Touch the Water Promenade Project - North Shore Promenade Final Concept Design

Environmental Overview
Final Report

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

Under Contract to:
Dub Architects Ltd.
Edmonton, Alberta

Project Number EP-826
August 2021

Prepared by:
Spencer Environmental Management Services Ltd.
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17 August 2021
File: EP-826

Dear Mr. Dub,

Re: Final Environmental Overview for Touch the Water North Shore Promenade Final Concept

We are pleased to submit this pdf copy of the above-mentioned final Environmental Overview. This final report reflects comments received by City of Edmonton reviewers in July 2021. This report examined the North Shore Promenade final concept adopted by the City and is intended to serve as a resource for future project design phases and environmental assessments.

Thank you for your assistance throughout this study and for the opportunity to be of service.

Sincerely,

Spencer Environmental
Management Services Ltd.

Andra Bismanis, M.Sc., P.Biol.
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President

cc: Kevin Dieterman, BLA, CSLA, ISL Engineering and Land Services Ltd.

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1.0 INTRODUCTION

1.1 Background

The City of Edmonton (the City) proposes to develop the Touch the Water Promenade Project (TTWP) in Edmonton's North Saskatchewan River Valley (NSRV). The project would extend along the north bank of the North Saskatchewan River (NSR) from Government House Park to the Rossdale area (Figure 1, Appendix A). The proposed project is intended to increase access and connectivity to the NSRV, meet the objectives of the City's Ribbon of Green Master Plan (1992), and be consistent with the following: Breathe: Edmonton's Green Network Strategy (2017); River Valley Alliance's (RVA's) Plan of Action (2007); RVA's Phase II Capital Program and River Crossing. The TTWP would be located within the boundaries of the North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP; Bylaw 7188) and would form part of the existing river valley trail system connecting Government House Park and Louise McKinney Park.

The City divided the greater TTWP into two discrete project components based on funding priorities: 1) the North Shore Promenade (NSP) extending upstream of the Walterdale Bridge along the north riverbank to west of Government House Park, (approximately 3.0 km long); and 2) the Rossdale Reach (RR) extending from Walterdale Bridge downstream to 94 Avenue in Rossdale (approximately 1 km long) (Figure 1, Appendix A). Both project components are currently in the conceptual design phase, which requires completion of a desktop Environmental Overview (EO) for each component. The EO will form the basis of future Bylaw 7188 environmental assessment requirements. The City has retained Dub Architects Ltd. (Dub) to prepare conceptual design for the entire TTWP and Dub has retained Spencer Environmental Management Services Ltd. (Spencer Environmental) to serve as environmental consultant to the project and to complete the EO's. The NSP component is the focus of this EO report. A stand-alone EO report for the RR project is available under separate cover.

1.2 Project Location, Disposition and Land Use Zoning

The project area assessed by this EO is located on the north bank of the NSR and extends from Government House Park to just upstream of Walterdale Bridge (105 Street NW) (Figure 2, Appendix A). The project area is currently zoned A (Metropolitan Recreational Zone) and falls within Bylaw 7188 lands (Figure 2 and 3, Appendix A). Much of the project area has previously been disturbed with development of river valley trails and lookouts, transportation infrastructure (River Valley Road and Groat Road, Dudley Menzies, High Level and Walterdale bridges), manicured park areas (Government House Park and the Victoria Golf Course) and Royal Glenora Club.

1.3 Project Description

Concept design has been an iterative process undertaken over several years and has included a staged public and stakeholder engagement program with input sought at key milestones. For example, in autumn of 2020 the City presented to the public and other stakeholders, two early conceptual design directions for the overall TTWP project,

prepared by the design consultants: Concept Option 1 (Gateways), and Concept Option 2 (Threads). The Gateways concept focused on developing discrete gateways or nodes as gathering spaces, which were connected by trails or promenades of various types. The Threads concept took a more linear approach that focussed more on through-movement and less on destination gathering spaces. Threads built on and enhanced the existing shared-use path (SUP)/multi-use trail system in the TTWP project area and provided several promenades and lookouts. By considering what was heard during public engagement, input from regional Indigenous Nations and Communities, results from several technical studies, and City policy direction, the City directed the design consultants to refine, adjusted and improve on those early concept directions. The end result was identification of a preferred, final TTWP concept design, released on the City's website in May of 2021(Dub Architects Ltd. and Stoss Landscape Urbanism 2021), that consists of three relatively large, featured spaces connected by prominent pathways of variable design, and includes several enhanced river viewpoints/rest stops/platforms at key locations. Following is a more detailed description of the NSP portion of the TTWP final concept.

1.3.1 North Shore Promenade Preferred / Final Concept

The proposed final concept for the NSP consists of two significant featured spaces and four additional lookout or promenade features, all connected by either a split or combined pathway that integrates at key points into the existing, adjacent open spaces and pathways and parallels approximately 3.0 km of riverbank. This concept is best understood by examining the illustrative materials provided in Appendix B that were excerpted from the concept package provided by the design consultant. Following is a short narrative description of the key concept components, moving upstream to downstream (west to east).

The concept begins with a significant redevelopment of the existing Government House Park, which includes re-establishment of the Groat Creek/ NSR confluence (*Government House Park and Groat Daylighting*) (Figures 3 to 8, Appendix B). The redeveloped park is shown as a mix of naturalized and manicured areas (some retained), with new seating, new gathering spaces, new active play areas and new internal circulation paths (Figures 4 and 5, Appendix B). The park features a re-established, meandering reach of lower Groat Creek, including naturalized riparian zones. The creek would be fed primarily by treated water diverted from the nearby existing (and retained in place) end of pipe treatment system, would be contoured to provide for some additional stormwater treatment in each of the stream's deeper pools and meanders, with elevations controlled by a weir. Upstream of the weir the creek would function more as a constructed wetland. The creek would discharge to the NSR and would be designed so as to promote creek and river water mixing at the creek mouth, downstream of the weir, with the intention of creating fish habitat. The creation of this inlet would require extensive riverbank armoring to maintain the new banks and prevent erosion and sedimentation into the river. Some of this would be large, stepped blocks referred to as Touch the Water Scramble (Figure 5, Appendix B). The new multi-use path crosses through the park, over the new creek channel - at the weir, and swings overland toward the river.

At *Groat Bridge*, the path passes under Groat Road Bridge where it takes the form of an elevated multi-use pathway approximately halfway up the riverbank (path surface at

approximate elevation of the 50 year flood event). Downstream of the bridge the path swings back inland and continues east, elevated, eventually tying back into the existing path elevation at the top of the riverbank. At this point, the path diverges into an optional westbound path/switchback that rises, swings south and cantilevers over the river, parallel to and slightly lower than the Groat Bridge surface. There, the path extends and rounds into a widened river lookout. Path users can choose to retrace their steps or continue northward connecting to the new bridge northbound SUP and beyond (Figures 9 to 13, Appendix B).

Moving downstream, the concept features a Split Path Promenade (Figures 14 to 17, Appendix B), paralleling River Valley Road and consisting of: a 4 m wide realigned multi-use trail situated ~5.4 m south of the road, and a 3.0 m wide "slow" path situated at the top of riverbank and above the 100 year flood elevation, with the two paths separated by ~8.0 m treed buffer. The split paths merge at Victoria Park, where the proposed multi-use path retains and improves on the connection north across the road to the existing park. The NSP multiuse path then continues east parallel to the road but also forks to bend south where it becomes a 5.6 m wide, ~140 m long, curved and cantilevered accessible platform (*Victoria*) situated above the crest of the riverbank and at the 100 year flood elevation (Figures 18 to 24, Appendix B). The platform is separated from the multi-use trail by a sizeable stand of trees. The platform terminates where it merges back into the multi-use trail to form the Combined Path Promenade (Figure 25 to 28, Appendix B), adjacent multi-use and slow paths with a total width of 6.0m, situated at the top of bank (at 100 year flood elevation) and stretching ~600m to just east of the Royal Glenora Club, where it ties into the proposed *High Level Bridge Hill* area.

This featured area is less about gathering and more about movement. The concept recognizes *High Level Bridge Hill* as an existing activity centre and current hub of several trails/stairs/pedestrian bridge (Figures 29 to 34, Appendix B). The concept proposes to improve accessibility and enhance the existing network in the area, by adding an elevated, accessible multi-use pathway creating new access to/from the valley, maintaining the stairs, formalizing a parking area and providing enhanced tree/shrub plantings on the slopes. In this area, the main path continues towards the High Level Bridge, and at the Dudley Menzies Bridge splits into a 6.0 m wide, combined multi-use path and slow path, accessible platform that bends around and under the Dudley Menzies and High Level bridges, at the 50 year flood elevation. It then returns to higher ground and parallels Fortway Road, following the top of riverbank (Figures 8 & 9, Appendix B).

Approximately 300 m to the east, the pathway again splits to create The Deck, an elevated, 3 m wide promenade, approximately 330 m in length, curving above the middle and lower riverbank, with the deck surface at the elevation of the 50 year flood (Figures 35 to 40, Appendix B). The Deck includes seating/gathering benches and a lookout. The Deck is slightly lower than the multi-use path behind it, separated by trees and is accessible from the path by stairs. Past The Deck, the multi-use path continues into the Rossdale Reach project boundary.

Enhanced native plantings are proposed throughout the NSP project area including along the riverbank and between the multi-use trail and River Valley Road. Appendix B includes

cross sections for each the above-described pathways and features showing elevations in relation to normal river elevations and various river flood and ice cover conditions.

1.4 Environmental Overview Objectives

The primary EO objectives were to:

- identify relevant environmental sensitivities on the project lands through desktop characterization and a site reconnaissance;
- identify environmental opportunities and constraints related to the feasibility of the final proposed concept and associated amenities in the project area;
- at a very high level, identify potential impacts that could arise and should be considered in future design phases;
- identify potential environmental regulatory requirements associated with the proposed concept and associated amenities in the project area; and
- identify additional environmental investigations required to meet those permitting requirements.

2.0 METHODS

2.1 General Approach

Beginning in 2019, we undertook the following activities to prepare this EO:

- Desktop review of existing project area information, City of Edmonton 2017 aerial imagery, City of Edmonton pictometry (then 2018 latest available) and online open data sources to document the existing environmental context in the project area.
- Desktop review focussed on the Valued Environmental Components (VECs) identified in the City of Edmonton's "A Guide to Completing Environmental Impact Assessments" (i.e., surface water, groundwater, fisheries, geology/geomorphology and soils, vegetation, wildlife and historical resources).
- Site reconnaissance of the project area.
- GIS-based mapping of relevant environmental information.
- Qualitative assessment of the potential interaction of the elements of the proposed NSP final concept with documented conditions and resources in the project area, in 2021.
- Identification of potential permitting requirements and need for additional studies.

2.2 Desktop Review

2.2.1 Online Open Data Sources

The following online open data sources were searched/reviewed:

- Alberta Conservation Information Management System (ACIMS) online data map, searched 25 November 2019 for records of rare plant species or uncommon plant communities in the project area (AEP 2019a).
- Fish and Wildlife Management Information System (FWMIS), searched 25 November 2019, using the Fish and Wildlife Internet Mapping Tool (FWIMT), for recorded instances of special status wildlife species and historical fish sampling records in the project area (AEP 2019b). The search area comprised a 1 km radius circle centered on the project area.
- A search of the eBird database on 17 January 2020 for records of special status bird species in the project area.

2.2.2 Literature Review

The following studies/documents were searched/reviewed:

- Touch the Water Promenade Project North Shore Promenade – Fisheries Environmental Overview (Kingfisher Aquatics Ltd. 2021).
- Preliminary Geotechnical Assessment Report North Shore Promenade River Bank between Walterdale Bridge and Groat Bridge, Edmonton, Alberta (Tetra Tech Canada Inc. 2019).
- Touch the Water Promenade and North Shore Promenade – Draft Report Hydrotechnical Assessment (Northwest Hydraulic Consultants Ltd. 2019).

- Touch the Water and North Shore Promenade Project. Edmonton, Alberta, Canada. Statement of Justification (SoJ) (Turtle Island Cultural Resource Management Inc. 2019).
- Downtown Public Places Plan (City of Edmonton 2018).
- Touch the Water Biophysical Data Summary (Stantec Consulting Ltd. 2017).
- Breathe – Edmonton's Green Network Strategy. Strategic Plan (City of Edmonton 2017).
- River Crossing Heritage Interpretive Plan (City of Edmonton 2017).
- West Rossdale Urban Design Plan (City of Edmonton 2010).
- Walterdale Bridge Replacement Environmental Assessment Edmonton, Alberta Final Report (Spencer Environmental 2012).
- Natural Connections Strategic Plan – City of Edmonton Integrated Natural Areas Conservation Plan (City of Edmonton 2007).
- River Valley Alliance Plan of Action 2007-2025 (RVA 2007).
- Ribbon of Green Master Plan (Edmonton Parks and Recreation 1992).
- Repurposing the Rossdale Generating Station and Riverfront Plaza: Views and Perspectives (City of Edmonton n.d.).

2.3 Field Reconnaissance

A site reconnaissance of the project area was conducted on 12 December 2019 to inspect existing conditions and note any areas that may need to be considered in promenade design. Photographs were taken during the site reconnaissance.

2.4 Fisheries Assessment

As part of this EO exercise, Kingfisher Aquatics Ltd. (Kingfisher) conducted a desktop review of existing fish and fish habitat conditions in the project area of the NSR, in 2019. Their desktop review comprised a search of FWMIS and review of select historical documents. They supplemented their desktop review with field investigations conducted on 24 and 25 October 2019, which included habitat assessment of a 4.65 km study section of the NSR in the project vicinity. That assessment comprised a large river habitat inventory of the study section and near-shore (within 30 m of the bank) assessment of water depths, fish cover and substrates within the NSP project area. In addition, Kingfisher characterized the river channel profile, assessed streambank conditions, collected video and photograph logs, documented the presence of anthropogenic alterations and existing infrastructure and conducted in situ measurements of temperature, dissolved oxygen, specific conductivity, pH and turbidity. Kingfisher then analysed the final concept at a high level to identify potential fisheries issues, impacts and permitting requirements of the NSP concept.

3.0 EXISTING ENVIRONMENTAL CONTEXT

Existing conditions information is described below by VEC for the NSP project area.

3.1 Surface Water, Groundwater

The only surface water body in the project area is the North Saskatchewan River (NSR), which is the drinking water source for the City of Edmonton. The headwaters of the river originate at the Saskatchewan Glacier in the Rocky Mountains, 500 km upstream from Edmonton. The river length within Edmonton is approximately 48 km. Several tributary streams release into the NSR in the city, but there are no surface tributaries currently in the project area. There are 16 outfalls and two water intake structures within the project area that are owned by EPCOR (NHC 2019, Tetra Tech 2019).

Dub retained Northwest Hydraulic Consultants Ltd. (NHC) (NHC 2019) to provide a hydrotechnical assessment for the proposed TTWP, including the NSP project area. Their scope of work included a site reconnaissance on 14 and 15 August 2019 and a desktop aerial photograph assessment of lateral stability of the north riverbank. NHC also developed a one-dimensional hydraulic model to determine river levels under open water and ice cover conditions and a two-dimensional hydraulic model to estimate local flow velocities along the bank to assess risk of bank erosion, deposition and ice forces.

NHC (2019) found that, in general, the north bank of the NSR in the project area is not susceptible to significant bank erosion and has been relatively stable for the past 60 years. Based on NHC's (2019) velocity contour maps for the NSP project area, highest velocities are generally in the center of the river channel near Groat Bridge. Lowest velocities were found in a narrow band along the riverbank.

Ice cover typically forms on the NSR in November in Edmonton (NHC 2019). Ice formation generally begins with the production of frazil ice particles, which eventually consolidate into larger ice floes (frazil pans). Once a certain density of the ice floes is present, the floes will consolidate into a solid ice cover, which corresponds to a rise in water level.

Historical groundwater information was available from previous studies completed at the old Walterdale Bridge in 2011 and Groat Road Bridge in 2016. In August 2011, Thurber (2011) installed a standpipe piezometer in the vicinity of the new Walterdale Bridge north abutment in alluvial sand and gravel overlying bedrock. Groundwater measurements were taken at the time of installation and again two months later with a groundwater level of 11 m below ground surface (approximate elevation of 615.3 m) (Thurber 2011 in Spencer Environmental 2012). Thurber's (2011) report stated that groundwater at this location was likely hydraulically connected to the water level in the river, therefore, groundwater levels were expected to fluctuate throughout the year accordingly.

Thurber installed one standpipe piezometer near the north end of Groat Bridge in April 2016 to monitor groundwater levels. Groundwater levels were measured on 2 or 3 May 2016 and 18 May 2016, approximately one month after the boreholes were drilled.

Groundwater on the north side of the river was 8.4 m below ground surface. As they noted for the Walterdale Bridge groundwater information, Thurber stated that groundwater levels on the alluvial terraces on the north side of Groat Road Bridge were expected to closely mirror river levels (Thurber 2016 in Spencer Environmental 2017).

North Saskatchewan River Floodplain

Based on available flood hazard mapping for the NSP project (AEP 2015) (Figures 1a through d, Appendix C), a portion of the riverbank is located in the floodway (defined by AEP as: "The portion of the flood hazard area where flows are deepest, fastest and most destructive. The floodway typically includes the main channel of a stream and a portion of the adjacent overbank area. New development is discouraged in the floodway.") A portion of Government House Park and lands near the Royal Glenora Club are located in the flood fringe (defined by AEP as: "the portion of the flood hazard area outside of the floodway. Water in the flood fringe is generally shallower and flows more slowly than in the floodway. New development in the flood fringe may be permitted in some communities and should be flood-proofed.").

It should be noted that a new AEP floodplain study of the NSR in Edmonton is currently underway and mapped conditions could change pending the results of that study (NHC 2019).

3.2 Fisheries

The information provided below represents a summary of findings by Kingfisher. Kingfisher's full report is available in Appendix D of this report.

At the time of investigations, within the study area, the NSR flowed through a single, unobstructed channel where point and side bar formations were common. While islands and channel braiding are rare in this portion of the NSR, a small island was present in the project area along the north bank of the river near Victoria Park. A variety of more unique habitat features were present in the upper to middle part of the study reach including lower velocity side channel habitat adjacent to the island, numerous small backwaters associated with streambank irregularities, and several cobble shoals. Anthropogenic alterations to the bank were evident throughout the study section. In general, these disturbances were concentrated in the upper and lower ends of the study area with concrete riprap armouring along MacKinnon Ravine Park and Government House Park, the Groat Road Bridge north pier and abutment and the Walterdale Bridge riprap apron.

The majority of instream habitat within the study area was rated as moderate capability habitat. This habitat was typified as having shallow to moderate water depths with relatively diverse substrates while fish cover was generally limited. Extremely shallow and homogenous water depths and a lack of substrate diversity were the primary limiting factor associated with the low capability habitat identified in the centre of the study section. The side channel was rated as high capability habitat due to its relative rarity within the study section. Overall, no major limiting factors were identified, and the habitat appeared capable of supporting a wide variety of fish species. While the side channel was considered a unique habitat feature and likely provides high value rearing habitat for a variety of species, no

habitat attributes were present that would be considered important or critical for sensitive or federally and/or provincially listed species.

Streambank habitat capability was assessed based on streambank conditions and the level of disturbance (i.e., changes to natural form and function of the streambank). The streambanks at the upstream and downstream ends of the study area have been subject to substantial disturbance (i.e., riprap, outfalls, buildings) and were considered to have low habitat capability while the streambanks in the middle of the study area were considered to have moderate to high habitat capability based on a low level of disturbance and the presence of a diverse and mature riparian vegetation community (south of Victoria Park).

Historical capture data indicated that the NSP study section of the NSR is inhabited by a diverse assemblage of sport, coarse and forage fish species. The frequency and extent of habitat use is dependant on the life cycle stage and specific habitat requirements of each species. The study section included slow velocity, moderate depth holding habitat that was suitable for larger-bodied fish species as well as moderate velocity, low depth areas with relatively clean substrates that could provide preferential feeding habitat for species that target benthic invertebrates (e.g., mountain whitefish and mooneye) and/or suitable spawning and rearing habitat for species requiring coarse substrates.

Overall, most of the instream habitat within the study section was rated as moderate capability. While a wide range of fish species are known to occupy the project area throughout the year and the island side channel was judged to provided high quality rearing habitat for multiple species, the local habitat was not considered critical or important to the viability of these species.

The majority of forage fish species known to inhabit the NSP study reach are considered generalists that are able to tolerate a wide variety of environmental conditions. Most of these species likely occupy the study section on a year-round basis, likely inhabiting slower moving waters along the river margins, along armouring, and in backwater areas. Sucker species likely occupy the area on a year-round basis for all life cycle phases. Based on relatively high capture records, goldeye, mooneye, mountain whitefish, and walleye are expected to occur in higher numbers in the project area compared to other sport fish species that appear to use the area sporadically, and on a limited basis. The relative abundance of coarse substrates and boulder cover along armoured banks offer moderate to high quality habitat for burbot. Lake sturgeon have been found in the area but an overall lack of deep water (>4 m) and suitable spawning habitat in the project area suggests that they primarily use the habitat for migration. Preferential northern pike habitat, which is closely associated with dense aquatic vegetation and low flow velocities habitat that is often provided by snyes, backwaters and oxbow channels in large river settings, was rare within the study section.

3.3 Geology/Geomorphology and Soils

The City of Edmonton retained Tetra Tech (2019) to conduct a preliminary desktop geotechnical evaluation of the proposed NSP project area that included a review of existing available borehole data, published geological information, historical aerial photographs,

and records of existing structures relevant to geotechnical aspects of the site and a site reconnaissance.

Tetra Tech (2019) described the surficial geology near Groat Road Bridge and Walterdale Bridge as gully, creek valley and scarp materials, which consist of thin colluvium, thin alluvium, and mixed glacial and bedrock materials. The central portion of the project area, between the two bridges, was described as mainly river terrace deposits comprising alluvial gravel, sand and silt from the NSR. Stratigraphy indicates there is approximately 6 m of alluvium originating from river terrace and flood plain deposits comprising clay, silt and gravel underlain by bedrock. The top of bedrock is approximately 616 m elevation and comprises interbedded bentonitic shales and sandstones with numerous coal seams.

Evidence of a major slope failure was not observed during Tetra Tech's (2019) site visit. Minor cracks that were observed along pedestrian trails could indicate creep slope movement. Active erosion was observed along the riverbank in many locations.

Tetra Tech (2019) found that the proposed NSP project is considered geotechnically feasible provided geological concerns or constraints relating to bank slope stability, existing and proposed foundations and structures, long-term erosion and presence of existing fill are appropriately addressed in future phases of the project. It is expected that once refined locations of the proposed promenade structures are known, more detailed geotechnical assessments will be conducted.

Tetra Tech (2019) also identified the need to confirm the presence of historical coal mines within the project area.

3.3.1 Contaminated Soils

The City of Edmonton (2019) reviewed their files for the project area for the potential presence of contaminated soils. The Phase 1 ESA for the NSP project area did not identify any areas of potential environmental concern triggering an investigation. Regardless, any newly generated contaminated soils information will be fully addressed in a future Environmental Impact Assessment to be completed in the next phase of the project.

3.4 Vegetation

Vegetation within the project area is a mixture of manicured land and natural shrub and forest communities (Figures 2a through d, Appendix C). The City's urban Primary Land and Vegetation Inventory (uPLVI) mapped five native plant communities in the NSP project area: balsam poplar (*Populus balsamifera*) forest, medial (semi-open) shrub, open shrub, closed shrub and non maintained grass/shrubs (Figures 2a through d, Appendix C). During the site visit it was confirmed that balsam poplar was the dominant tree species within the forested communities of the NSP project area. The entire length of the riverbank from Groat Road Bridge to the Walterdale Bridge, as well as portions of Government House Park and Victoria Park comprised balsam poplar forest community. Other tree species interspersed within this community included Manitoba maple (*Acer negundo*), trembling aspen (*Populus tremuloides*) and white spruce (*Picea glauca*). The shrub layer

in the balsam poplar forest community comprised red-osier dogwood (*Cornus sericea*), buckbrush (*Symphoricarpos occidentalis*) and prickly rose (*Rosa acicularis*). The herbaceous layer appeared to be dominated by smooth brome (*Bromus inermis*); however, this was difficult to determine due to the winter conditions present during our site reconnaissance. These findings are consistent with the findings in Spencer Environmental (2017).

The medial shrub community was confirmed as present along the NSR and near the top of the ravine bank in Government House Park. It consisted mostly of smaller Manitoba Maple trees and willows (*Salix sp.*); some small balsam poplar trees were also present. The herbaceous layer appeared to be dominated by smooth brome; however, this was difficult to determine due to the winter conditions present during the site reconnaissance.

The open shrub community was located on a small island in the NSR; therefore, species composition could not be observed during the site reconnaissance.

The closed shrub and non maintained grass/shrub communities were not closely observed during the site reconnaissance. Species typically found in these communities include a mixture of native and exotic shrubs, forbs and grasses, such as prickly rose, willow, buckbrush, creeping thistle (*Cirsium arvense*) and smooth brome.

Portions of Government House Park, Victoria Park and lands north of the High Level Bridge contain manicured/maintained grass landscapes.

Natural Areas

One River Valley Natural Area identified by the City of Edmonton (2010) is located in the project area, 059 RV. This natural area spans the entire project area and comprises the small band of native vegetation between the NSR and the multi-use trail. It also encompasses the native vegetation at Government House Park and native vegetation in Victoria Park between the skating oval and the Royal Glenora Club. The natural area extends beyond both east and west project area limits. The Natural Area designation is reflective of City mapping efforts that predate the uPLVI and the sensitivity mapping.

Special Status Species

In Alberta, rare plant species are typically considered to be those that are found in fewer than 20 locations in the province. These plants are given provincial conservation rankings of S1 or S2. S1 species are known from five or fewer locations in the province, while S2 species are known to occur in 6-20 locations. The province typically considers species ranked S3 (21-100 known occurrences) as uncommon, rather than rare, and thus, S3 species are not tracked and mitigation measures for their disturbance are not required. However, the City of Edmonton considers species ranked as S1, S2 and S3 to be rare.

A search of ACIMS records for the proposed project area returned records of two special status vascular plant species in and near the project area: flat-topped white aster (*Doellingeria umbellate*) and smooth sweet cicely (*Osmorhiza longistylis*). Flat-topped

white aster (S3) was last reported in the vicinity of the proposed project area in 1952. As this species has not been reported since, its occurrence in the project area is unlikely. Smooth sweet cicely (S3) has been documented in the vicinity of the proposed project area several times in the last 10 years, most recently in 2013; however, the exact locations of those ACIMS records are unknown. This species is typically observed in moist wooded areas, such as the moist forests along the NSR. Consequently, this species could potentially occur in the moist forests in the proposed project area. Smooth sweet cicely was not observed on the north bank of the NSR in the vicinity of Groat Bridge during 2016 rare plant surveys (Spencer Environmental 2017).

3.5 Wildlife

3.5.1 Available Habitat

Wildlife habitat within the project area is limited due to existing disturbance and development including several roadways (Groat Road and associated interchange north of Groat Road Bridge, River Valley Road), bridges (Groat Road Bridge, Dudley Menzies Bridge, High Level Bridge, Walterdale Bridge), multi-use trails and manicured parks (e.g., Government House Park and Victoria Park Golf Course). High quality and connected wildlife habitat is restricted to the vegetated river valley slopes adjacent the project area, the north riverbank within the project area and the south riverbank outside the project area. The relatively narrow band of natural vegetation along the north riverbank could provide suitable habitat for urban-adapted species, particularly areas that do not experience high levels of human use. Based on the site reconnaissance, the section of riverbank south of the west end of Victoria Park and extending downstream just past the island appeared to represent the highest quality natural, mature forested habitat in the project area (e.g., the area between the match lines on Figure. 2c in Appendix C). This area had shallower and terraced slopes and was the widest (approximately 50 m wide) and least disturbed vegetated area in the project area.

3.5.2 Wildlife Species (Common and Special Status)

While approximately 200 wildlife species have been observed within the city, most of which were observed in the NSRV (Pattie and Fisher 1999; Fisher and Acorn 1998; Russell and Bauer 2000, Westworth and Associates 1980), many fewer would be expected in the project area. Of those species the most common are tolerant to human activity. Species include migrants, breeding individuals and resident species. Species migrating through the area may not remain in the regional area, they may instead rest or forage for a short time before continuing their migration.

Amphibians and Reptiles

Limited amphibian breeding habitat is available in the project area. The riparian woods adjacent to the river may provide suitable habitat for terrestrial post-breeding stages of several amphibian species (e.g., wood frogs [*Lithobates sylvaticus*] and boreal chorus frogs [*Pseudacris maculate*]), however, there is low potential for them to occur in the project area as there is a paucity of wetland breeding habitat.

The steep slopes along the NSR in the project area are not suitable for most reptile species, however, the upland areas along the river floodplain may provide habitat for common garter snake (*Thamnophis sirtalis*), provincially ranked *Sensitive*. Common garter snakes have broad foraging habitat preferences, including habitat with ample ground cover such as woody debris and leaf litter often found in aspen stands. All terrestrial reptiles in Alberta, including snakes, congregate in winter dens or hibernacula. Hibernacula may be naturally occurring pits or crevices in rocky outcrops, burrows co-opted from small to medium-sized mammals or excavated by snakes themselves (Russell and Bauer 2000). No known hibernacula are located within the project area.

Avifauna

During breeding bird surveys around the Groat Bridge (Spencer Environmental 2017) and Walter Bridge (Spencer Environmental 2012) common, urban-adapted bird species were observed including: American crow (*Corvus brachyrhynchos*), American robin (*Turdus migratorius*), black-capped chickadee (*Poecile atricapillus*), black-billed magpie (*Pica hudsonia*), cedar waxwing (*Bombycilla cedrorum*), chipping sparrow (*Spizella passerine*), house finch (*Haemorhous mexicanus*), red-eyed vireo (*Vireo olivaceus*), song sparrow (*Melospiza melodia*), white-breasted nuthatch (*Sitta carolinensis*), white-throated sparrow (*Zonotrichia albicollis*) and yellow warbler (*Setophaga petechia*). No special status species were observed during either of these surveys. A search of eBird returned no results of any special status bird species observed by the public near the project area.

Mammals

Small-, medium- and large-sized urban-adapted mammals are likely the most common mammals to occur in the project area. Small furbearers, such as hares (*Lepus sp*.) and squirrels (*Tamiasciurus hudsonicus*), are commonly observed within the NSRV. Based on habitat preference, other species, including voles, mice and bats may use the forested habitat in the project area. Coyotes (*Canis latrans*) are also known to frequent the river valley and surrounding areas. Within the project area, a pack of coyotes is frequently seen near Government House Park (*pers. comm.* A. Forrest). As reported by local media outlets, several coyotes were seen stranded on the river ice during an ice jam/high flow event in the Government House Park area in December 2019.

Ungulate species use habitat in the inner-city parkland areas less frequently than more suitable habitat located on agricultural lands in outer City lands. Both white-tailed (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus*) have been observed in the river valley area outside the downtown core. Deer or moose (*Alces alces*) that are observed within the inner-city regions of the river valley are likely dispersing to other areas of habitat. The limited forest cover and presence of human activity throughout this area of the river valley likely prevents the establishment of resident deer and moose populations.

Cougars (*Puma concolor*) and Canada Lynx (*Lynx canadensis*) also have been observed in Edmonton's river valley and are known to exist in areas surrounding the City of Edmonton. A lynx was observed in August 2019 just downstream of the project area and reported by media. The two species occur very rarely and likely use the river valley and associated

ravines as travel corridors. Cougars and lynx are not expected to be resident species in the project area or the larger city.

Special Status Species

A FWMIS search of a 1.5 km radius centered on the project area returned results of five special status wildlife species: bay-breasted warbler (*Setophaga castanea*), cape may warbler (*Setophaga tigrine*), northern myotis (*Myotis septentrionalis*), peregrine falcon and short-eared owl (*Asio flammeus*). In addition to the FWMIS records of special status species we have also identified one additional species on Schedule 1 of SARA as potentially present based on suitable habitat in the project area: little brown myotis (*Myotis lucifugus*). Bay-breasted and cape may warblers both have a provincial status of *Sensitive*, and the cape may warbler is listed as *Special Concern* under the Alberta *Wildlife Act*. Both bay-breasted and cape may warblers breed in mature coniferous or mixedwood forests of the boreal forest, and as a result may migrate through the Edmonton area but are not expected to utilize any project area habitat for breeding. Short-eared owls utilize large, open areas with low vegetation cover as habitat. No suitable short-eared owl habitat is located within the project area.

Peregrine falcons are provincially listed as *Threatened* under Alberta's *Wildlife Act* and are federally listed as *Special Concern* under Schedule 1 of the *Species at Risk Act* (SARA). Peregrine falcons are known to nest in two locations within/nearby the project area: on the High Level Bridge (within the project area) and on the Biological Sciences Building at the University of Alberta (approximately 350 m south of the project area on the south side of the river) (A. Bismanis, *pers. comm*.). Due to the close proximity of known nests to the project area, it is possible that peregrine falcons may occasionally forage in the project area, therefore, their likelihood of occurrence in the project area is rated as moderate.

Based on our understanding of species-habitat associations, the presence of old mature trees in the forested areas along the riverbank, bridges, old buildings and the proximity of the NSR 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 project area that would be suitable for roosts. However, the little brown myotis may also roost on the Groat Road Bridge, Dudley Menzies Bridge and High Level Bridge. The likelihood of occurrence in the project area for the little brown myotis was rated as moderate because of the project area's proximity to the NSR, a suitable foraging area and water source, and suitable available habitat for roosting immediately adjacent to the project 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.

3.5.1 Wildlife Movement

The NSRV cuts through the city's developed core, providing a permeable passageway into, and out of, the city. Although it is considered a regional biological corridor, its functionality in the city centre, particularly along the north bank of the NSR, is reduced. Barriers to wildlife movement in the project area include steep valley slopes combined with bridges, roads, trails and outfalls in the valley bottom and urban development that extends along the top-of-bank. Wildlife movement along the north riverbank in the project area, where the proposed promenade and associated infrastructure would be built, is currently somewhat hindered by steep riverbanks, and more particularly by bridges and roadways in some locations. River Valley Road, running along the top-of-bank, in particular, has created a pinch point within this portion of the NSRV, particularly for north-south wildlife movements. For wildlife movement parallel to the river, the vegetated riverbank in the project is relatively permeable to wildlife movement in areas where the riverbank is less steep and there are alternative routes around existing outfall structures, riprap and concrete blocks. Within the project area, west of Groat Bridge is the least developed area with no roads, manicured park space and river valley ravines and is, therefore, more permeable to wildlife movement compared to east of the bridge. Outside the project area, relatively superior habitat connectivity and corridor functionality is found on the south side of the NSR across from the project area.

3.6 Historical Resources

The City of Edmonton retained Turtle Island Cultural Resource Management Inc. (Turtle Island) (2019) to conduct a desktop archaeological and palaeontological review for the entire TTWP project area, including the NSP project area. Turtle Island identified four cultural resource sites within the NSP proposed project area. They are typed as either campsite, scatter, burial, fur trade or historic, with some being typed as more than one of these categories. They have been assigned Historical Resource Values (HRVs) of 1, 4 and 5 for archeological, 2 for historic period and 4 for cultural. These HRV scores are defined as:

- HRV 1: designated under the *Historical Resources Act* (HRA) as a Provincial Historic Resource
- HRV 2: designated under the HRA as a Registered Historic Resource
- HRV 4: contains a historic resource that may require avoidance
- HRV 5: high potential to contain a historic resource

3.7 Environmental Sensitivities (per City of Edmonton data)

The City of Edmonton's Environmental Sensitivity mapping (Solstice Canada 2016) shows lands ranging from moderate value to extremely high value within the project area (Figures 3a through d, Appendix C). Lands around the bridges and roadways were classified as moderate value. The river valley south of River Valley Road was a mosaic of high, very high and extremely high values. Lands within Government House Park and Victoria Park were mostly classified as high value, with some patches of very high and extremely high value. The NSR is classified as very high value. The City considers lands designated as high, very high and extremely high value as lands suitable for protection or conservation. Areas of moderate value represent areas that have potential to be restored.

4.0 SUMMARY OF POTENTIAL ENVIRONMENTAL REGULATORY REQUIREMENTS

Relevant federal, provincial and municipal legislation and policy that often has potential to result in the need for environmental (or other) approvals or to influence construction practices for river valley infrastructure projects are summarized in Table 1 in Appendix E.

Ultimately, regulatory requirements for the project will be dependent on project designs, construction plans, and project schedules. Based on the information available for the preferred NSP concept, the anticipated federal and provincial regulatory requirements are provided in Table 4.1 below.

