Vireo	*Vireo gilvus*	Secure						
Philadelphia Vireo	*Vireo philadelphicus*	Secure						
Red-eyed Vireo	*Vireo olivaceus*	Secure				BBS		
Blue Jay	*Cyanocitta cristata*	Secure				CLP 2019		
Black-billed Magpie	*Pica hudsonia*	Secure				CLP 2019		
American Crow	*Corvus brachyrhynchos*	Secure				BBS		
Common Raven	*Corvus corax*	Secure				CLP 2019		
Tree Swallow	*Tachycineta bicolor*	Secure						
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Secure						
Bank Swallow	*Riparia riparia*	Sensitive		Threatened	Threatened		Moderate	Breeding/foraging
Cliff Swallow	*Petrochelidon pyrrhonota*	Secure						
Barn Swallow	*Hirundo rustica*	Sensitive		Threatened	Threatened		Moderate	Breeding/foraging
Black-capped Chickadee	*Poecile atricapillus*	Secure				BBS, CLP 2019		
Boreal Chickadee	*Poecile hudsonicus*	Secure						
Red-breasted Nuthatch	*Sitta canadensis*	Secure				CLP 2019		

Common Name	Scientific Name*	Provincial Status (General Status of AB Wild Species 2015)	Wildlife Act Designation and New Species Assessed by ESCC	COSEWIC Designation**	SARA Designation (Schedule 1)	Species Recorded in Study Area***	Likelihood of Occurrence	Potential Habitat Use
White-breasted Nuthatch	*Sitta carolinensis*	Secure				BBS, CLP 2019		
Brown Creeper	*Certhia americana*	Sensitive					Low	Migrating
House Wren	*Troglodytes aedon*	Secure				BBS		
Ruby-crowned Kinglet	*Regulus calendula*	Secure						
Townsend's Solitaire	*Myadestes townsendi*	Secure						
Swainson's Thrush	*Catharus ustulatus*	Secure						
Hermit Thrush	*Catharus guttatus*	Secure						
American Robin	*Turdus migratorius*	Secure						
Gray Catbird	*Dumetella carolinensis*	Secure				BBS		
European Starling	*Sturnus vulgaris*	Exotic/Alien						
Bohemian Waxwing	*Bombycilla garrulus*	Secure				CLP 2019		
Cedar Waxwing	*Bombycilla cedrorum*	Secure				BBS		
House Sparrow	*Passer domesticus*	Exotic/Alien						
Pine Grosbeak	*Pinicola enucleator*	Secure						
Purple Finch	*Haemorhous purpureus*	Secure						
House Finch	*Haemorhous mexicanus*	Secure				CLP 2019		
Common Redpoll	*Acanthis flammea*	Secure						
Pine Siskin	*Spinus pinus*	Secure						
American Goldfinch	*Spinus tristis*	Secure						
American Tree Sparrow	*Spizelloides arborea*	Secure						
Chipping Sparrow	*Spizella passerina*	Secure				BBS		
Clay-colored Sparrow	*Spizella pallida*	Secure				BBS		
Savannah Sparrow	*Passerculus sandwichensis*	Secure						
Song Sparrow	*Melospiza melodia*	Secure				BBS		
Lincoln's Sparrow	*Melospiza lincolnii*	Secure						
White-throated Sparrow	*Zonotrichia albicollis*	Secure						
White-crowned Sparrow	*Zonotrichia leucophrys*	Secure						
Dark-eyed Junco	*Junco hyemalis*	Secure				BBS		
Common Grackle	*Quiscalus quiscula*	Secure						
Brown-headed Cowbird	*Molothrus ater*	Secure				BBS		
Baltimore Oriole	*Icterus galbula*	Sensitive					Low	Migrating
Tennessee Warbler	*Oreothlypis peregrina*	Secure						
Orange-crowned Warbler	*Oreothlypis celata*	Secure						
Yellow Warbler	*Setophaga petechia*	Secure				BBS		
Cape May Warbler	*Setophaga tigrina*	Sensitive	Special Concern				Low	Breeding/foraging
Yellow-rumped Warbler	*Setophaga coronata*	Secure						
Bay-breasted Warbler	*Setophaga castanea*	Sensitive					Low	Breeding/foraging
American Redstart	*Setophaga ruticilla*	Secure						
Common Yellowthroat	*Geothlypis trichas*	Sensitive					Low	Breeding/foraging
Western Tanager	*Piranga ludoviciana*	Sensitive					Moderate	Breeding/Foraging
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Secure						
Snowshoe Hare	*Lepus americanus*	Secure				BBS		
White-tailed Jack Rabbit	*Lepus townsendii*	Secure				CLP 2019		
Least Chipmunk	*Neotamias minimus*	Secure						
Red Squirrel	*Tamiasciurus hudsonicus*	Secure				BBS		
Northern Flying Squirrel	*Glaucomys sabrinus*	Secure						
Northern Pocket Gopher	*Thomomys talpoides*	Secure						
American Beaver	*Castor canadensis*	Secure				CLP 2019		

Common Name	Scientific Name*	Provincial Status (General Status of AB Wild Species 2015)	Wildlife Act Designation and New Species Assessed by ESCC	COSEWIC Designation**	SARA Designation (Schedule 1)	Species Recorded in Study Area***	Likelihood of Occurrence	Potential Habitat Use
Deer Mouse	*Peromyscus maniculatus*	Secure						
Southern Red-backed Vole	*Myodes gapperi*	Secure						
Muskrat	*Ondatra zibethicus*	Secure						
Common Porcupine	*Erethizon dorsatum*	Secure						
Little Brown Myotis	*Myotis lucifugus*	May Be At Risk		Endangered	Endangered		High	Roosting/foraging
Northern Myotis	*Myotis septentrionalis*	May Be At Risk	Data Deficient	Endangered	Endangered		Low	Roosting/foraging
Silver-haired Bat	*Lasionycteris noctivagans*	Sensitive		HP Candidate (SSC)			Moderate	Roosting/foraging
Big Brown Bat	*Eptesicus fuscus*	Secure						
Hoary Bat	*Aeorestes cinereus*	Secure		HP Candidate (SSC)			Low	Roosting/foraging
Coyote	*Canis latrans*	Secure				CLP 2019		
Red Fox	*Vulpes vulpes*	Secure				CLP 2019		
Long-tailed Weasel	*Mustela frenata*	May Be At Risk		Not at Risk		CLP 2019	Low	Foraging/dispersal
Ermine	*Mustela erminea*	Secure						
Least Weasel	*Mustela nivalis*	Secure				CLP 2019		
Striped Skunk	*Mephitis mephitis*	Secure						
Mountain Lion/Cougar	*Puma concolor*	Secure						
Canada Lynx	*Lynx canadensis*	Sensitive		Not at Risk				
Moose	*Alces alces*	Secure				CLP 2019		
Mule Deer	*Odocoileus hemionus*	Secure						
White-tailed Deer	*Odocoileus virginianus*	Secure				BBS		

* Scientific names are based on the Cornell Lab of Ornithology's 2018 Clements Checklist (birds) and the Government of Alberta's 2015 Wild Species Status List (mammals, amphibians, reptiles)
** HP = High priority; MP = mid-priority; LP = low priority candidate by the species specialists subcommittee (SSC)
*** Sources of species records: BBS = breeding bird survey observation (26 June 2019), FWMIS = Fish and Wildlife Management Information System (Accessed 06 March 2020; observation dates unknown), CLP 2019 = mammal tracking surveys (January/February 2018, Capital Line Partners [2019])

Appendix H: *Historical Resources Act* Requirements

Alberta

HRA Number: 4715-20-0025-002
October 05, 2020

Historical Resources Act Approval with Conditions

Proponent: City of Edmonton
#402, 9925 - 109 Street, Edmonton, AB T5K 2J8
Contact: Satya Gadidasu

Agent: Circle CRM Group Inc.
Contact: Margarita de Guzman

Project Name: **B128 Blackmud Creek Pedestrian Bridge Replacement**

Project Components: Bridge

Application Purpose: Requesting HRA Approval / Requirements

Historical Resources Act approval is granted for the activities described in this application and its attached plan(s)/sketch(es) subject to the following conditions.

David Link
Assistant Deputy Minister
Heritage Division
Alberta Culture, Multiculturalism
and Status of Women

SCHEDULE OF CONDITIONS

ARCHAEOLOGICAL RESOURCES

Historical Resources Act approval is granted in relation to archaeological resources, subject to the conditions outlined below.

1. *Historical Resources Act* approval relative to archaeological resources is granted conditionally on the understanding that all ground disturbance activities will be confined to the identified project footprint. If final project planning requires the expansion of development activities (including temporary workspace, temporary storage and new access) outside of the approved boundary, then these final plans must be submitted for review by Alberta Culture, Multiculturalism and Status of Women. The final plans must be submitted in a new Historic Resources Application prior to the onset of development activities, and must be accompanied by GIS shapefiles.

PALAEONTOLOGICAL RESOURCES

Conditional *Historical Resources Act* approval is granted on the understanding that a Historic Resources Impact Assessment for palaeontological resources in the form of a monitoring program will be conducted, as outlined below.

SCHEDULE OF CONDITIONS (continued)

1. The following *Historical Resources Act* conditions are based on the results of Historic Resources Impact Assessment studies carried out by Sandstone Palaeontology Consulting under Palaeontological Research Permit No. 20-033.

2. A monitoring program is required for all areas of high palaeontological potential.

3. No excavation activities are to take place on the project until a professional consulting palaeontologist is on site to monitor construction activities. Should significant palaeontological resources be encountered during the conduct of the monitoring program, the Royal Tyrrell Museum of Palaeontology must be contacted. It may then be necessary for Alberta Culture, Multiculturalism and Status of Women to issue further instructions regarding these resources.

4. The Historic Resources Impact Assessment for palaeontological resources is to be conducted on behalf of the proponent by a palaeontologist qualified to hold a palaeontological research permit within the Province of Alberta. A permit must be issued by Alberta Culture, Multiculturalism and Status of Women prior to the initiation of any palaeontological field investigations. Please allow ten working days for the permit application to be processed. To obtain contact information for consultants qualified to undertake this work, please consult the list of Alberta Historic Resource Consultants.

ABORIGINAL TRADITIONAL USE SITES

There are no *Historical Resources Act* requirements associated with Aboriginal traditional use sites of a historic resource nature; however, the proponent must comply with Standard Requirements under the Historical Resources Act: Reporting the Discovery of Historic Resources, which are applicable to all land surface disturbance activities in the Province.

HISTORIC STRUCTURES

There are no *Historical Resources Act* requirements associated with historic structures; however, the proponent must comply with Standard Requirements under the *Historical Resources Act*: Reporting the Discovery of Historic Resources, which are applicable to all land surface disturbance activities in the Province.

PROVINCIALLY DESIGNATED HISTORIC RESOURCES

There are no *Historical Resources Act* requirements associated with Provincially Designated Historic Resources; however, the proponent must comply with Standard Requirements under the *Historical Resources Act*: Reporting the Discovery of Historic Resources, which are applicable to all land surface disturbance activities in the Province.

ADDITIONAL COMMENTS

1. In addition to any specific conditions detailed above, the proponent must abide by all Standard Conditions under the *Historical Resources Act*.

Lands Affected: All New Lands

Proposed Development Area:

MER	RGE	TWP	SEC	LSD List

SCHEDULE OF CONDITIONS (continued)

4	24	51	32		5
4	24	51	32		5

Documents Attached:

Document Name	Document Type
Project Drawings	Illustrative Material

STANDARD REQUIREMENTS UNDER THE *HISTORICAL RESOURCES ACT*: REPORTING THE DISCOVERY OF HISTORIC RESOURCES

If development proponents and/or their agents become aware of historic resources during the course of development activities, they are required, under Section 31 of the *Historical Resources Act*, to report these discoveries to the Heritage Division of Alberta Culture, Multiculturalism and Status of Women. This requirement applies to all activities in the Province of Alberta.