Table 4.1. Possible Federal and Provincial Approvals Required for Preferred North Shore Promenade Concept

Regulation	Relevant Concept Features
Fisheries Act	Infrastructure or activity located on low riverbank (riparian habitat) will likely require a Request for Review, potentially resulting in the need for an Authorization and fish habitat offsetting
Canadian Navigable Waters Act	Approval may be required; the determination will consider promenade elevations and instream structures, such as riprap, or berms to build elevated pathway riverbank piers.
Water Act	Approval for instream structures, such as riverbank amouring, NSR shoreline realignment (inlet creation) for Groat Creek Daylighting; possible approval for placement of fill or permanent infrastructure in the floodplain.
Public Lands Act	Disposition for new structures to permanently occupy the bed and shore of the NSR and shoreline realignment (inlet creation) for Groat Creek Daylighting Temporary disposition for any required instream work
Historical Resources Act	Application to Province required; Historical Resource Impact Assessment likely required for earthworks in the NSRV

5.0 POTENTIAL IMPACTS AND OPPORTUNITIES AND CONSTRAINTS

5.1 Potential Impacts

Table 5.1 summarizes potential adverse environmental impact types that may be associated with development of the preferred concept. This assessment qualitatively considered the impact of permanent infrastructure and assumed the use of typical construction methods. It did not consider additional measures required to account for erosion protection, ice scour, etc. This table does not account for the application of mitigation measures, such as plant community restoration. That level of analysis is beyond the scope of this report, which is intended to be an overview that serves as a precursor to a full EIA. More positive project features that would assist to mitigate these adverse impacts, are accounted for at a high level in the subsequent sections describing positive impacts and opportunities.

Table 5.1. Types of Adverse Impacts Potentially Associated with Proposed North Shore Promenade Preferred Concept, by VEC

Environmental Sensitivity	Impact Type*
Slope Stability	Construction of components on steep riverbanks has potential to affect slope stability.
Hydrology	Potential for shoreline armouring to cause bank erosion and bank and riverbed scour under frozen and non-frozen conditions.
Fisheries	Increase in impervious surface area that could facilitate conveyance of untreated stormwater and contaminants into the NSR, adversely affecting water quality. Some riverbank components have potential to directly or indirectly impact fisheries resources in the NSR. Kingfisher (2021) provides a detailed analysis in Appendix D, Table 7, that should be carefully considered. Following are select, summarized key points, provided as examples of potential impacts: • Groat Creek daylighting would result in localized and relatively major changes to the existing riparian habitat and local open water fish habitat (Note: potential for both a negative and positive impact) and would require extensive instream work; barriers in constructed channel may cause fish entrapment. • Support structures for *Victoria* promenade could result in loss of small areas of high-quality riparian habitat. • Instream works have potential to spread aquatic invasive species. • Some potential for increased pressure on fisheries associated with the post-construction/use of the NSP.
Native Vegetation	Pathway construction may require removal of native forest vegetation (e.g., at *Victoria* and *The Deck*).

Environmental Sensitivity	Impact Type*
Wildlife Habitat	Potential for a decrease in available mature habitat, including higher quality forested habitat along the riverbank (e.g., at *Victoria*).
Wildlife Passage	Reduction in landscape permeability for wildlife owing to presence of more river valley infrastructure compared to current conditions, particularly along the vegetated riverbank. Groat Creek daylighting may create a localized barrier to wildlife movement along the riverbank, deflecting some animals inland, under some high water/wet conditions. Note: in general, the use of elevated infrastructure will assist in maintaining some movement permeability immediately parallel to the river.

*Qualitative assessment only

Potential Positive Impacts

- Daylighting lower Groat Creek is expected to improve collected runoff water quality, relative to the existing engineered end of pipe treatment system.
- Daylighted creek confluence creates potential to establish unique off-channel fish habitat.
- Lower Groat Creek daylighting would increase available aquatic habitat diversity and aquatic and terrestrial wildlife richness by introducing wetland habitat.
- The landscaping concept at Government House Park would naturalize much of this area.

5.2 Opportunities and Constraints

The following section highlights environmental opportunities (which includes the above potential positive impacts providing direction for further exploration) and constraints specific to the proposed NSP project area. This section in intended to be used to inform future phases of the project.

5.2.1 Opportunities

- Daylighting and restoration of Groat Creek are likely to result in improved water quality of runoff discharged to the river, would increase the diversity and total area of available fish habitat by providing unique off-channel habitat, and would create wetland plant communities/habitat. Efforts could be made to maximize these features in the next design phases.
- Specific to fisheries, there is potential to design to improve riparian conditions through: bank stabilization, reclamation of disused infrastructure and enhancement of riparian vegetation.
- There is potential to clean up concrete and other debris along the riverbank.
- Support regional fisheries management objectives (regarding habitat, populations, fishing opportunities, public input).

- This project has potential to support species recovery efforts (in this case for Lake Sturgeon). This opportunity should be explored.
- The project should explore opportunities to strategically locate outfalls based on environmental protection principles (e.g., reduce number of discharge points, reduce footprint on riverbank, etc.).
- Proposed re-establishment of native species communities, for example, at Government House Park, may represent a naturalizing of some areas and would create wildlife habitat.
- The project is designed to enhance the existing available recreational amenities in the project area.
- The preferred concept minimizes disturbance footprint by locating infrastructure in existing disturbed areas.
- Further, the preferred concept utilizes existing infrastructure, where feasible. The City's intent is to fully explore this approach.

5.2.2 Constraints

Following are some potential environmental constraints that will influence future design or construction practices:

- The NSRV has a rich pre-settlement and settlement history. As a result, there is a risk that surficial disturbance for trail and associated infrastructure construction may disturb unknown historical resources. Risk should be mitigated through design and preparation of HRIAs and collaboration with the Provincial ministry.
- Construction activities will be subject to the following restricted activity periods:
    - In-stream activities in the NSR (Class C) are subject to a Restricted Activity Period (RAP) of 16 September to 31 July.
    - All vegetation clearing should be avoided during the breeding bird season from 20 April to 20 August.
    - Clearing of large trees and snags should be avoided during breeding owl season from 15 February to 20 April.
    - Clearing of large trees and snags and building demolition should be avoided during the bat breeding season from 01 May and 15 September.
    - Wildlife trees within the proposed project footprint should be identified and removal or damage avoided.
- The concept proposes development of some project components within the floodway and flood fringe components of the Flood Hazard Zone identified by the Government of Alberta as of 2015. NSR flooding could damage infrastructure during frozen and non-frozen conditions.
- Several other projects are underway or proposed for this area in the long term. For example, Royal Glenora Club renovations by others (under construction), Centre Line LRT potential new river crossing (near the High Level Bridge), and the High Level Line initiative. How these projects interface and their cumulative effects should be considered. Note: these proposed initiatives could also be viewed as an opportunity to realize positive synergies.

6.0 FUTURE INVESTIGATIONS

Based on the preferred concept design, the following investigations are recommended to facilitate future design phases and eventual acquisition of environmental permits and approvals.

6.1 Surface Water, Groundwater

NHC (2019) made the following recommendations for future phases of the TTWP project, including in the NSP area:

- All features on the bank should be assessed for erosion potential and potential mitigation.
- Proposed support structures should be assessed to determine potential local scour depth and scour mitigation measures including riprap.
- Proposed bank hardening features should be assessed to determine potential scour depth and scour mitigation measures including riprap.
- All proposed features should be designed with consideration of the flood peak elevations and associated risks of flood damage.
- Hydrodynamic forces during peak floods should be assessed on all features extending into the river channel. *Note: the preferred concept has no such features, other than proposed riprap.*
- Vertical support structures should be designed in accordance with CSA guidelines for ice loads on bridge piers.
- All proposed features should be designed with consideration of the typical freeze-up ice levels and associated risks (e.g., ice scarring from ice floes during break-up or freeze-up).
- Regular maintenance should be performed to remove any debris from features after spring runoff, flood events, etc.

6.2 Fisheries

Assuming that there are no major changes to the concept design as currently proposed, the fisheries information presented in Kingfisher (2021) (Appendix D) is considered to be sufficient for use in a fisheries impact assessment in support of environmental permitting applications pursuant to the federal *Fisheries Act* and the provincial *Water Act*. Additional design and construction details, however, will be required before the fisheries impact assessment can be completed. It is assumed that this information will become available in future phases of the project. Of course, when preliminary design is examined, additional information gaps may be identified. Key information that will be required to complete the impact assessment includes (but is not limited to) the following:

- Design plans with sufficient detail to determine physical footprints of ***permanent*** and ***temporary*** infrastructure on the bed and banks of the NSR.
- Construction plans detailing construction methodologies and schedules.

6.3 Geology/Geomorphology and Soils

- Tetra Tech Canada Inc. (2019) recommended that detailed geotechnical investigations and evaluations take place once the locations and design of the proposed NSP project promenade(s) and associated structures are known.
- Determine if additional contamination investigations should be undertaken.

6.4 Vegetation

The following site-specific vegetation investigations should be conducted in the directly affected areas of the proposed NSP project area:

- A seasonally appropriate site-specific plant community and rare plant survey to document conditions and determine whether any rare plants or unique plant communities will be adversely impacted by the project.
- Concurrent with the rare plant survey, a weed survey should be conducted to determine if noxious and/or prohibited noxious weeds are present that will require management/removal.

6.5 Wildlife

The following site-specific wildlife investigations should be conducted in the directly affected areas of the proposed NSP project area:

- Seasonally appropriate breeding bird survey to determine the presence/absence of special status species.
- Visual survey to document incidental wildlife observations and evidence of habitat use including animal sightings, tracks, droppings, nests, dens, etc.
- Document and map wildlife trees (i.e., trees with visible nests, or large trees with cavities) and other critical habitat.
- Acquire and analyse City of Edmonton camera trap data, if data are available, to document wildlife species and related movements in the project area.

6.6 Historical Resources

Turtle Island (2019) recommends a Historical Resources Impact Assessment (HRIA) be completed for this project. An HRIA would identify areas to avoid during construction, if possible. Then a Historical Resource Application could be submitted to Alberta Culture, Multiculturalism and the Status of Women (ACMSW) for their review and assessment regarding requirements for future field investigations. ACMSW prefers to review final project disturbance footprints, including staging areas, in applications, however, they will accept submission of multiple alignment options.

6.7 Environmental Sensitivities

In future phases of the project, refine the City's original environmental sensitivity mapping with field-collected, site-specific vegetation data mapping from the project area.

7.0 SUMMARY AND CONCLUSIONS

The City of Edmonton, consistent with the River Valley Alliance Plan of Action (2007), proposes to construct a promenade and associated structures in the NSRV from Government House Park to the new Walterdale Bridge. The proposed North Shore Promenade project will be located within the boundaries of the North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188). The project is currently near the final stages of the concept design phase.

There is a known, rich, pre-settlement and settlement history in the project area *and* there is potential to disturb unknown historical resources. To date, studies have indicated that overall river valley biophysical and development conditions in the North Shore Promenade project area are amenable to a recreational promenade experience. The proposed NSP project would enhance the recreational and river-viewing experience in the project area. It would enhance the already continuous river valley pathway connection from Government House Park to Walterdale Bridge while providing improved access to the NSRV from the top-of-bank at Constable Ezio Faraone Park to the Dudley Menzies Bridge and improved interface with the NSR at several locations. The proposed concept represents an improved recreation initiative.

The preferred concept also represents a change in the character of this reach of the north riverbank. It has potential to exert some adverse impacts on the existing natural environment. Based on the desktop environmental information presented in this Environmental Overview that considers surface water, groundwater, fisheries, geology/geomorphology and soils, vegetation, wildlife and historical resources, several potential adverse impacts were identified, largely because the proposed project represents the introduction of new permanent and significant infrastructure along a 3 km corridor paralleling the river, a reach that is currently relatively undeveloped compared to other reaches, such as the Rossdale area downstream. The impact would generally be concentrated along and at the top of the now-vegetated and relatively natural riverbank. The new infrastructure would result in a less permeable north riverbank corridor for wildlife compared to current conditions, although this EO recognizes that inclusion of some elevated structures does temper this impact. On the other hand, this EO identifies the preferred concept as also having some positive impacts on natural resources, providing opportunities to clean up localities and restore native species to some areas. In particular, the proposed redevelopment of Government House Park represents a positive initiative as an overall naturalization of that area, with re-establishment of lower Groat Creek and conversion of manicured areas to natural habitats. This aspect is likely to be a significant, local, net gain.

Recognizing the lack of site-specific environmental information, and depending on the final construction footprint, we recommend undertaking additional site assessments related to hydrotechnical assessments, possibly fish habitat (to be determined pending final design), geotechnical concerns, vegetation, wildlife and historical resources. That information would support future environmental permitting application requirements. As the project advances, we also recommend consultation with environmental regulators to

discuss the proposed infrastructure footprint and proposed construction practices. Regulators' comments may influence design and construction decisions.

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8.2 Personal Communications

A. Bismanis, P. Biol., Environmental Scientist, Spencer Environmental Management Services Ltd.

A. Forrest, P. Biol., Environmental Scientist, Spencer Environmental Management Services Ltd.

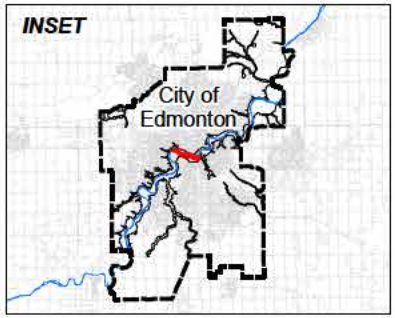
Appendix A: Project Overview Figures

Figure 1.
Project Overview
North Shore Promenade
TTWP

Legend

Project Areas

- North Shore Promenade
- Rossdale Reach
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)



Map Date: 08 July 2021
Imagery Date: May 2017

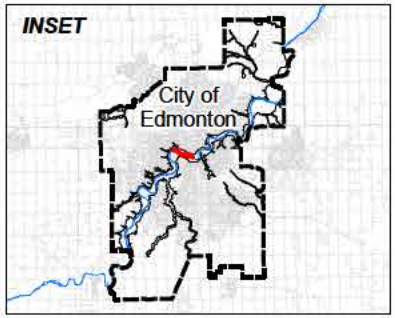
SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Note: The watercourse in Groat Ravine is no longer present. Other FMWIS watercourse data may not accurately indicate current conditions.

Figure 2.
Project Area
North Shore Promenade
TTWP

Legend

- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)



Map Date: 08 July 2021
Imagery Date: May 2017

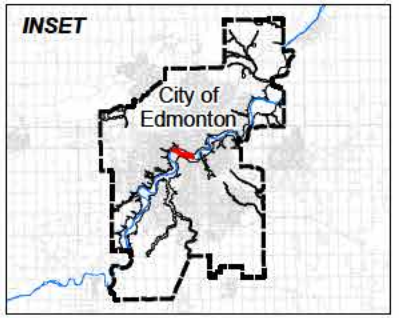
SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Note: The watercourse in Groat Ravine is no longer present. Other FMWIS watercourse data may not accurately indicate current conditions.

Figure 3.
City of Edmonton
Land Use Zoning
North Shore Promenade
TTWP

Legend

- Project Area
- Watercourse (FWMIS, 2018)
- A — Zoning (COE, 2020)



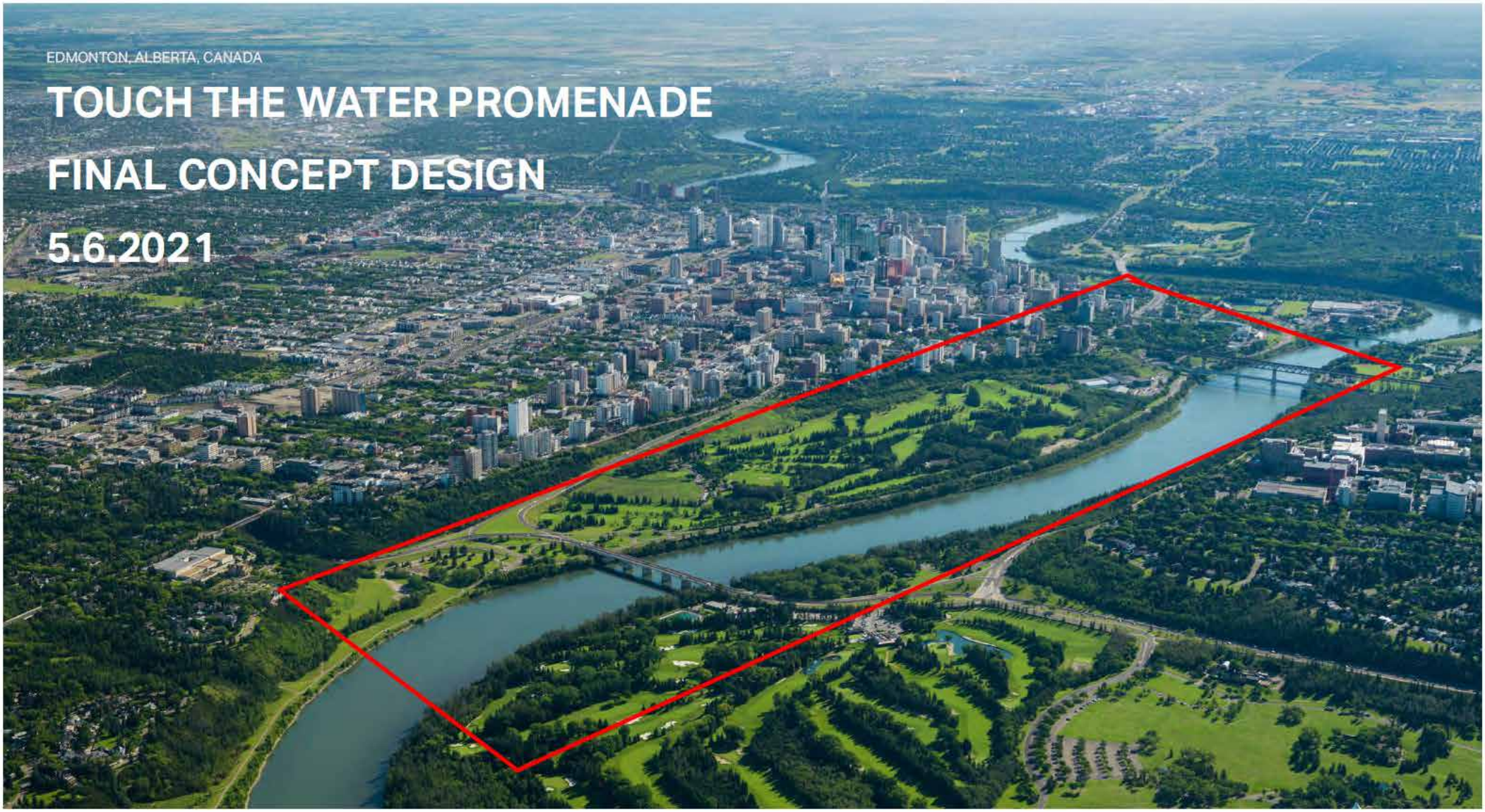
Map Date: 08 July 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Note: The watercourse in Groat Ravine is no longer present. Other FMWIS watercourse data may not accurately indicate current conditions.

Appendix B: Final Concept for North Shore Promenade – (Dub Architects Ltd. and Stoss Landscape Urbanism 2021)

Figure 1. Project Overview - Existing Conditions



dub STOSS

Figure 2. Project Overview - Preferred Concept

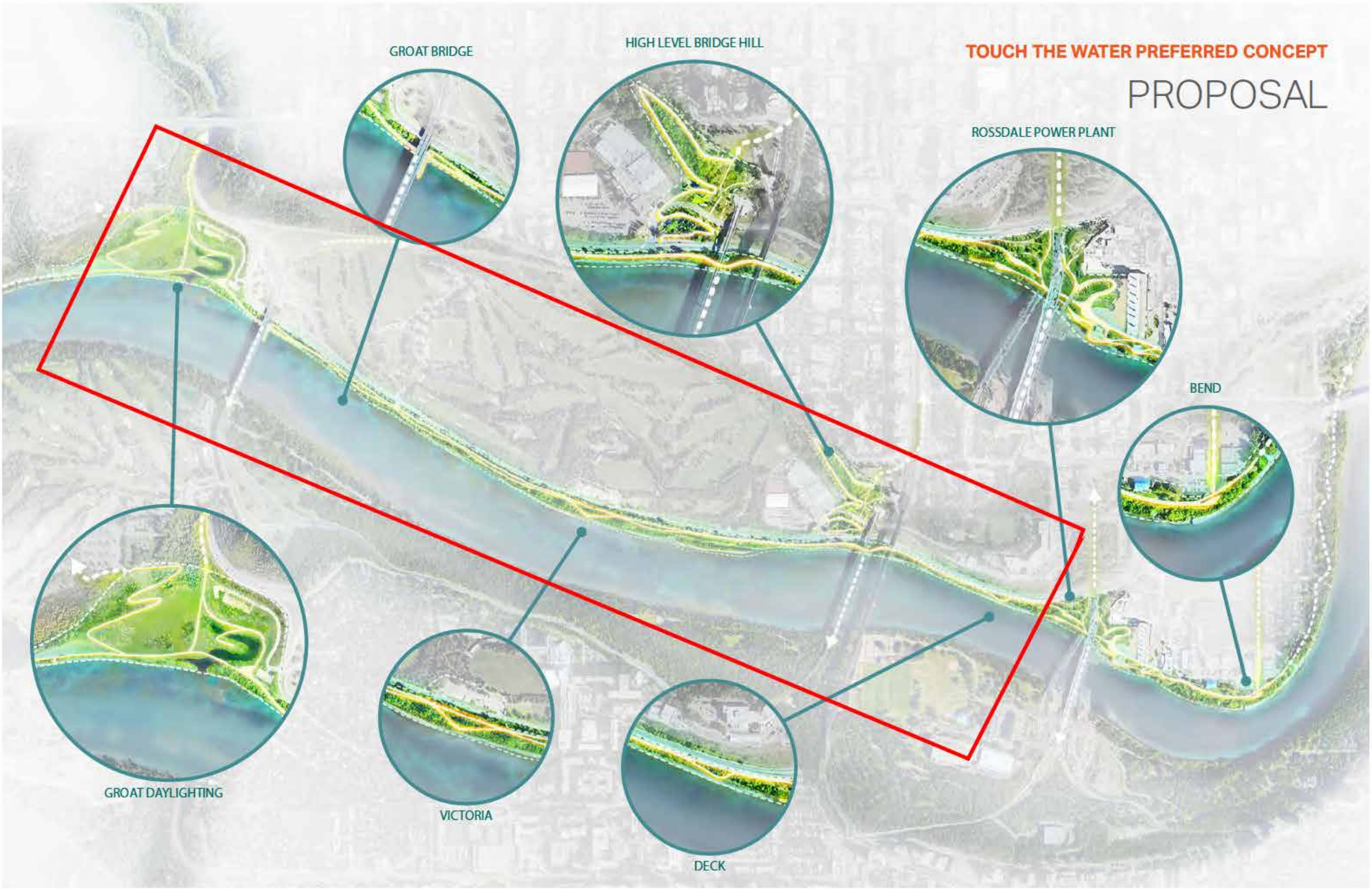


Figure 3. Government House Park and Groat Daylighting - Existing Conditions

Figure 4. Government House Park and Groat Daylighting - Preferred Concept

GOVERNMENT HOUSE PARK & GROAT DAYLIGHTING

PROPOSAL

Figure 5. Government House Park and Groat Daylighting - Preferred Concept Elements

GOVERNMENT HOUSE PARK & GROAT DAYLIGHTING

PROPOSAL

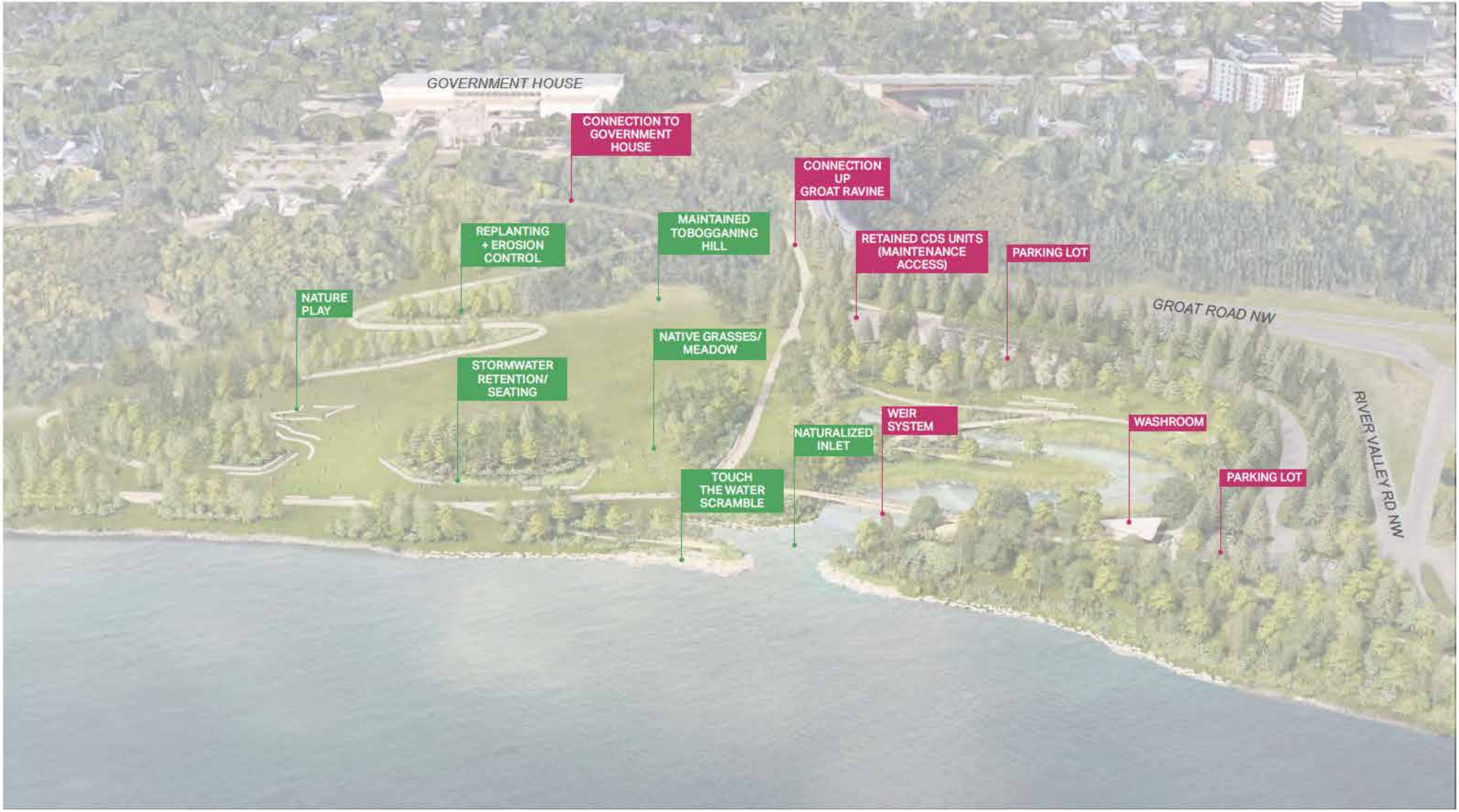


Figure 6. Government House Park and Groat Daylighting - Retained Infrastructure

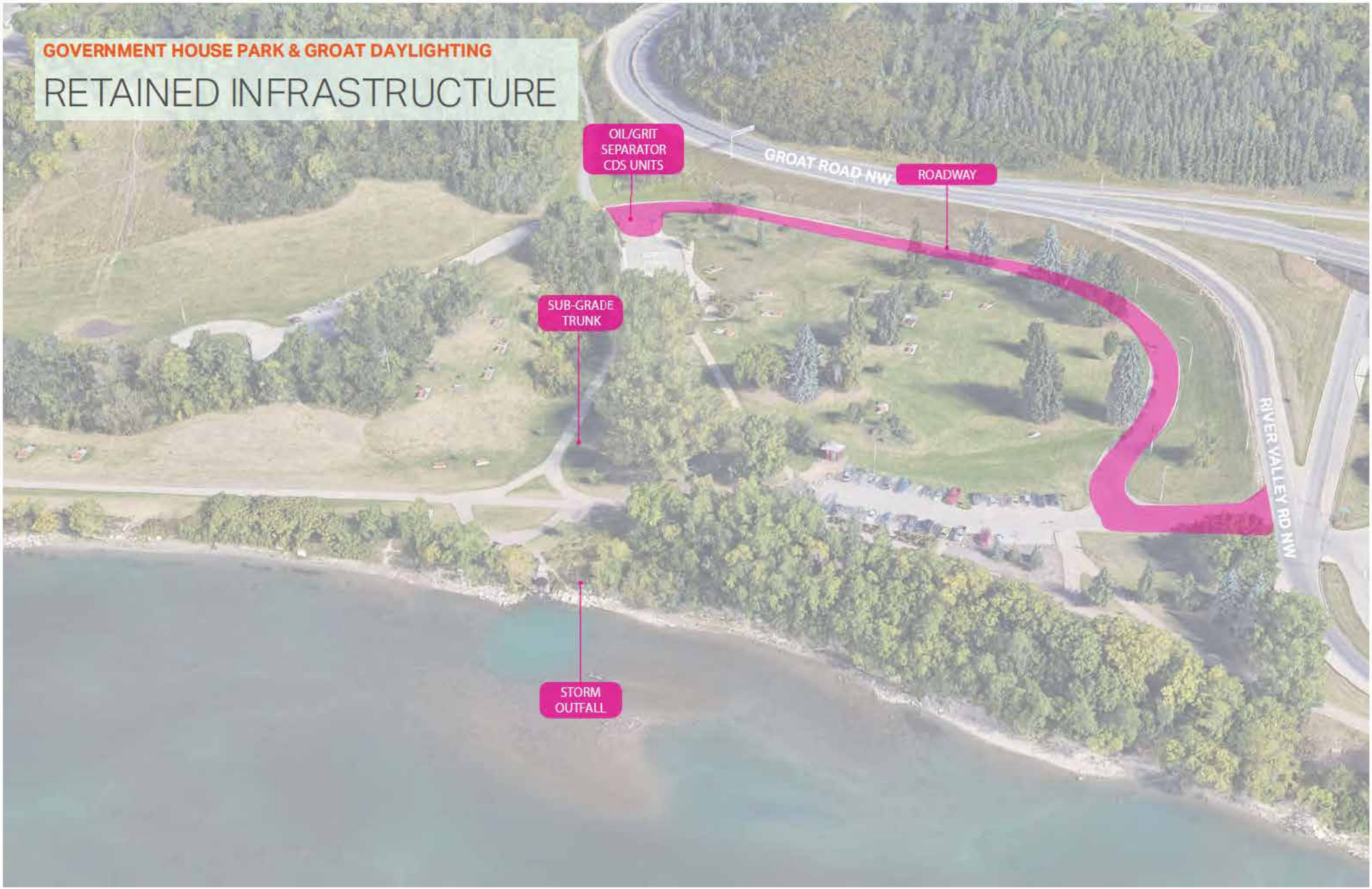


Figure 7. Government House Park and Groat Daylighting - Proposed Stormwater System

GOVERNMENT HOUSE PARK & GROAT DAYLIGHTING

PROPOSED STORMWATER SYSTEM

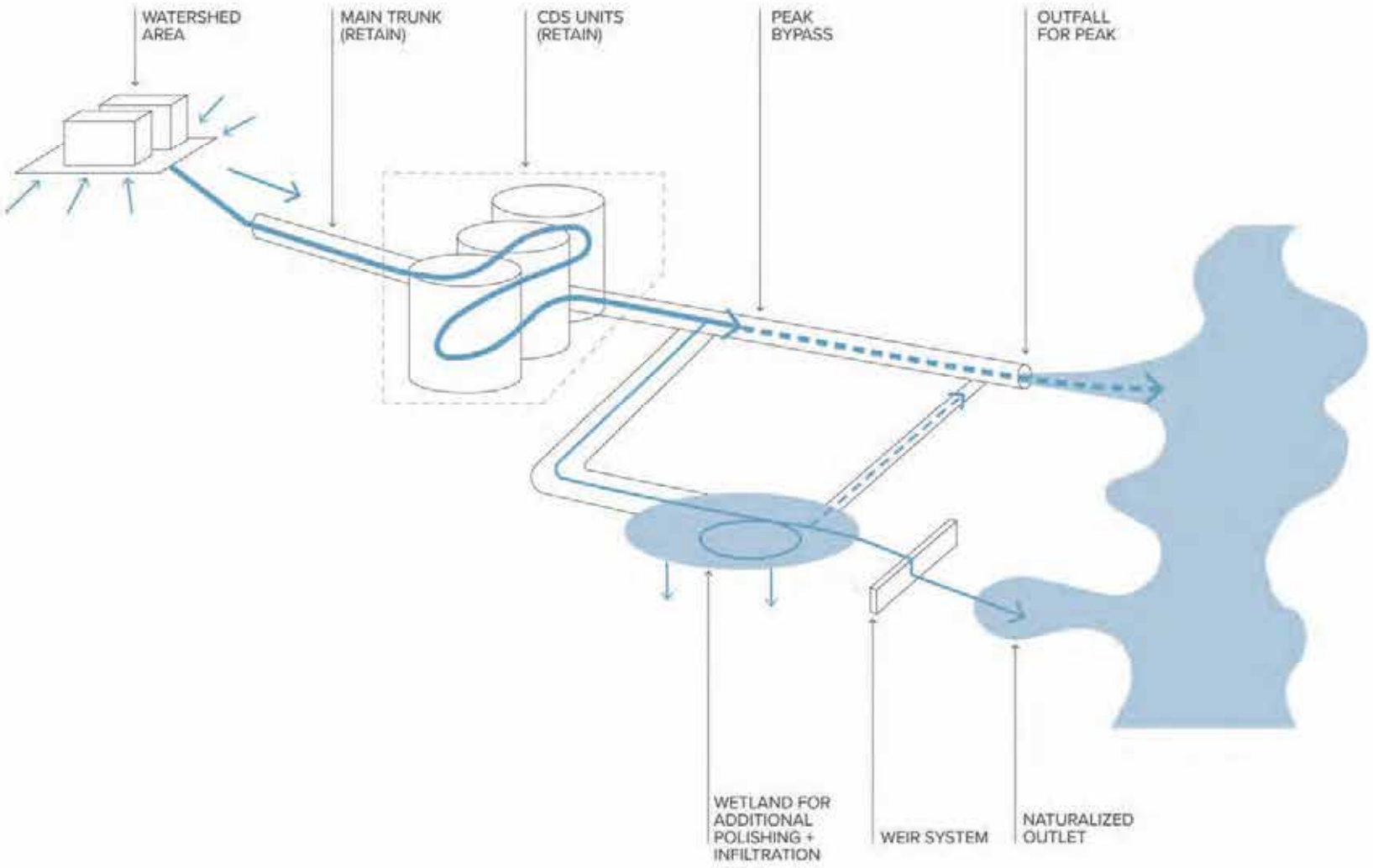


Figure 8. Government House Park and Groat Daylighting - Proposed Vegetation

GOVERNMENT HOUSE PARK & GROAT DAYLIGHTING

PROPOSED CONDITION: VEGETATION

Figure 9. Groat Bridge - Existing Conditions

Figure 10. Groat Bridge - Preferred Concept

GROAT BRIDGE

PROPOSAL

Figure 11. Groat Bridge - Preferred Concept Elements

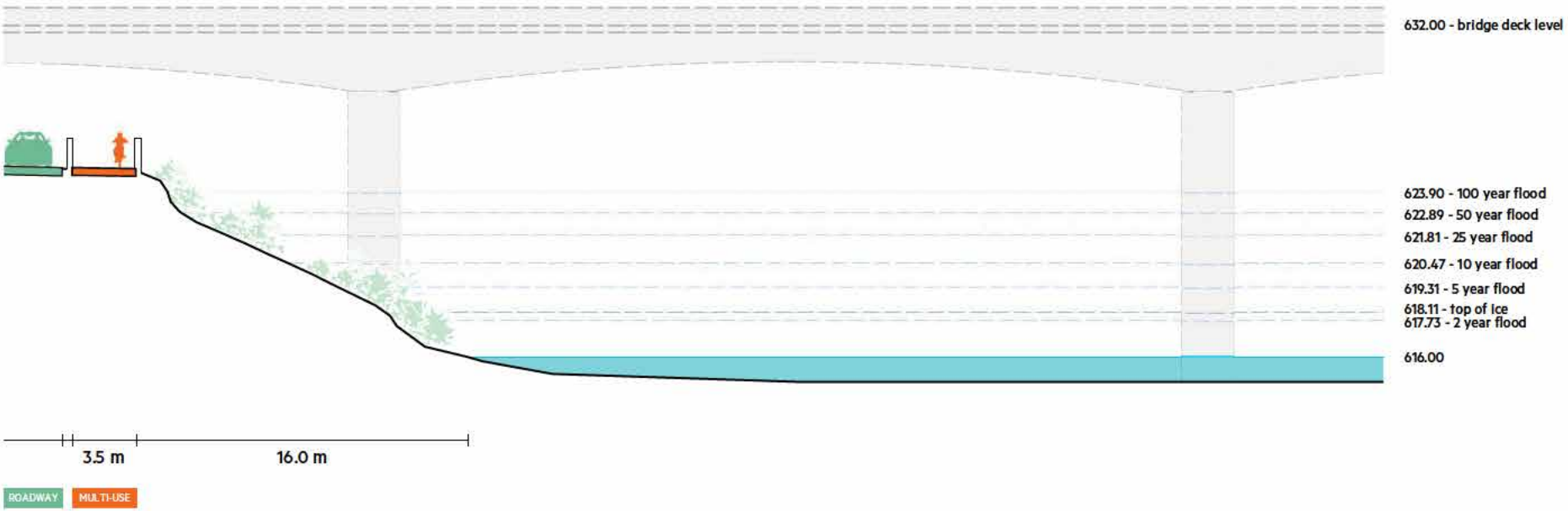
GROAT BRIDGE

PROPOSAL

Figure 12. Groat Bridge - Existing Pathway

GROAT BRIDGE

EXISTING PATHWAYS CONDITION

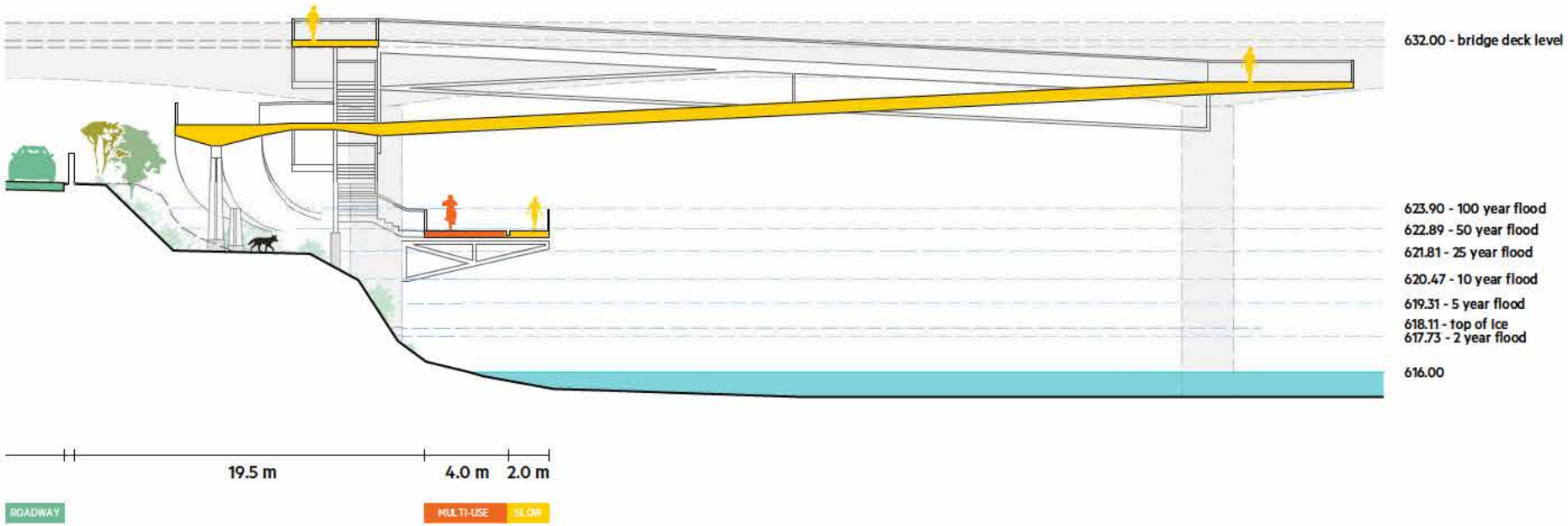


EXISTING

Figure 13. Groat Bridge - Proposed Pathway

GROAT BRIDGE

PROPOSED PATHWAYS



PROPOSED

10 m

Figure 14. Split Path Promenade - Existing Pathway

Figure 15. Split Path Promenade - Proposed Pathway

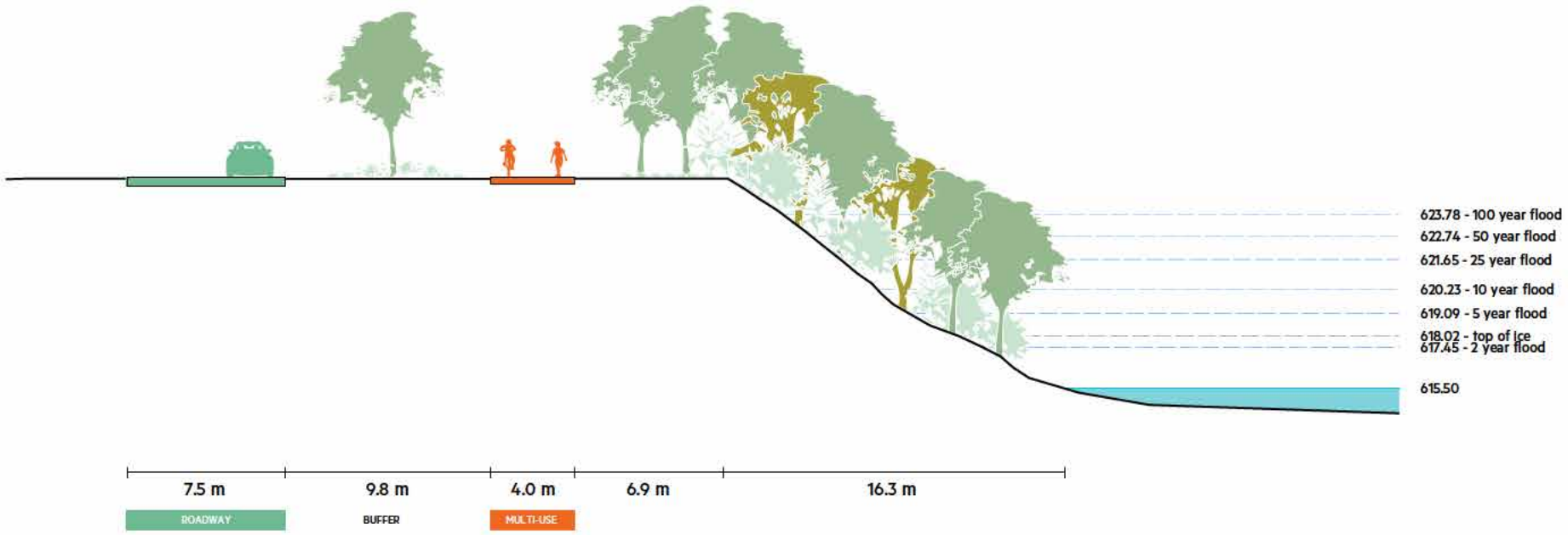
SPLIT PATH PROMENADE

PROPOSED PATHWAYS

Figure 16. Split Path Promenade - Existing Pathway Cross Section

SPLIT PATH PROMENADE

EXISTING PATHWAYS CONDITION



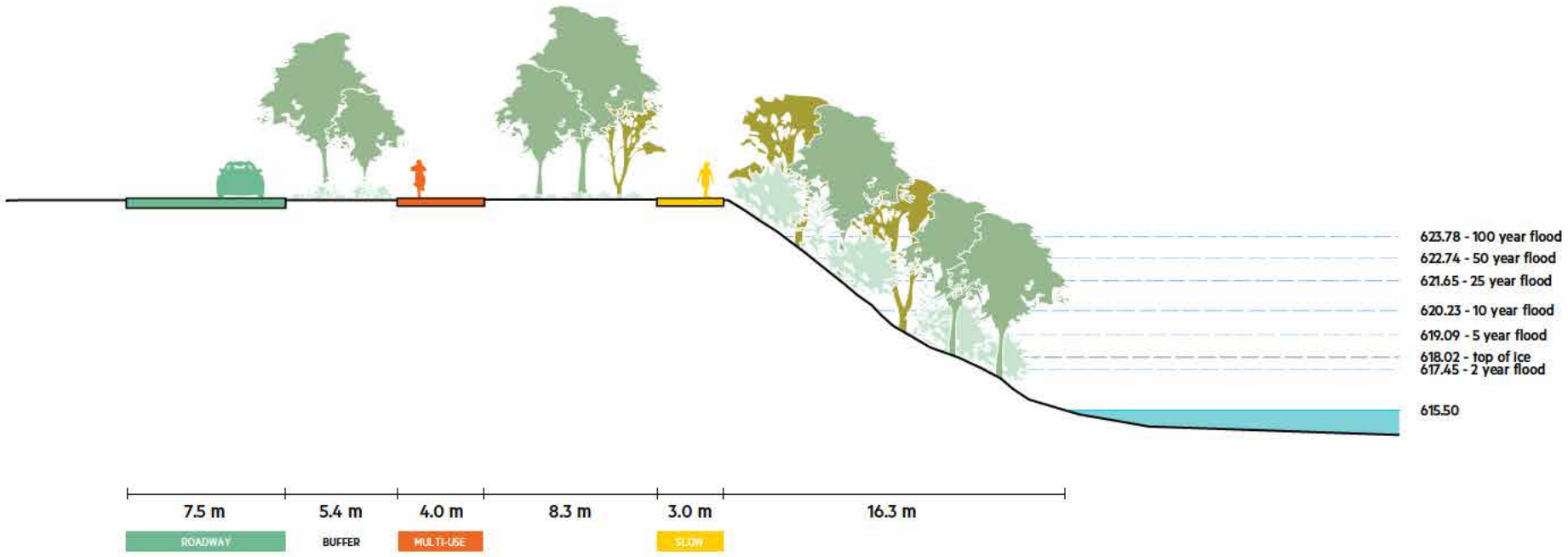
EXISTING

10 m

Figure 17. Split Path Promenade - Proposed Pathway Cross Section

SPLIT PATH PROMENADE

PROPOSED PATHWAYS



PROPOSED

10 m

Figure 18. Victoria - Existing Conditions

Figure 19. Victoria - Preferred Concept

VICTORIA

PROPOSAL

Figure 20. Victoria - Preferred Concept Elements

VICTORIA

PROPOSAL

Figure 21. Victoria - Existing Pathway

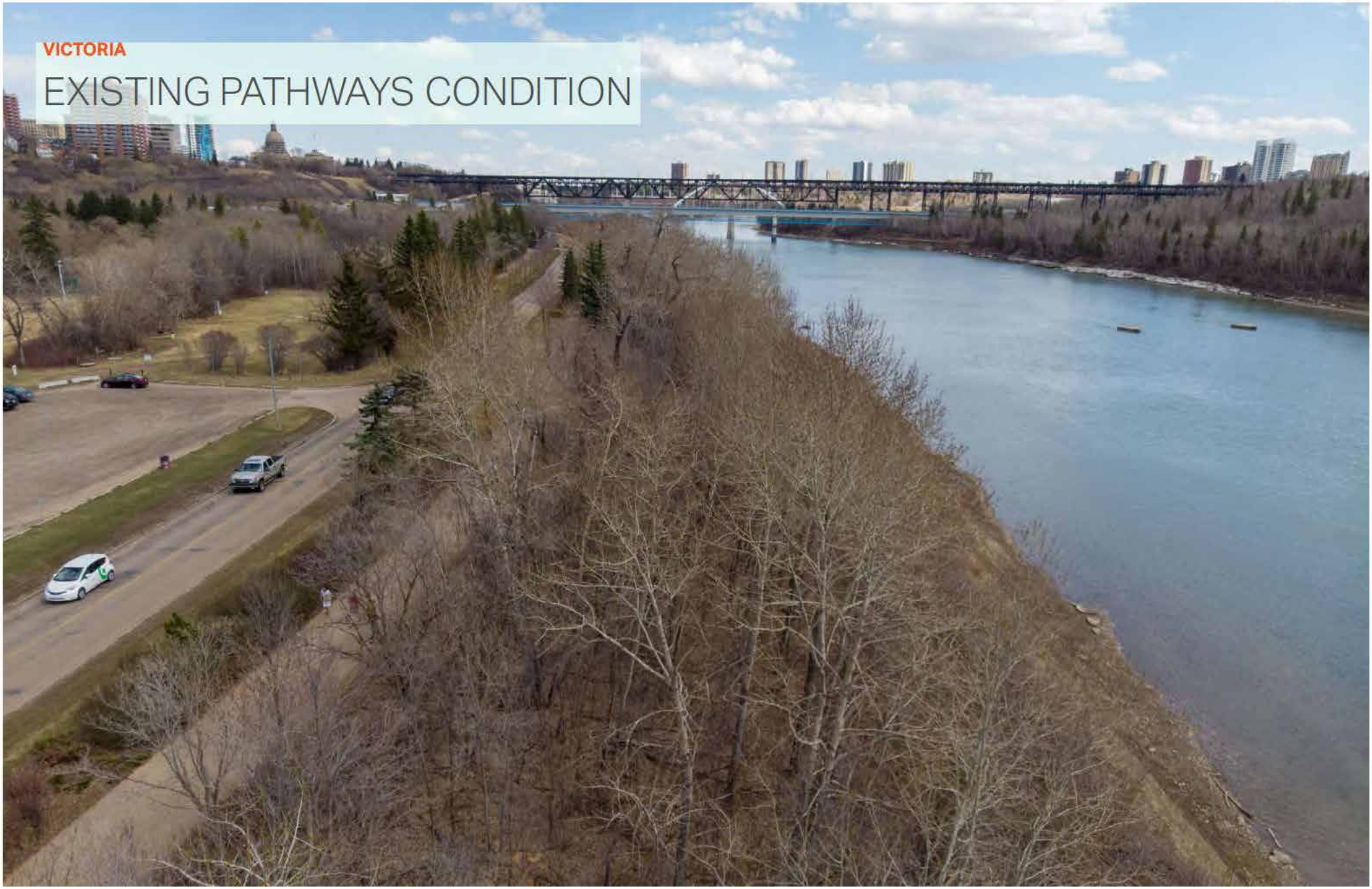


Figure 22. Victoria - Proposed Pathway

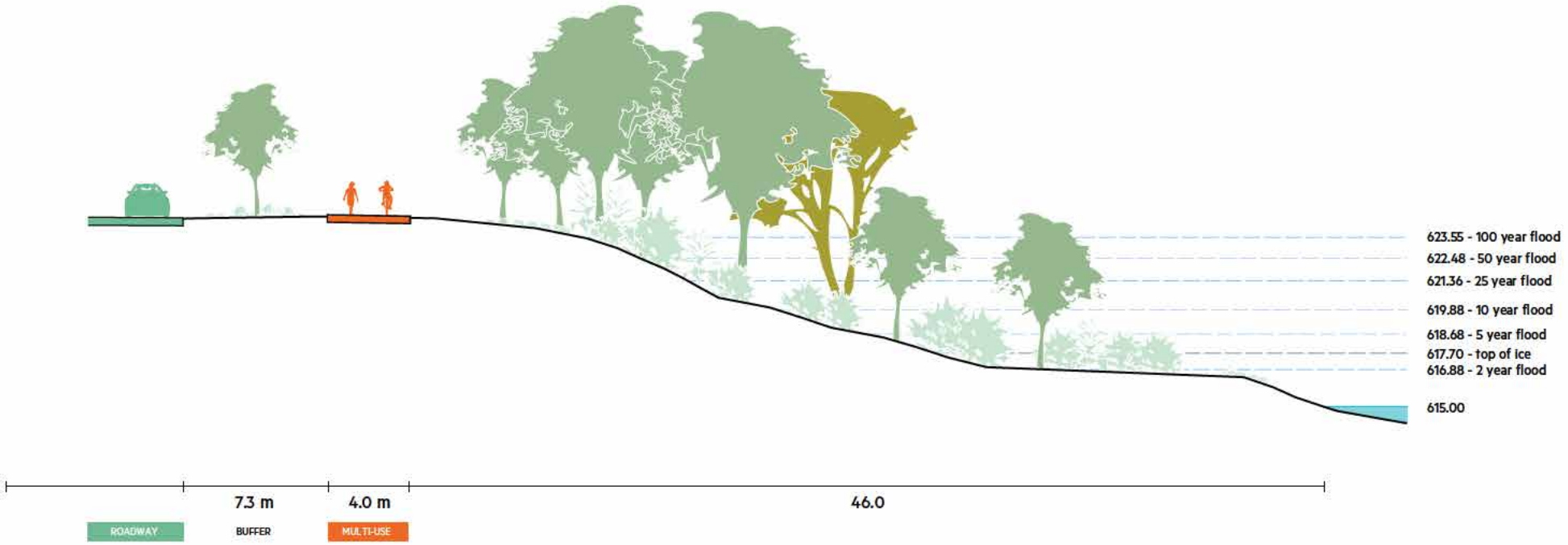
VICTORIA

PROPOSED PATHWAYS

Figure 23. Victoria - Existing Pathway Cross Section

VICTORIA

EXISTING PATHWAYS CONDITION



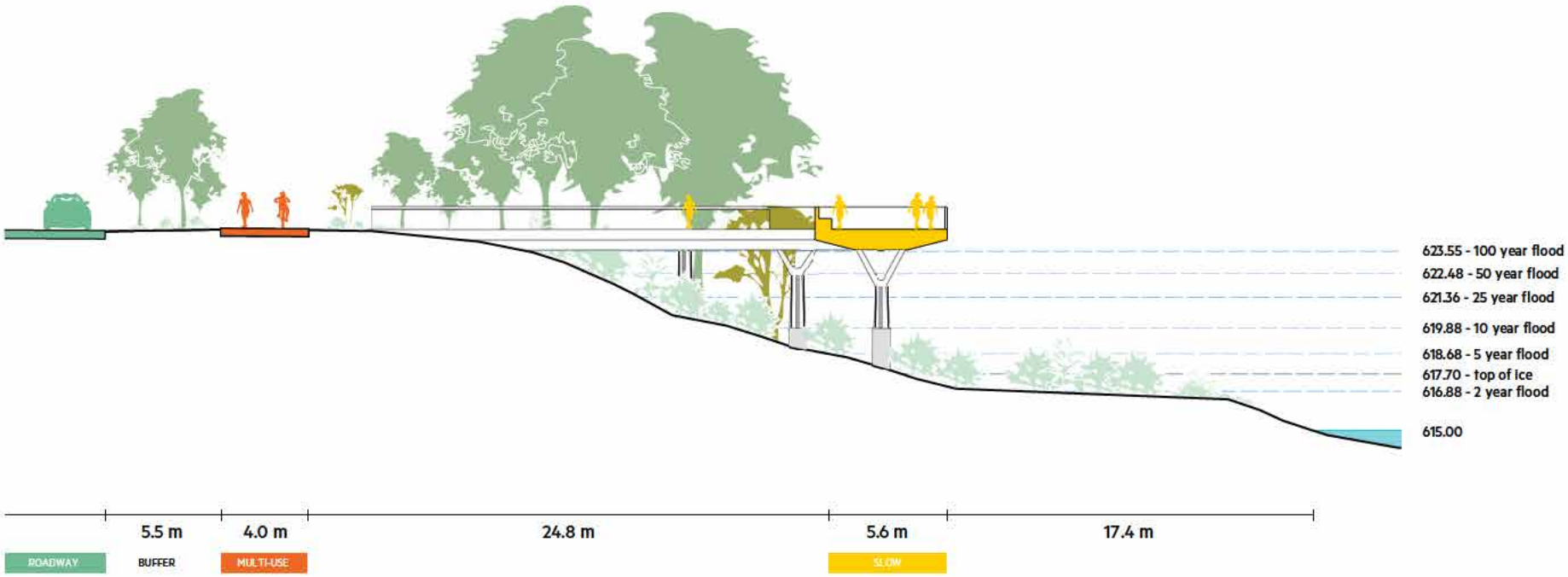
EXISTING

10 m

Figure 24. Victoria - Proposed Pathway Cross Section

VICTORIA

PROPOSED PATHWAYS



PROPOSED

10 m

Figure 25. Combined Path Promenade - Existing Pathway

Figure 26. Combined Path Promenade - Proposed Pathway

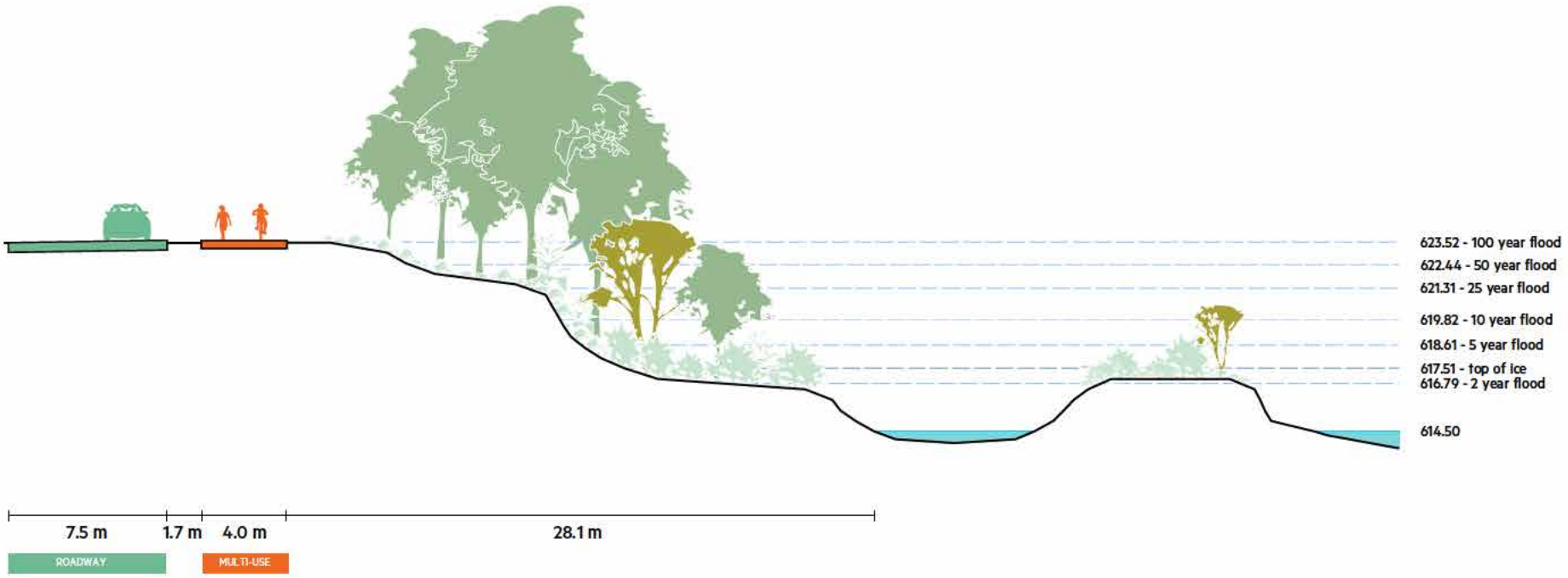
COMBINED PATH PROMENADE

PROPOSED PATHWAYS

Figure 27. Combined Path Promenade - Existing Pathway Cross Section

COMBINED PATH PROMENADE

EXISTING PATHWAYS CONDITION

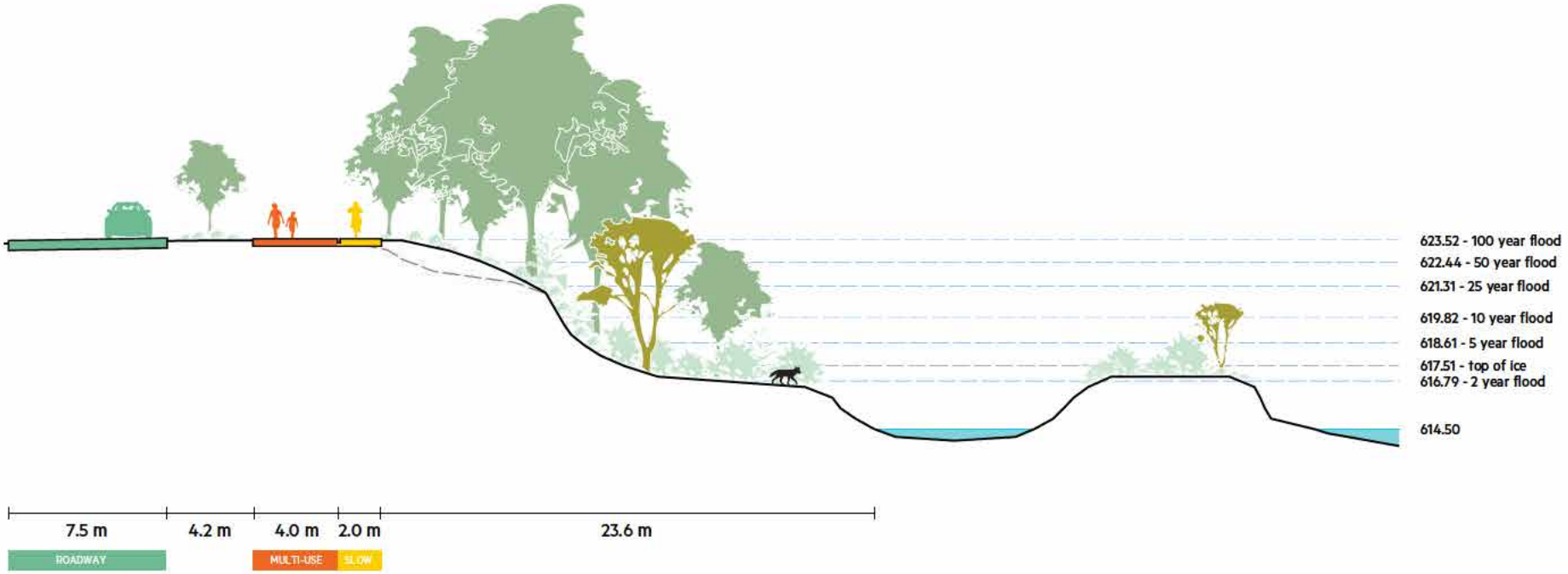


EXISTING

Figure 28. Combined Path Promenade - Proposed Pathway Cross Section

COMBINED PATH PROMENADE

PROPOSED PATHWAYS



PROPOSED

10 m

Figure 29. High Level Bridge Hill - Existing Conditions

Figure 30. High Level Bridge Hill - Preferred Concept

Figure 31. High Level Bridge Hill - Preferred Concept Elements

Figure 32. High Level Bridge Hill - Accessibility

Figure 33. High Level Bridge Hill - Existing Pathway

HIGH LEVEL BRIDGE HILL

EXISTING PATHWAYS CONDITION

EXISTING

10 m

Figure 34. High Level Bridge Hill - Proposed Pathway

HIGH LEVEL BRIDGE HILL

PROPOSED PATHWAYS

PROPOSED

Figure 35. The Deck - Existing Conditions

Figure 36. The Deck - Preferred Concept

THE DECK

PROPOSAL

Figure 37. The Deck - Preferred Concept Elements

THE DECK

PROPOSAL

Figure 38. The Deck - Existing Pathway

THE DECK

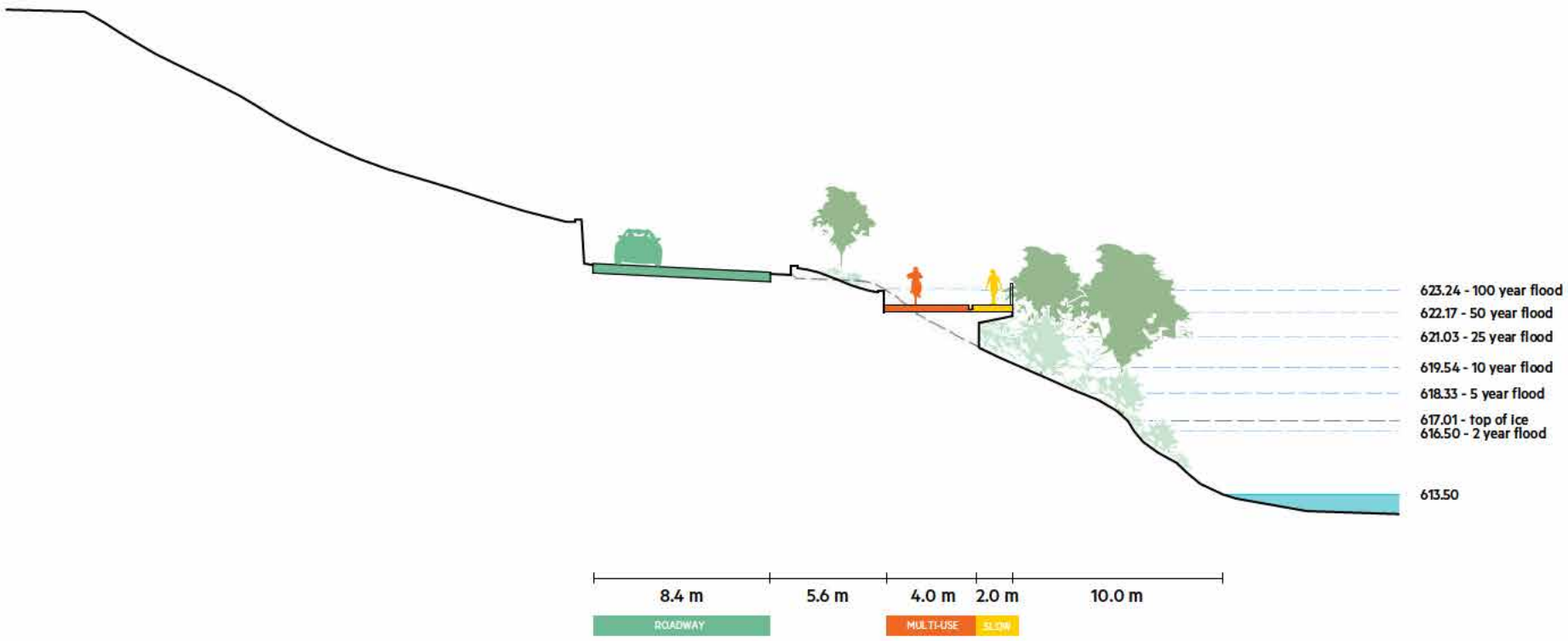
EXISTING PATHWAYS CONDITION

EXISTING

Figure 39. The Deck - Proposed Pathway

THE DECK

PROPOSED PATHWAYS

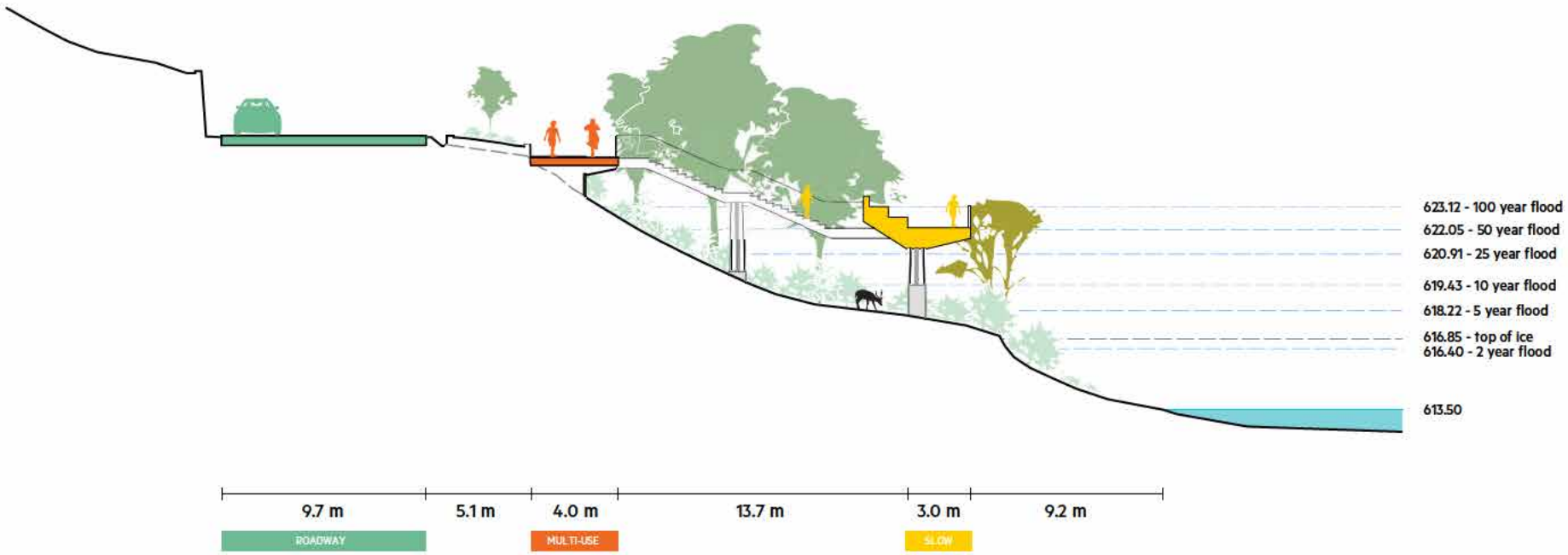


PROPOSED

Figure 40. The Deck - Proposed Pathway and Access to the Deck

THE DECK

PROPOSED PATHWAYS

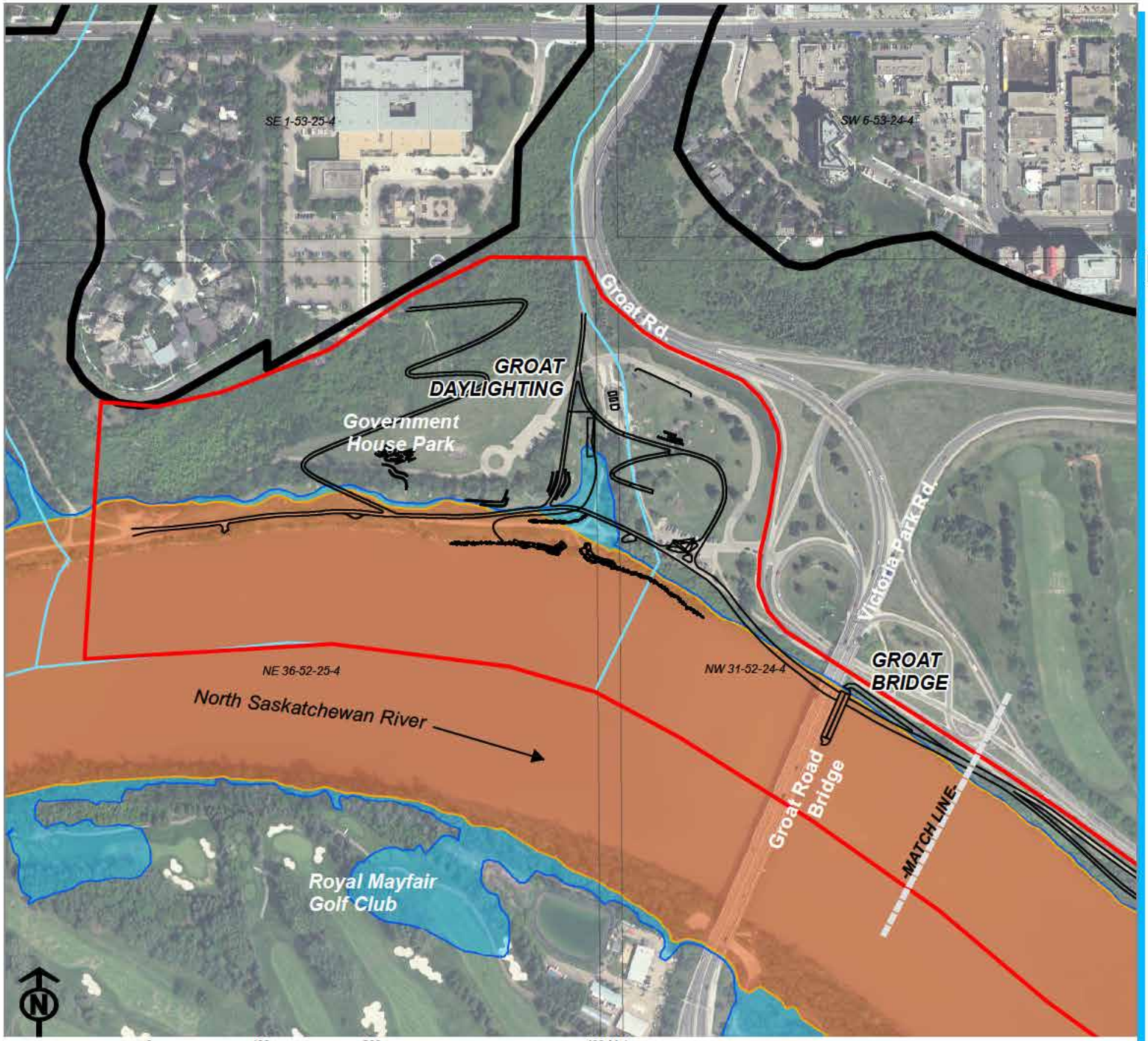


PROPOSED

10 m

Appendix C: Existing Environmental Conditions

Figure 1a.
Flood Hazard Mapping
North Shore Promenade
TTWP

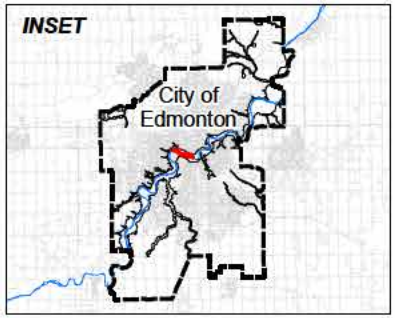


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)***

Flood Hazard Area**

- Floodway
- Flood Fringe

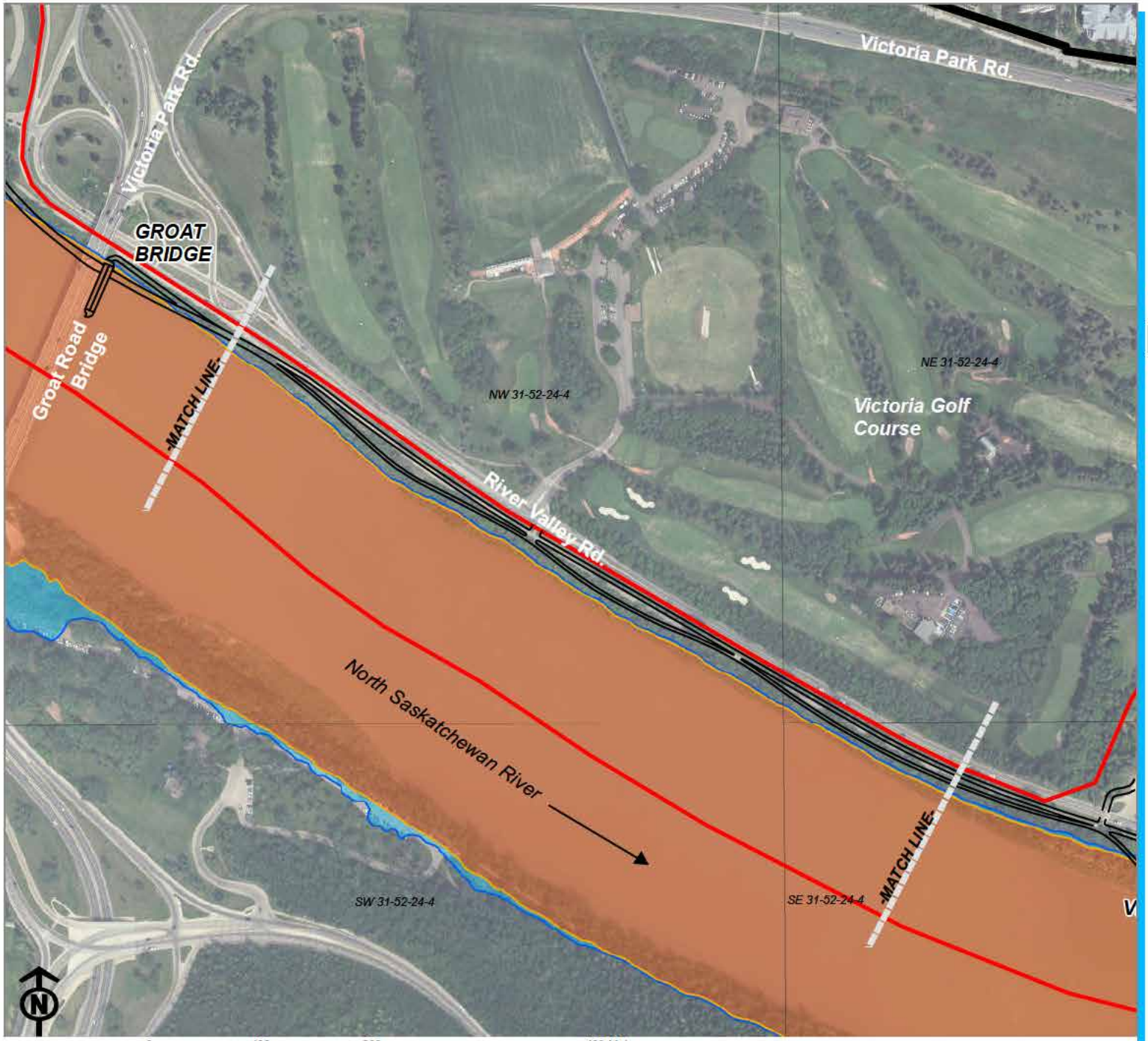


Map Date: 08 July 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**Flood Hazard Mapping (AEP, 2015); Government of Alberta is currently updating the City of Edmonton s flood hazard mapping data so the information presented here could change.
***Note: The watercourse in Groat Ravine is no longer present. Other FMWIS watercourse data may not accurately indicate current conditions.