1.0 REPORTING THE DISCOVERY OF ARCHAEOLOGICAL RESOURCES

The discovery of archaeological resources is to be reported to Darryl Bereziuk, Director, Archaeological Survey, at 780-431-2316 (toll-free by first dialing 310-0000) or darryl.bereziuk@gov.ab.ca.

2.0 REPORTING THE DISCOVERY OF PALAEONTOLOGICAL RESOURCES

The discovery of palaeontological resources is to be reported to Dan Spivak, Head, Resource Management, Royal Tyrrell Museum of Palaeontology, at 403-820-6210 (toll-free by first dialing 310-0000) or dan.spivak@gov.ab.ca.

3.0 REPORTING THE DISCOVERY OF HISTORIC PERIOD SITES

The discovery of historic structures to be reported to Rebecca Goodenough, Manager, Historic Places Research and Designation Program, at 780-431-2309 (toll-free by first dialing 310-0000) or rebecca.goodenough@gov.ab.ca. Please note that some historic structure sites may also be considered Aboriginal traditional use sites.

4.0 REPORTING THE DISCOVERY OF ABORIGINAL TRADITIONAL USE SITES

The discovery of any Aboriginal traditional use site that is of a type listed below is to be reported to Valerie Knaga, Director, Aboriginal Heritage Section, at 780-431-2371 (toll-free by first dialing 310-0000) or valerie.k.knaga@gov.ab.ca.

Aboriginal Traditional Use sites considered by Alberta Culture, Multiculturalism and Status of Women to be historic resources under the *Historical Resources Act* include:

Historic cabin remains;
Historic cabins (unoccupied);
Cultural or historical community camp sites;

Ceremonial sites/Spiritual sites;
Gravesites;
Historic settlements/Homesteads;
Historic sites;
Oral history sites;
Ceremonial plant or mineral gathering sites;
Historical Trail Features; and,
Sweat/Thirst/Fasting Lodge sites

5.0 FURTHER SALVAGE, PRESERVATIVE OR PROTECTIVE MEASURES

If previously unrecorded historic resources are discovered, proponents may be ordered to undertake further salvage, preservative or protective measures or take any other actions that the Minister of Alberta Culture, Multiculturalism and Status of Women considers necessary.

Appendix I: Palaeontological Historical Resources Impact Assessment (Sandstone 2020)

Palaeontological Historical Resources Impact Assessment of the B128 Blackmud Creek Pedestrian Bridge Replacement Project

Prepared for:

City of Edmonton
402, 9925 – 109 Street
Edmonton AB

Via:

Circle CRM Group Inc.
60, 4807 - 32 Street SE
Calgary AB

Prepared by:

Emily Frampton, M.Sc.
Sandstone Palaeontology Consulting
201, 1021 13 Avenue SW
Calgary AB

Permit Number 20-033

August 2020

EXECUTIVE SUMMARY

The B128 Blackmud Creek Pedestrian Bridge Replacement Project is the removal and subsequent replacement of a new pedestrian bridge that crosses Blackmud Creek along Running Creek Road NW within the City of Edmonton. The original bridge was constructed years earlier and is now in need of replacement. The new bridge will be constructed via removal of the old bridge, excavation of new bridge footings on either side of Blackmud Creek along the north and south slopes, and installation of the new bridge. The Project is located in LSD 5-32-51-24 W4, in southwest Edmonton, just north of Anthony Henday Dr. and east of 111 St. NW.

Historical Resources Act requirements were issued for this Project on May 4, 2020 (HRA No. 4715-20-0025-001). The requirements consist of a palaeontological Historical Resources Impact Assessment that must include all areas of high palaeontological potential within the Project area. Areas of high palaeontological potential include the base and slopes of Blackmud Creek. Numerous areas within and surrounding the Project area have Historical Resource Values of 5p: High Palaeontological Resource Sensitivity, indicating that fossils could be encountered on those lands. The pHRIA for this Project took place on June 24, 2020. This report provides the results of that palaeontology survey.

Bedrock in the Project area is the Late Cretaceous Horseshoe Canyon Formation. The formation is composed of sandstone, siltstone, shale and coal with minor bentonite. The formation is highly fossiliferous, with plants, sharks, fish, amphibians, reptiles and dinosaurs having been collected. Surficial geology in the Project area consists of glaciolacustrine deposits on the uplands above Blackmud Creek Valley. Colluvium is mapped on the slopes, with modern alluvium mapped along the creek.

Survey of the Blackmud Creek Valley found bedrock exposures of the fossiliferous Horseshoe Canyon Formation throughout the Project area. The bedrock consisted mainly of dark grey crumbly mudstone, with interbedded units of sandstone, coal and ironstone. Fossils included coalified plant and wood debris, and dark grey to black fossilized wood with a glassy preservation. No other fossils were noted. The bedrock was exposed on the lower part of the slope, extending upward from the creek. It was overlain by glaciolacustrine silt and sand, suggesting that the lower part of the valley is underlain by bedrock, with the upper part of the valley underlain by glaciolacustrine deposits of low palaeontological potential. Modern alluvial deposits of silt and sand occurred along Blackmud Creek. A single exposure of Holocene alluvial deposits composed of gravel channel or flood deposits and overbank silt was noted in the Project area. It was examined for fossils but none were found.

The Blackmud Creek pedestrian bridge replacement will be constructed near the base of the valley and is just west of a large bedrock exposure. Based on construction plans for the Project, the old bridge and old timber abutments will be removed and will be replaced with a new longer, but narrower pedestrian bridge. Excavation will be required to remove the old bridge and abutments and to construct the new bridge. Although no significant fossils were found during the pHRIA in the Project area, the regional area has yielded significant fossils, including a hadrosaur bonebed. Bedrock of the Horseshoe Canyon Formation will be disturbed by Project construction and the potential of impacts to palaeontological resources is considered high. Monitoring of the Blackmud Creek pedestrian bridge replacement during construction is recommended.

ACKNOWLEDGEMENTS

Field Studies

Permit Holder	Emily Frampton

Reporting

Report Author	Emily Frampton

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1. Introduction

The B128 Blackmud Creek Pedestrian Bridge Replacement Project (the Project) is the removal and subsequent replacement of a new pedestrian bridge that crosses Blackmud Creek along Running Creek Road NW within the City of Edmonton (Figure 1.1). The original bridge was constructed years earlier and is now in need of replacement. The new bridge will be constructed via removal of the old bridge, excavation of new bridge footings on either side of Blackmud Creek along the north and south slopes, and installation of the new bridge. The Project is located in LSD 5-32-51-24 W4, in southwest Edmonton, just north of Anthony Henday Dr. and east of 111 St. NW.

Historical Resources Act requirements were issued for this Project on May 4, 2020 (HRA No. 4715-20-0025-001). The requirements consist of a palaeontological Historical Resources Impact Assessment (pHRIA) that must include all areas of high palaeontological potential within the Project area. Areas of high palaeontological potential include the base and slopes of Blackmud Creek surrounding the Project footprint. Numerous areas within and surrounding the Project area have Historical Resource Values of 5p: High Palaeontological Resource Sensitivity, indicating that fossils could be encountered on those lands. The pHRIA for this Project took place on June 24, 2020. This report provides the results of that palaeontology survey.

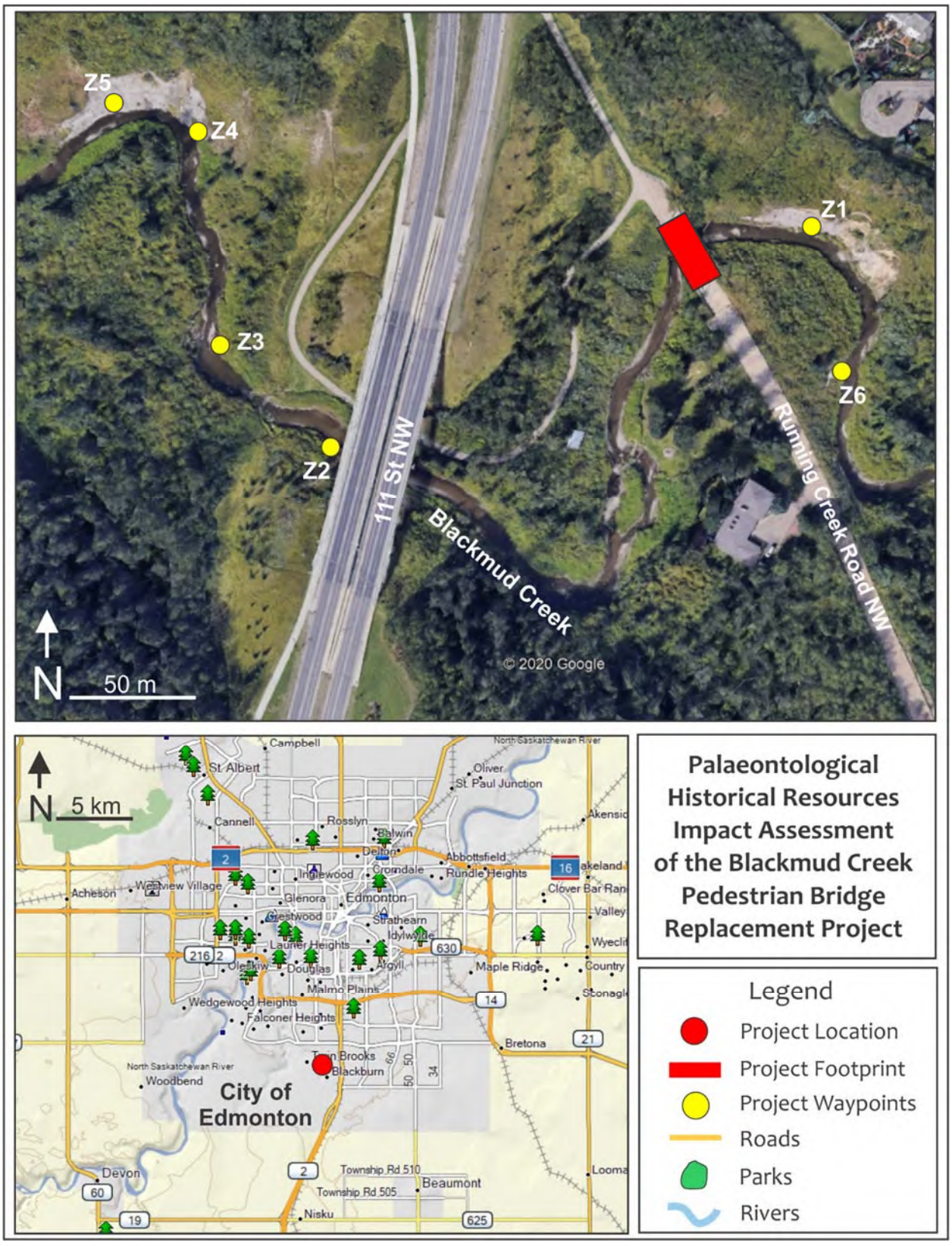

Figure 1.1. Project Footprint Location and Waypoints.

2. Geology and Palaeontology

2.1 Bedrock Geology

Bedrock in the Project area is the Late Cretaceous Horseshoe Canyon Formation (Prior et al. 2013). The formation is composed of sandstone, siltstone, shale and coal with minor bentonite. Siltstone and shale beds are the most common units; sandstone beds are discontinuous and frequently occur only as lenses. Fifteen coal seams of limited geographical extent have been recognized throughout the formation (Jerzykiewicz 1997).

The Horseshoe Canyon Formation is approximately 250 m thick in the Edmonton region (Eberth and Straight 1998). It gradationally overlies and is laterally continuous with the marine Bearpaw Formation. The upper contact with the thin Whitemud Formation is also gradational (Jerzykiewicz 1997). It is the lowest member of the Edmonton Group and is overlain successively by the Whitemud, Battle and Scollard formations (Larson et al. 2010).

The Horseshoe Canyon Formation has been divided into 5 informal units. Unit 1 (lower Horsehoe Canyon Formation) is a coal- and mudstone-dominated succession deposited during a warm and wet phase in a lower coastal plain setting. Other depositional environments of Unit 1 include interbedded estuarine, tidal channel, barrier island and lagoonal deposits that grade into a delta plain succession dominated by meandering channels (Braman 1988). Unit 1 also comprises more than half the total thickness of the formation (Larson et al. 2010). Unit 2 is the Drumheller Marine Tongue, a sandstone, siltstone and lenticular limestone unit that contains two diachronous brackish water bivalve marker beds and represents a marine transgression (Jerzykiewicz 1997). Unit 3 is comprised of stacked freshwater fluvial paleochannel sandstones, and Unit 4 is an overbank-mudstone and palaeosol-dominated interval. Units 2 to 4 were all deposited in a time of cool, dry temperatures (Larson et al. 2010). The top-most unit, Unit 5, is a coaly interval characterized by locally thick palaeochannel sandstones and patchy occurrences of extra-basinal conglomerate clasts. This unit was deposited under wet and warmer conditions than in Units 2 to 4 (Larson et al. 2010).

2.2 Palaeontology

The Horseshoe Canyon Formation is highly fossiliferous. A full species list can be found in Ryan and Russell (2000) and includes plants (mostly conifers), sharks including the ray *Myledaphus* and rhinobatids, Holostean, elopomorph and esocoid fish, amphibians (frogs, salamanders) and reptiles (turtles, crocodiles, lizards). Numerous dinosaurs have been collected from the formation including hadrosaurs, ceratopsians, ankylosaurs, dromaeosaurs, ornithomimids and tyrannosaurs (Larson et al. 2010). Mammals and birds have also been found in the formation (Eberth and Straight 1998).

There are numerous fossil sites within the City of Edmonton, most notably the Danek bonebed. Bedrock exposures of the Horseshoe Canyon Formation outcrop along the North Saskatchewan River, and the Whitemud and Blackmud creeks within the city limits with fossils found throughout these areas. Fossils include plant material and amber, ammonites, a tyrannosaurid (large theropod) tooth, isolated hadrosaur (duckbill dinosaur) skeletal elements and an incomplete hadrosaur skeleton (HeRMIS 2020). The Danek Bonebed is a mainly monodominant

bonebed that produces disarticulated remains of the hadrosaur *Edmontosaurus regalis*. Rare ceratopsian and tyrannosaurid bones and teeth have also been collected from the bonebed, along with hundreds of hadrosaur skeletal elements (Bell and Campione 2014; Burns et al. 2014). The Danek Bonebed is approximately 2 km southwest of the Project area along Whitemud Creek.

2.3 Surficial Geology

Surficial geology in the Project area consists of glaciolacustrine deposits on the uplands surrounding Blackmud Creek Valley, and colluvium and alluvium along the slopes and creek (Bayrock 1972). The glaciolacustrine deposits consist of clay, silt and sand deposited within or along the margin of glacial lakes. Material deposited offshore includes rhythmically laminated to massive fine sand, silt and clay, and can locally contain debris released by the melting of floating ice. Littoral or nearshore sediments are massive to stratified, well-sorted silty sand, pebbly sand and minor gravel that can occur in beaches, bars and deltas. The deposit is thick and is considered nonfossiliferous (Fenton et al. 2013). Colluvium occurs along slopes of the creek valley (Bayrock 1972). Colluvium is a gravity deposit comprised of slope erosion and slump events composed of mixed glacial deposits and bedrock that have eroded from above. This deposit forms a thin veneer covering the valley slopes and often overlies exposures of bedrock. Stream alluvium is found along the base of valley and consists of clay, silt and sand. This is a modern deposit of Blackmud Creek.

3. Methods

During the pHRIA, areas of high paleontological potential on and surrounding the Project footprint were examined via pedestrian traverse. The Project footprint was surveyed as a local assessment in order to determine the geology underlying the pedestrian bridge. A regional assessment was conducted on foot of other exposures along Blackmud Creek in the vicinity of the Project area. Any exposures noted were photographed and a waypoint was taken. Stratigraphy and sedimentology of the exposures was recorded. All exposures were examined for fossils. If fossils were noted, their significance was determined and a sample collected. If the fossils were not significant or too weathered to be identifiable, they were noted and photographed, but not collected. Data collected on stratigraphy, lithology and the presence or absence of fossils from the regional survey at other exposures surrounding the Project footprint were extrapolated to the Project footprint to determine if Project excavation would disturb any potentially fossiliferous bedrock or surficial deposits.

4. Results

The new replacement pedestrian bridge will be constructed at the base of Blackmud Creek Valley. The valley is approximately 20 to 25 m deep and thickly vegetated (Plate 1), with only a few exposures of bedrock of the Horseshoe Canyon Formation. Waypoints were taken of several of those exposures in the vicinity of the Project footprint and detailed descriptions of lithology and stratigraphy at these waypoints are listed in Table 4.1. Both the Project footprint and the waypoints are mapped on Figure 1.1.

Table 4.1 Description of Exposures within the Project area.

Waypoint	Lithology Description
Z1	Approximately 4 to 5 m high and 10 m long exposure of the Horseshoe Canyon Formation. A large portion of the exposure is covered in a veneer of light brown glaciolacustrine sand. The bedrock, where exposed, consists of dark grey crumbly mudstone to siltstone interbedded with thicker units of soft grey sandstone. Coalified wood and plant debris was noted discontinuously throughout the dark grey mudstone to siltstone. No other fossils were observed.
Z2	Modern alluvial deposits of silt and sand exposed along Blackmud Creek.
Z3	Approximately 5 m long and 1 to 3 m high exposure of alluvial deposits and bedrock of the Horseshoe Canyon Formation. The bedrock consists of light grey sandstone overlain by alluvial deposits most likely of Holocene age. A thin to an approximately 20 cm thick discontinuous unit of gravel (channel deposit) overlies the bedrock. The gravel is in turn overlain by grey-brown silt of overbank (floodplain) origin. These alluvial deposits likely represent a remnant of older deposits of Blackmud Creek that have been mostly eroded away by the modern creek. The exposure was examined for fossils, but none were observed.
Z4	Approximately 5 to 6 m high and 15 m long exposure of the Horseshoe Canyon Formation. The bedrock consists of dark grey crumbly mudstone to siltstone interbedded with thicker units of soft grey sandstone. An approximately 10 cm thick unit of coal occurs near the top of the exposure. The exposure was examined for fossils, but none were found.
Z5	West end of the same exposure as Z4. A similar lithology occurs as in Z4, with dark grey crumbly mudstone interbedded with light grey soft units of sandstone. At the west end of the exposure near the base, a light grey indurated sandstone unit is overlain by a unit of dark grey siltstone. Fossilized wood with a unique glassy texture was noted in the dark siltstone just above the contact with the sandstone. A 10 cm thick unit of blocky ironstone overlies the dark grey siltstone. Except for the fossilized wood, no other fossils were observed.
Z6	Eroded sandstone of the Horseshoe Canyon Formation exposed above the creek bank. No fossils were noted.

4.1 Blackmud Creek Valley

Within Blackmud Creek Valley, bedrock of the Horseshoe Canyon Formation, glaciolacustrine deposits of sand, and Holocene to modern alluvial deposits were noted. Bedrock of the Horseshoe Canyon Formation outcropped as several large exposures along the slope, with one exposure (Z1) just east of proposed Project area (Plate 2). The largest of these bedrock exposures were upwards of 6 m high, and extended from the base of the slope upwards. At Z1, Z4 and Z5, the bedrock was overlain by varying thicknesses of glaciolacustrine sand that did not exceed 50 cm thick (Plate 3). Above this, the valley was thickly vegetated with no exposures. The glaciolacustrine sand above the bedrock would often erode down and mix with eroded bedrock below to create a veneer of colluvium on sections of the bedrock exposures (Plate 4). Where the bedrock was exposed and not covered in colluvium or vegetation, it consisted of thick dark gray crumbly mudstone to siltstone that was interbedded with rare units of light grey recessive siltstone to sandstone (Plate 5). A coal unit was noted at the top of Z4 and Z5 (Plate 6), and at the base of the exposure at Z5, a light grey indurated sandstone unit is overlain by dark grey siltstone. A 10 cm thick unit of blocky ironstone overlies the dark grey siltstone (Plate 7). Coalified plant and wood debris was noted in the crumbly mudstone at Z1. Fossilized wood with a unique glassy preservation was noted at the base of Z5 in the dark grey siltstone (Plates 8 and 9). No other fossils were observed in the bedrock.

In addition to bedrock and glaciolacustrine deposits, Holocene to modern river alluvium was also noted within Blackmud Creek Valley. Modern river alluvium of silt and sand occurred along Blackmud creek (Plate 10). As this is a modern deposit, it does not yield fossils. A single exposure of Holocene river alluvium was noted at Z3. This deposit consists of a discontinuous gravel unit of varying thickness (not exceeding 30 cm thick) overlain by brown blocky silt (Plate 11). The gravel is a channel or flood deposit and the overlying silt is an overbank or floodplain deposit. These units are Holocene in age (less than 9000 years old) and represent the reestablishment of creeks and rivers after final glacial withdrawal. These units are underlain by bedrock of the Horseshoe Canyon Formation. They were examined for fossils, but none were found.

5. Conclusions and Recommendations

Survey of the Blackmud Creek Valley found bedrock exposures of the fossiliferous Horseshoe Canyon Formation throughout the Project area. The bedrock consisted mainly of dark grey crumbly mudstone, with interbedded units of sandstone, coal and ironstone. Fossils included coalified plant and wood debris, and dark grey to black fossilized wood with a glassy preservation. No other fossils were noted. The bedrock is exposed on the lower part of the slope, extending upward from the creek. It is overlain by glaciolacustrine silt and sand, suggesting that the lower part of the valley is underlain by bedrock, with the upper part of the valley underlain by glaciolacustrine deposits of low palaeontological potential. Modern alluvial deposits of silt and sand occurred along Blackmud Creek. A single exposure of Holocene alluvial deposits composed of gravel channel or flood deposits and overbank silt was noted in the Project area. It was examined for fossils but none were found.

The Blackmud Creek pedestrian bridge replacement will be constructed near the base of the valley and is just west of a large bedrock exposure. Based on construction plans for the Project, the old bridge and old timber abutments will be removed and will be replaced with a new longer, but narrower pedestrian bridge. Excavation will be required to remove the old bridge and abutments and to construct the new bridge. Although no significant fossils were found during the pHRIA in the Project area, the regional area has yielded significant fossils, including a hadrosaur bonebed. Bedrock of the Horseshoe Canyon Formation will be disturbed by Project construction and the potential of impacts to palaeontological resources is considered high. Monitoring of the Blackmud Creek pedestrian bridge replacement during construction is recommended.

6. References Cited

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7. Photographic Plates

Plate 1. Thickly vegetated Blackmud Creek Valley and existing bridge (Project footprint).

Plate 2. Bedrock of the Horseshoe Canyon Formation just east of the existing bridge, Z1.

Plate 3. Bedrock of the Horseshoe Canyon Formation overlain by glaciolacustrine silt, Z1.