Figure 1b.
Flood Hazard Mapping
North Shore Promenade
TTWP

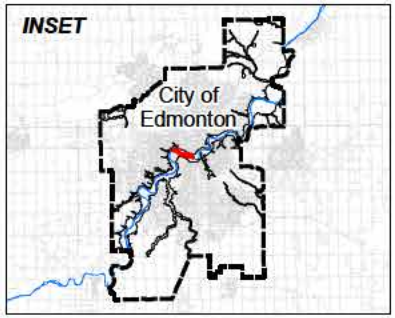


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Flood Hazard Area**

- Floodway
- Flood Fringe

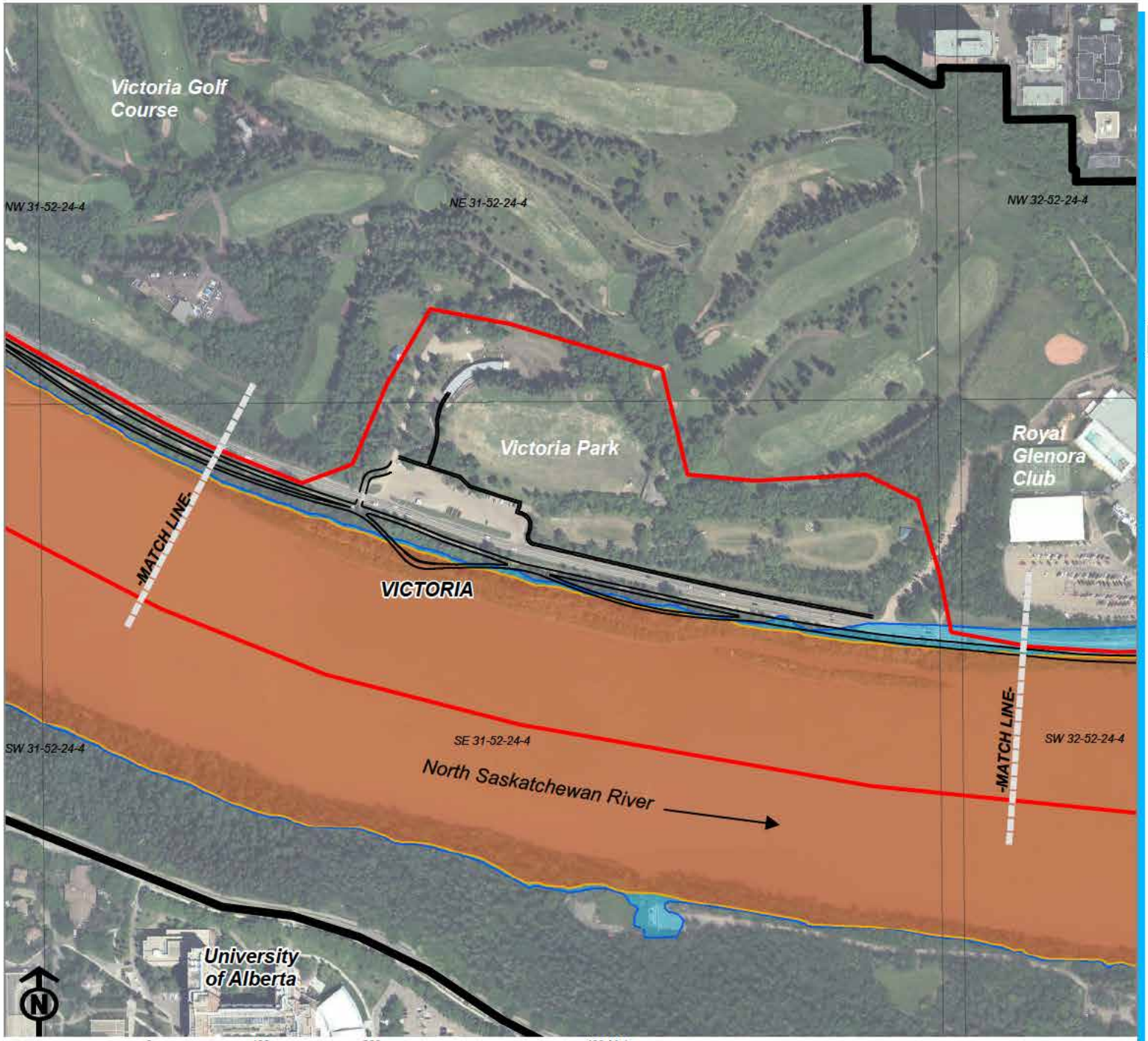


Map Date: 18 June 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**Flood Hazard Mapping (AEP, 2015); Government of Alberta is currently updating the City of Edmonton s flood hazard mapping data so the information presented here could change.

Figure 1c.
Flood Hazard Mapping
North Shore Promenade
TTWP

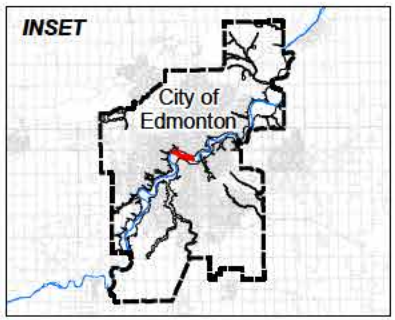


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Flood Hazard Area**

- Floodway
- Flood Fringe

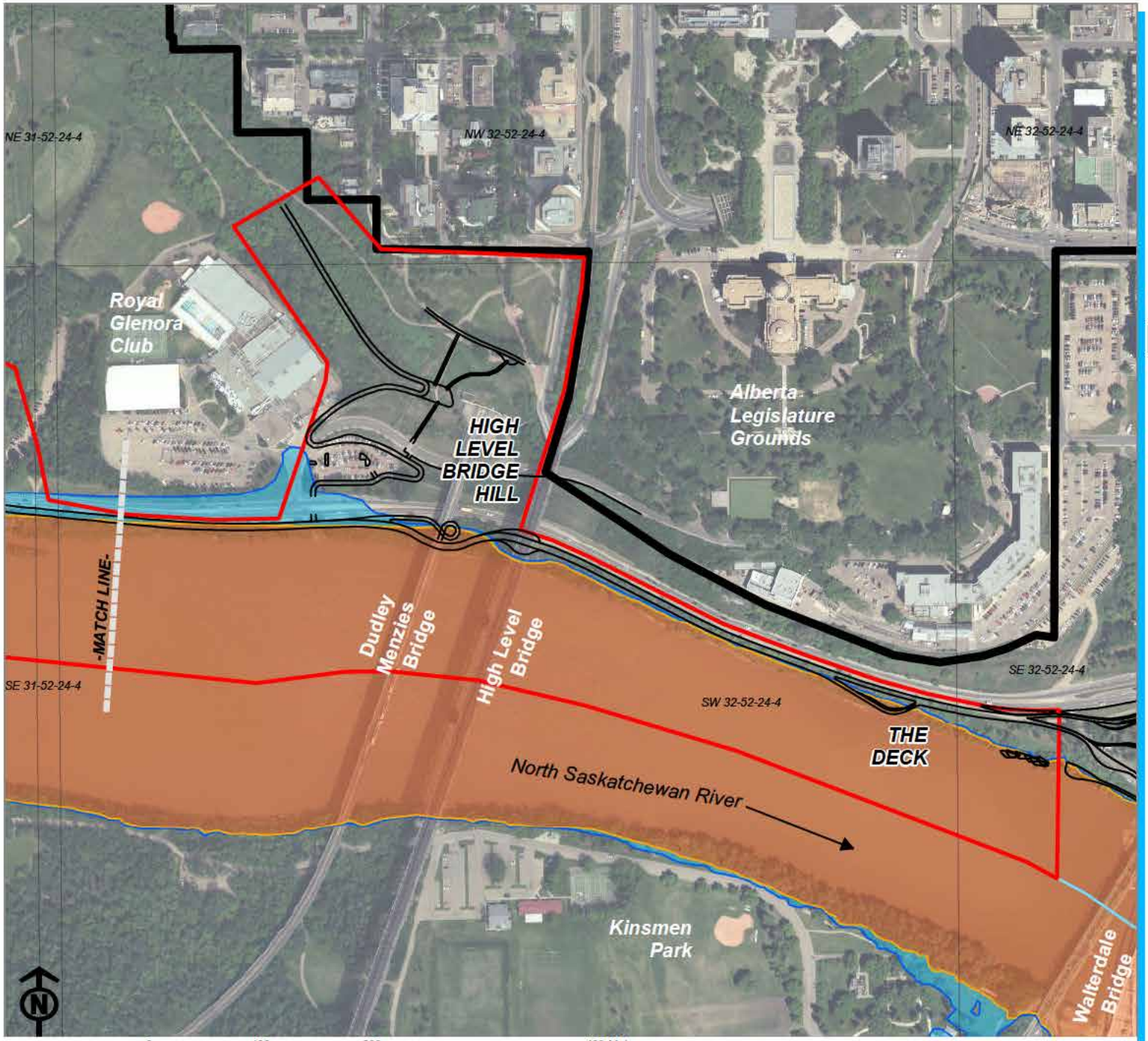


Map Date: 18 June 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**Flood Hazard Mapping (AEP, 2015); Government of Alberta is currently updating the City of Edmonton s flood hazard mapping data so the information presented here could change.

Figure 1d.
Flood Hazard Mapping
North Shore Promenade
TTWP

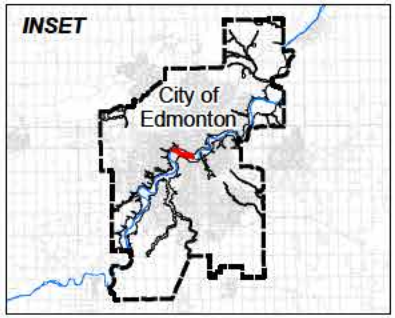


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Flood Hazard Area**

- Floodway
- Flood Fringe



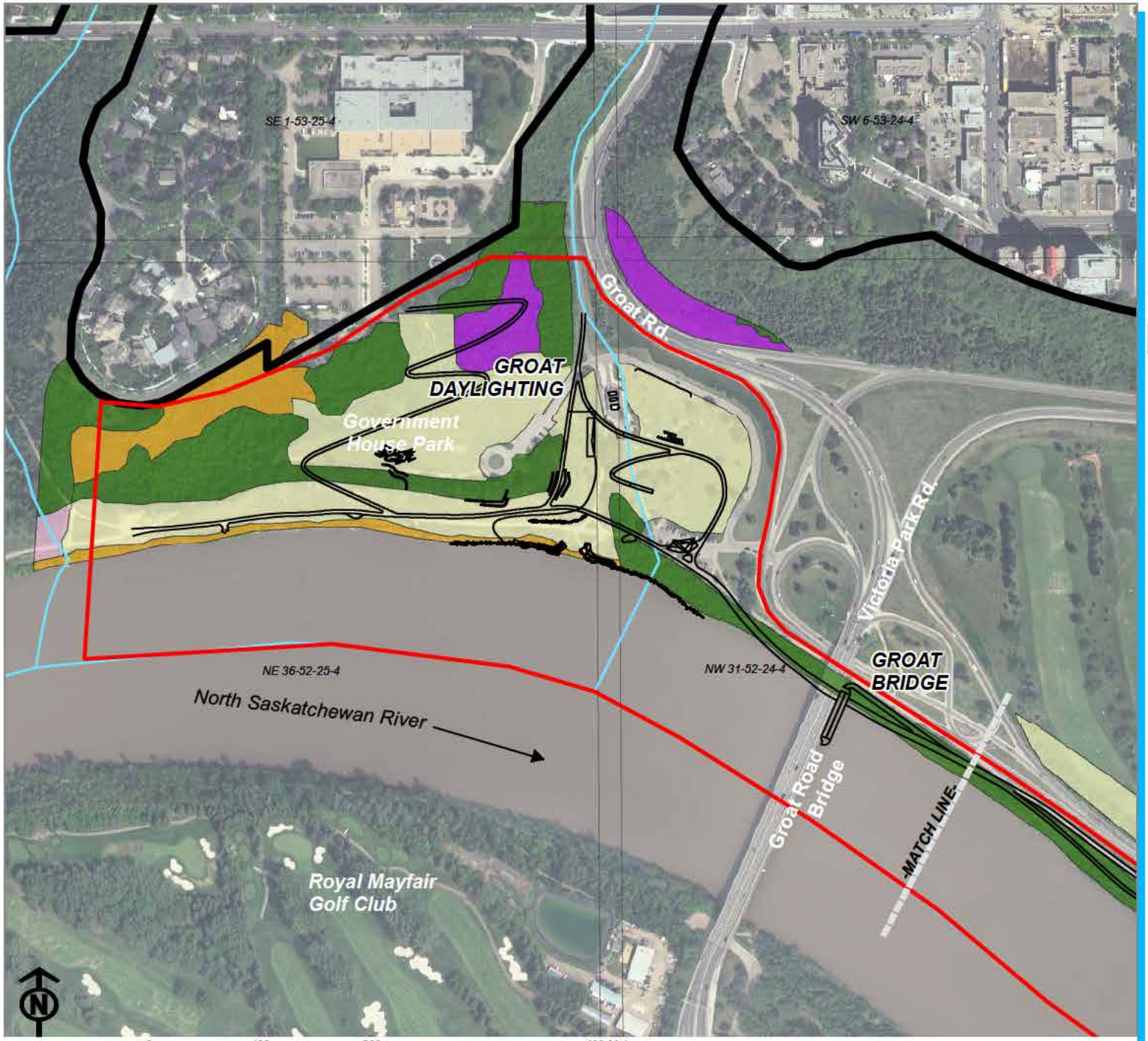
Map Date: 18 June 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**Flood Hazard Mapping (AEP, 2015); Government of Alberta is currently updating the City of Edmonton s flood hazard mapping data so the information presented here could change.

Figure 2a.
Urban Primary Land and Vegetation Inventory (uPLVI)

North Shore Promenade
TTWP

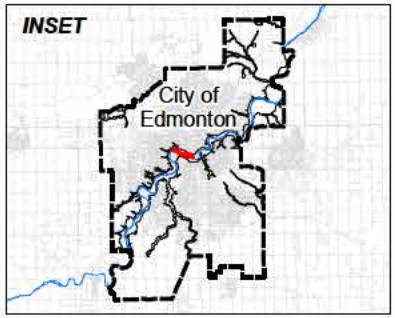


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)***

Urban Primary Land and Vegetation Inventory (uPLVI)**

- Forested
- Transplant Trees
- Medial Shrub
- Open Shrub
- Closed Shrub
- Maintained Grass
- Non maintained Grass/Shrubs



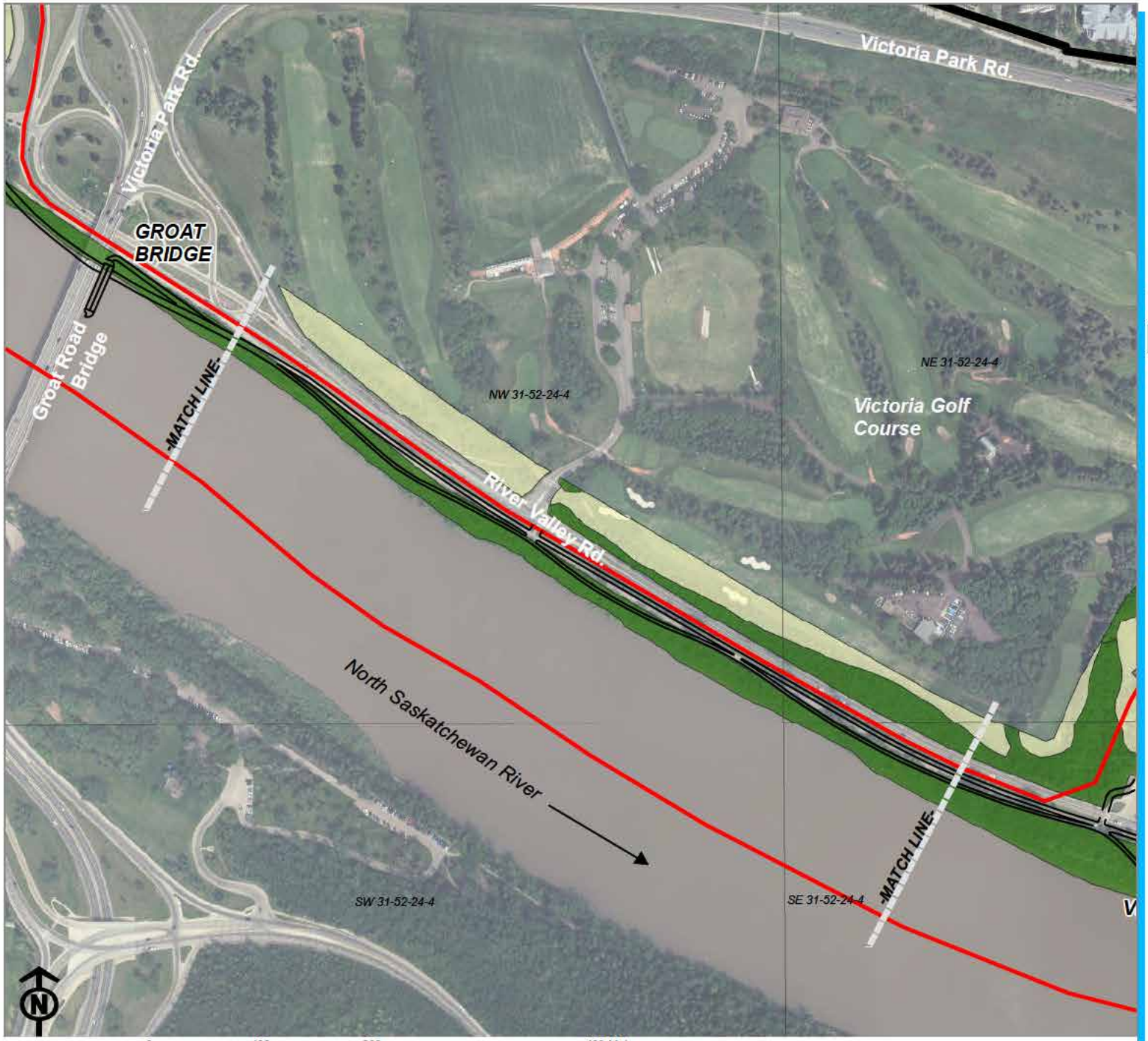
Map Date: 08 July 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**City of Edmonton Urban Primary Land and Vegetation Inventory (uPLVI) (Greenlink Forestry, 2014).
***Note: The watercourse in Groat Ravine is no longer present. Other FMWIS watercourse data may not accurately indicate current conditions.

Figure 2b. Urban Primary Land and Vegetation Inventory (uPLVI)

North Shore Promenade
TTWP

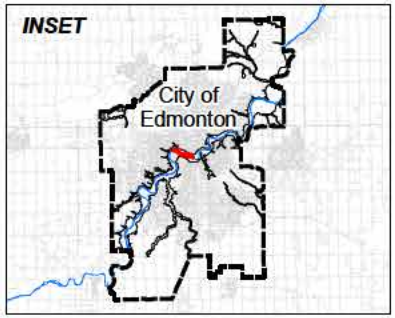


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Urban Primary Land and Vegetation Inventory (uPLVI)**

- Forested
- Transplant Trees
- Medial Shrub
- Open Shrub
- Closed Shrub
- Maintained Grass
- Non maintained Grass/Shrubs



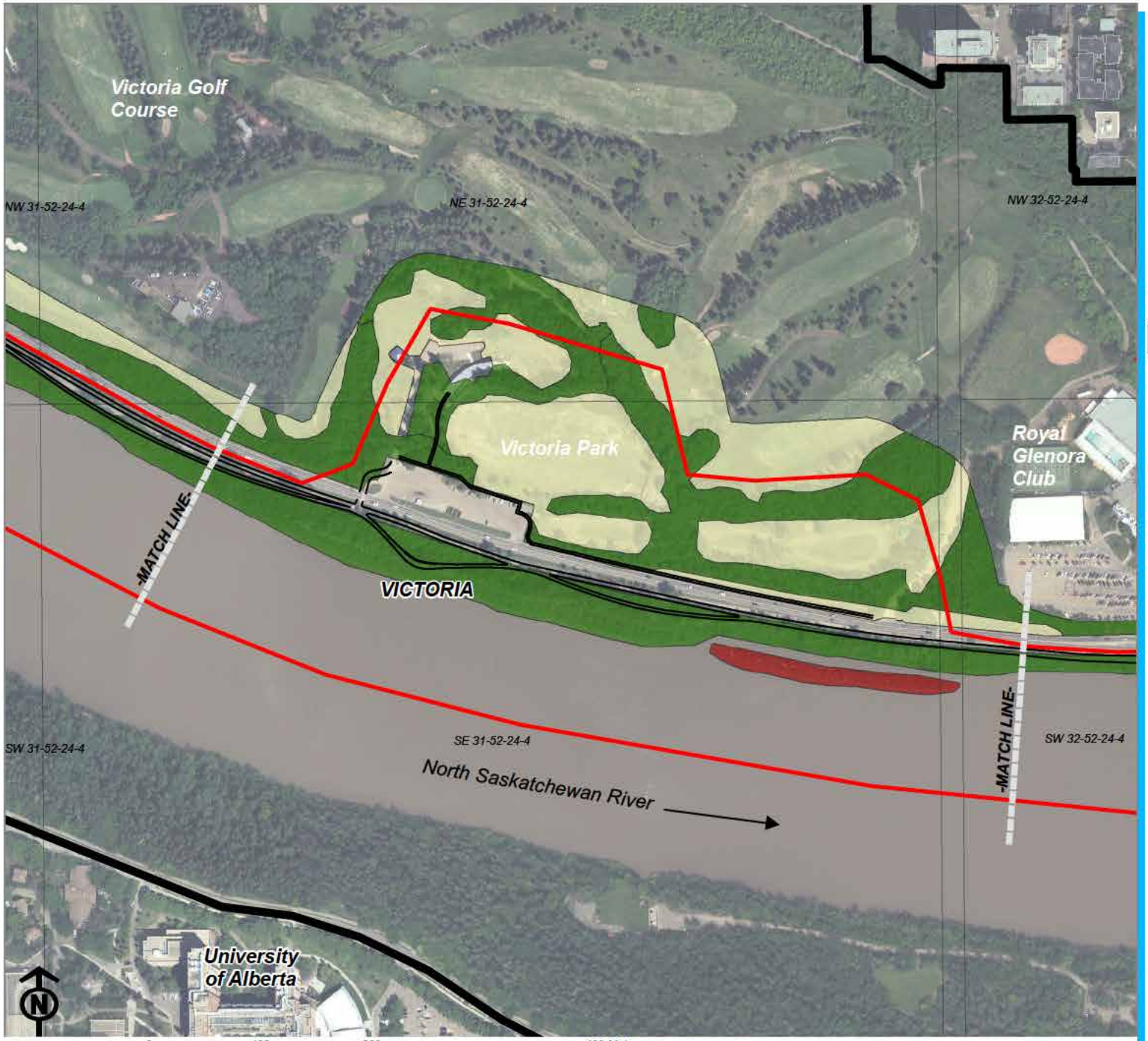
Map Date: 18 June 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**City of Edmonton Urban Primary Land and Vegetation Inventory (uPLVI) (Greenlink Forestry, 2014).

Figure 2c. Urban Primary Land and Vegetation Inventory (uPLVI)

North Shore Promenade
TTWP

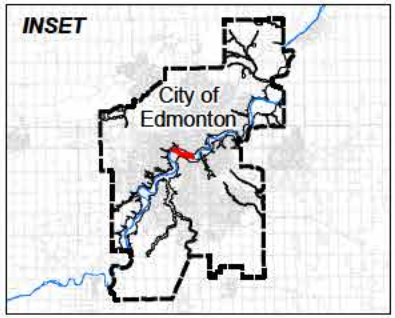


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Urban Primary Land and Vegetation Inventory (uPLVI)**

- Forested
- Transplant Trees
- Medial Shrub
- Open Shrub
- Closed Shrub
- Maintained Grass
- Non maintained Grass/Shrubs



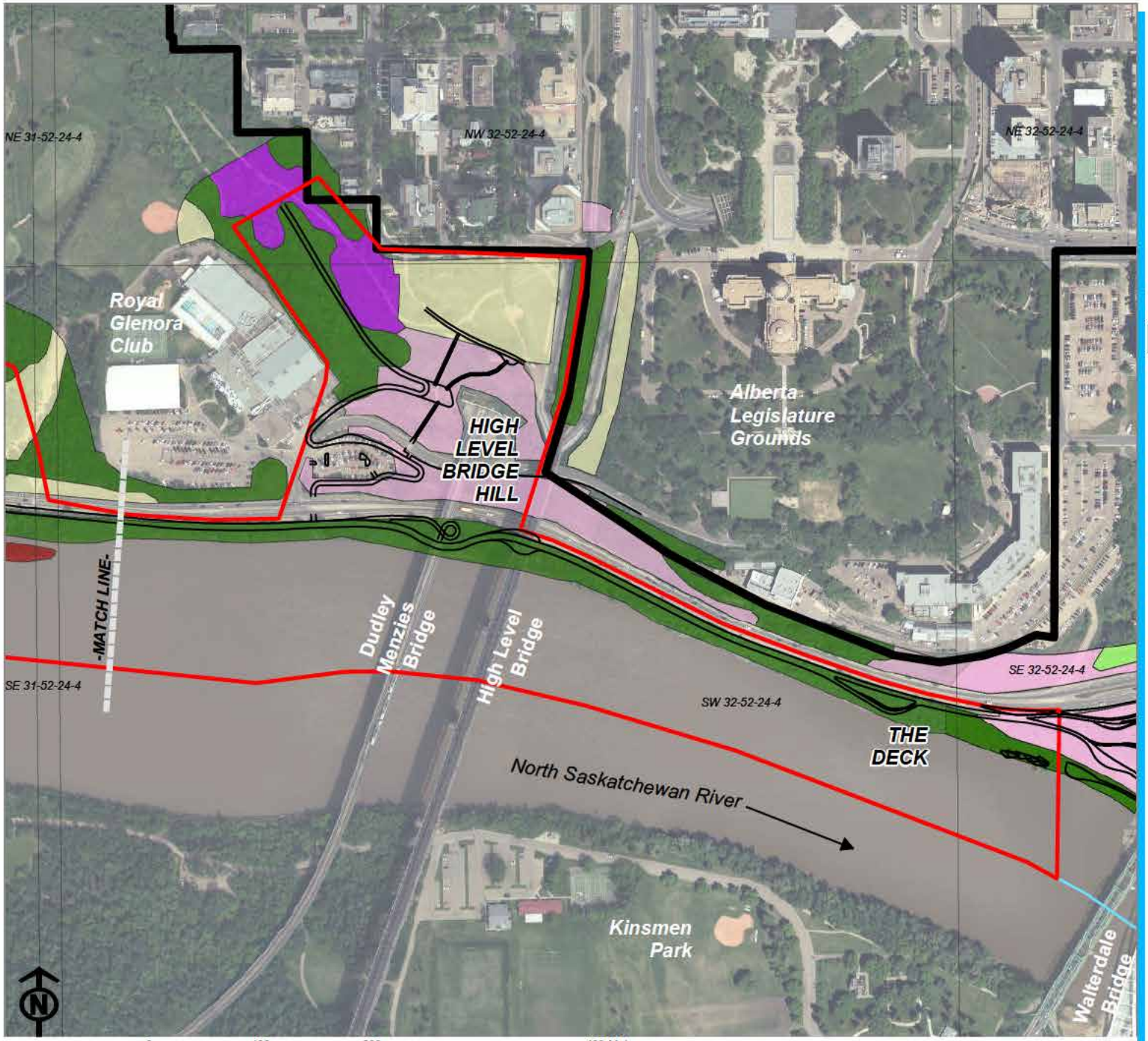
Map Date: 18 June 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**City of Edmonton Urban Primary Land and Vegetation Inventory (uPLVI) (Greenlink Forestry, 2014).

Figure 2d.
Urban Primary Land and Vegetation Inventory (uPLVI)

North Shore Promenade
TTWP

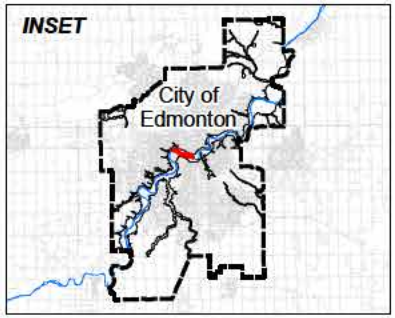


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Urban Primary Land and Vegetation Inventory (uPLVI)**

- Forested
- Transplant Trees
- Medial Shrub
- Open Shrub
- Closed Shrub
- Maintained Grass
- Non maintained Grass/Shrubs



Map Date: 08 July 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**City of Edmonton Urban Primary Land and Vegetation Inventory (uPLVI) (Greenlink Forestry, 2014).

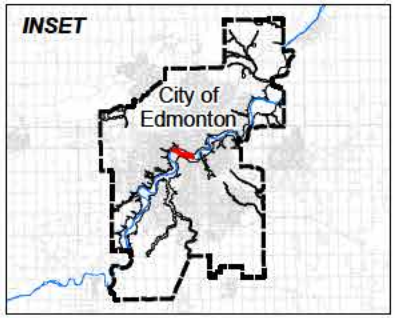
Figure 3a.
City of Edmonton Environmental Sensitivities
North Shore Promenade TTWP

Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)***

Environmental Sensitivity**

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



Map Date: 08 July 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**City of Edmonton Environmental Sensitivity Project (Solstice Canada, 2015).
***Note: The watercourse in Groat Ravine is no longer present. Other FMWIS watercourse data may not accurately indicate current conditions.