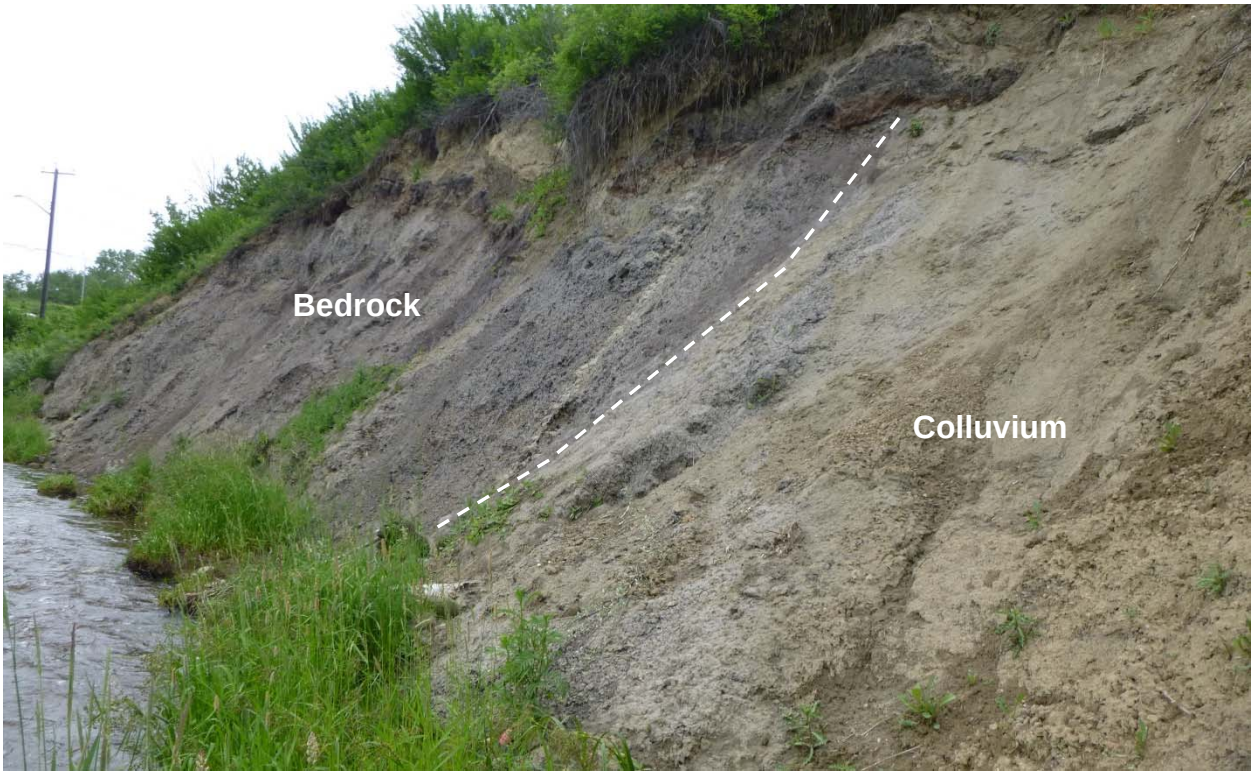


Plate 4. Veneer of light brown colluvium overlying bedrock (bedrock is dark grey), Z1.

Plate 5. Crumbly dark grey mudstone and interbedded siltstone, Z1.

Plate 6. Coal seam at the top of the exposure, Z4 and Z5.

Plate 7. Indurated grey sandstone, grey dark grey siltstone and blocky ironstone, Z5.

Plate 8. Fossilized wood in the dark grey siltstone, Z5.

Plate 9. Example of the glassy preservation of the fossilized wood, Z5.

Plate 10. Modern river alluvium of silt and sand, Z2.

Plate 11. Holocene alluvial deposits of gravel and silt overlying bedrock, Z3.

8. APPENDIX

Alberta

HRA Number: 4715-20-0025-001
May 04, 2020

Historical Resources Act Requirements

Proponent: City of Edmonton
#402, 9925 - 109 Street, Edmonton, AB T5K 2J8
Contact: Satya Gadidasu

Agent: Circle CRM Group Inc.
Contact: Margarita de Guzman

Project Name: **B128 Blackmud Creek Pedestrian Bridge Replacement**

Project Components: Bridge

Application Purpose: Requesting HRA Approval / Requirements

Pursuant to Section 37(2) of the *Historical Resources Act*, a Historic Resources Impact Assessment is required for all or portions of those activities described in this application and its attached plan(s)/sketch(es). The Historic Resources Impact Assessment is to be conducted in accordance with the instructions outlined in the following schedule.

David Link
Assistant Deputy Minister
Heritage Division
Alberta Culture, Multiculturalism
and Status of Women

SCHEDULE OF REQUIREMENTS

ARCHAEOLOGICAL RESOURCES

Historical Resources Act approval is granted in relation to archaeological resources, subject to the conditions outlined below.

1. *Historical Resources Act* approval relative to archaeological resources is granted conditionally on the understanding that all ground disturbance activities will be confined to the identified project footprint. If final project planning requires the expansion of development activities (including temporary workspace, temporary storage and new access) outside of the approved boundary, then these final plans must be submitted for review by Alberta Culture, Multiculturalism and Status of Women. The final plans must be submitted in a new Historic Resources Application prior to the onset of development activities, and must be accompanied by GIS shapefiles.

SCHEDULE OF REQUIREMENTS (continued)

PALAEONTOLOGICAL RESOURCES

Pursuant to Section 37(2) of the *Historical Resources Act*, a Historic Resources Impact Assessment for palaeontological resources is to be conducted on behalf of the proponent by a palaeontologist qualified to hold a palaeontological research permit within the Province of Alberta. A permit must be issued by Alberta Culture, Multiculturalism and Status of Women prior to the initiation of any palaeontological field investigations. Please allow ten working days for the permit application to be processed.

1. The Historic Resources Impact Assessment must address all areas of high palaeontological potential within the project area.

2. The Historic Resources Impact Assessment is to be carried out prior to the initiation of any land surface disturbance activities under snow free, unfrozen ground conditions. Should the project require survey under winter conditions, assessment procedures must be discussed in advance with the Royal Tyrrell Museum of Palaeontology.

3. Results of the Historic Resources Impact Assessment must be reported to Alberta Culture, Multiculturalism and Status of Women and subsequent *Historical Resources Act* approval must be granted before development proceeds.

ABORIGINAL TRADITIONAL USE SITES

There are no *Historical Resources Act* requirements associated with Aboriginal traditional use sites of a historic resource nature; however, the proponent must comply with Standard Requirements under the Historical Resources Act: Reporting the Discovery of Historic Resources, which are applicable to all land surface disturbance activities in the Province.

HISTORIC STRUCTURES

There are no *Historical Resources Act* requirements associated with historic structures; however, the proponent must comply with Standard Requirements under the *Historical Resources Act*: Reporting the Discovery of Historic Resources, which are applicable to all land surface disturbance activities in the Province.

PROVINCIALLY DESIGNATED HISTORIC RESOURCES

There are no *Historical Resources Act* requirements associated with Provincially Designated Historic Resources; however, the proponent must comply with Standard Requirements under the *Historical Resources Act*: Reporting the Discovery of Historic Resources, which are applicable to all land surface disturbance activities in the Province.

ADDITIONAL COMMENTS

1. To obtain contact information for consultants qualified to undertake the assessment work specified above, please consult the list of Alberta Historic Resource Consultants.

2. In addition to any specific conditions detailed above, the proponent must abide by all Standard Conditions under the *Historical Resources Act*.

SCHEDULE OF REQUIREMENTS (continued)

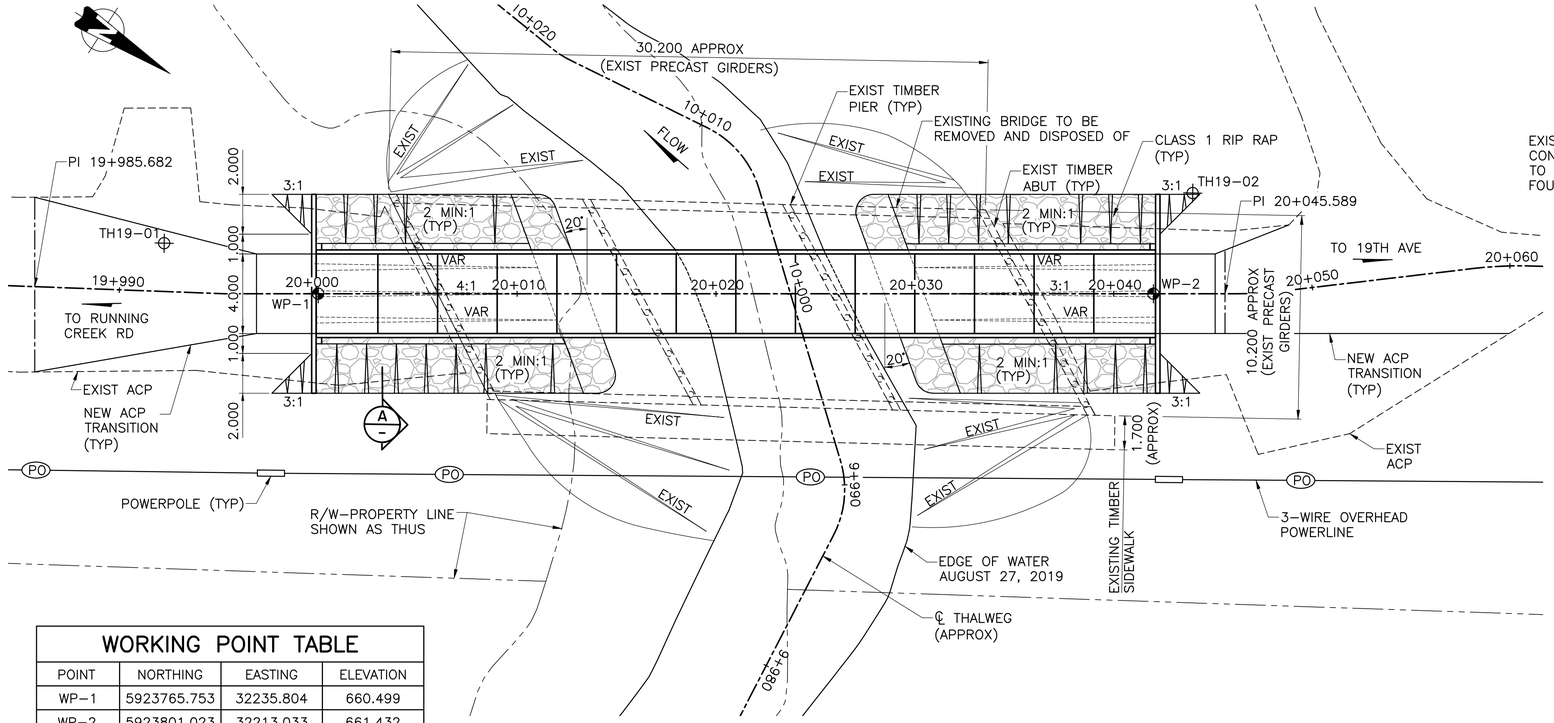
Lands Affected: All New Lands

Proposed Development Area:

MER	RGE	TWP	SEC	LSD List
4	24	51	32	5

Documents Attached:

Document Name	Document Type
Orthophoto Map	Illustrative Material



WORKING POINT TABLE			
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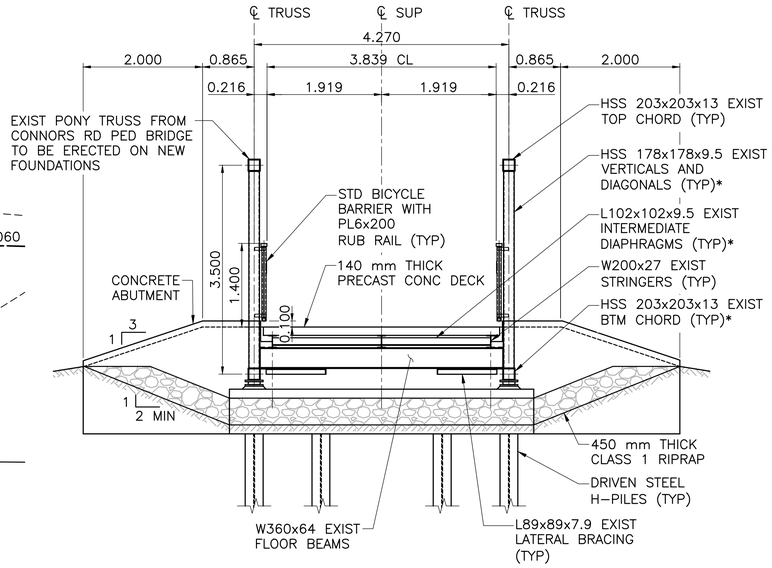
WP-2	5923801.023	32213.033	661.432