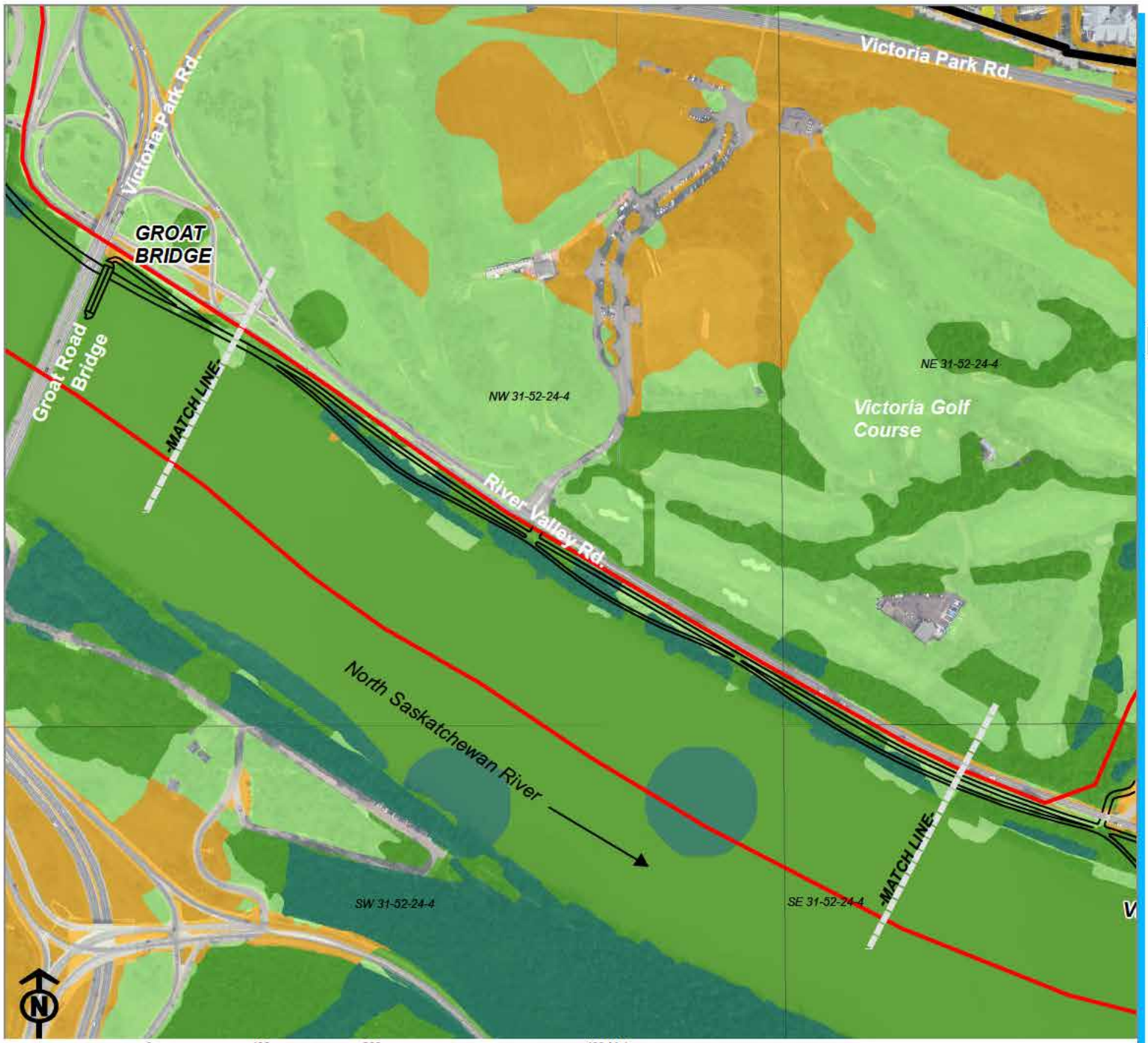


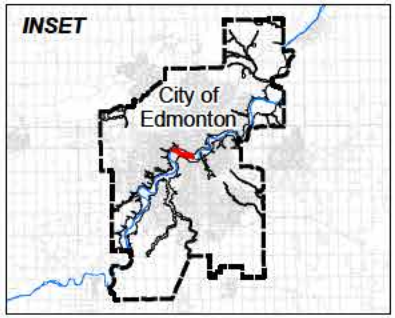
Figure 3b.
City of Edmonton Environmental Sensitivities
North Shore Promenade TTWP

Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Environmental Sensitivity**

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

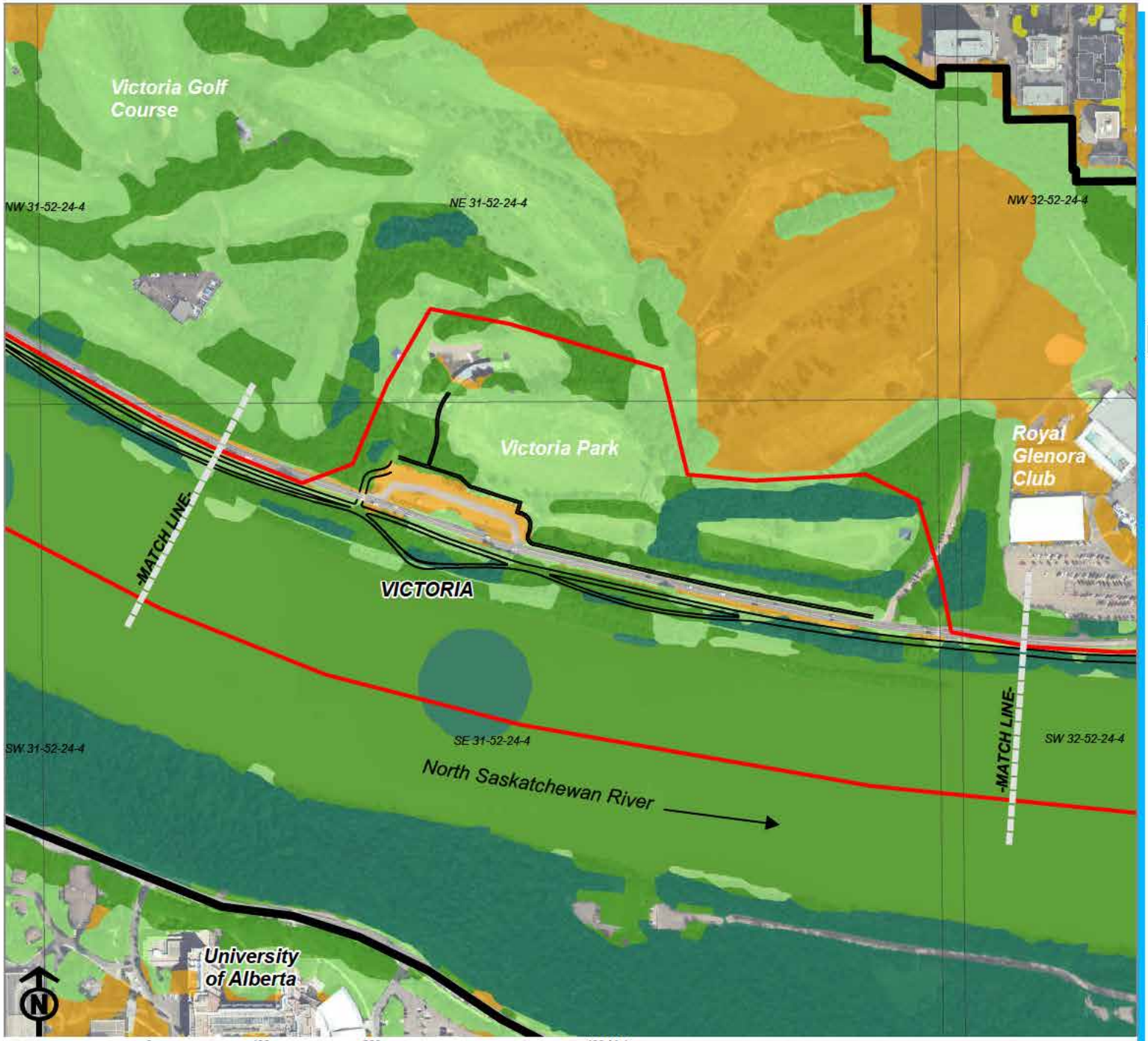


Map Date: 18 June 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**City of Edmonton Environmental Sensitivity Project (Solstice Canada, 2015).

Figure 3c.
City of Edmonton Environmental Sensitivities
North Shore Promenade
TTWP

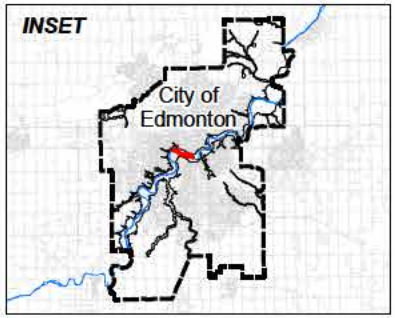


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Environmental Sensitivity**

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

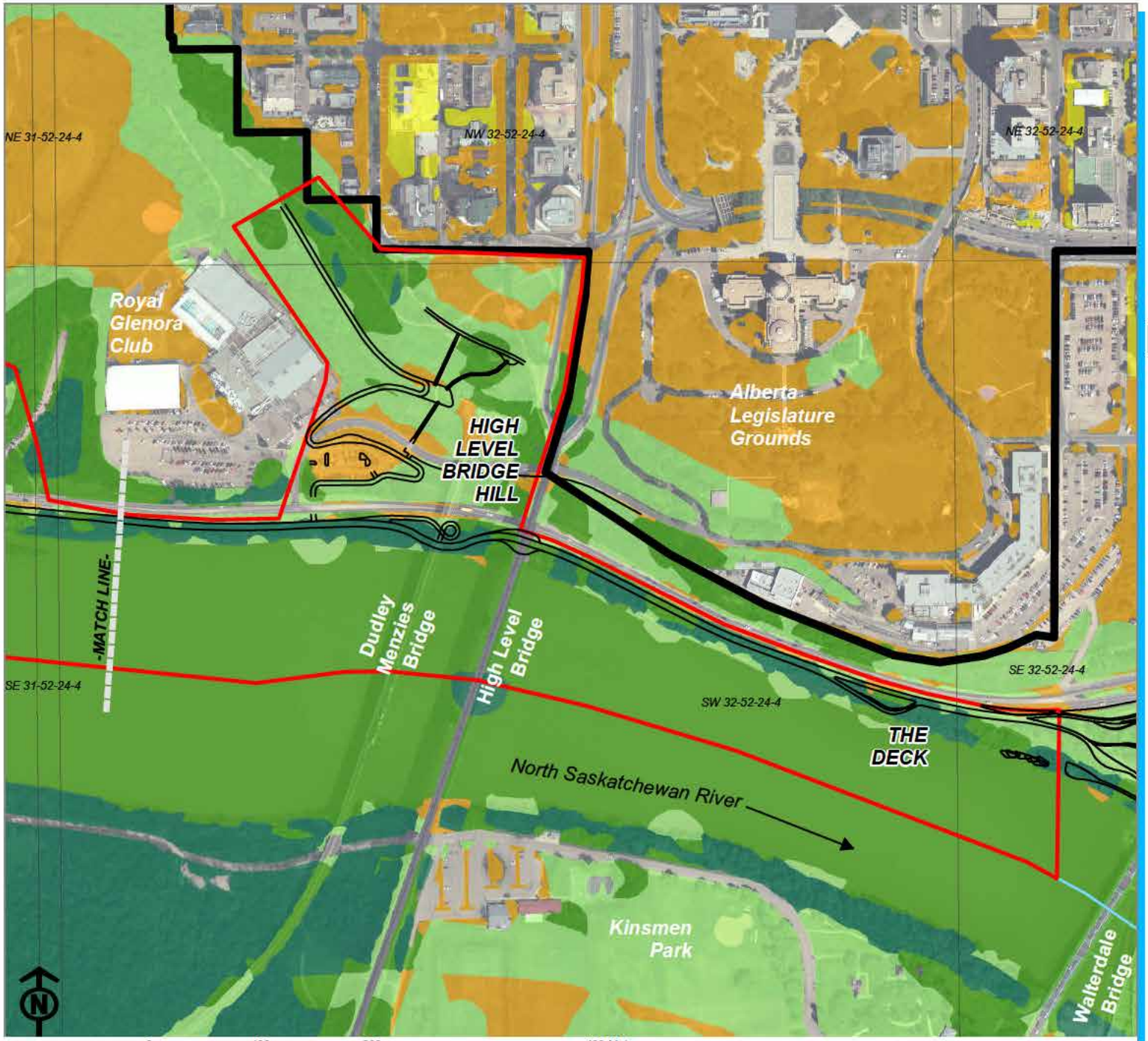


Map Date: 18 June 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**City of Edmonton Environmental Sensitivity Project (Solstice Canada, 2015).

Figure 3d.
City of Edmonton Environmental Sensitivities
North Shore Promenade TTWP

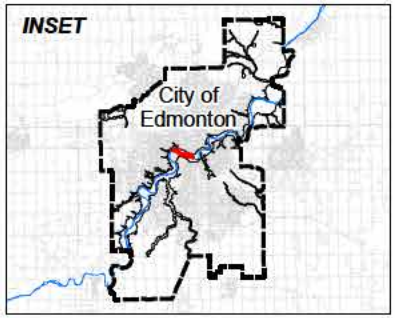


Legend

- Concept Design*
- Project Area
- Bylaw 7188 Boundary (COE, 2010)
- Watercourse (FWMIS, 2018)

Environmental Sensitivity**

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



Map Date: 18 June 2021
Imagery Date: May 2017

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Conceptual design provided by Dub Architects (2021).
**City of Edmonton Environmental Sensitivity Project (Solstice Canada, 2015).

Appendix D: Fisheries Environmental Overview (Kingfisher Aquatics Ltd. 2021)

Kingfisher Aquatics

Touch the Water Promenade Project – North Shore Promenade

Conceptual Design Fisheries Resources Overview

PREPARED FOR:

Spencer Environmental Management Services Ltd.

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List of Acronyms

AEP	Alberta Environment and Parks
ASRD	Alberta Sustainable Resource Development
AESRD	Alberta Environment and Sustainable Resource Development
AT	Alberta Transportation
CoP	Code of Practice
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DFO	Fisheries and Oceans Canada
FSI	Fish Sustainability Index
FWMIS	Fish and Wildlife Management Information System
GoA	Government of Alberta
HADD	Harmful Alteration, Disruption, and Destruction
LRT	Light Rail Transit
LUB	Left Upstream Bank
NAD83	North American Datum 1983
NSR	North Saskatchewan River
QAES	Qualified Aquatic Environment Specialist
RAP	Restricted Activity Period
RUB	Right Upstream Bank
SARA	Species at Risk Act
TWPP	Touch the Water Promenade Project
UTM	Universal Transverse Mercator

1.0 INTRODUCTION

The City of Edmonton (the City) and the River Valley Alliance have proposed the Touch the Water Promenade Project. The TWPP aims to improve public experience and access to and within the North Saskatchewan River valley through the development of a public promenade and accompanying infrastructure along the north bank of the NSR between Government House Park and 94th Avenue NW.

The TWPP is being delivered in accordance with the City's Policy C591 – Capital Project Governance and will be developed in three stages (conceptual design; preliminary design; and detailed design/build implementation). The TWPP is currently in the conceptual design stage which is being led by Dub Architects Ltd. (Dub Architects). Kingfisher Aquatics Ltd (Kingfisher) was retained to provide fisheries expertise for the TWPP.

The TWPP consists of two distinct areas referred to as the North Shore Promenade and the Rossdale Reach. The North Shore Promenade is situated between the Government House Park and the Walterdale Bridge and the Rossdale Reach extends downstream from the Walterdale Bridge to 94th Avenue NW. This document provides a description of existing fisheries conditions, an overview of potential fisheries issues, and an analysis of the preferred concept design for the North Shore Promenade area (the Project).

2.0 PROJECT DESCRIPTION

The Project will involve infrastructure upgrades to existing park facilities and construction of new developments along the north bank (the RUB) of the NSR to improve connectivity to the adjacent park trail systems. Dub Architects has proposed a preferred concept design (Dub and Stoss 2021) through which design objectives will be achieved. Key elements of the design options that will interface with the NSR are described below. A detailed description of all aspects of the proposed Project is provided in the Environmental Overview document (Spencer Environmental 2021).

The preferred concept design includes development of infrastructure at five main areas (as described below) and improvements to the existing trail system at two key locations.

Groat Daylighting

- Located in Government House Park (Figure 1.)
- Involves relocation of the Groat Ravine stormwater system outlet (to an upslope location), upgrades to water treatment facilities, and re-establishment of a Groat Creek confluence with the NSR. The Groat Ravine stormwater system outlet will release flows into a constructed wetland (that will be maintained by a weir system), or routed through a subsurface overflow pipe with an outfall on the NSR (when flows are high). Other project components include upgrades to park pathways, park facilities, construction of two pedestrian bridges over the wetland feature, and installation of tiered platforms (referred to as the Touch the Water Scramble) that would be incorporated into the bank erosion control armouring at the Groat Creek confluence with the NSR.


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FIGURE 1.
Study Area Overview
LEGEND
Project Area
Study Area
Major Roadways
Flow Direction
Class A Habitat
Preferred Concept
Kingfisher Aquatics
107 AVE NW
STONY PLAIN RD NW
GROAT RD NW
102 AVE NW
JASPER AVE NW
104 AVE NW
103A AVE NW
ROWLAND RD NW
VICTORIA RD NW
Groat Bridge
Groat Daylighting
Split Path Promenade
RIVER VALLEY RD NW
Victoria
Combined Path Promenade
NORTH SASKATCHEWAN RIVER
SASKATCHEWAN DR NW
High Level Bridge Hill
The Deck
100 AVE NW
TOSSDALE HILL NW
87 AVE NW
CONNORS RD NW
WALTERDALE HILL NW
ELIZABETH PARK RD NW
QUEEN
Mill Creek Ravine
Kinsmen Park
William Hawrelak Park
Royal Mayfair Golf Club
Victoria Golf Course
Government House Park
Mackinnon Ravine Park
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017, 11 U 333383.57 M E 5934173.84 M N, 16/12/2019.

Groat Bridge

- Located adjacent to the north pier of Groat Bridge (Figure 1.)
- Involves the development of a suspended pathway (near the middle of the bank) that will pass under the Groat Bridge on the south side of the north bridge pier, construction of a ramp that will transition from the existing multi-use pathway up to the pedestrian lane crossing over the NSR on the east side of Groat Bridge, and construction of a staircase that will facilitate access to the suspended pathway from the Groat Bridge pedestrian lane.

Split Path Promenade

- Located between Groat Bridge and the Victoria Park Parking Area (Figure 1.)
- Involves the development of a low-speed pathway along the crest of the upper NSR bank that will be separated from the existing multi-use pathway by a vegetated buffer.

Victoria

- Located adjacent to the Victoria Park Parking Area (Figure 1.)
- Involves the development of an elevated pathway that will extend outward (towards the NSR) from the existing multi-use pathway and will be suspended over the lower part of the NSR bank.

Combined Path Promenade

- Located between the Victoria Park Parking Area and the Dudley B Menzies Bridge (Figure 1.)
- Involves the development of a low-speed pathway immediately adjacent to the existing multi-use trail on the upper bank of the NSR.

High Level Bridge Hill

- Located adjacent the north end of the Dudley B Menzies Bridge (Figure 1.)
- Involves the development of a suspended pathway (that will pass under the Dudley B Menzies Bridge on the south side of the north bridge pier), construction of a plaza and a pathway network (that will extend to Constable Ezio Faraone Park), and development of other park facilities.

The Deck

- Located between the High Level Bridge and the Walterdale Bridge (Figure 1.)
- Involves the development of an elevated platform and seating area that will be suspended over the middle and lower portion of the NSR bank and will be connected to the existing multi-use pathway by stairs and a suspended pathway.

3.0 EXISTING CONDITIONS

3.1 SETTING

The Project is situated on the north bank of the NSR near the centre of the Edmonton metropolitan area. Most of the river valley bottom that immediately borders the Project is green space, including Victoria Park and the Victoria Golf Course to the north and MacKinnon Ravine Park to the west (Figure 1). However, the Rossdale neighborhood, which is located east of the Project, is one of the oldest areas in the City and has been subject to extensive urbanization. Instream developments located within the active channel of the NSR in the vicinity of the Project include:

- the Walterdale Bridge located at the eastern boundary of the Project;
- the High Level Bridge and Dudley B. Menzies LRT Bridge located between the Kinsmen Park and Constable Ezio Faraone Park;
- the Groat Road Bridge located between Government House Park and Emily Murphy Park;
- numerous stormwater outfall structures including the Groat Ravine outfall in Government House Park; and
- two mid-river water intake structures located between Victoria Park and the University of Alberta.

The NSR originates at the Saskatchewan Glacier in the Columbia Icefields and flows over 1000 km from its headwaters to the Alberta – Saskatchewan border. There are two dams on the river that regulate flow; the Bighorn Dam is located on the NSR west of Nordegg and the Brazeau Dam is located on the Brazeau River which is a major tributary to the NSR (ASRD 2008). The NSR channel meanders through the City in an irregular pattern forming point and side bars throughout (Allan 1984). The valley surrounding the Project is generally entrenched with steep valley walls. Urban development in the valley can be extensive in areas where the valley walls have gentler slopes and are stable while steep or unstable portions of the valley appear to be largely undisturbed by anthropogenic activities.

AEP hydrologic unit code designations for the NSR in the vicinity of the Project are as follows:

HUC 2 – #11 – “North Saskatchewan River”

HUC 4 – #1102 – “Middle North Saskatchewan River”

HUC 6 – #110202 – “Whitemud/Blackmud Creeks”

HUC 8 – #11020201 – “North Saskatchewan Below Strawberry”.

3.2 STUDY AREA

The preferred concept design indicates that Project activities will be located within an approximately 3000 metre long section of the NSR, between Government House and the Walterdale Bridge (the Project Area).

A 4650 metre study area was established to assess existing fisheries conditions within the NSR in the vicinity of the Project. The study area encompassed the entire length of the Project, extending from approximately 750 metres upstream to approximately 1000 metres downstream of the Project limits and included a portion of the study area for the TWPP Rossdale Reach Conceptual Design Fisheries Overview (Kingfisher 2021). Figure 1 provides a visual overview of both the Project Area and study area.

3.3 EXISTING INFORMATION REVIEW

The FWMIS was queried to produce a Fish and Wildlife Report for the NSR in the vicinity in of the Project. This report was used to confirm the fish species that are known to occupy the NSR in the vicinity of the Project.

Provincial fisheries management has indicated that contemporary fisheries management objectives for the NSR in vicinity of the Project have not been formalized at this time (Pers. Comm. O. Watkins). Other pertinent literature that was reviewed to assess general conditions and management objectives of the NSR included:

- Fisheries Management Objectives of the North Saskatchewan River (ASRD 2008)
- Alberta Lake Sturgeon Recovery Plan, 2011-2016 (Alberta Lake Sturgeon Recovery Team 2011).
- Sustaining the Recovery of Lake Sturgeon (*Acipenser fulvescens*) in the North Saskatchewan River of Alberta (Watkins 2016)
- Lake Sturgeon Fish Sustainability Index. (AEP 2019a)
- Goldeye Fish Sustainability Index. (AEP 2019b)
- Mooneye Fish Sustainability Index. (AEP 2019c)

3.4 FIELD ASSESSMENT METHODS

Field investigations on the NSR were conducted on October 24 and 25, 2019. The investigations included:

- habitat assessment of a 4650 metre section of the NSR adjacent to the Project which consisted of:
    - large river habitat inventory of the study section; and
    - near-shore (within 30 m of the bank) assessment of water depths, fish cover, and substrates within the Project Area;
- characterization of the river channel profile using a depth sounder along 24 transects that were established perpendicular to the river flow every 200 metres within the study area;
- assessment of streambank conditions of the RUB at each of the 24 transects;
- collection of video and photograph logs of RUB riparian conditions within the study area;

- documentations of anthropogenic alterations and existing infrastructure on the RUB within the study area; and
- in situ measurement of temperature, dissolved oxygen, specific conductivity, pH, and turbidity at one location within the NSR.

Field investigations were conducted following Kingfisher's standard procedures (Appendix A). The procedures were developed to be consistent with the methods described in the Alberta Fish Habitat Manual (AT 2009), which were designed to meet the requirements of the Code of Practice for Watercourse Crossings (AEP 2019d) as well as the information requirements of Fisheries and Oceans Canada (DFO).

3.5 RESULTS

3.5.1 Fish Populations

Since 2000, FWMIS (AEP 2019e) has record of 17 fish species being captured from within the 4650 metres of the NSR that was encompassed by the study area (Table 1, Appendix B). Overall, non-sport fish have been captured in greater numbers than sport species. Species of the Catostomidae family (sucker species) where the most prevalent in the study area but the single most captured species was Walleye, a sport fish.

The FWMIS has records of 24 fish species occupying the NSR within 25 kilometres of the Project (Table 2). Most of the fish species encountered in this section of the NSR are not listed by COSEWIC or the SARA and are considered to be *Secure* under the provincial *Wildlife Act* (Table 2). However, Saskatchewan River populations of lake sturgeon are listed as *Endangered* by COSEWIC (COSEWIC 2006) and are ranked as *Threatened* under the *Wildlife Act* (AEP 2019f). At present, Saskatchewan River lake sturgeon populations are not listed under SARA (SARA Public Registry 2019). Primary limiting factors to lake sturgeon recovery include habitat fragmentation due to dams, poor water quality, overharvesting, and life history characteristics (slow growth and delayed maturity) that reduce population resiliency (ASRD 2002). Sauger and spoonhead sculpin are listed under the *Wildlife Act* as *Sensitive* and *May Be At Risk* respectively; the listings are due to limited information regarding sauger and spoonhead sculpin populations in Alberta (AEP 2019g and AEP 2019h).

Table 1. Historic fish captures from the 4.65 km study section on the NSR.

Species1	Total						
	2009	2010	2013	2016	2017	2018	Total
Burbot		1		4	8	6	19
Emerald Shiner	2	3		58	7	7	77
Goldeye	7			8	9	9	33
Longnose Dace				56	1	9	66
Longnose Sucker		1		43	19	14	77
Mountain Whitefish	18	15		15	11		67
Mooneye		3		8	22	16	49
Northern Pike		2		10	3	2	17
Quil back				5	4	2	11
River Shiner				30			30
Sauger				3	3	10	16
Shorthead Redhorse	6			12	9		27
Spottail Shiner		1		28			29
Trout-perch		2		50	5	15	72
Walleye	1	7		75	38	23	144
White Sucker	3	3		49	24	13	92
Yellow Perch			7				7

1 From FWMIS; does not include species with fewer than 5 individuals captured or records older than 20 years

Table 2. Status and management ranking for fish species found in the NSR within 25 km of the Project.

Fish Species[1]			Status			Provincial Management Priority Ranking[4]
Common Name	Scientific Name	Code	Federal[2]		Provincial[3]	
			COSEWIC	SARA	Wildlife Act	
Brook Stickleback	*Culaea inconstans*	BRST	No Listing	No Status	Secure	5
Burbot	*Lota lota*	BURB	No Listing	No Status	Secure	3
Emerald Shiner	*Notropis atherinoides*	EMSH	No Listing	No Status	Secure	5
Fathead Minnow	*Pimephales promelas*	FTMN	No Listing	No Status	Secure	5
Goldeye	*Hiodon alosoides*	GOLD	No Listing	No Status	Secure	3
Lake Chub	*Couesius plumbeus*	LKCH	No Listing	No Status	Secure	5
Lake Sturgeon	*Acipenser fulvescens*	LKST	Endangered	No Status	Threatened	1
Longnose Dace	*Rhinichthys cataractae*	LNDC	No Listing	No Status	Secure	5
Longnose Sucker	*Catostomus*	LNSC	No Listing	No Status	Secure	4
Mountain Whitefish	*Prosopium williamsoni*	MNWH	No Listing	No Status	Secure	5
Mooneye	*Hiodon tergisus*	MOON	No Listing	No Status	Secure	3
Northern Pike	*Esox lucius*	NRPK	No Listing	No Status	Secure	2
Pearl Dace	*Margariscus margarita*	PRDC	No Listing	No Status	Secure	5
Quil back	*Carpoides cyprinus*	QUIL	No Listing	No Status	Undetermined	4
River Shiner	*Notropis blennius*	RVSH	No Listing	No Status	Secure	5
Sauger	*Stizostedion canadense*	SAUG	No Listing	No Status	Sensitive	3
Shorthead Redhorse	*Moxostoma macrolepidotum*	SHRD	No Listing	No Status	Secure	4
Silver Redhorse	*Moxostoma anisurum*	SLRD	No Listing	No Status	Undetermined	4
Spoonhead Sculpin	*Cottus ricei*	SPSC	Not At Risk	No Status	May Be At Risk	5
Spottail Shiner	*Notropis hudsonius*	SPSH	No Listing	No Status	Secure	5
Trout-perch	*Percopsis omiscomaycus*	TRPR	No Listing	No Status	Secure	5
Walleye	*Sander vitreus*	WALL	No Listing	No Status	Secure	2
White Sucker	*Catostomus commersoni*	WHSC	No Listing	No Status	Secure	4
Yellow Perch	*Perca flavescens*	YLPR	No Listing	No Status	Secure	not listed

1 From FWMIS; does not include species with fewer than 5 individuals captured or records older than 20 years
2 SARA Public Registry 2019
3 AESRD 2015
4 ASRD 2008

Alberta fisheries management (ASRD 2008) has designated several native sportfish species found within the study area as higher management priority (priority ranking 1 to 3, Table 2). These species include:

Burbot

Burbot typically lead a nocturnal, solitary life in the colder parts of large rivers, sheltering under rocks, weed beds, debris, and cut-banks during the day, and foraging at night (McPhail 1997). They are predominantly piscivorous, but they also eat insects, macro-invertebrates, and prey heavily on whitefish eggs in some systems (Nelson and Paetz 1992). The spawning season occurs from mid winter to early spring, often under ice (Nelson and Paetz 1992). In rivers, burbot spawn in low velocity areas in main channels, or in side channels behind depositional bars where water depths are less than two metres (McPhail 1997). The preferred substrate in rivers appears to be fine gravel, sand, or even fine silt; eggs are broadcast into the water column above the streambed but eventually settle into interstices in the substrate (McPhail 1997).

Goldeye

Goldeye diet is relative to the size of individual fish and availability of food types. Food sources consist primarily of aquatic and aerial insects although goldeye will also feed on other fish, zooplankton, and occasionally aquatic tetrapods such as shrews (Nelson and Paetz 1992). They typically spawn in May and/or June often grouping in large schools and migrating to spawning areas from deeper overwintering areas. Spawning generally occurs in pools and backwater areas of higher turbidity (Kennedy and Sprules 1967).

Lake Sturgeon

Adult lake sturgeon are generally found in deeper water (5 m to 10 m) over substrates of mud, clay, sand or gravel. Habitat utilization is low where velocities exceed 0.7 m/s (COSEWIC 2006). Food sources consist of benthic organisms such as clams, snails, insect larvae, some fish, and plant material (Nelson and Paetz 1992). Spawning occurs in the late spring with maturity reached when an individual is about 15 years old and about 90 centimetres in fork length (Watters 1993). Spawning habitats are fast-flowing rocky areas, usually below rapids, or dams. Adults often return to the same spawning sites year after year and undertake long migrations to reach spawning habitat (ASRD 2002).

Mooneye

Mooneye are found in large clear rivers, often in deeper holes with swift currents and firm substrates; they appear to be relatively intolerant of silt and turbid waters (Joynt and Sullivan 2003). Mooneye have similar diets to goldeye, feeding mostly on aquatic invertebrates (Nelson and Paetz 1992). Spawning occurs in the spring from April to June.

Northern Pike

Northern pike prefer relatively shallow, vegetated, clear waters. They typically avoid high velocity habitat and seek outside channels, sloughs, and backwater areas in river systems. Northern pike are largely sedentary and territorial, only moving in and out of deeper water as needed during seasonal changes (Harvey 2009). Using an ambush style of hunting that relies on camouflage in aquatic vegetation, northern pike are predominantly piscivores, but will also eat invertebrates, crustaceans, and tetrapods such as muskrats and ducklings (Harvey 2009). They spawn in the early spring in shallow, marshy areas or flooded vegetation in shallow bays.

Sauger

Sauger can be found in larger, deeper, and more turbid portions of rivers. They feed mostly on bottom-dwelling fishes and aquatic insects, as well as leaches, crayfish and other macroinvertebrates (Nelson and Paetz 1992). Emerald shiners are an important part of the sauger diet during most of the year (Scott and Crossman 1973). Spawning occurs in the spring in variable depths (0.5 m to 3.5 m) where eggs are broadcast over shoals of gravel or rubble (Nelson and Paetz 1992).

Walleye

Walleye are tolerant of a wide range of conditions. In rivers they are found most often in habitats with stable banks and cobble/fines or boulder/gravel substrates where the shoreline is uniform and water velocities are low and where instream cover is limited to roughness and overhead cover is provided by turbidity (Hartman 2009). Walleye feed mostly on fish and aquatic invertebrates (Nelson and Paetz 1992). Spawning occurs in early spring along cobble or gravel reefs with depths of one half metre to one and a half metres. Water velocities at spawning sites can vary but are usually relatively swift. Walleye are broadcast spawners that release eggs into the water column where they fall to the bottom, adhere to the gravel, and sink into interstitial spaces (Scott and Crossman 1973).

3.5.2 Fish Habitat

3.5.2.1 Large River Habitat Inventory

Within the study area, the NSR flowed through a single, unobstructed channel where point and side bar formations were common. While islands and channel braiding are rare in this portion of the NSR, a small island was present in the Project Area along the north bank of the river near Victoria Park. The Project is located in a relatively straight section of the NSR where the channel was quite wide and water depths were relatively shallow. Channel depth profiles from within the study section are provided in Appendix C. The mean wetted width and mean depth across the 24 transects was 180 metres and 1.21 metres, respectively. The channel was narrower and water depths were substantially greater within the large meanders that existed upstream (near Hawrelak Park) and downstream (near the Rossdale Neighborhood) of the Project Area. Through the upstream meander, the thalweg was located near the RUB; it transitioned to the LUB near the Groat Road Bridge before gradually moving back to the RUB between the High Level Bridge and the Walterdale Bridge. Near the downstream end of the study area, the thalwag rapidly shifted to the LUB, along the outside of the downstream meander.

A map delineating fish habitat within the study area is provided on Figures 2A and 2B. A summary of results for the large river habitat inventory is presented in Table 3. The RUB was generally low, gently sloped, and stable throughout the study area. Armoured/stable habitat was predominant along the RUB within the study section and was documented in sections extending upstream and downstream of the Groat Road Bridge and downstream from the High-Level Bridge, past the Rossdale Generating Station. Depositional habitat was also relatively common along the RUB, primarily upstream of the High Level Bridge and near the Rossdale Neighborhood, while erosional habitat along the RUB was rare.

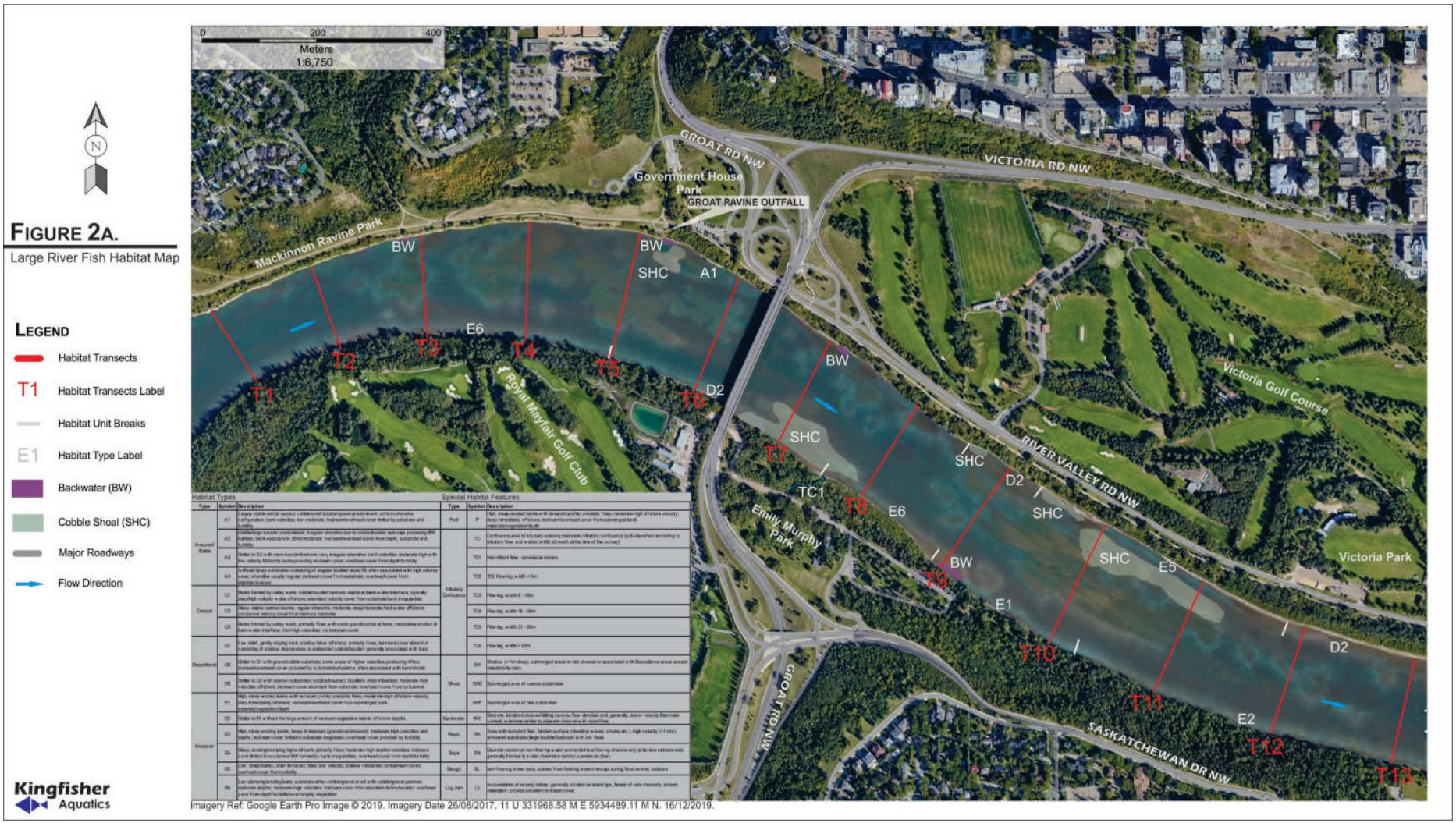
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FIGURE 2A.
Large River Fish Habitat Map
LEGEND
Habitat Transects
T1 Habitat Transects Label
Habitat Unit Breaks
E1 Habitat Type Label
Backwater (BW)
Cobble Shoal (SHC)
Major Roadways
Flow Direction
Kingfisher Aquatics
Mackinnon Ravine Park
Government House Park
GROAT RAVINE OUTFALL
GROAT RD NW
VICTORIA RD NW
Royal Mayfair Golf Club
Victoria Golf Course
RIVER VALLEY RD NW
Emily Murphy Park
Victoria Park
GROAT TRAIL NW
SASKATCHEWAN DR NW
BW
SHC
A1
D2
E1
E2
E5
E6
T1
T2
T3
T4
T5
T6
T7
TC1
T8
T9
T10
T11
T12
T13
Habitat Types
Special Habitat Features
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 11 U 331968.58 M E 5934489.11 M N. 16/12/2019.

FIGURE 2B.
Large River Fish Habitat Map

LEGEND

- Habitat Transects
- T1 Habitat Transects Label
- Habitat Unit Breaks
- E1 Habitat Type Label
- Backwater (BW)
- Cobble Shoal (SHC)
- Major Roadways
- Light Rail Transit
- Flow Direction

Kingfisher Aquatics

Habitat Types

Type	Symbol	Description
Armored Bank	A1	Layers stable and at repose; cobble/small boulder/gravel predominant; uniform armoring 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 substrates; overhead cover from depth/turbidity
Cascade	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 finer with some gravel/cobble at base; moderately eroded at bank-water interface; moderate velocities; no instream cover
Depositional	D1	Low relief, gently sloping bank; shallow fallow 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; increased overhead cover provided by substrate/turbulence; often associated with bank/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
Shoreline	E1	High, steep eroded banks with terraced profile; unstable; fines; moderate-high offshore velocity; deep immediately offshore; instream/overhead cover from submerged bank material/vegetation/depth
	E2	Similar to E1 where the large amount of instream vegetative debris; offshore depths
	E3	High, steep eroding banks; loose fill deposits (gravel/cobble/sand); moderate-high velocities and depths; instream cover limited to substrate roughness; overhead cover provided by turbidity
	E4	Steep, eroding/slumping high-fill bank; primarily fines; moderate-high depths/velocities; instream cover limited to occasional BW formed by bank irregularities; overhead cover from depths/turbidity
	E5	Low, steep banks, often terraced; fines; low velocity; shallow; moderate; no instream cover; overhead cover from turbidity
	W6	Low sloping/eroding bank; substrate often cobble/gravel w/ silt in cobble/gravel patches; moderate depths; moderate-high velocities; instream cover from abundant debris/boulder; overhead cover from depth/turbidity/overhanging vegetation

Special Habitat Features

Type	Symbol	Description
Tributary Confluence	TC	Confluence area of tributary entering mainstem; tributary confluence sub-classified according to tributary flow and whether with or mouth at the time of the survey)
	TC1	Intermittent flow; ephemeral stream
	TC2	TC2 Flow (eg., width < 5m
	TC3	Flow (eg., width 5 - 10m
	TC4	Flow (eg., width 10 - 20m
	TC5	Flow (eg., width 21 - 50m
	TC6	Flow (eg., width > 50m
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 or with more fines
Rapid	RA	Area with turbulent flow; broken surface (standing waves, choke etc.); high velocity (>1 m/s); armoured substrate (large boulder/bedrock) with few fines
Bays	BA	Discrete section of non-flow (eg side connected to a flow (eg. mainstem) 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 inside bends, heads of side channels, stream mouths; provides excellent instream cover

Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 11 U 333836.56 M E 5934165.35 M N. 26/11/2019.

Table 3. Summary of results for large river habitat inventory.

Habitat Unit[1] or Feature[2]	Number of Units		Total Combined Length (m)[3]		Percentage of Bank Length (%)	
	LUB	RUB	LUB	RUB	LUB	RUB
A1	0	3	0	2476	0.0	53.9
A4	2	1	253	241	5.4	5.2
D1	0	2	0	654	0.0	14.2
D2	2	2	717	719	15.2	15.6
E1	3	0	623	0	13.2	0.0
E2	1	0	658	0	14.0	0.0
E4	1	0	1003	0	21.3	0.0
E5	1	1	550	506	11.7	11.0
E6	2	0	908	0	19.3	0.0
BW	1	5	Not Calculated[2]			
SHC	1	6				
Tributaries	1	0				

1 Habitat features are defined in Appendix A
2 Habitat features dimensions were not calculated due to lack of distinct habitat feature boundaries.
3 Lengths derived from habitat map

The LUB was generally low with steep to vertical grades through the upper and middle portions of the study area. Downstream of the Walterdale Bridge, the height of the LUB increased while bank angles remained relatively steep. Bank instability was most apparent at the upstream and downstream end of the study area. Habitat along the LUB was composed primarily of erosional habitat while armoured/stable habitat and depositional habitat was relatively rare.

A variety of more unique habitat features were also present in the upper to middle part of the study area including a lower velocity side channel habitat adjacent to the island, numerous small backwaters associated with streambank irregularities, and several cobble shoals.

3.5.2.2 Streambank and Near-Shore Habitat

A summary of RUB streambank and channel characteristics that were measured at 24 transects within the study area is presented in Appendix D. Bank heights ranged from one to ten metres but were generally between three metres and five metres. Banks were gently sloped throughout the majority of the study section although the banks upstream of the Groat Road Bridge were relatively steep. Bank substrates were composed largely of fine materials but often included boulders that were associated with riprap armouring. Near-shore substrates were composed primarily of cobble and boulder although the prevalence of fine substrates increased with downstream direction.

Near-shore (within 30 m of the bank) water depths generally ranged from zero to one metre. Transitions in depth were most abrupt in the upper and lower portions of the study sections (near the Groat Bridge and Walterdale Bridge). In these areas, water depths typically exceeded one metre within a few metres of the shore. Water depths were comparatively shallower through the middle portion of the study area. The side channel adjacent to the island was composed almost entirely of shallow (<0.5 m) run habitat interspersed with short riffles. A small area near the upstream end of the side channel did exceed a half metre in depth but no area was deeper than one metre. Detailed maps of the near-shore conditions are presented in a series of figures in Appendix E.

Bank were generally stable within the study area although areas of minor instability were evident at certain locations. Riparian vegetation composition and density varied widely throughout the study area. Riparian vegetation was sparse upstream of the Groat Road Bridge; grass was predominant although there were a few small trees within the concrete rubble riprap immediately adjacent to the NSR. A largely contiguous, narrow band of mature trees and shrub undergrowth existed downstream of the Groat Road Bridge. The band of vegetation widened with downstream direction and was approximately 50 metres wide near the Victoria Park parking lot. Downstream of the island, the riparian margin narrowed but remained largely unbroken until the area under the Walterdale Bridge, which had been armoured with riprap and was nearly devoid of vegetation. A narrow, intermittent band of vegetation was present between the existing pathway and the NSR downstream of the bridge. Anthropogenic influences including numerous outfalls and infrastructure associated with the Rossdale Generating Station were prevalent in this section; mature trees were rare and there were several exposed or partially vegetated areas. Further downstream, riparian coverage increased with trees and shrubs predominant.

Anthropogenic alterations to the bank were evident throughout the study section. In general, these disturbances were concentrated in the upper and lower ends of the study area. The concrete riprap armouring along MacKinnon Ravine Park and Government House Park, the Groat Road Bridge north pier and abutment, the Walterdale Bridge riprap apron, the two pumphouses, and the Edmonton Fire and Rescue boat launch were the most significant disturbances identified in addition to 46 outfall structures that were located throughout the study section. Anthropogenic alterations are mapped on figures provided in Appendix E and photographs showing bank conditions at each transect are provided in Appendix F.

3.5.3 Water Quality

In situ water quality was measured at one location within the NSR (Table 4).

Table 4. In *situ* water quality from the NSR (October 24, 2019).

Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)	Temperature (^{o}C)	Specific Conductivity (µS/cm)	Discharge * (m^3/s)
11.3	8.3	3.33	4.5 @ 16:30	432	154.1

*Retrieved from the Alberta River Basins application (GoA 2019)

3.6 SUMMARY

3.6.1 Existing Conditions

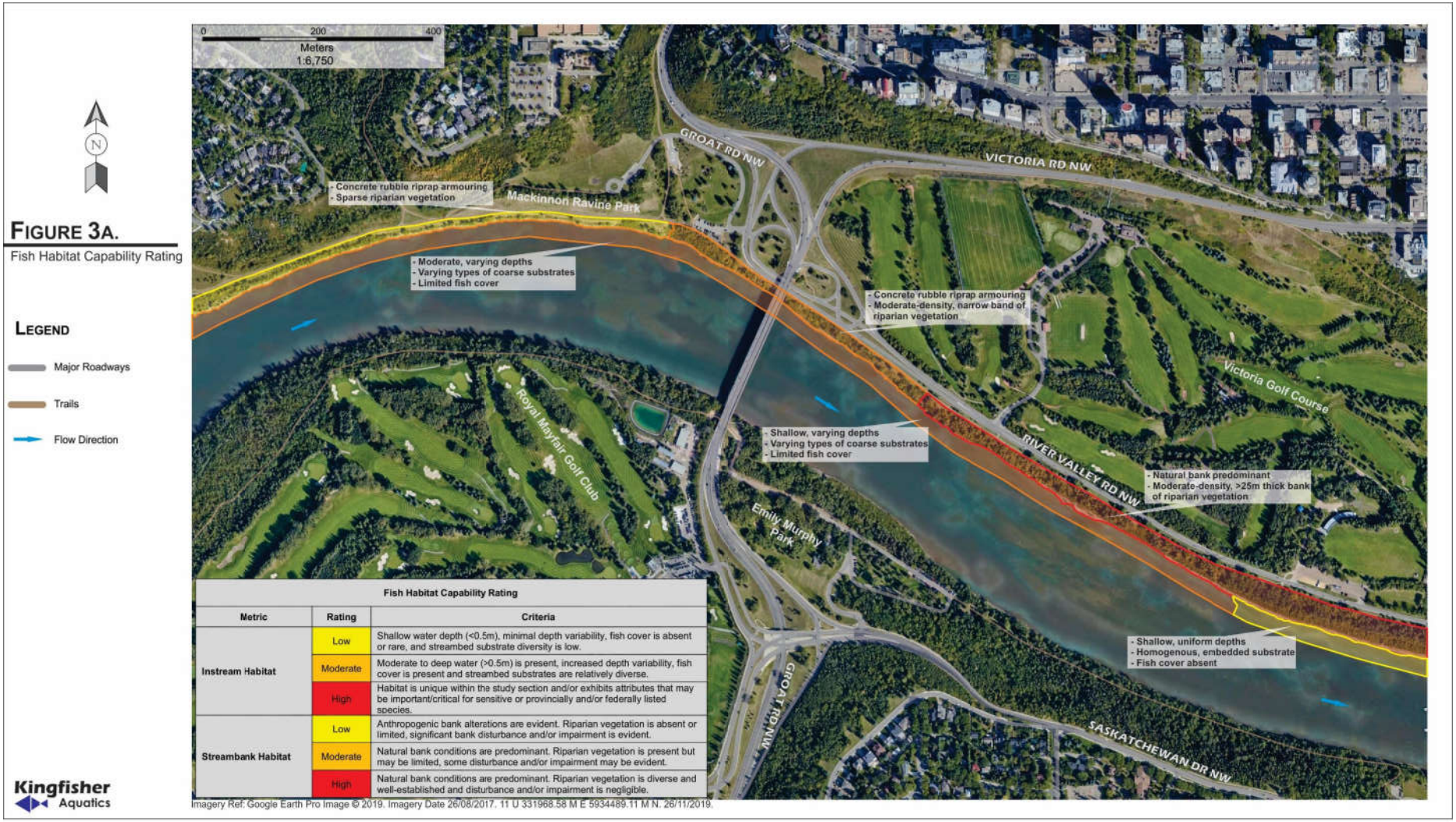
The majority of instream habitat within the study area was rated as moderate capability habitat (Figure 3). This habitat was typified as having shallow to moderate water depths with relatively diverse substrates while fish cover was generally limited. Extremely shallow and homogenous water depths and a lack of substrate diversity were the primary limiting factor associated with the low capability habitat identified in the centre of the study section. The side channel was rated as high capability habitat due to its relative rarity within the study section. Overall, no major limiting factors were identified, and the habitat appeared capable of supporting a wide variety of fish species. While the side channel was considered a unique habitat feature and likely provides high value rearing habitat for a variety of species, no habitat attributes were present that would be considered important or critical for sensitive or federally and/or provincially listed species.

Streambank habitat capability was assessed based on streambank conditions and the level of disturbance (i.e. changes to natural form and function of the streambank). The streambanks at the upstream and downstream ends of the study area have been subject to substantial disturbance (i.e. riprap, outfalls, buildings) and were considered to have low habitat capability while the streambanks in the middle of the study area were considered to have moderate to high habitat capability based on a low level of disturbance and the presence of a diverse and mature riparian vegetation community (Figure 3).

Historical capture data indicated that the reach of the NSR in the vicinity of the Project is inhabited by a diverse assemblage of sport, coarse and forage fish species. The frequency and extent of the habitat use is dependant on the life cycle stage and specific habitat requirements of each species. The study area included slow velocity, moderate depth holding habitat that was suitable for larger-bodied fish species as well as moderate velocity, low depth areas with relatively clean substrates that could provide preferential feeding habitat for species that target benthic invertebrates (e.g. mountain whitefish and mooneye) and/or suitable spawning and rearing habitat for species requiring coarse substrates.

Most forage fish species known to inhabit the study area can be considered generalists that are able to tolerate a wide variety of environmental conditions. Most of these species probably occupy the study section on a year-round basis, likely inhabiting slower moving waters along the river margins, along armouring, within the island side channel, and in backwater areas. Sucker species have been captured relatively frequently and likely occupy the area on a year-round basis for all life cycle phases. Goldeye, mooneye, mountain whitefish, and walleye have been captured from the study area more frequently and in greater numbers compared to other sport fish species that appear to use the area sporadically, and on a limited basis. While burbot capture numbers have been low, the relative abundance of coarse substrates and boulder cover along armoured banks offered moderate to high quality habitat for this species. Lake sturgeon have been found in the area but an overall lack of deep water (>4 m) and suitable spawning habitat suggests that they primarily use the habitat for migration. Preferential northern pike habitat, which is closely associated with dense aquatic vegetation and low flow velocity habitat that is often provided by snyes, backwaters and oxbow channels in large river settings, was rare within the study section.

Most forage and coarse fish species previously captured in the study area likely utilize the area for overwintering, feeding, migration, and rearing. Similarly, the most frequently encountered sportfish species may also be capable of fulfilling most of their life history requirements within or near the study area. Spawning habitat for a variety of cool-water species requiring coarse substrates was available in the study area while spawning habitat for species requiring aquatic vegetation was virtually nonexistent.



Fish Habitat Capability Rating

Metric	Rating	Criteria
Instream Habitat	Low	Shallow water depth (<0.5m), minimal depth variability, fish cover is absent or rare, and streambed substrate diversity is low.
	Moderate	Moderate to deep water (>0.5m) is present, increased depth variability, fish cover is present and streambed substrates are relatively diverse.
	High	Habitat is unique within the study section and/or exhibits attributes that may be important/critical for sensitive or provincially and/or federally listed species.
Streambank Habitat	Low	Anthropogenic bank alterations are evident. Riparian vegetation is absent or limited, significant bank disturbance and/or impairment is evident.
	Moderate	Natural bank conditions are predominant. Riparian vegetation is present but may be limited, some disturbance and/or impairment may be evident.
	High	Natural bank conditions are predominant. Riparian vegetation is diverse and well-established and disturbance and/or impairment is negligible.

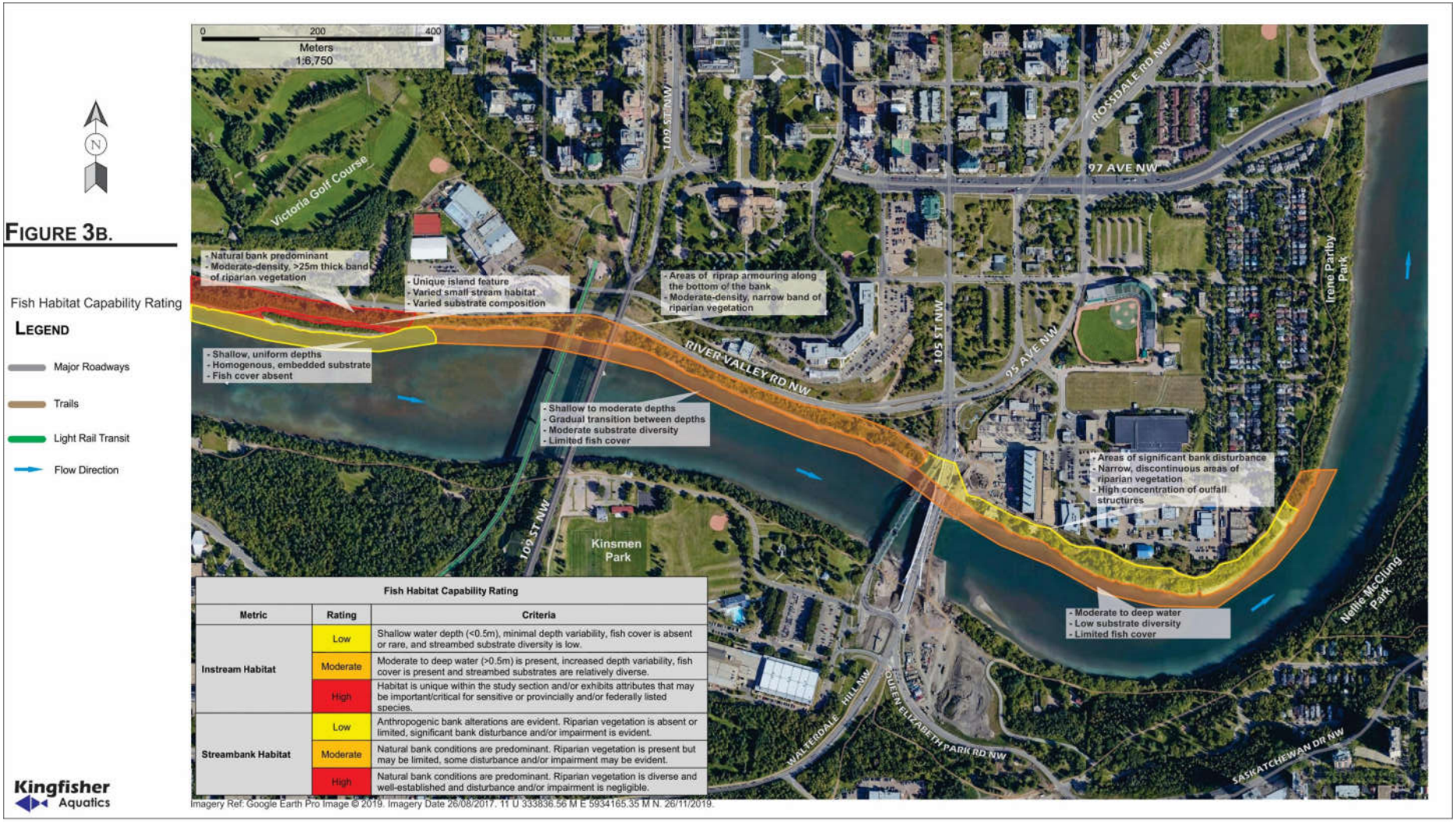


FIGURE 3B.

Fish Habitat Capability Rating

LEGEND

- Major Roadways
- Trails
- Light Rail Transit
- Flow Direction

Fish Habitat Capability Rating

Metric	Rating	Criteria
Instream Habitat	Low	Shallow water depth (<0.5m), minimal depth variability, fish cover is absent or rare, and streambed substrate diversity is low.
	Moderate	Moderate to deep water (>0.5m) is present, increased depth variability, fish cover is present and streambed substrates are relatively diverse.
	High	Habitat is unique within the study section and/or exhibits attributes that may be important/critical for sensitive or provincially and/or federally listed species.
Streambank Habitat	Low	Anthropogenic bank alterations are evident. Riparian vegetation is absent or limited, significant bank disturbance and/or impairment is evident.
	Moderate	Natural bank conditions are predominant. Riparian vegetation is present but may be limited, some disturbance and/or impairment may be evident.
	High	Natural bank conditions are predominant. Riparian vegetation is diverse and well-established and disturbance and/or impairment is negligible.

Kingfisher Aquatics

3.6.2 Fisheries Management Considerations

Fish Sustainability Index assessments have been completed for three of the species found within NSR in Edmonton. The FSI assessment detail provincial priorities and objectives to recover populations. There are also other species residing within the vicinity of the Project that have been identified as priority FSI species; however, provincial assessments of these species have not been completed. These include river populations of northern pike and walleye, burbot, mountain whitefish, and sauger.

Lake Sturgeon *(from AEP 2019a)*

The historic adult density of lake sturgeon in this section of the NSR was high, and although populations are slowly increasing from critically low populations, current adult density is listed as very low. The main threats to the recovery of lake sturgeon are overfishing and poor river water quality in the past century, particularly in the NSR. Improved sewage treatment and catch-and-release fishing have been key to initiating species recovery efforts. However, dams on the Saskatchewan River system and long-term population declines have effectively isolated two populations of lake sturgeon, adding to the difficulty of recovery and species conservation efforts. In addition, lake sturgeon are very long-lived (100+ years in some cases and slow to mature) which means impacts to the population from overfishing and harvest pressure can be very severe. AEP has listed the need for habitat protection in this section of the NSR as moderate, and the need for protection from overharvest as very high.

Goldeye *(from AEP 2019b)*

The current FSI adult density of goldeye is listed as moderate, while historic adult density in the region was very high. Goldeye have been generally declining in Alberta due to three main threats. Poor water quality, and low dissolved oxygen resulting from nutrient run-off from intensive agricultural land use, resulted in major population declines in the Battle River. Changes to natural river flows due to major dams may have caused declines in the Peace-Athabasca populations and overfishing may have adversely affected local populations near the cities of Edmonton and Red Deer. Improved monitoring efforts, and a better understanding of the effects that dams, water use, and land use along large rivers have on these fish will be necessary for species recovery. The need for habitat protection in this section of the NSR is moderate, while the need for overharvest protection in the NSR drainage is considered very high.

Mooneye *(from AEP 2019c)*

Historically, mooneye adult density in the NSR has been low. Mooneye are a relatively recent arrival in Alberta rivers; the first report in Alberta was in the 1970's (Roberts 1974). Dams located near the headwaters of mainstem rivers like the NSR may have resulted in habitat changes that supported mooneye such as reduced glacial silt and decreased summer flows that allowed Mooneye to expand their range into most of the rivers in the Saskatchewan River system. Recently, there is some indication that mooneye numbers have been increasing; however, they are commonly misidentified for goldeye and monitoring for both species has been inconsistent, so conclusions are relatively uncertain. The largest threats to the sustainability of mooneye are poor water quality, particularly reduced dissolved oxygen from nutrient run-off, and dams that block migrations. To recover populations of mooneye, increased monitoring efforts, a better understanding of how land and river uses affects the fish, and an evaluation of current fishing regulations will be necessary. Habitat protection need in the area is moderate, and overfishing protection need is very high.

4.0 OVERVIEW OF POTENTIAL FISHERIES CONCERNS

4.1 FISH AND FISH HABITAT SENSITIVITIES

Fish sensitivity to perturbation/disturbance can be broadly defined as fish tolerance or adaptability to changes in environmental conditions (i.e. sediment concentrations, water temperature, dissolved oxygen, nutrient levels, etc.). Species have varying tolerance to environmental stressors but can be broadly categorized into three designations identified by Barbour *et al.* (1999) and described below.

Intolerant – Species that are sensitive to environmental or anthropogenic stresses.

Intermediate – Species that are neither particularly sensitive nor insensitive to environmental or anthropogenic stresses.

Tolerant – Species that are fairly insensitive or adaptive to environmental or anthropogenic stresses.

Tolerance designations for individual species can vary depending on local conditions and professional judgements. Table 5 provides a summary of tolerance designations for the fish species known to inhabit the NSR near the City of Edmonton.

As described in Section 3.6.1, most of the instream habitat within the study section was rated as moderate capability. While a wide range of fish species are known to occupy the Project Area throughout the year and the island side channel was judged to provided high quality rearing habitat for multiple species, the local habitat was not considered critical or important to the viability of these species. The majority of the NSR in the vicinity of the Project is designated as a Class C waterbody (AESRD 2012). Class C habitat is defined as moderate sensitivity habitat that is broadly distributed and is sensitive enough to be potentially damaged by unconfined or unrestricted activities within a waterbody (Alberta Environment 2000). Class A habitat, which is considered to have high sensitivity (Alberta Environment 2000), is also present at several locations along the NSR within the City of Edmonton. This designation was established to protect localized deep-water habitat (generally >4 m depth) that has been identified as preferential habitat for lake sturgeon (AESRD 2012). The nearest Class A habitat to the Project is located approximately 3500 metres downstream of the Project Area.

Table 5. Tolerance designations for fish known to inhabit the NSR near the City of Edmonton.

Designation	Species	Basis/Source
Intolerant	Goldeye	➢ Barbour *et al.* 1999
	Lake Sturgeon	➢ Professional judgement based on provincial and federal status.
	Mountain Whitefish	➢ Barbour *et al.* 1999
	Mooneye	➢ Barbour *et al.* 1999
	Sauger	➢ Professional judgement based on provincial status.
Intermediate	Brook Stickleback	➢ Barbour *et al.* 1999
	Burbot	➢ Barbour *et al.* 1999
	Emerald Shiner	➢ Barbour *et al.* 1999
	Lake Chub	➢ Barbour *et al.* 1999
	Longnose Dace	➢ Halliwell *et al.* 1999 (as cited in Grabarkiewicz and Davis 2008) ➢ Professional judgement
	Longnose Sucker	➢ Barbour *et al.* 1999
	Northern Pike	➢ Halliwell *et al.* 1999 (as cited in Grabarkiewicz and Davis 2008) ➢ Barbour *et al.* 1999
	Pearl Dace	➢ Barbour *et al.* 1999
	Quillback	➢ Barbour *et al.* 1999
	River Shiner	➢ Barbour *et al.* 1999
	Shorthead Redhorse	➢ Halliwell *et al.* 1999 (as cited in Grabarkiewicz and Davis 2008) ➢ Barbour *et al.* 1999
	Silver Redhorse	➢ Halliwell *et al.* 1999 (as cited in Grabarkiewicz and Davis 2008) ➢ Barbour *et al.* 1999
	Spoonhead Sculpin	➢ Barbour *et al.* 1999
	Spottail Shiner	➢ Barbour *et al.* 1999
	Trout-perch	➢ Barbour *et al.* 1999
	Walleye	➢ Halliwell *et al.* 1999 (as cited in Grabarkiewicz and Davis 2008) ➢ Barbour *et al.* 1999
	Yellow Perch	➢ Halliwell *et al.* 1999 (as cited in Grabarkiewicz and Davis 2008) ➢ Barbour *et al.* 1999
Tolerant	Fathead Minnow	➢ Halliwell *et al.* 1999 (as cited in Grabarkiewicz and Davis 2008) ➢ Barbour *et al.* 1999
	White Sucker	➢ Halliwell *et al.* 1999 (as cited in Grabarkiewicz and Davis 2008) ➢ Barbour *et al.* 1999

4.2 POTENTIAL ISSUES

The construction of infrastructure within or near waterbodies has potential to affect aquatic resources through multiple impact pathways. Based on conceptual plans, potential impacts associated with the Project can be grouped into the five key categories described in Table 6.

Table 6. Description of potential aquatic impact pathways associated with the preferred concept.

Impact Category		Potential Effect
Water Quality	Erosion and Sediment	➢ Reduction in habitat quality ➢ Decreased food production (i.e. impacts to lower trophic resources) ➢ Reduced fish health and/or increased fish mortality ➢ Mortality of fish eggs
	Chemical Contaminants	➢ Reduced fish health and/or increased fish mortality
Direct Fish Mortality	Instream Construction Project Operation	➢ Fish entrapment, impingement, entrainment which can result in fish mortality
	Increased Angling Pressure	➢ Increased exploitation of the resource
Direct Habitat Impacts	Instream Construction Riparian Disturbance	➢ Reduction in habitat availability ➢ Reduction in habitat quality
Fish Disturbance	Instream Construction	➢ Interference with fish movements due to temporary or permanent infrastructure that alters flow patterns and/or water velocities
	Boating Activity	➢ Reduction in habitat quality ➢ Reduced fish health and/or increased fish mortality.
Invasive Species	Instream Construction	➢ Reduction in habitat quality ➢ Increase in fish mortality

Kingfisher reviewed the preferred concept design to assess potential Project interactions with fish and fish habitat (Table 7).

Table 7. Summary of potential impacts associated with the preferred concept.

Impact Category		Impact Description
Water Quality	Erosion and Sediment Chemical Contaminants	➢ Project activities conducted instream or adjacent to the NSR have potential to result in sediment and/or chemical contaminants (i.e. hydrocarbons from equipment) being mobilized into the NSR. • In general, instream and lower bank riparian disturbances are localized around the Groat Daylighting site. These potential disturbances are expected to be relatively intensive but represent a relatively small footprint (≤ 10% of the length of the Project Area). • Upgrades to the Groat Ravine stormwater system water treatment facilities could reduce point-source pollution into the NSR. • The Groat Bridge development would likely result in localized disturbances to the lower and middle bank around the north pier of the Groat Bridge and minor disturbances to the middle and upper bank upstream and downstream of the bridge. • The Split Path Promenade would likely result in a small-scale reduction in riparian vegetation and may result in minor disturbances to the upper bank (depending on construction methodology and final design plans). • The Victoria development would likely result in minor disturbances to the middle and upper bank and relatively small but intensive disturbances to the lower bank (due to support structures). • The Combined Path Promenade would likely result in a small-scale reduction in riparian vegetation and may result in minor disturbances to the upper bank (depending on construction methodology and final design plans). • The High Level Bridge Hill development would likely result in localized disturbances to the lower and middle bank around the north pier of the Dudley B Menzies Bridge and minor upper bank disturbances upstream and downstream of the bridge. • The Deck would result in minor disturbances to the middle and upper bank and minor to major disturbances to the lower bank (due to the support structures).
Direct Fish Mortality	Instream Construction	➢ Potential for fish entrapment, impingement, and/or entrainment in isolation areas that would likely be required to construct instream components at the Groat Daylighting site.
	Project Operation	➢ Potential for fish mortality if fish become stranded in the wetland feature at the Groat Daylighting site if habitat connectivity is not maintained (e.g. if there is potential for fish to access the habitat during high waters but are then unable to leave the area when flows and water levels subside).
	Increased Angling Pressure	➢ Potential that improved access to the NSR will result in increased angling pressure.
Direct Habitat Impacts	Instream Construction	➢ Depending on construction plans, there is potential for temporary footprint(s) associated with isolation works that will be required to facilitate instream construction. ➢ Depending on design plans, there is potential for a permanent gain in available habitat at the Groat Daylighting site. ➢ Potential instream works at the Groat Daylighting site will affect Moderate Capability habitat (Figure 3A).
	Riparian Disturbance	➢ Potential riparian disturbances to the lower bank would affect low, moderate, and high capability streambank habitat as indicated below (Figure 3A and 3B). • Groat Daylighting – Low to Moderate Habitat • Groat Bridge – Moderate Capability Habitat • Split Path Promenade – Moderate to High Capability Habitat • Victoria – High Capability Habitat • Combined Path Promenade – High to Moderate Capability Habitat • The Deck – Moderate Capability Habitat
Fish Disturbance	Change in Access to Habitat	➢ Potential for fish to be able to access previously unavailable habitat at the Groat Daylighting site including the re-established confluence of Groat Creek and the wetland feature.
	Channel Constriction	➢ Potential for fish movements to be affected if instream isolation works or permanent infrastructure is extensive enough to significantly affect flow patterns and/or water velocities.
	Boating Activity	➢ Potential that improved access to the NSR at the Groat Daylighting site could result in increased boating activity in the area.
Invasive Species	Instream Construction Boating Activity	➢ Instream works and/or recreational activities have potential to spread aquatic invasive species.

4.3 REGULATORY CONSIDERATIONS

4.3.1 Permitting and Approvals

Regulatory requirements for the Project will be dependent on project designs, construction plans, and project schedules. Overall, it is expected that requisite permits and approvals will encompass a broad range of environmental disciplines including fisheries resources. The primary regulatory body overseeing the protection of fish and fish habitat in Canada is DFO, through the enforcement of the *Fisheries Act* and the *Species At Risk Act (*where it applies to aquatic species under the *Fisheries Act)*. In Alberta, AEP also regulates activities occurring on waterbodies through the *Water Act*. Based on current conceptual design options, it is expected that the Project will require:

- a DFO Request for Review and potentially an Authorization under the *Fisheries Act*; and
- a *Water Act* approval and/or notice(s) under the *Water Act*.

As discussed in Section 3.5.1, the fish species inhabiting the NSR adjacent to the Project Area not listed under the *Species At Risk Act* at this time and therefore permitting under the *Species at Risk Act* is not expected to be required. Requirements for other permits and approvals are discussed in the Environmental Overview (Spencer Environmental 2021).

4.3.1.1 Fisheries and Oceans Canada

In Canada, projects that will likely result in the death of fish and/or the harmful alteration, disruption, or destruction 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*. DFO provides list of steps to guide proponents in determining if they should submit a request for project review to DFO. For most projects in Alberta these steps include:

- Determining if there are aquatic species at risk or critical habitat that could be affected by the project. Approval from DFO will be required if the project will affect an aquatic species at risk in a way that is prohibited by the *Species at Risk Act.*
- Determining if the DFO Measures to Protect Fish and Fish Habitat (DFO 2019) can be implemented in their entirety including:
    - preventing the death of fish;
    - maintaining riparian vegetation;
    - carrying out works, undertakings and activities on land;
    - maintaining fish passage;
    - ensuring proper sediment control; and
    - preventing entry of deleterious substances in water

- Determining if the project will occur on a waterbody that does not require DFO review, which includes:
    - Artificial waterbodies that are not connected to a waterbody that contains fish hat any time during any given year, such as
        - private ponds
        - roadside drainage ditches
        - quarries and aggregate pits
        - irrigation ponds or channels
        - stormwater management ponds
        - agricultural drains and drainage ditches
        - commercial ponds
    - any other waterbody that:
        - does not contain fish at any time during any given year
        - is not connected to a waterbody that contains fish at any time during any given year
- Determining if the project falls within the standards and codes of practice requiring submission of a notification form.

If it is determined that a DFO review is required, then a Request for Review application will need to be submitted to DFO along with detailed project plans and fisheries information. If DFO determines that the project is likely to cause death of fish and/or HADD of fish habitat then the proponent will need to apply for a Section 34.4(2)(b) or 35 (2)(b) Authorization under the *Fisheries Act*. The Authorization will detail terms and conditions that the proponent must adhere to avoid, mitigate, offset and monitor impacts to fish habitat resulting from the project.

Fish habitat offsetting is required where impacts to fish habitat are unavoidable. Habitat offsetting typically takes the form of enhancement, remediation or creation of fish habitat. Habitat offsetting plans to counterbalance anticipated impacts are to be prepared by the proponent and submitted to DFO along with an application for Authorization. DFO has indicated that further guidance for habitat offsetting will be released in the future.

4.3.1.2 Alberta Water Act

Waterbodies in Alberta are regulated under the *Water Act* which is provincial legislation that supports and promotes the conversation and management of water in Alberta. *Water Act* approvals are required when an activity will impact a waterbody or when surface or groundwater will need to be diverted. Certain activities such as the construction, maintenance, replacement or removal of a watercourse crossing or outfall structure are exempted under the *Water (Ministerial)* Regulations and are managed under Codes of Practice.

4.3.2 Information Requirements and Schedules

In general, DFO applications and *Water Act* approval applications must provide sufficient information to allow for regulators to assess potential impacts resulting from the project. Typical information requirements include:

- Proponent contact information.
- Detailed project information including:
    - project description;
    - project location;
    - design plans; and
    - information regarding the construction methodology and schedule.
- Description of existing fish and fish habitat conditions.
- Assessment of potential effects of the proposed project and description of mitigation measures and residual effects.

AEP and DFO may request additional information over the course of their review if deemed necessary to complete their assessment of a project. In addition, submissions to regulators must include accurate information that represents final design plans and realistic construction methods and schedules since approvals/permits will often be issued with conditions that reference the information provided to the regulators. For some permits, regulators have defined time limits to complete their review while other permits do not have defined deadlines for decisions to be rendered (Table 8). In general, application completeness, project complexity, project risk, and review staff availability will all factor into permitting timelines.

Table 8. Summary of schedule/timelines for regulators to issue permits.

Regulator	Request/Permit	Schedule/Timeline
DFO	Request for Review	➢ No specific time review limits, anticipate minimum of three months.
	Authorization[1]	➢ From the date of receipt of an application, the Minister has 60 calendar days to determine if the application is complete, incomplete or inadequate, and to notify the applicant of this determination. If the application is not complete or inadequate, the notification will identify the information or documentation that must still be provided by the applicant. [Subsection 4(3)]; and ➢ From the date of the notification that the application is complete, the Minister has 90 calendar days to either issue the authorization or notify the applicant in writing that the authorization is refused. [Subsection 4(5)] ➢ Either time limit (60- or 90-day) may cease to apply should one or more of the following occur: • the applicant proposes amendments to their application; • the applicant requests in writing that the processing of the application be suspended; • circumstances require that information or documents other than those referred to in subsection 2(1) be obtained or that amendments to the information or documents submitted by the applicant be made before an authorization can be issued or a notification of refusal can be given; • consultation is required before an authorization can be issued or a notification of refusal can be given; or • an Act of Parliament, a regulation made under an Act of Parliament or a land claims agreement provides that a decision be made or that conditions be met before an authorization can be issued or a notification of refusal can be given."
AEP	Water Act Approval	➢ No specific time review limits, anticipate minimum of one year
	Code of Practice (watercourse crossing, outfall structure)	➢ Provide notice at least 14 days prior to starting the project. ➢ To comply with CoPs, a project may also require the specifications and recommendations of a Qualified Aquatic Environment Specialist.