NOTE:
WORKING POINTS ARE ℄ BRG ABUTMENTS AT
℄ TOP OF FINISHED DECK



* NOTE:
SOME SECTION SIZES VARY FROM AS-BUILT TRUSS
DRAWINGS BASED ON FIELD MEASUREMENTS

A
SECTION
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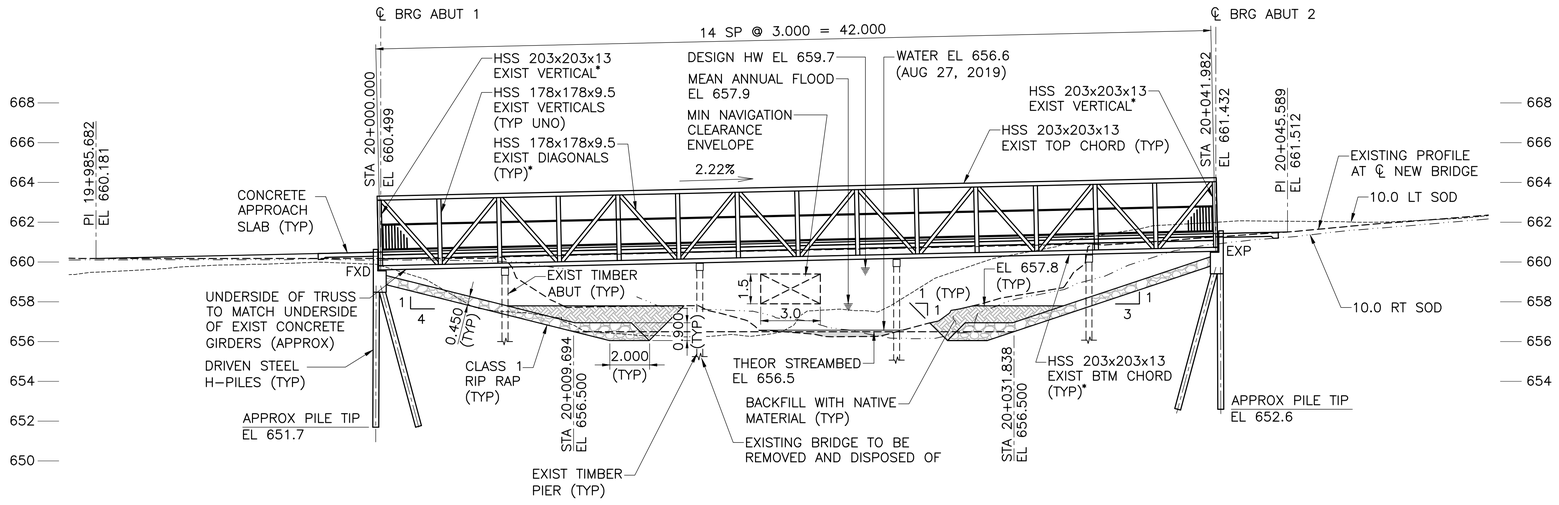


ELEVATION
LOOKING WEST 1:150

*NOTE:
SOME SECTION SIZES VARY FROM AS-BUILT TRUSS
DRAWINGS BASED ON FIELD MEASUREMENTS

REFERENCE DRAWINGS	
CONNORS RD PEDESTRIAN BRIDGE – REINFORCING SCHEDULE	CD13-84-01
CONNORS RD PEDESTRIAN BRIDGE – MISCELLANEOUS DETAILS	CD12-84-01
CONNORS RD PEDESTRIAN BRIDGE – HANDRAIL DETAILS	CD11-84-01
CONNORS RD PEDESTRIAN BRIDGE – DECK LAYOUT & DETAILS	CD10-84-01
CONNORS RD PEDESTRIAN BRIDGE – TRUSS & GIRDER DETAILS	CD09-84-01
CONNORS RD PEDESTRIAN BRIDGE – TRUSS & GIRDER LAYOUT	CD08-84-01
CONNORS RD PEDESTRIAN BRIDGE – BEARING DETAILS	CD07-84-01
CONNORS RD PEDESTRIAN BRIDGE – BENT DETAILS	CD06-84-01
CONNORS RD PEDESTRIAN BRIDGE – NORTH & SOUTH ABUTMENTS – REINF	CD05-84-01
CONNORS RD PEDESTRIAN BRIDGE – NORTH & SOUTH ABUTMENT DETAILS	CD04-84-01
CONNORS RD PEDESTRIAN BRIDGE – GENERAL ARRANGEMENT	CD03-84-01
CONNORS RD PEDESTRIAN BRIDGE – BRIDGE APPROACHES & DETAILS	CD02-84-01
CONNORS RD PEDESTRIAN BRIDGE – SITE PLAN	CD01-84-01
PRECAST CONCRETE 33 FT SPAN TYPE "HC" CURB STRINGER	S-785
PRECAST CONCRETE 33 FT SPAN TYPE "HC" INTERIOR STRINGER	S-784
DESCRIPTION	DRAWING

INDEX

3	INFORMATION – SHEET 2	BLAC 210 S03
2	INFORMATION – SHEET 1	BLAC 210 S02
1	GENERAL LAYOUT	BLAC 210 S01
SHEET	DESCRIPTION	DRAWING

1

NO.	REVISIONS	BY	DATE	APP'D
7				
6				
5				
4				
3				
2				
1	UPDATED DRAWING INDEX	JE	2020-03-16	KJG

NO.	ISSUE	BY	DATE
2	AS BUILT / TO GBIS		
1	TENDER AWARD DATE		

PROGRAM NO.
CONTRACT NO.

CONSTRUCTION RETURN
CONTRACTOR
SURVEYOR
DATE
FILE NUMBER
CONSTRUCTION ENGINEER DATE
GENERAL SUPERVISOR DATE

BPTEC ENGINEERING
Suite 200, 4220-98 Street NW (780) 436-5376
Edmonton, AB T6E 6A1 www.bptec.ca 521-035.7

PERMIT TO PRACTICE
BPTEC ENGINEERING LTD.
ORIGINAL SIGNED BY KEN GALM
ON MARCH 16, 2020
PERMIT NUMBER: P0132
The Association of Professional
Engineers and Geoscientists of Alberta

APPROVED FOR CONSTRUCTION
DATE

PROFESSIONAL ENGINEER ALBERTA
ORIGINAL STAMPED AND SIGNED
BY: Jesse Edwards
ON: Mar. 16, 2020

DEPARTMENT / BRANCH	APPROVAL	DATE

TRANSPORTATION INFRASTRUCTURE DELIVERY DATE

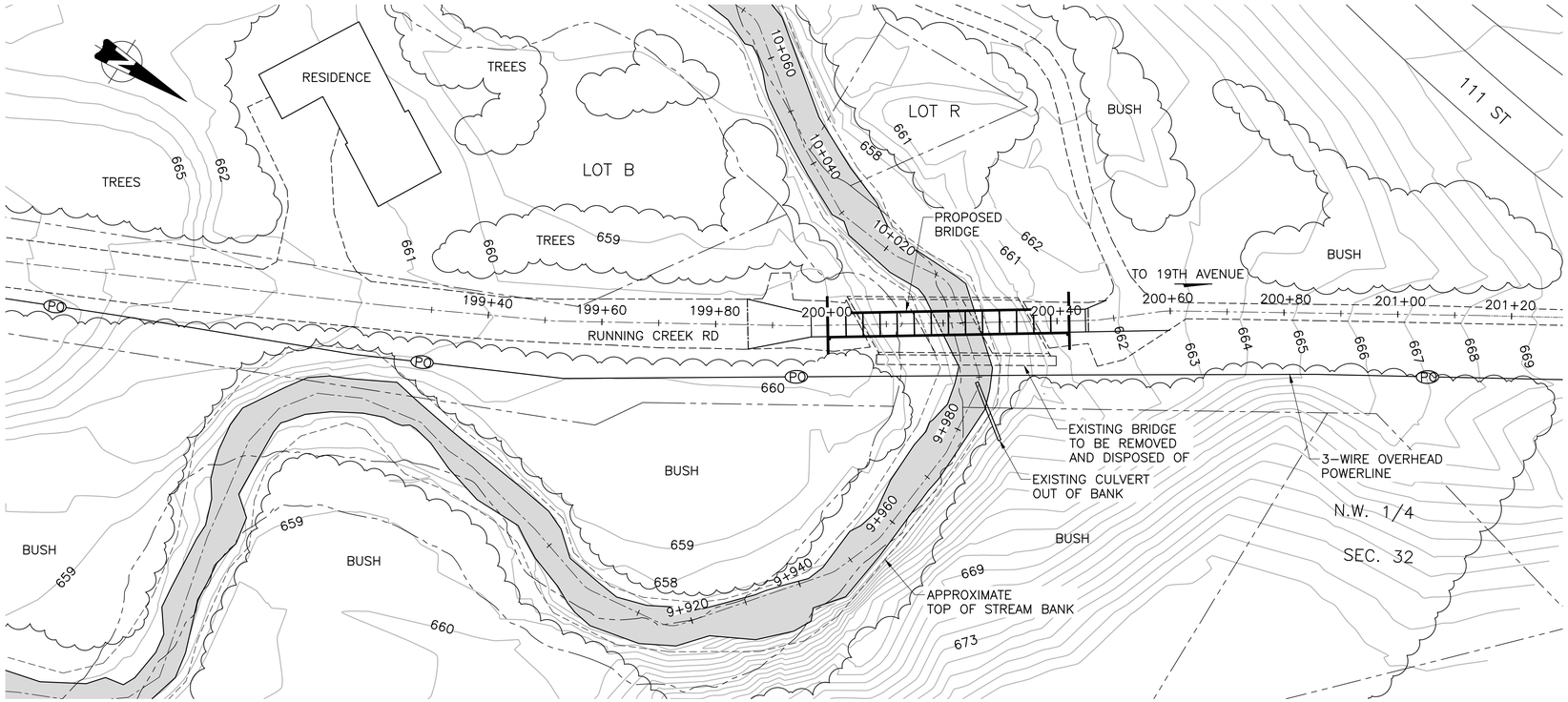
SURVEY
JOB NO. 521-035.4
SCALE AS NOTED
HOR
VER

DRAWN AD DATE 2020-03-12
DESIGNED JE DATE 2020-03-12
CHECKED KJG DATE 2020-03-12

THE CITY OF Edmonton
INTEGRATED INFRASTRUCTURE SERVICES
INFRASTRUCTURE PLANNING AND DESIGN BRANCH

PROJECT
111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT
GENERAL LAYOUT

DRAWING
BLAC 210 S01



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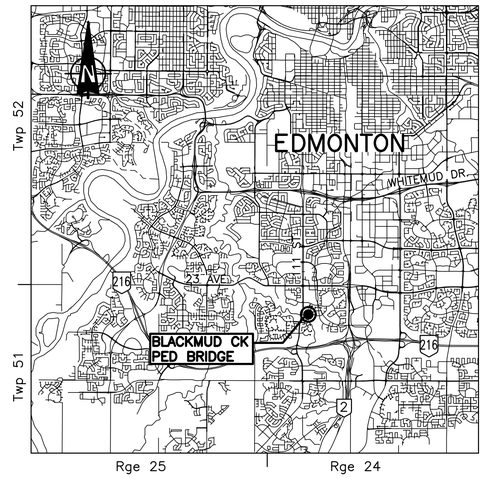