4.4 INFORMATION GAPS

Assuming that there are no major changes to the preferred concept design, the fisheries information presented in this document is considered to be sufficient to support a fisheries impact assessment that would meet the standard information requirements for environmental permitting under the *Fisheries Act* and the *Water Act*. However, as described in Section 4.3, additional design and construction details will be required before the fisheries impact assessment can be completed. It is assumed that this information will become available as the Project progresses at which time information gaps may become apparent. Information that will be required to complete the impact assessment includes (but is not necessarily limited to) the following:

- Design plans with sufficient detail to determine physical footprints of permanent and temporary infrastructure on the bed and banks of the NSR.
- Construction plans detailing construction methodologies and schedules.

4.5 OPPORTUNITIES AND CONSTRAINTS

Given the broad scope of the Project and considering the phased delivery approach, there is opportunity for the Project to incorporate objectives that are subsidiary to the stated overall goals of the Project. In a fisheries context, these opportunities primarily relate to potential design modifications that will either reduce environmental disturbance or improve/enhance existing riparian and/or instream habitat. Similarly, analysis of design at the concept stage allows for the Project to be developed in a manner that minimizes potential constraints by identifying key issues in the early stages of the Project. A summary of potential opportunities and constraints based on the proposed concept options is provided in Table 9.

Table 9. Summary of fisheries opportunities and constraints associated with the preferred concept.

Opportunities	Constraints
Impact Avoidance ➢ Minimize instream footprint and disturbance to riparian areas. ➢ Maximize value of constructed fish habitat. ➢ Incorporate streambank improvements and/or habitat enhancements into the design plan. ➢ Incorporate bioengineering techniques where bank stabilization is required. **Support regional fisheries management objectives** ➢ The primary fisheries management objectives for the NSR are to protect biologically diverse and productive ecosystems that maintain healthy fish populations and to support social and economic benefits for Albertans (ASRD 2008). The management of fish resources involves four primary components (ASRD 2008): • sustaining, or achieving, a net gain in the quality and quantity of fish habitat, • ensuring that native and desired introduced fish population are maintained at satisfactory levels of abundance and distribution, • provide and maintain a high diversity quality and number of fishing opportunities, and • obtain information on public views and expectations for the condition and availability of fish resources in the province. **Support species recovery efforts** ➢ The Saskatchewan River populations of lake sturgeon are considered endangered by COSEWIC but no species recovery plan has been created under the SARA (SARA Public Registry 2019). However, Alberta has developed a five-year recovery plan that outlines the following objectives (Alberta Lake Sturgeon Recovery Team 2011). • Quantify and increase current population levels of lake sturgeon in the North and South Saskatchewan rivers. • Identity and protect critical habitat of lake sturgeon. • Identify potential threats to lake sturgeon from human activities and ecological processes and develop plans to avoid, eliminate, or mitigate these threats.	**Isolation of Instream Work Sites** ➢ It is likely that all instream work will need to be isolated from the rest of the NSR to facilitate construction. The installation and removal of isolation works can represent HADD. Some key considerations: • Regulators are unlikely to accept earthen berms as an isolation method. • Adverse impacts increase the longer that isolation works are in place. • Isolation measures must be more robust the longer they are in place, particularly if they are expected to remain in place during the winter and spring. • Isolation measures must be designed to accommodate a range in flows to ensure that the isolated area does not become inundated. Flows in the NSR are affected by upstream dam operations should be taken into consideration in the design of the isolation works. **Timing of Instream Work** ➢ The Project Area is located in a section of the NSR that is subject to a restricted activity period that extends from September 16 to July 31 (AESRD 2012). During this period, no instream work is allowed without approval from the provincial government contingent on the advice and recommendations of a QAES. Depending on the extent and duration of instream works within the RAP, additional measures may need to be implemented which include but are not necessarily limited to: • Completion of additional fisheries investigations. • Development of detailed mitigation plan that may require more extensive protection measures and/or more rigorous environmental monitoring. ➢ Conducting instream work during the winter can pose additional complications that increase risk to fish populations including: • Effective fish salvage (i.e. the successful capture and removal of fish from isolated construction areas) is unlikely if area is ice covered. • Increased risk to fish health if fish salvage is conducted when air temperatures are cold. • Increased complexity and safety concerns associated with turbidity monitoring during the winter.

4.6 SUMMARY

The preferred concept design includes components that could directly and indirectly affect the fisheries resources of the NSR. In most instances, potential impacts associated with construction activities that are completed above the one in two-year high-water mark can be mitigated through implementation of BMP's while instream works, or activities conducted below the one in two-year high-water mark typically require more site-specific mitigation planning and have a greater potential to require an Authorization under the *Fisheries Act*. Ultimately, the extent that fisheries resources are impacted and the need for habitat offsetting will depend on Project design and construction details that are yet to be determined. Review of the preferred concept design suggests that most design components present similar environmental and regulatory complexities in terms of constructing infrastructure in or immediately adjacent to fish habitat (Table 10).

Table 10. Summary of considerations for key factors associated with the preferred concept.

Key Factor	Considerations
Potential Impacts	➢ Key potential benefits include: • Re-establishment of the confluence of Groat Creek has potential to increase available fish habitat. • Upgrades to the Groat Ravine stormwater system water treatment upgrades have potential to improve local water quality. ➢ Key potential impacts of concerns include: • Instream construction activities (that are primarily localized around the Groat Daylighting site) have potential to adversely affect water quality. • Disturbances to the lower NSR bank has potential to reduce fish cover and adversely affect water quality. • Relatively large-scale disturbances to the upper NSR bank have potential to adversely affect water quality.
Regulatory	➢ Instream works will need to be isolated from the NSR. ➢ Environmental construction monitoring will be required for the duration of the Project. ➢ Project components/activities that disturb the bed and bank of the NSR are expected to require fisheries related permitting under the *Water Act* and the *Fisheries Act*. ➢ Project components/activities associate with Groat Creek and the wetland feature may require fisheries-related permitting under the *Water Act* and the *Fisheries Act*. ➢ Instream construction activities completed during the RAP may trigger the need for additional assessment, implementation of additional mitigation, and/or additional permitting. ➢ Anthropogenic features that are constructed below the 1:2-year high-water level are typically considered to be a footprint on fish habitat.
Information Gaps	➢ Additional field investigations will need to be conducted to assess existing conditions in Groat Creek. ➢ Other potential information gaps will be determined as the Project advances through delivery phases and design, construction, and schedule details become available.
Opportunities	➢ Potential to create unique off-channel habitat. ➢ Potential to improve local water quality. ➢ Potential to align Project design with fisheries management objectives through outfall upgrading and/or decommissioning that could result in improved water quality. ➢ Strategic design to situate Project developments within previously disturbed areas. ➢ Potential to improved riparian conditions through bank stabilization, reclamation of disused infrastructure, improvement to riprap, enhancement of riparian vegetation.
Constraints	➢ The size and duration of instream works will influence level of mitigation required to facilitate works (i.e. instream isolations). ➢ Instream activities should be scheduled to occur within the open window of the RAP (Aug 01 to Sept 15)

5.0 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.

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Project Biologist

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7.0 PERSONAL COMMUNICATION

Watkins, Owen, MSc. Nov 2019. Fisheries Biologist. Alberta Environment Parks Red Deer – North Saskatchewan River.

Appendix A

Assessment Methods

Kingfisher Aquatics Ltd. (Kingfisher) Standard Procedures 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 A berta; 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. A berta Government. Sportfishing Regulations. Portt et al. 2006. A review of fish sampling methods commonly used in Canadian freshwater habitats. A berta 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
Tr butary 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) LITERATURE CITED

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Appendix B

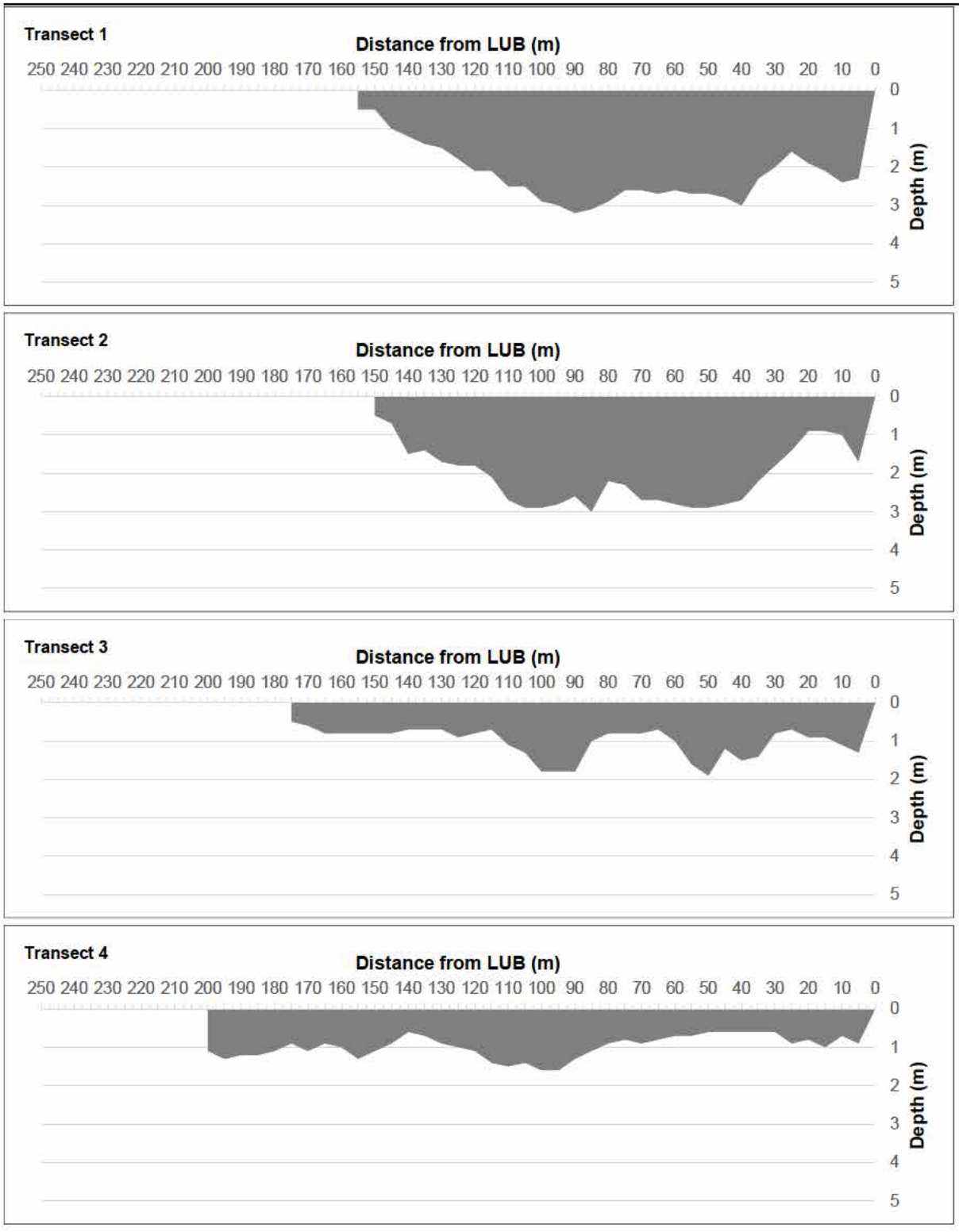
Existing Fish Capture Data

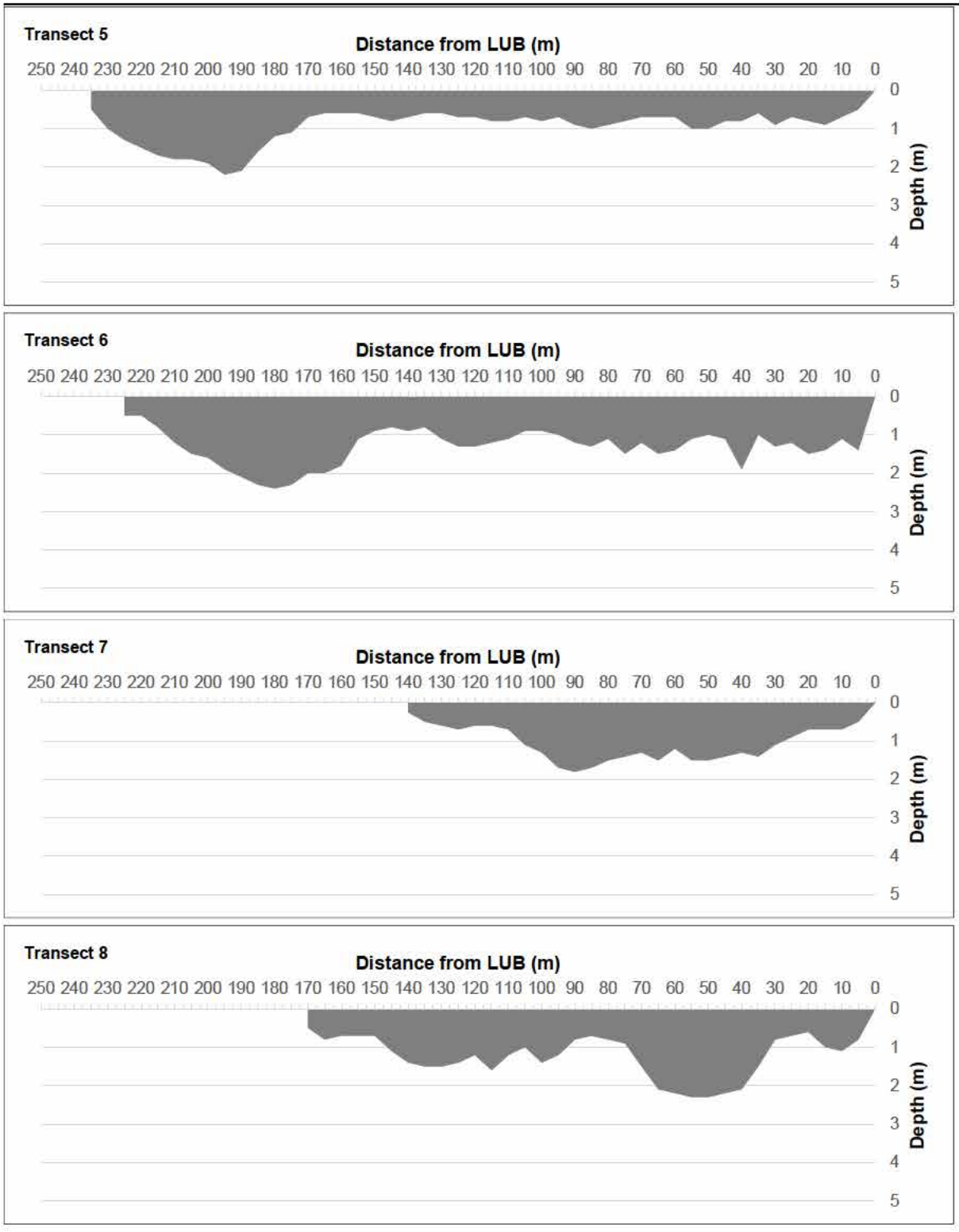
Year	Species	Count	Sampling Type	Sampling Effort
2009	EMSH	2	Electrofishing	2458 seconds
	GOLD	7		
	LNSC	9		
	MNWH	18		
	SHRD	6	Seine	60 m
	WALL	1		
	WHSC	3		
2010	BURB	1	Electrofishing	5877 seconds
	EMSH	3		
	LNSC	1		
	MNWH	15		
	MOON	3		
	NRPK	2	Seine	15 m
	SPSH	1		
	TRPR	2		
	WALL	7		
	WHSC	3		
2013	YLPR	7	Trap Net	N/L
2016	BURB	4	Electrofishing	14049 seconds
	EMSH	58		
	FAMCYPR	13		
	GOLD	8		
	LNDC	56		
	LNSC	43		
	MNWH	15		
	MOON	8		
	NRPK	10		
	QUIL	5		
	RVSH	30		
	SAUG	3		
	SHRD	12		
	SLRD	1		
	SPSH	28		
	TRPR	50		
	WALL	75		
	WHSC	49		
2017	BURB	9	Electrofishing	11861 seconds
	EMSH	4		
	FAMCATO	10		
	FAMCYPR	10		
	FTMN	1		
	GOLD	20		
	LNDC	1		
	LNSC	19		
	MNWH	11		
	MOON	22		
	NRPK	3		
	QUIL	4		
	SAUG	3		
	SHRD	9		
	SLRD	2		
	TRPR	5		
	WALL	38		
	WHSC	24		

Year	Species	Count	Sampling Type	Sampling Effort
2018	BURB	6	Electrofishing	6581 seconds
	EMSH	7		
	FAMCATO	4		
	FAMCYPR	2		
	FNDC	1		
	GOLD	9		
	LNDC	9		
	LNSC	14		
	MOON	16		
	NRPK	2		
	QUIL	2		
	SAUG	1		
	SHRD	10		
	SPSC	3		
	TRPR	15		
	WALL	23		
	WHSC	13		

Appendix C

Transect Depth Profiles


Transect 1
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 2
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 3
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 4
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)


Transect 5
Distance from LUB (m)
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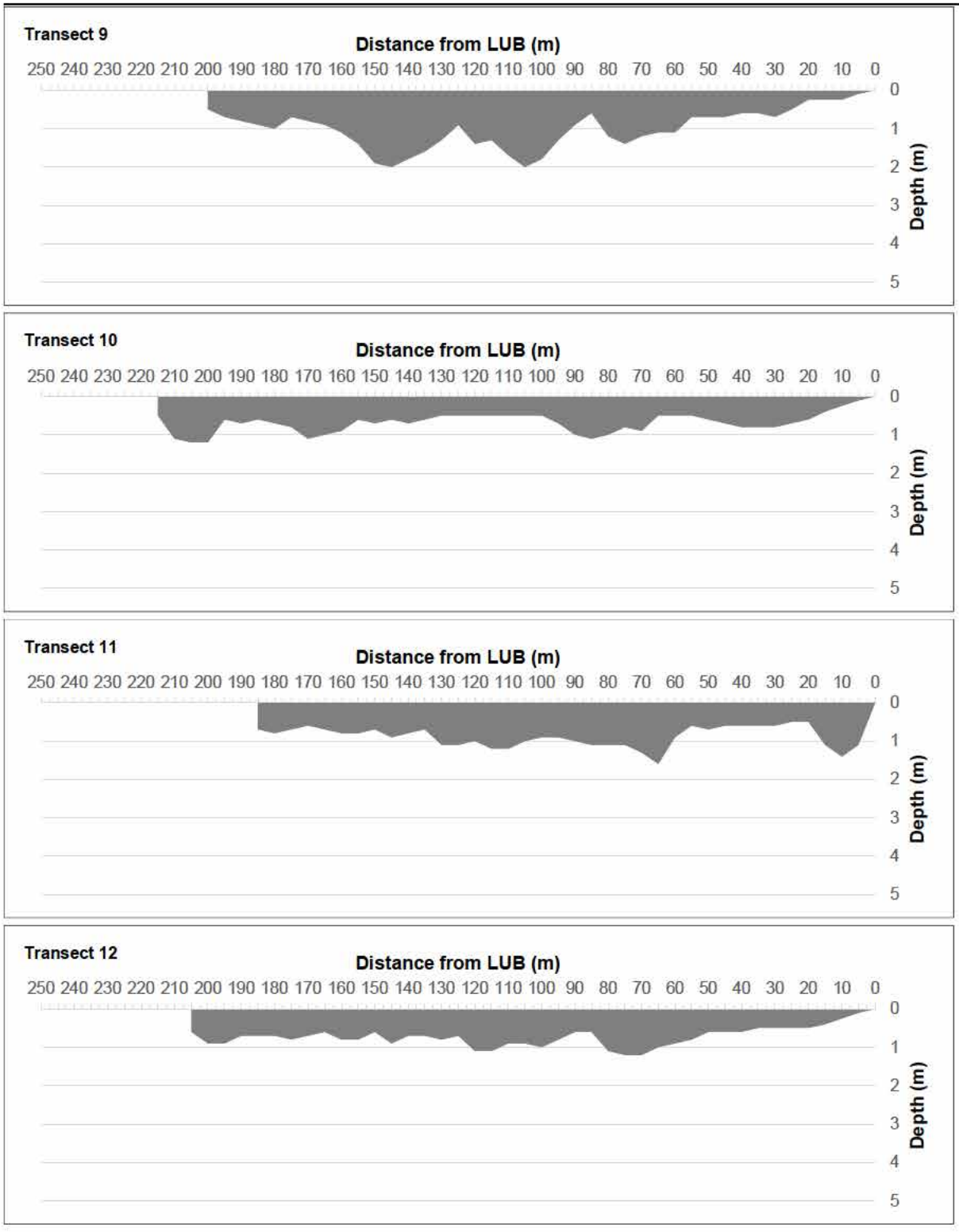
0 1 2 3 4 5
Depth (m)
Transect 6
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 7
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 8
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)


Transect 9
Distance from LUB (m)
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0 1 2 3 4 5
Depth (m)
Transect 10
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 11
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 12
Distance from LUB (m)
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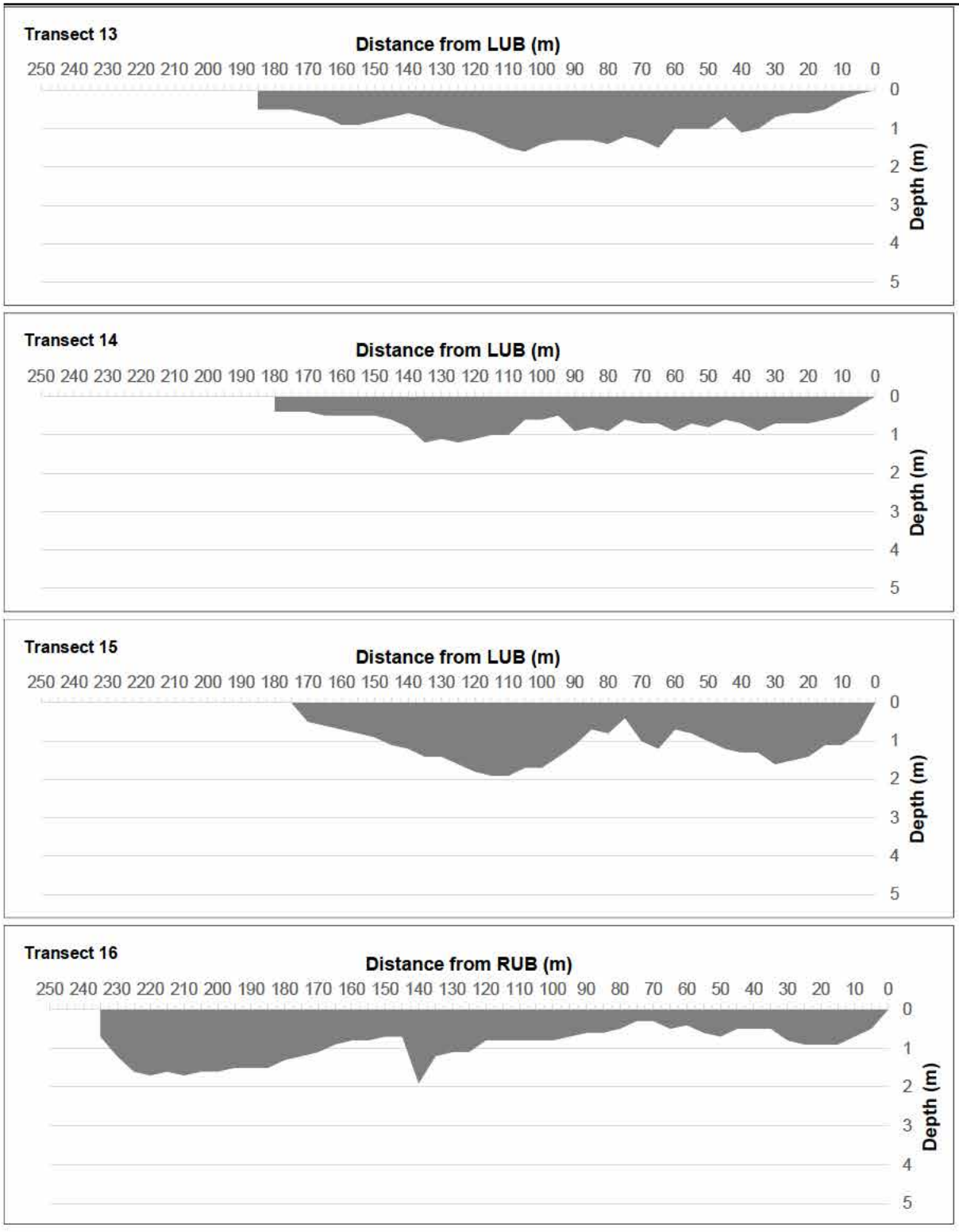
0 1 2 3 4 5
Depth (m)


Transect 13
Distance from LUB (m)
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0 1 2 3 4 5
Depth (m)
Transect 14
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 15
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 16
Distance from RUB (m)
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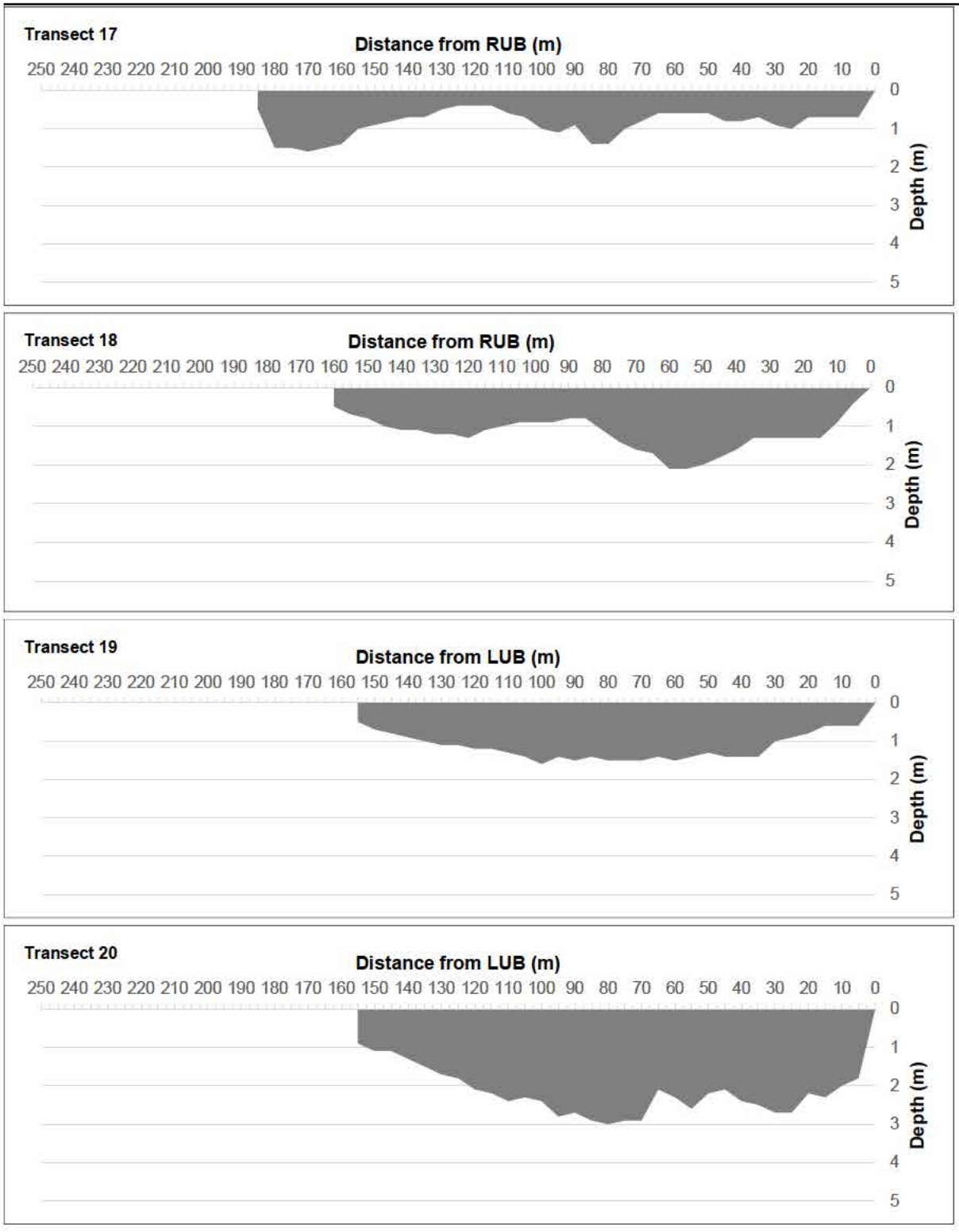
0 1 2 3 4 5
Depth (m)


Transect 17
Distance from RUB (m)
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0 1 2 3 4 5
Depth (m)
Transect 18
Distance from RUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 19
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 20
Distance from LUB (m)
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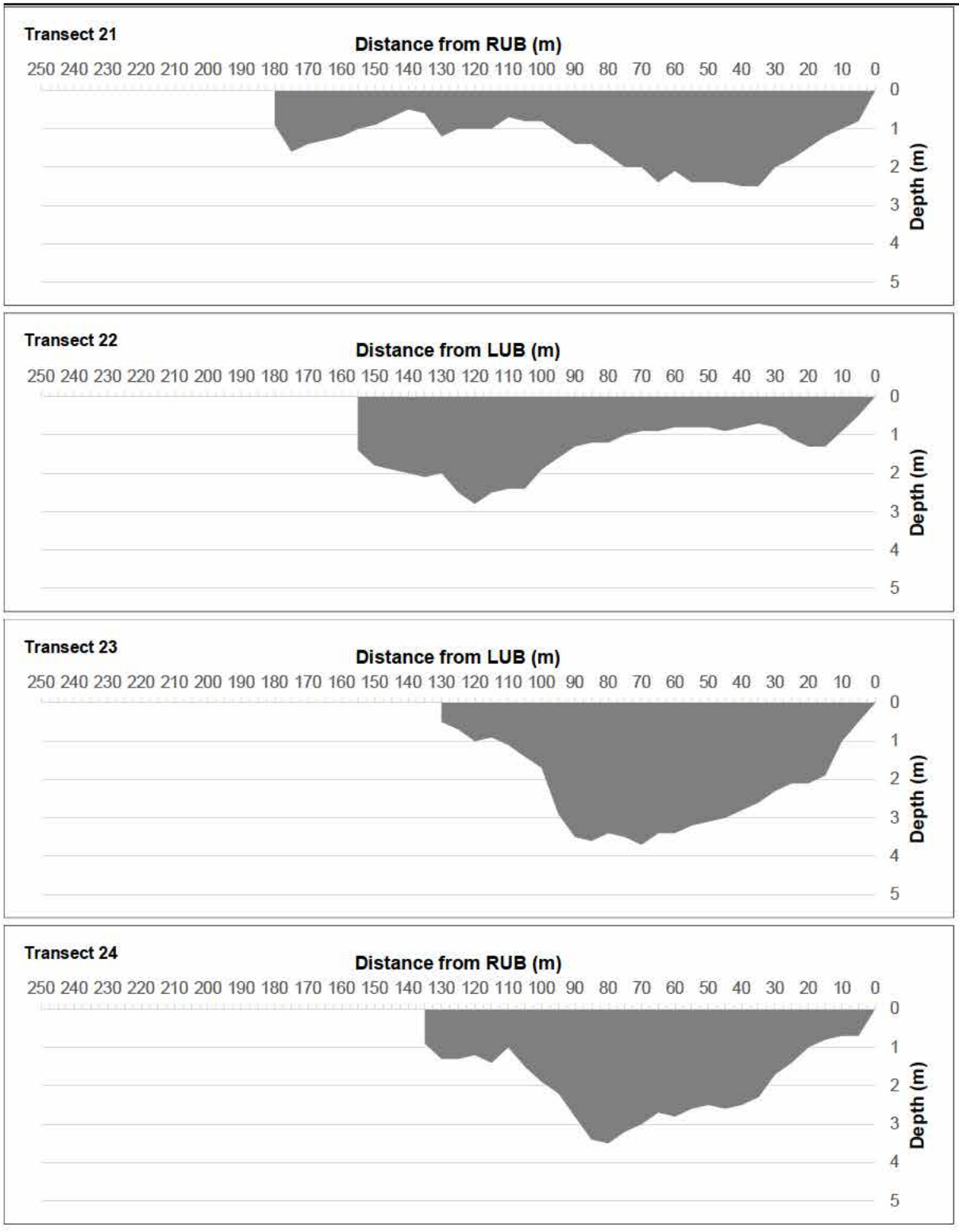
0 1 2 3 4 5
Depth (m)


Transect 21
Distance from RUB (m)
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0 1 2 3 4 5
Depth (m)
Transect 22
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 23
Distance from LUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)
Transect 24
Distance from RUB (m)
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
0 1 2 3 4 5
Depth (m)

Appendix D

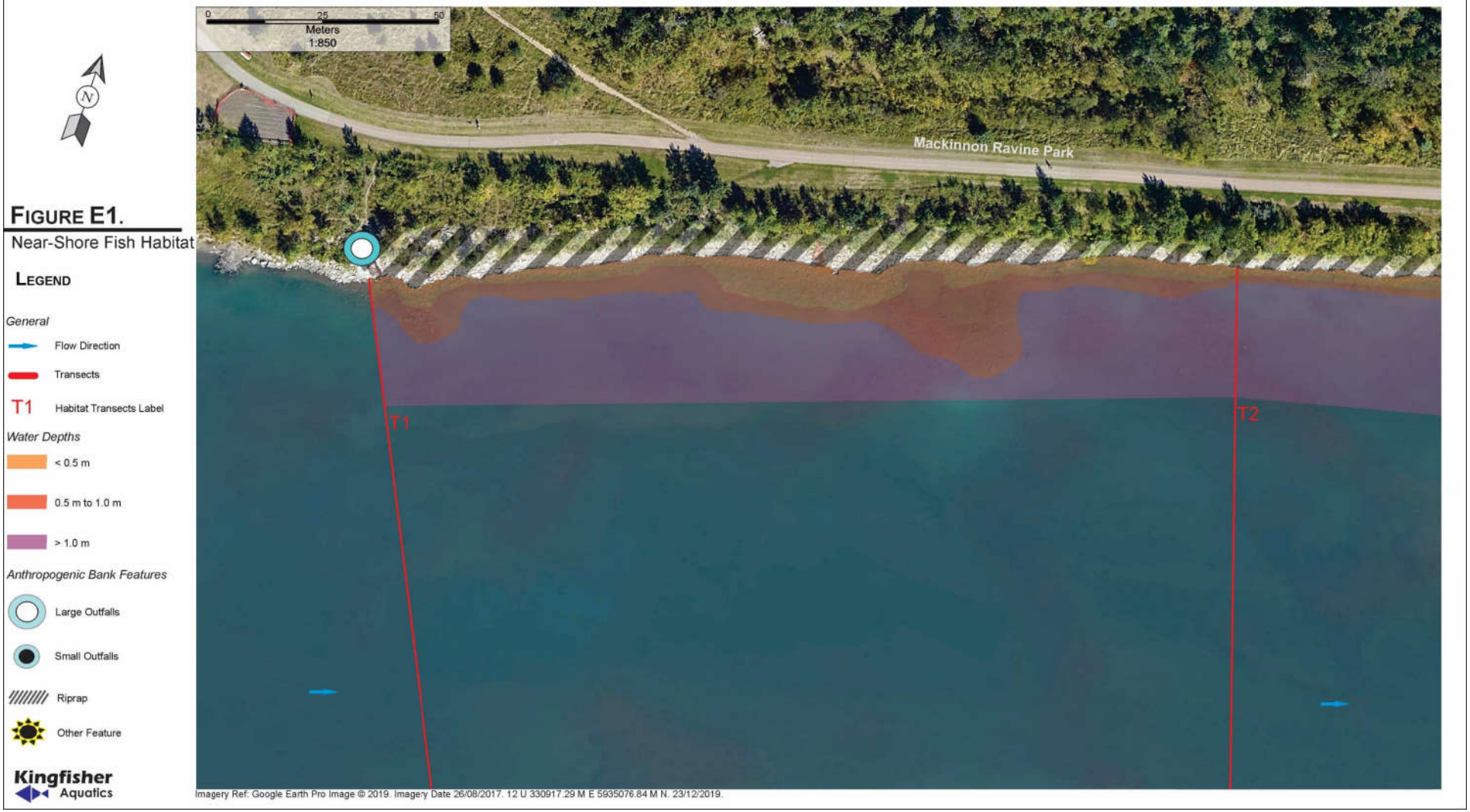
Transect Data

Location	Transect number		1	2	3	4	5	6	7	8	9	10	11	12
	Distance from Upstream Limit of Project Area (m)		+ 750	+ 550	+ 350	+ 150	- 50	-250	-450	- 650	- 850	- 1050	- 1250	- 1550
	UTM NAD 83 Easting		330776	330960	331157	331356	331555	331734	331893	332045	332208	332374	332546	332725
	UTM NAD 83 Northing		5935101	5935177	5935228	5935245	5935219	5935133	5935011	5934886	5934773	5934663	5934557	5934468
RUB	Large River Habitat Type		A1	A1	A1	A1	A1	A1	A1	A1	D2	E5	D2	D2
	Bank Height (m)		3	7	5	5	2 5	3	1 5	10	1.5	1 5	2	1.5
	Bank Angle (°)		55	75	75	75	85	50	75	45	20	80	85	35
	Riparian Veg (GR, SH, TR, EX, AR)		AR/GR	AR/TR	AR/GR	AR/TR	AR/GR	GR/SH	GR/SH	GR/TR	GR/TR	SH/TR	SH/GR	SH/GR
	Bank Stability (S or U)		S	S	S	S	S	S	S	S	S	S	S	S
	Undercut Measurement (m)		-	-	-	-	-	-	-	-	-	-	-	-
	Bank Substrate (Fn Gr Cb Bl Br)		Fn/Bl	Fn/Bl	Fn/Bl	Fn/Bl	Fn	Fn/Bl	Fn	Fn/Bl	Fn	Fn	Fn	Fn
Channel Characteristics	Streambed Substrate	Dominant	Cb	Cb	Cb	Cb	Cb	Cb	Cb	Cb	Cb	Cb	Gr	Fn
	(Fn Gr Cb Bl Br)	Sub-Dominant	Bl	Gr	Gr	Gr	Bl	Bl	Bl	Bl	Gr	Gr	Cb	Cb
	Wetted Width (m)		158	151	179	203	235	225	142	173	201	217	187	205
Specific comments for each transect														