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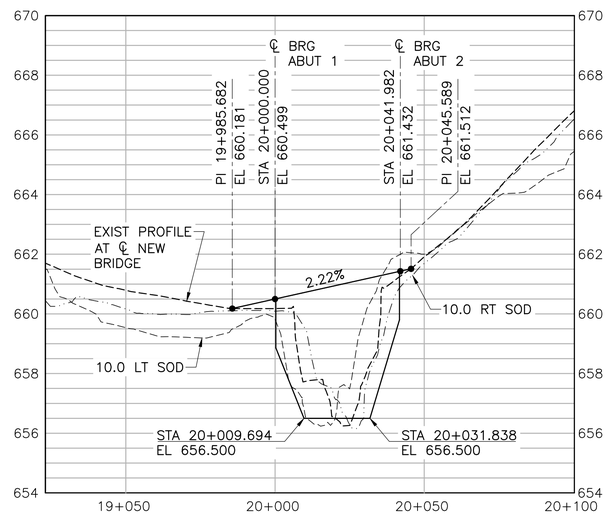

TRAIL PROFILE

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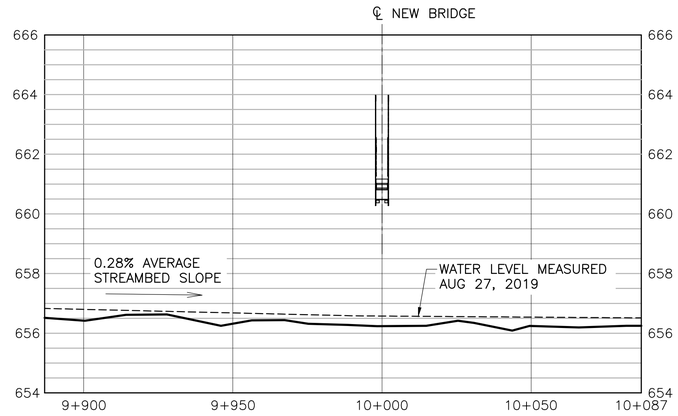
VERT 1:100



STREAMBED PROFILE

HORIZ 1:1000
VERT 1:100

GENERAL NOTES

- DIMENSIONS OF EXISTING BRIDGE ELEMENTS ARE BASED ON AVAILABLE INSPECTION INFORMATION AND HISTORICAL RECORDS. ACTUAL DIMENSIONS MAY VARY DUE TO ORIGINAL CONSTRUCTION TOLERANCES. THE CONTRACTOR SHALL CONFIRM ALL DIMENSIONS IN ADVANCE OF COMMENCING THE RELATED WORK.
- ALL DIMENSIONS SHOWN ON THE GENERAL LAYOUT AND INFORMATION SHEETS ARE GIVEN IN METRES UNLESS NOTED OTHERWISE. ALL OTHER DRAWINGS ARE DIMENSIONED IN MILLIMETRES, UNLESS NOTED OTHERWISE.

SURVEY INFORMATION

- SURVEY INFORMATION PROVIDED BY THE CITY OF EDMONTON (COMPLETED JULY 9, 2019) AND BPTEC ENGINEERING (COMPLETED AUGUST 27, 2019)
- SOME SITE FEATURES INCLUDING TOP OF BANK, EDGE OF WATER, TREELINES DIGITIZED FROM 2017 AERIAL PHOTOGRAPH. SUPPLEMENTAL TOPOGRAPHY BEYOND SURVEY LIMITS FROM FROM CITY OF EDMONTON DTM
- THE COORDINATES AND STATIONING ARE BASED ON NAD83 DATUM USING THE 3TM GRID PROJECTION, CENTRAL MERIDIAN 114. A COMBINED SCALE FACTOR (CSF) OF 0.999807 HAS BEEN ADOPTED FOR THIS PROJECT
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HYDROTECHNICAL SUMMARY

- DRAINAGE AREA = 695 km^2
- DESIGN HIGH WATER: Y = 3.2 m, V = 2.1 m/s, Q = 103 m^3/s
- MEAN ANNUAL FLOOD: Y_2 = 1.4 m, V_2 = 1.2 m/s, Q_2 = 18 m^3/s

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NO.	ISSUE	BY	DATE
2	AS BUILT / TO GBIS		
1	TENDER AWARD DATE		

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

BPTEC ENGINEERING
Suite 200, 4220-98 Street NW (780) 436-5376
Edmonton, AB T6E 6A1 www.bptec.ca 521-035.7

PERMIT TO PRACTICE
BPTEC ENGINEERING LTD.
ORIGINAL SIGNED BY KEN GALM ON MARCH 12, 2020
PERMIT NUMBER: P0132
The Association of Professional Engineers and Geoscientists of Alberta

APPROVED FOR CONSTRUCTION

DATE

PROFESSIONAL ENGINEER ALBERTA
ORIGINAL STAMPED AND SIGNED
BY: Jesse Edwards
ON: Mar. 12, 2020

DEPARTMENT / BRANCH	APPROVAL	DATE

TRANSPORTATION INFRASTRUCTURE DELIVERY DATE

SURVEY
JOB NO. 521-035.4
SCALE AS NOTED
HOR
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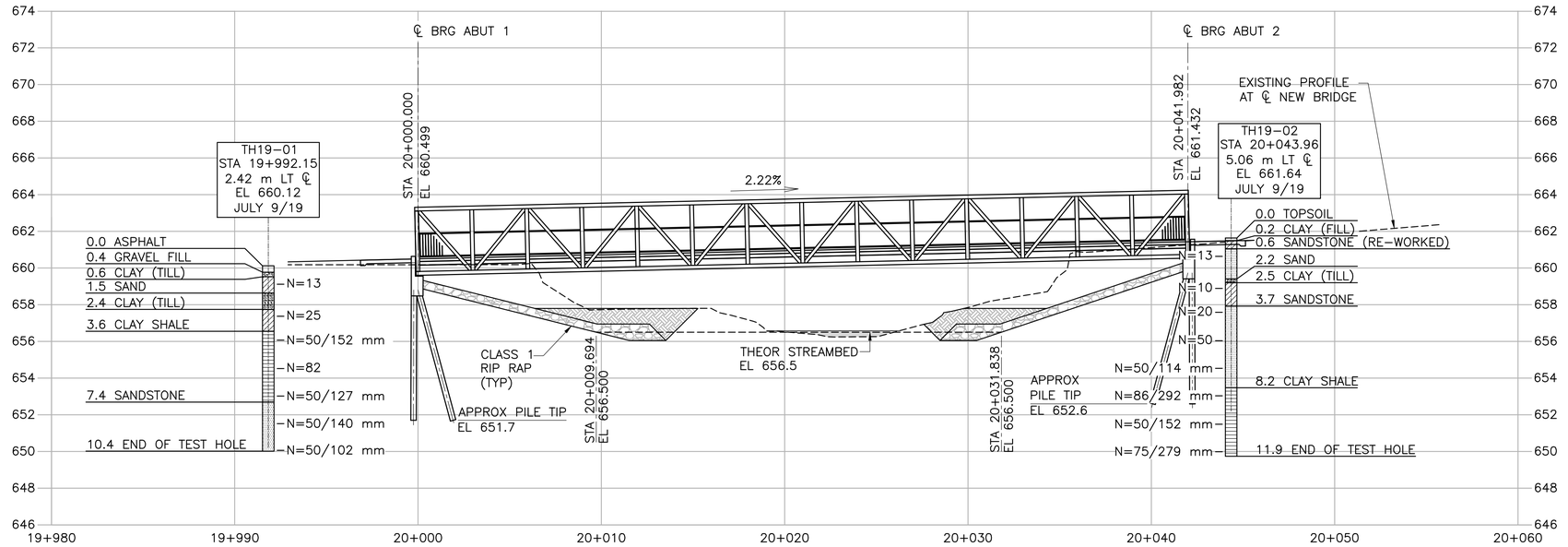
DESIGNED JE DATE 2020-03-12
CHECKED KJG DATE 2020-03-12

THE CITY OF Edmonton
INTEGRATED INFRASTRUCTURE SERVICES
INFRASTRUCTURE PLANNING AND DESIGN BRANCH

PROJECT
111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT
INFORMATION SHEET 1

DRAWING
BLAC 210 S02



ELEVATION

LOOKING WEST 1:150

GEOTECHNICAL

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PROJECT

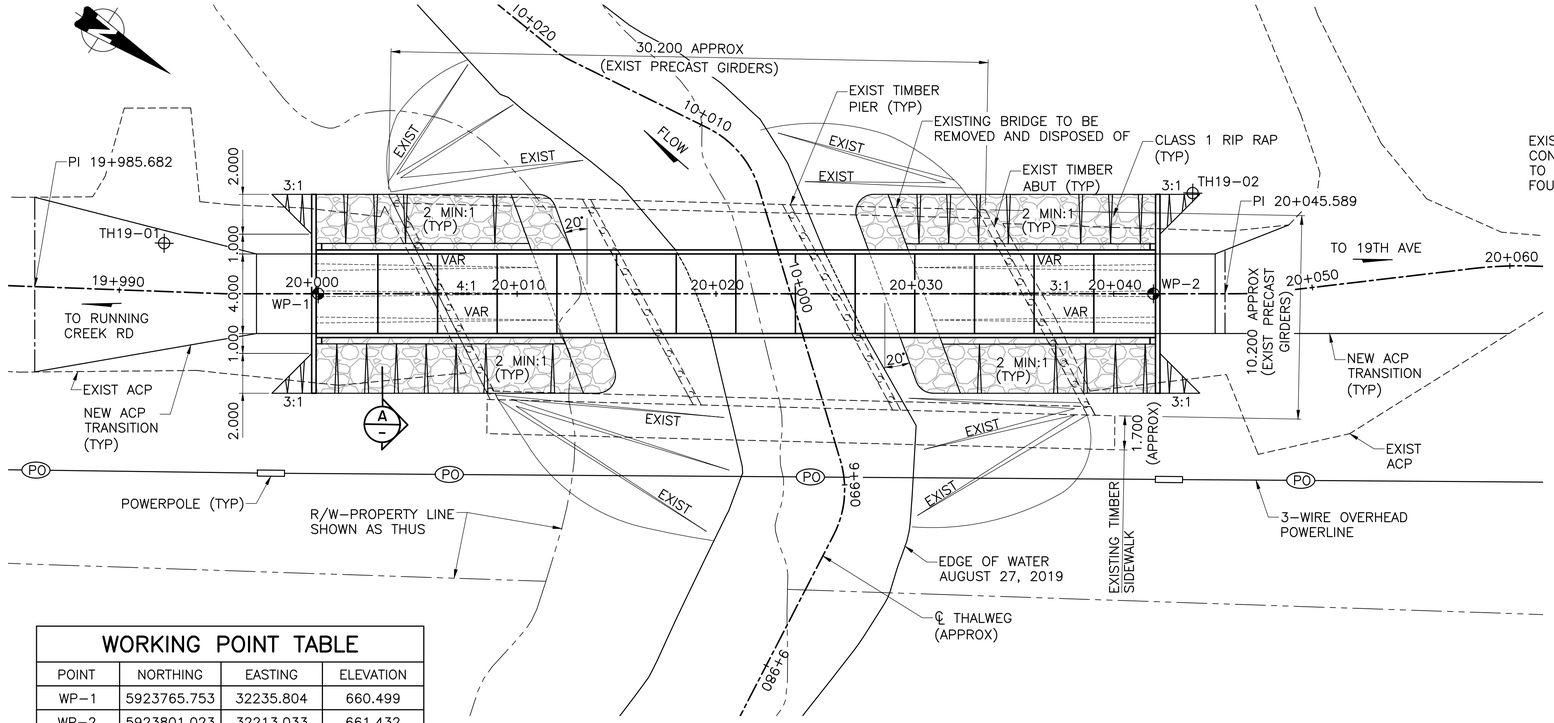
111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT

INFORMATION SHEET 2

DRAWING

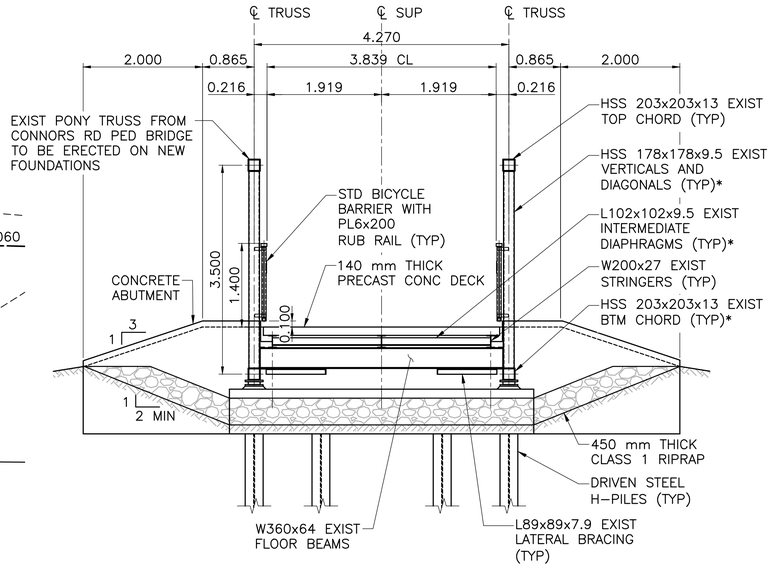
BLAC 210 S03

Appendix J: Design Drawings (BPTEC 2020)



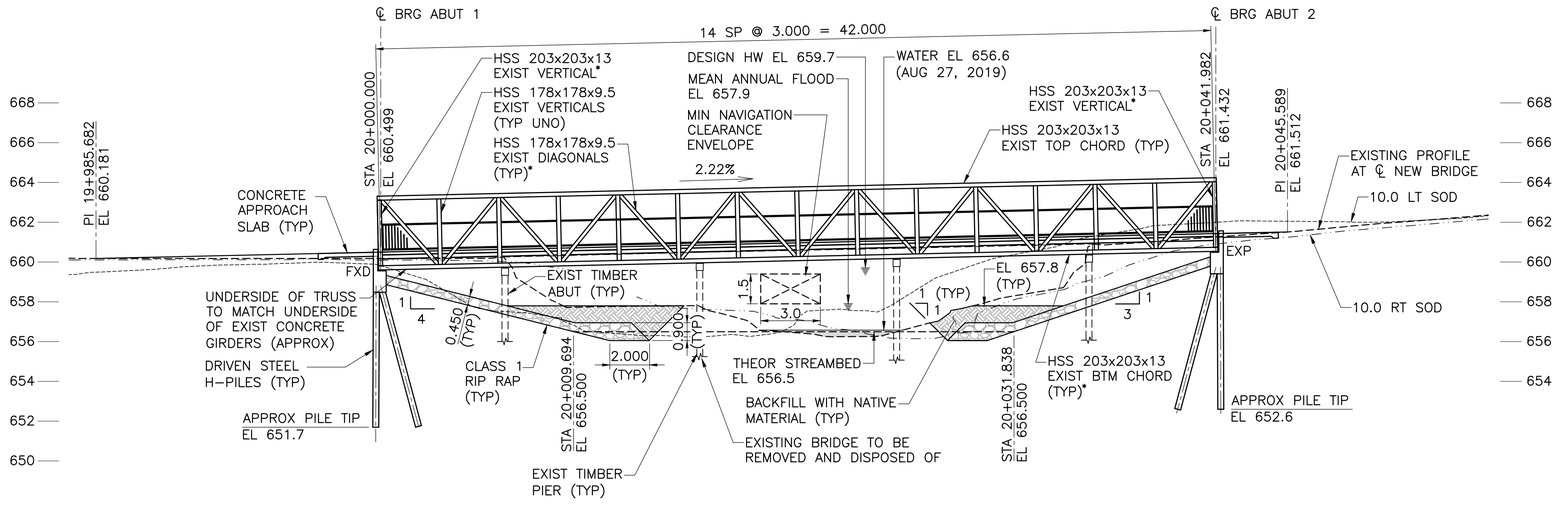
WORKING POINT TABLE			
POINT	NORTHING	EASTING	ELEVATION
WP-1	5923765.753	32235.804	660.499
WP-2	5923801.023	32213.033	661.432

NOTE:
WORKING POINTS ARE ℄ BRG ABUTMENTS AT
℄ TOP OF FINISHED DECK



* NOTE:
SOME SECTION SIZES VARY FROM AS-BUILT TRUSS
DRAWINGS BASED ON FIELD MEASUREMENTS

A
SECTION
1:50



ELEVATION
LOOKING WEST 1:150

*NOTE:
SOME SECTION SIZES VARY FROM AS-BUILT TRUSS
DRAWINGS BASED ON FIELD MEASUREMENTS

REFERENCE DRAWINGS	
CONNORS RD PEDESTRIAN BRIDGE – REINFORCING SCHEDULE	CD13-84-01
CONNORS RD PEDESTRIAN BRIDGE – MISCELLANEOUS DETAILS	CD12-84-01
CONNORS RD PEDESTRIAN BRIDGE – HANDRAIL DETAILS	CD11-84-01
CONNORS RD PEDESTRIAN BRIDGE – DECK LAYOUT & DETAILS	CD10-84-01
CONNORS RD PEDESTRIAN BRIDGE – TRUSS & GIRDER DETAILS	CD09-84-01
CONNORS RD PEDESTRIAN BRIDGE – TRUSS & GIRDER LAYOUT	CD08-84-01
CONNORS RD PEDESTRIAN BRIDGE – BEARING DETAILS	CD07-84-01
CONNORS RD PEDESTRIAN BRIDGE – BENT DETAILS	CD06-84-01
CONNORS RD PEDESTRIAN BRIDGE – NORTH & SOUTH ABUTMENTS – REINF	CD05-84-01
CONNORS RD PEDESTRIAN BRIDGE – NORTH & SOUTH ABUTMENT DETAILS	CD04-84-01
CONNORS RD PEDESTRIAN BRIDGE – GENERAL ARRANGEMENT	CD03-84-01
CONNORS RD PEDESTRIAN BRIDGE – BRIDGE APPROACHES & DETAILS	CD02-84-01
CONNORS RD PEDESTRIAN BRIDGE – SITE PLAN	CD01-84-01
PRECAST CONCRETE 33 FT SPAN TYPE "HC" CURB STRINGER	S-785
PRECAST CONCRETE 33 FT SPAN TYPE "HC" INTERIOR STRINGER	S-784
DESCRIPTION	DRAWING

INDEX

3	INFORMATION – SHEET 2	BLAC 210 S03
2	INFORMATION – SHEET 1	BLAC 210 S02
1	GENERAL LAYOUT	BLAC 210 S01
SHEET	DESCRIPTION	DRAWING

1

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1	UPDATED DRAWING INDEX	JE	2020-03-16	KJG

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Edmonton, AB T6E 6A1 www.bptec.ca 521-035.7

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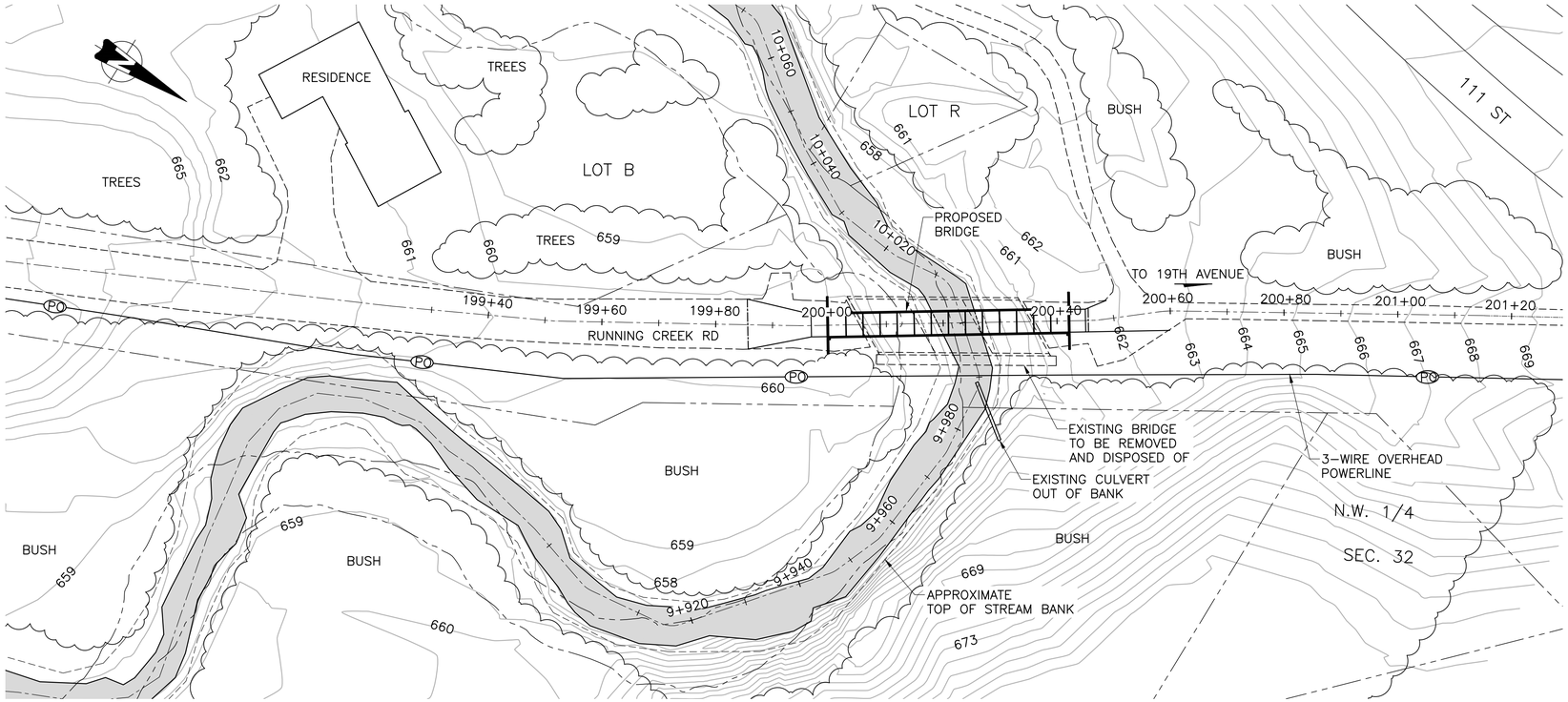
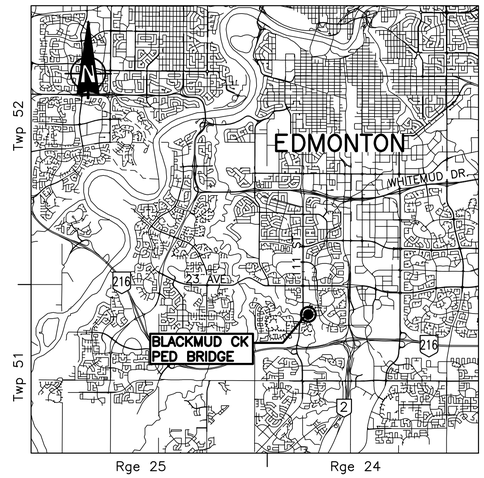
111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT
GENERAL LAYOUT

DRAWING
BLAC 210 S01



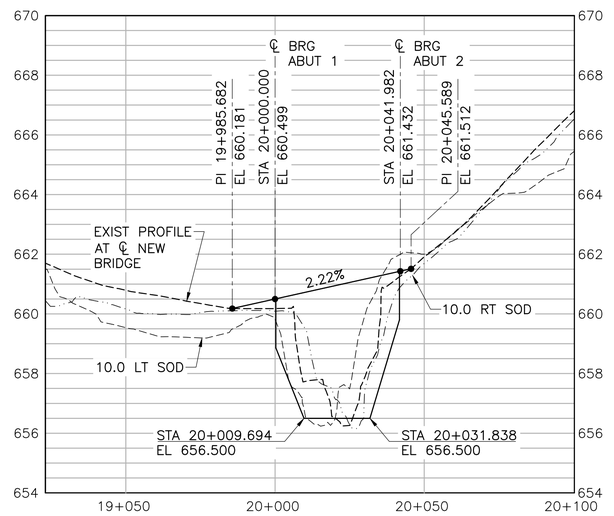
SITE PLAN

1:500



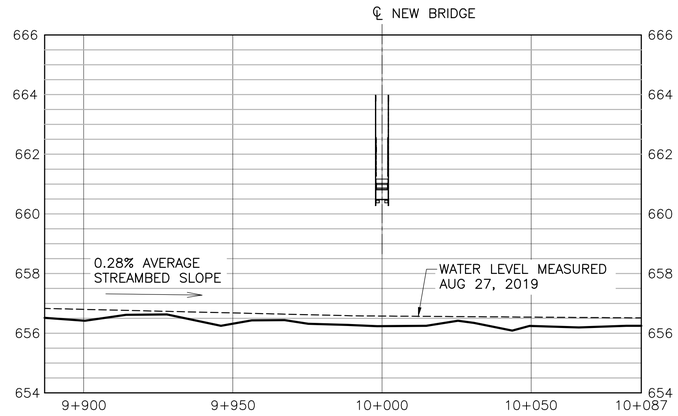
SITE MAP

1:100 000



TRAIL PROFILE

HORIZ 1:1000
VERT 1:100



STREAMBED PROFILE

HORIZ 1:1000
VERT 1:100

GENERAL NOTES

- DIMENSIONS OF EXISTING BRIDGE ELEMENTS ARE BASED ON AVAILABLE INSPECTION INFORMATION AND HISTORICAL RECORDS. ACTUAL DIMENSIONS MAY VARY DUE TO ORIGINAL CONSTRUCTION TOLERANCES. THE CONTRACTOR SHALL CONFIRM ALL DIMENSIONS IN ADVANCE OF COMMENCING THE RELATED WORK.
- ALL DIMENSIONS SHOWN ON THE GENERAL LAYOUT AND INFORMATION SHEETS ARE GIVEN IN METRES UNLESS NOTED OTHERWISE. ALL OTHER DRAWINGS ARE DIMENSIONED IN MILLIMETRES, UNLESS NOTED OTHERWISE.

SURVEY INFORMATION

- SURVEY INFORMATION PROVIDED BY THE CITY OF EDMONTON (COMPLETED JULY 9, 2019) AND BPTEC ENGINEERING (COMPLETED AUGUST 27, 2019)
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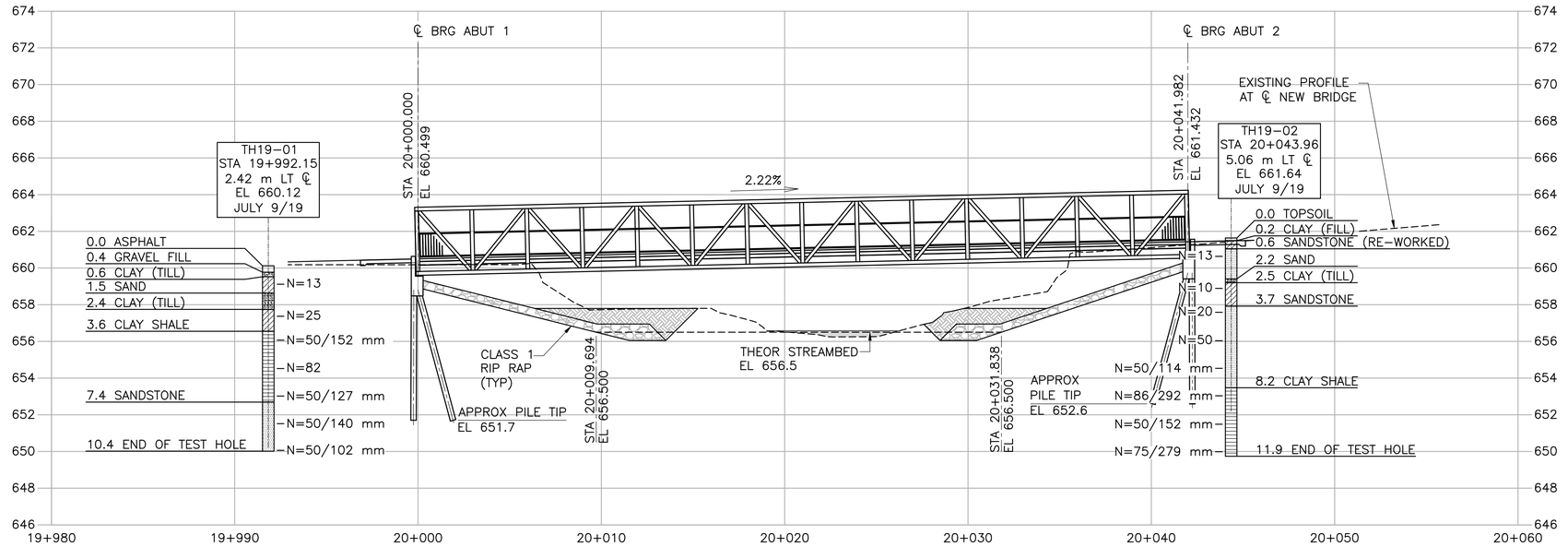
111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT
INFORMATION SHEET 1

DRAWING
BLAC 210 S02



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PROJECT

111 ST / OVER BLACKMUD CREEK BRIDGE REPLACEMENT

INFORMATION SHEET 2

DRAWING

BLAC 210 S03

Appendix K: Fisheries and Oceans Canada (DFO) Letter of Advice

Fisheries and Oceans Canada
Pêches et Océans Canada

Central & Arctic Region
Fish and Fish Habitat Protection Program
867 Lakeshore Rd.
Burlington, ON
L7S 1A1

Région centrale et de l'Arctique
Programme de protection du poisson et de son habitat
867 chemin Lakeshore
Burlington, ON
L7S 1A1

Your file *Votre référence*

20 May 2020

Our file *Notre référence*
20-HCAA-00572

City of Edmonton
12th Floor, Edmonton Tower
10111 104 Avenue NW
Edmonton, AB
T5J 0J4

Subject: Bridge, Blackmud Creek, Edmonton (20-HCAA-00572) – Implementation of Measures to Avoid and Mitigate the Potential for Prohibited Effects to Fish and Fish Habitat

Dear City of Edmonton:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) received your proposal on 16 March 2020. We understand that you propose to:

- Replace the existing pedestrian bridge with a single span bridge

In addition, the following aquatic species are subject to the *Aquatic Invasive Species Regulations* and may be found in the vicinity of your proposed work, undertaking, or activity:

- Phragmites
- Goldfish

Our review considered the following information:

- Request for Review form and associated documents submitted on 16 March 2020
- Email correspondence with Brendan Spearin (Fisheries and Oceans Canada) on 20 May 2020 regarding Aquatic Invasive Species.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*;

- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*; and
- the introduction of aquatic species into regions or bodies of water frequented by fish where they are not indigenous, which is prohibited under section 10 of the *Aquatic Invasive Species Regulations*.

The aforementioned impacts are prohibited unless authorized under their respective legislation and regulations.

To avoid and mitigate the potential for prohibited effects to fish and fish habitat (as listed above), we recommend implementing the measures listed below:

- Plan in-water works, undertakings and activities to respect timing windows to protect fish and fish habitat
    - No in-water work between 16 April – 30 June
- Capture, relocate and monitor for fish trapped within isolated, enclosed, or dewatered areas
    - Dewater gradually to reduce the potential for stranding fish
- Screen intake pipes to prevent entrainment or impingement of fish
    - Use the code of practice for water intake screens
- Limit impacts on riparian vegetation to those approved for the work, undertaking or activity
- Develop and implement an Sediment Control Plan to minimize sedimentation of the waterbody during all phases of the work, undertaking or activity
    - Conduct all in-water works, undertakings or activities in isolation of open or flowing water to reduce the introduction of sediment into the watercourse
        - Maintain the natural flow regime for any diversion works
    - Schedule work to avoid wet, windy and rainy periods (and heed weather advisories)
    - Inspect and maintain regularly the erosion and sediment control measures and structures during all phases of the project
    - Remove all exposed non-biodegradable sediment control materials once site has been stabilized
    - Operate machinery on land, or from barges or on ice
    - Monitor the watercourse to observe signs of sedimentation during all phases of the work, undertaking or activity and take corrective action
    - Dispose and stabilize all dredged material above the high water mark of nearby waterbodies to prevent entry in the water
- Do not deposit any deleterious substances in the water course
- Develop and implement a response plan to avoid a spill of deleterious substances
- Aquatic Invasive Species are introduced and spread through transporting sands and sediments and using contaminated construction equipment. To prevent Aquatic Invasive Species spread during construction in aquatic environments:
    - Clean, drain and dry any equipment used in the water; and,

.../3

    - Never move organisms or water from one body of water to another.
- Report any non-native species found
    - Approximate quantity of non-native fish removed(number of fish)
    - Size class(es) of non-native fish removed (Pictures would enhance the ability to report all items, and is encouraged as part of the report)
    - Please submit report to:

      Nicole Kimmel, Aquatic Invasive Species Specialist
      Fish & Wildlife Policy Branch, Alberta Environment and Parks
      24th Flr, Commerce Place, 10155 102 St NW,
      Edmonton, Alberta, Canada T5J 4G8
      Office: 780-427-7791 Cell: 780-975-3793
      nicole.kimmel@gov.ab.ca

Provided that you incorporate these measures into your plans, the Program is of the view that your proposal is not likely to result in the contravention of the above mentioned prohibitions and requirements.

Should your plans change or if you have omitted some information in your proposal, further review by the Program may be required. Consult our website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) or consult with a qualified environmental consultant to determine if further review may be necessary. It remains your responsibility to remain in compliance with the *Fisheries Act*, the *Species at Risk Act* and the *Aquatic Invasive Species Regulations.*

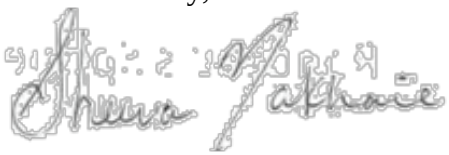
Whirling disease, a disease of finfish, caused by infection with a microscopic parasite called Myxobolus cerebralis, has been identified in Alberta. There may be a requirement for you to apply for a permit from the Canadian Food Inspection Agency to move certain species of finfish, such as rainbow trout, and things, such as sediments, within or out of Alberta. Please visit http://www.inspection.gc.ca/animals/aquatic-animals/domestic-movements/eng/1450122972517/1450122973466 for more information.

It is also your *Duty to Notify* DFO if you have caused, or are about to cause, the death of fish by means other than fishing and/or the harmful alteration, disruption or destruction of fish habitat. Such notifications should be directed to (http://www.dfo-mpo.gc.ca/pnw-ppe/CONTACT-eng.html).

We recommend that you notify this office at least 10 days before starting your project and that a copy of this letter be kept on site while the work is in progress. It remains your responsibility to meet all other federal, territorial, provincial and municipal requirements that apply to your proposal.

If you have any questions with the content of this letter, please contact Sheeva Nakhaie at 905-315-5270, or by email at Sheeva.Nakhaie@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,



Sheeva Nakhaie
Biologist, Triage and Planning