Location	Transect number		13	14	15	16	17	18	19	20	21	22	23	24
	Distance from Upstream Limit of Project Area (m)		+ 1750	+ 1950	+ 2150	+ 2350	+ 2550	+ 2750	+ 2950	- 3150	-3350	-3550	- 3750	- 3950
	UTM NAD 83 Easting		332917	333114	333314	333514	333707	333883	334072	334235	334412	334593	334774	334890
	UTM NAD 83 Northing		5934405	5934357	5934364	5934349	5934296	5934205	5933413	5934018	5933844	5933844	5933892	5934052
RUB	Large River Habitat Type		D2	D2	D1	D1	A1	A1	A1	A4	A1	A1	D1	D1
	Bank Height (m)		2	1 5	6	3	5	5	1	5	10	3	5	4
	Bank Angle (°)		25	75	70	40	65	45	40	30	40	40	50	80
	Riparian Veg (GR, SH, TR, EX, AR)		GR/SH	GR/SH	GR/EX	SH/GR	TR/GR	SH/TR	SH/GR	AR	GR/TR	GR/SH	TR/SH	TR/SH
	Bank Stability (S or U)		S	S	S	S	Minor U	S	S	S	S	Minor U	Minor U	Minor U
	Undercut Measurement (m)		-	-	-	-	-	-	-	-	-	-	-	-
	Bank Substrate (Fn, Gr, Cb, Bl, Br)		Fn/Gr	Fn	Fn	Fn	Fn/Gr	Fn/Bl	Fn	Bl	Fn	Fn	Fn	Fn
Channel Characteristics	Streambed Substrate	Dominant	Gr	Gr	Fn	Gr	Gr	Cb	Fn	Fn	Fn	Fn	Fn	Fn
	(Fn, Gr, Cb, Bl, Br)	Sub-Dominant	Cb	Cb		Fn	Cb	Gr	Gr	Bl		Bl		
	Wetted Width (m)		186	182	175	234	189	162	159	158	182	155	131	136
Specific comments for each transect														

Appendix E

Near-Shore Fish Habitat Maps


0
25
50
Meters
1:850
N
Mackinnon Ravine Park
T1
T2
FIGURE E1.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
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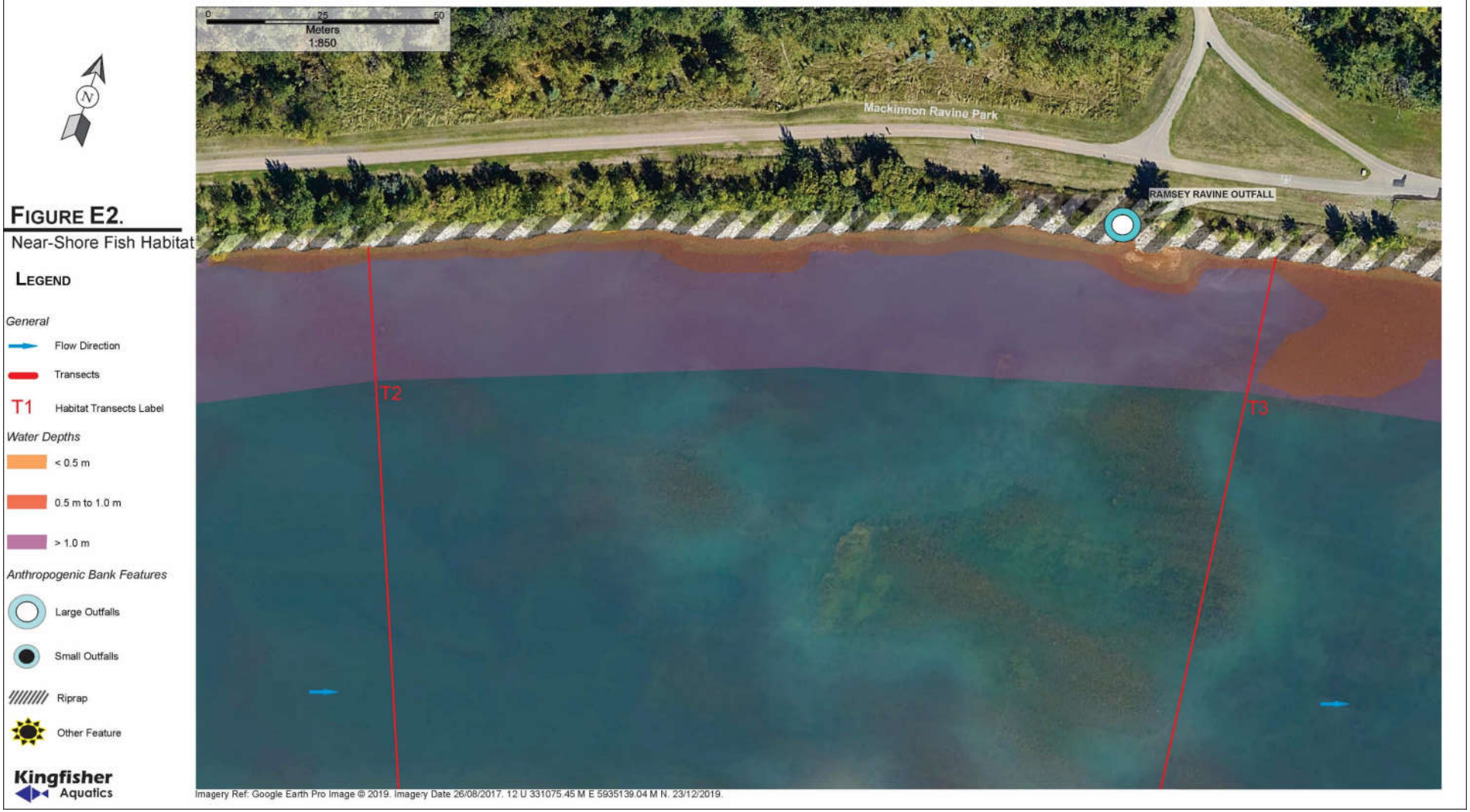
0
25
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Meters
1:850
N
Mackinnon Ravine Park
RAMSEY RAVINE OUTFALL
T2
T3
FIGURE E2.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
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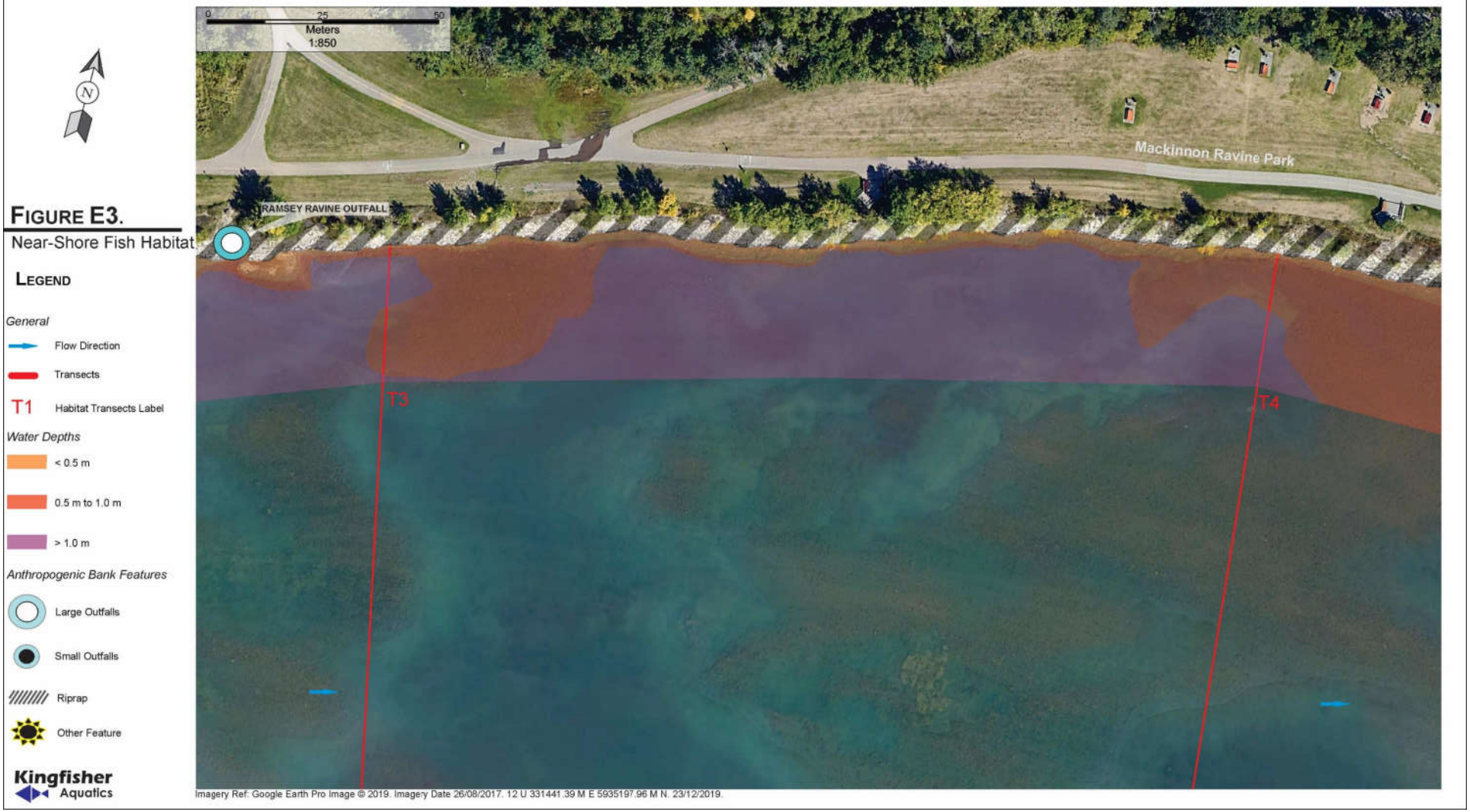
0
25
50
Meters
1:850
N
RAMSEY RAVINE OUTFALL
Mackinnon Ravine Park
T3
T4
FIGURE E3.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 331441.39 M E 5935197.96 M N. 23/12/2019.


0
25
50
Meters
1:850
N
Mackinnon Ravine Park
T4
T5
FIGURE E4.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 331637.79 M E 5935146.28 M N. 23/12/2019.


0
25
50
Meters
1:850
N
Mackinnon Ravine Park
T4
T5
FIGURE E4.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 331637.79 M E 5935146.28 M N. 23/12/2019.


0
25
50
Meters
1:850
N
Government House Park
GROAT CREEK OUTFALL
T5
T6
FIGURE E5.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 331774.75 M E 5935062.01 M N. 26/11/2019.


0
25
50
Meters
1:850
RIVER VALLEY RD NW
GROAT ROAD BRIDGE ABUTMENT
T6
T7
GROAT RD NW
FIGURE E6.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
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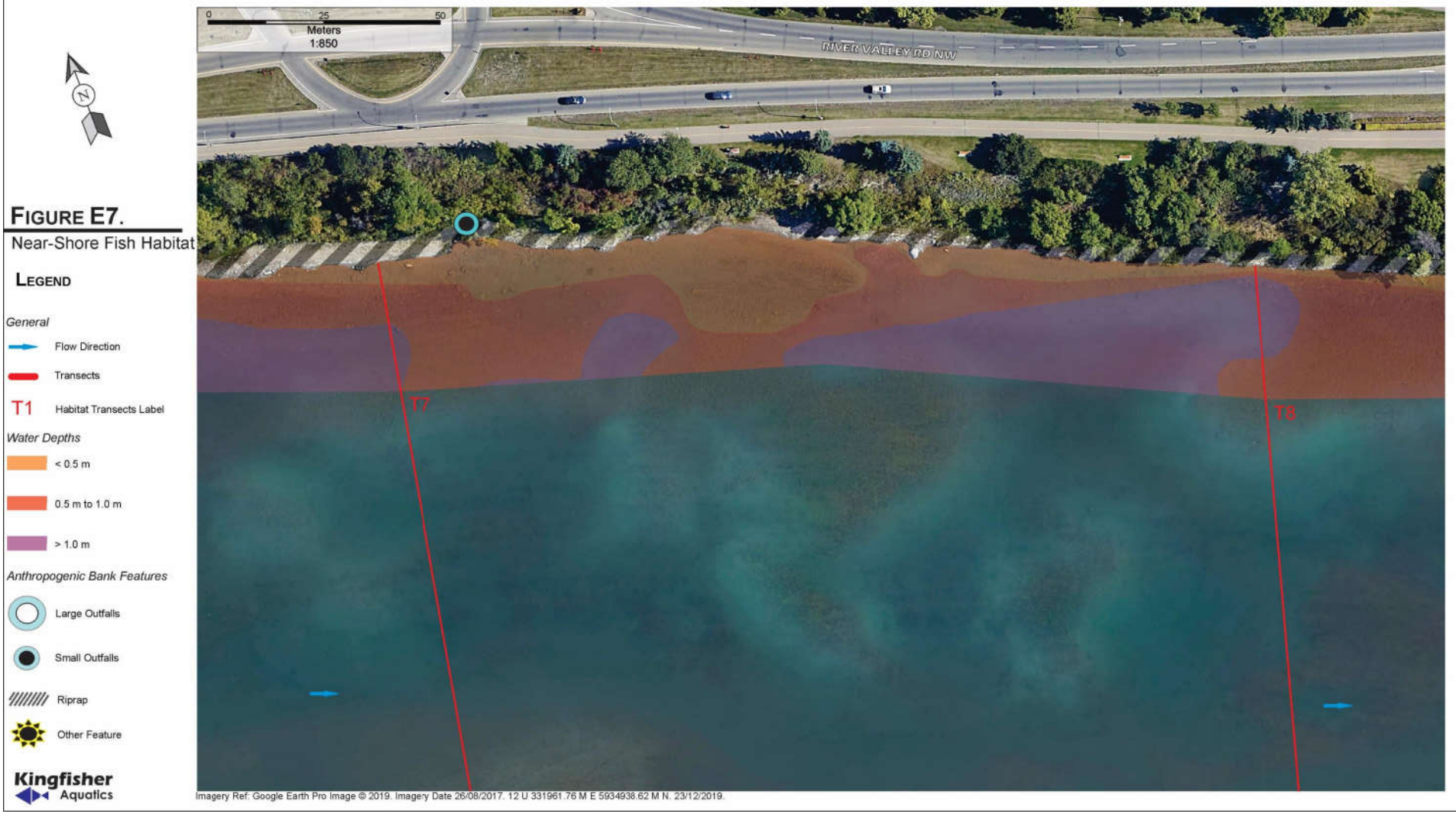
0
25
50
Meters
1:850
RIVER VALLEY RD NW
T7
T8
FIGURE E7.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
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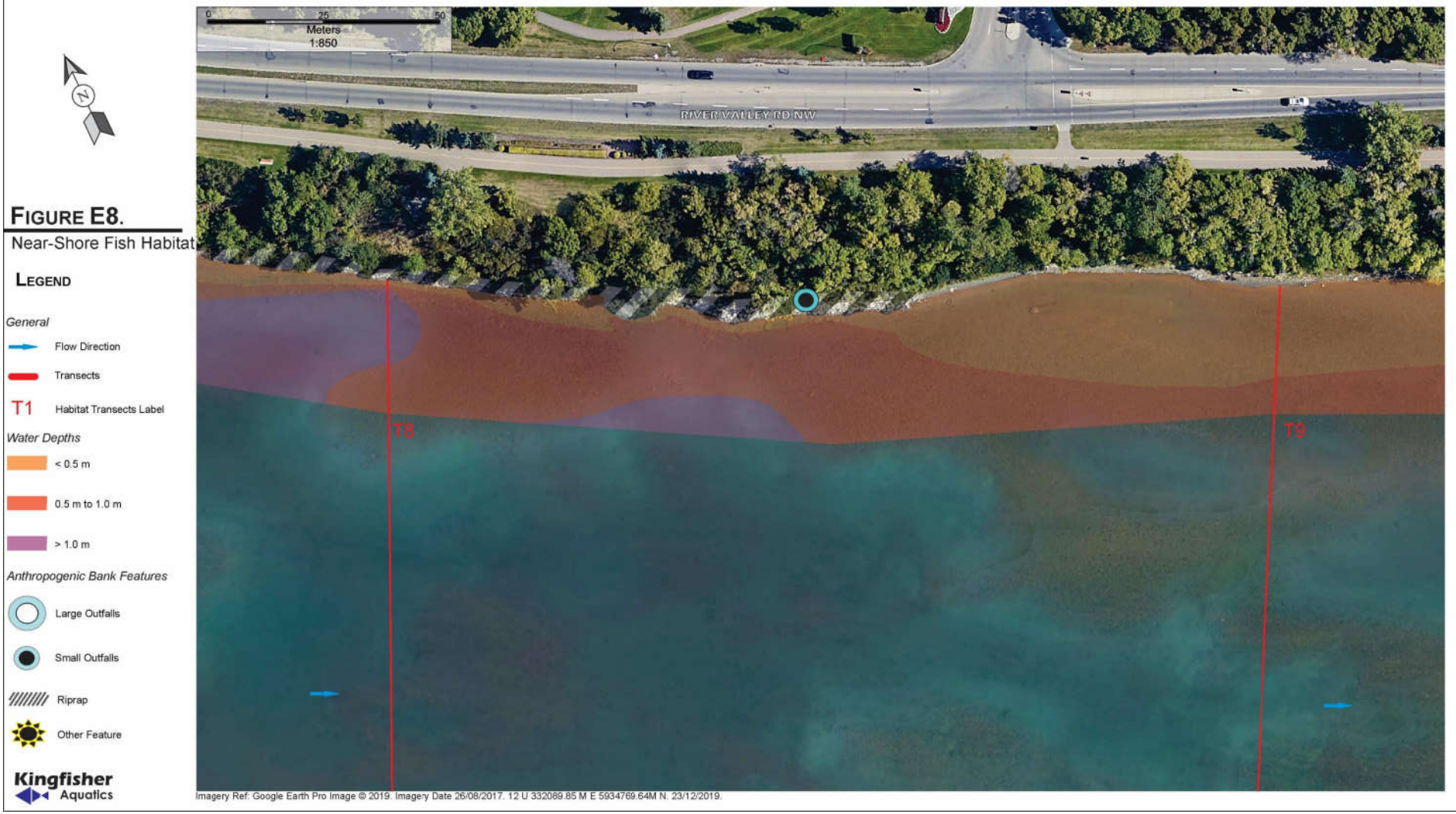
0
25
50
Meters
1:850
RIVER VALLEY RD NW
T8
T9
FIGURE E8.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
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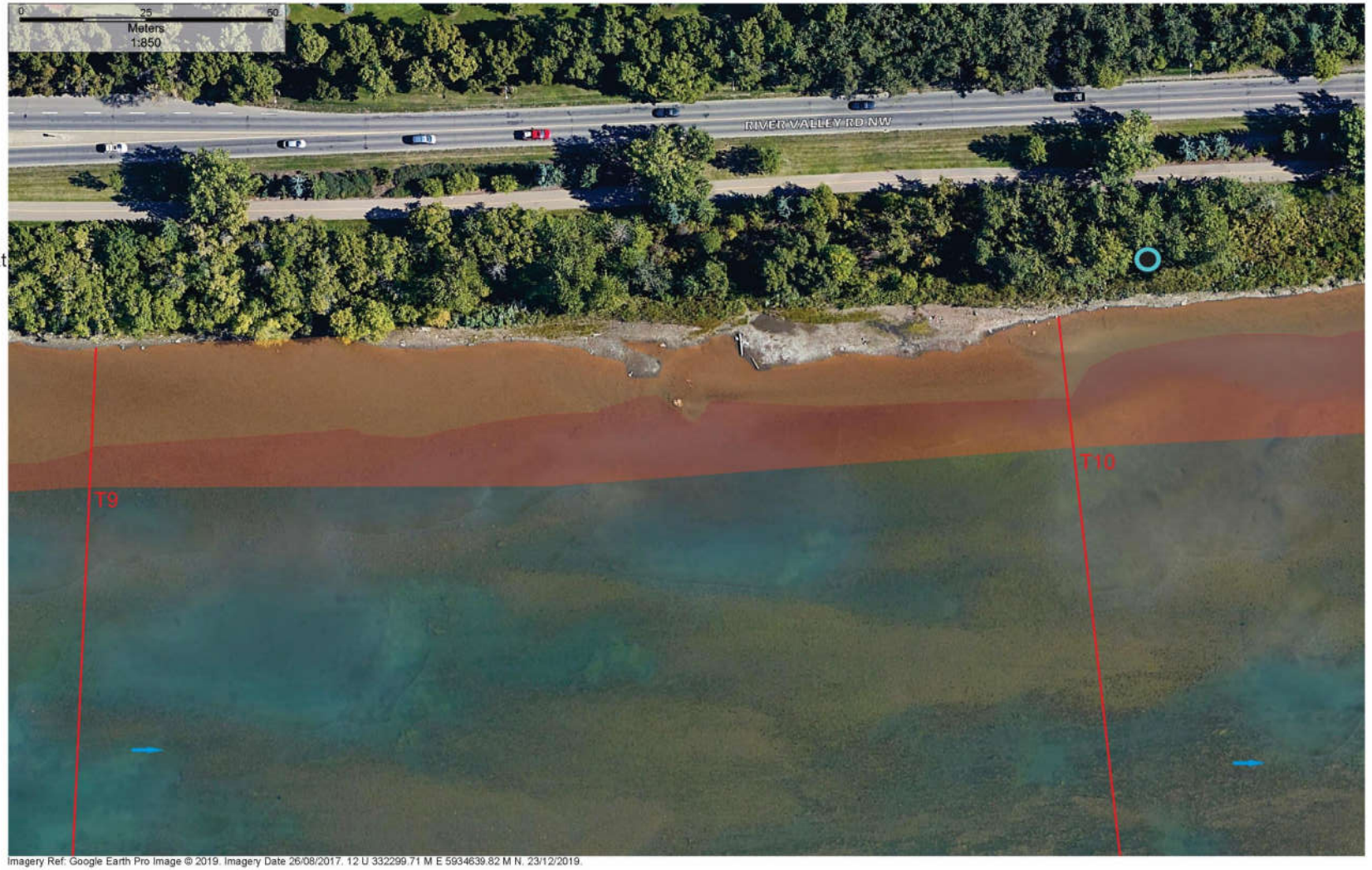


FIGURE E9.

Near-Shore Fish Habitat

LEGEND

General

Flow Direction

Transects

T1 Habitat Transects Label

Water Depths

< 0.5 m

0.5 m to 1.0 m

> 1.0 m

Anthropogenic Bank Features

Large Outfalls

Small Outfalls

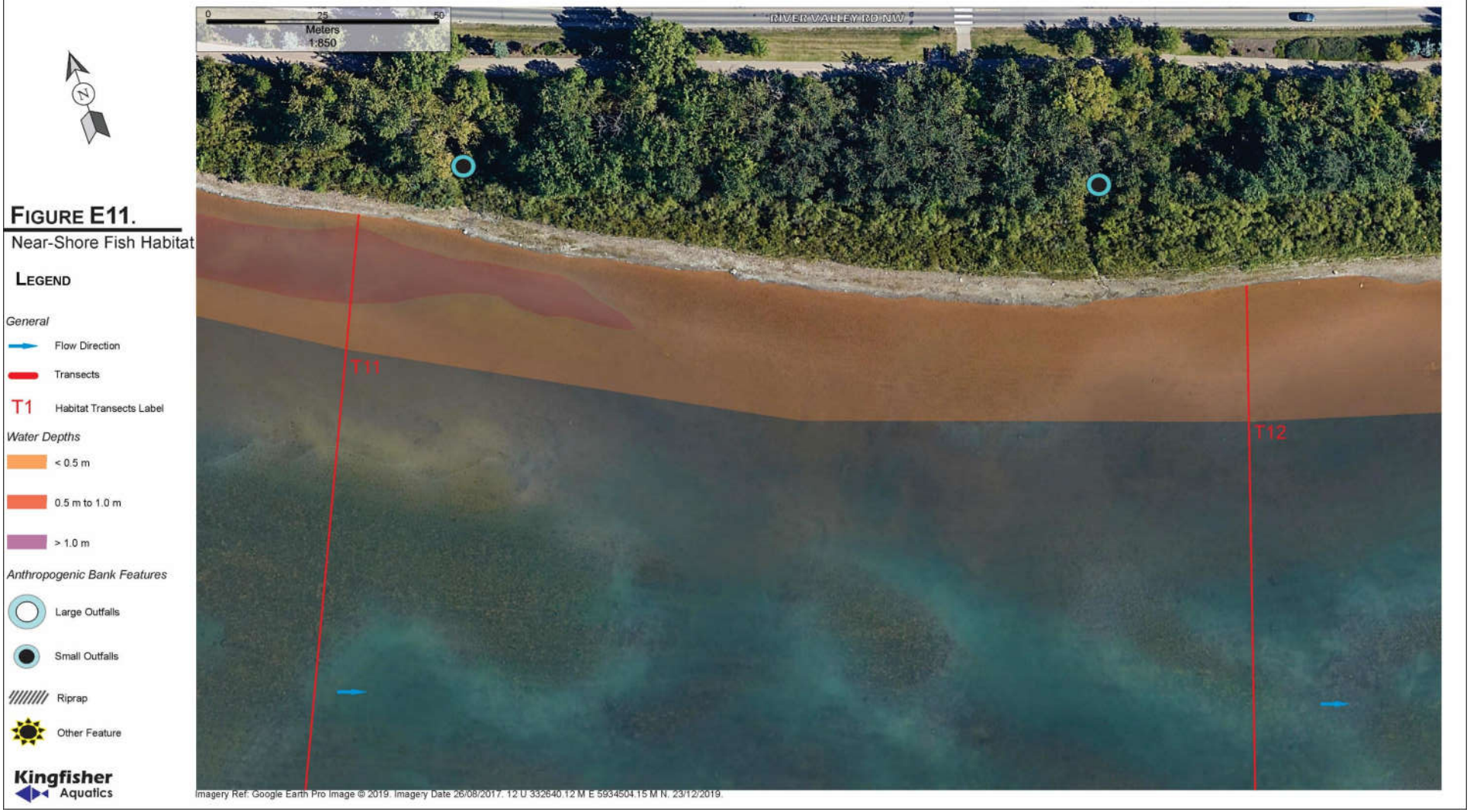
Riprap

Other Feature

Kingfisher Aquatics

Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 332299.71 M E 5934639.82 M N. 23/12/2019.


0
25
50
Meters
1:850
RIVER VALLEY RD NW
T10
T11
FIGURE E10.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 332469.57 M E 5934613.39 M N. 23/12/2019.


0
25
50
Meters
1:650
RIVER VALLEY RD NW
T11
T12
FIGURE E11.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
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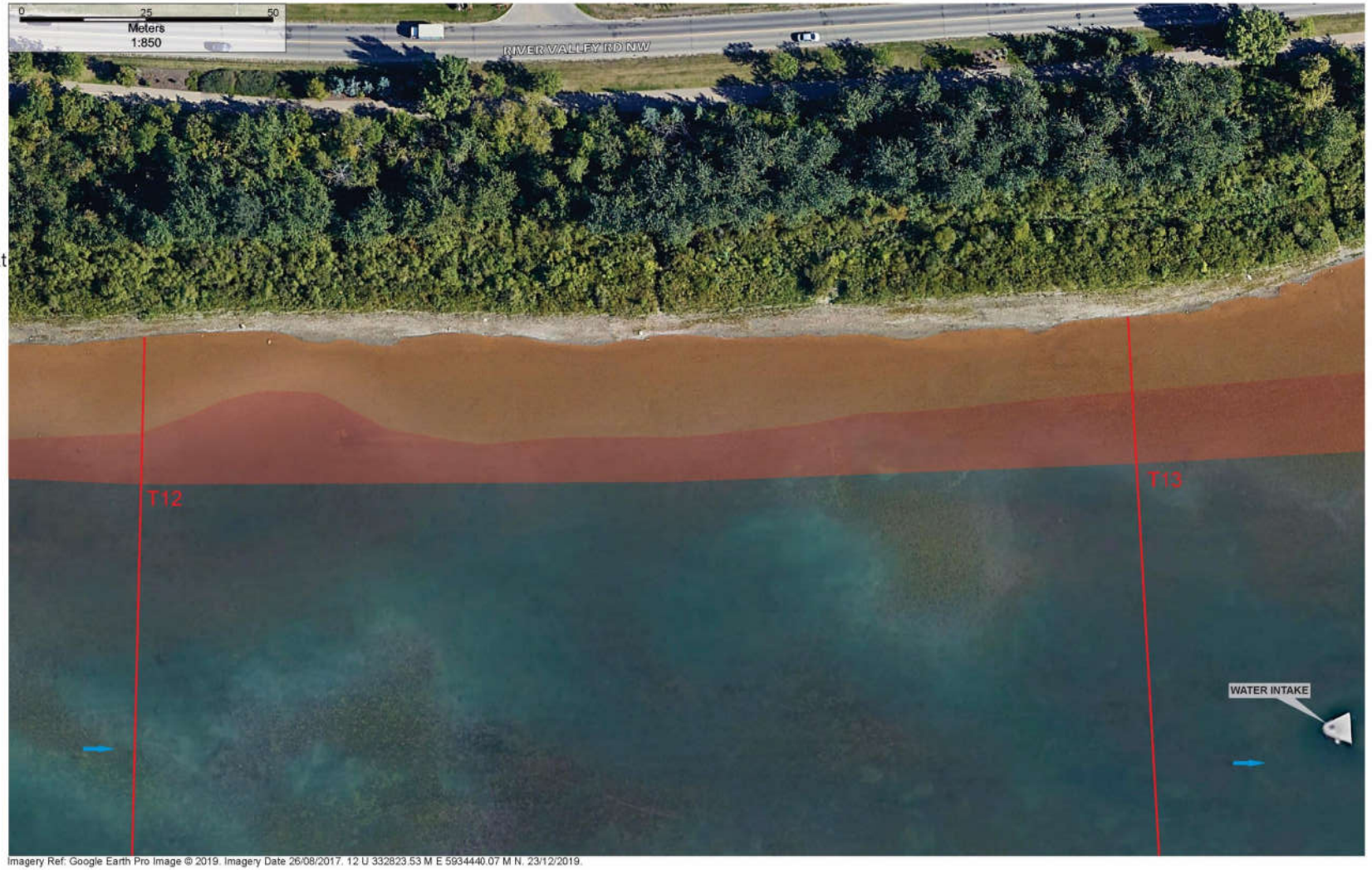

FIGURE E12.

Near-Shore Fish Habitat

LEGEND

General

- Flow Direction
- Transects
- T1 Habitat Transects Label

Water Depths

- < 0.5 m
- 0.5 m to 1.0 m
- > 1.0 m

Anthropogenic Bank Features

- Large Outfalls
- Small Outfalls
- Riprap
- Other Feature

Kingfisher Aquatics

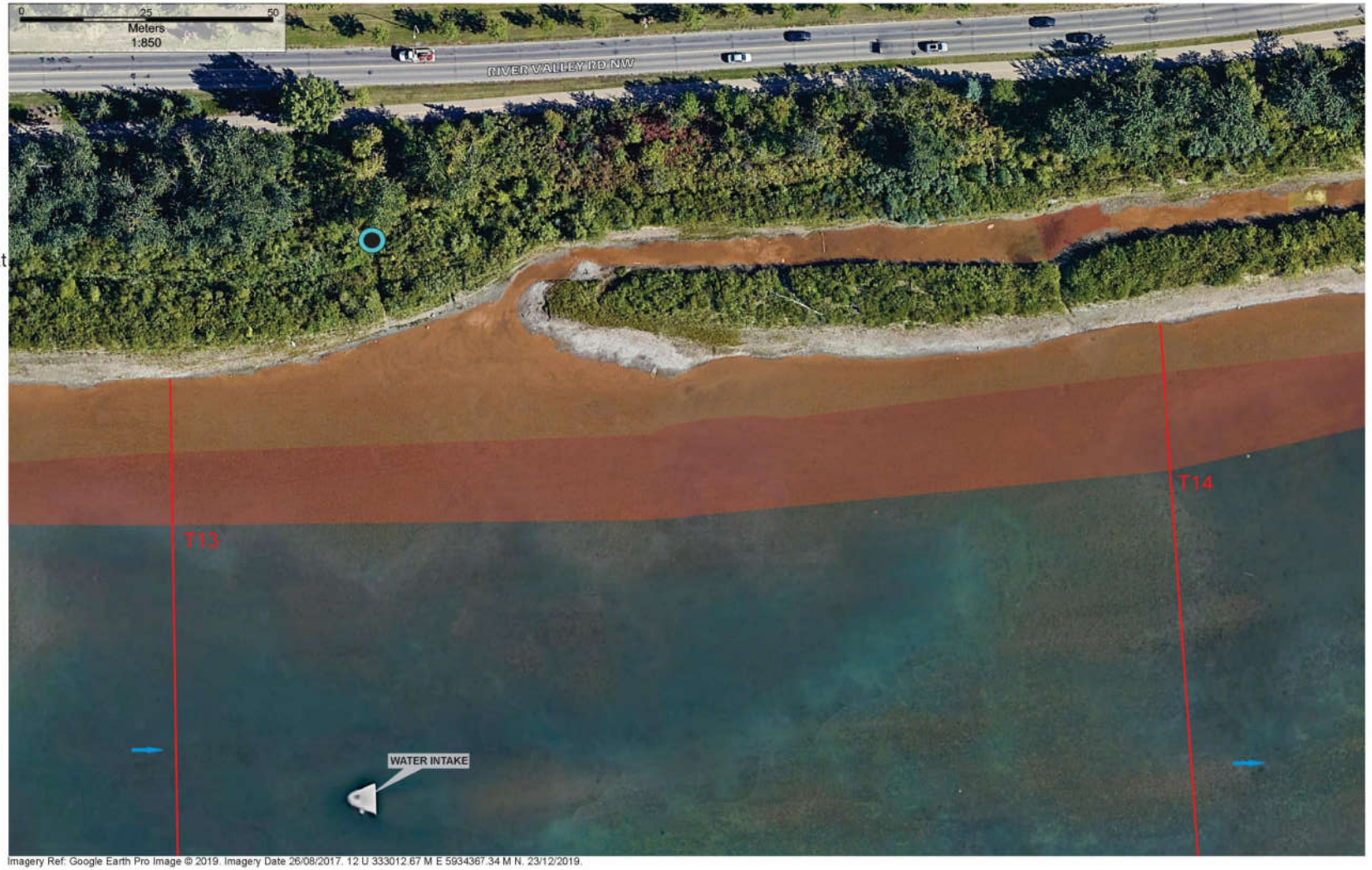

FIGURE E13.

Near-Shore Fish Habitat

LEGEND

General

- Flow Direction
- Transects
- T1 — Habitat Transects Label

Water Depths/Habitat

- < 0.5 m
- 0.5 m to 1.0 m
- > 1.0 m
- Riffle

Anthropogenic Bank Features

- Large Outfalls
- Small Outfalls
- Riprap
- Other Feature

Kingfisher Aquatics


0
25
50
Meters
1:850
RIVER VALLEY RD NW
T14
T15
FIGURE E14.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths/Habitat
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Riffle
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
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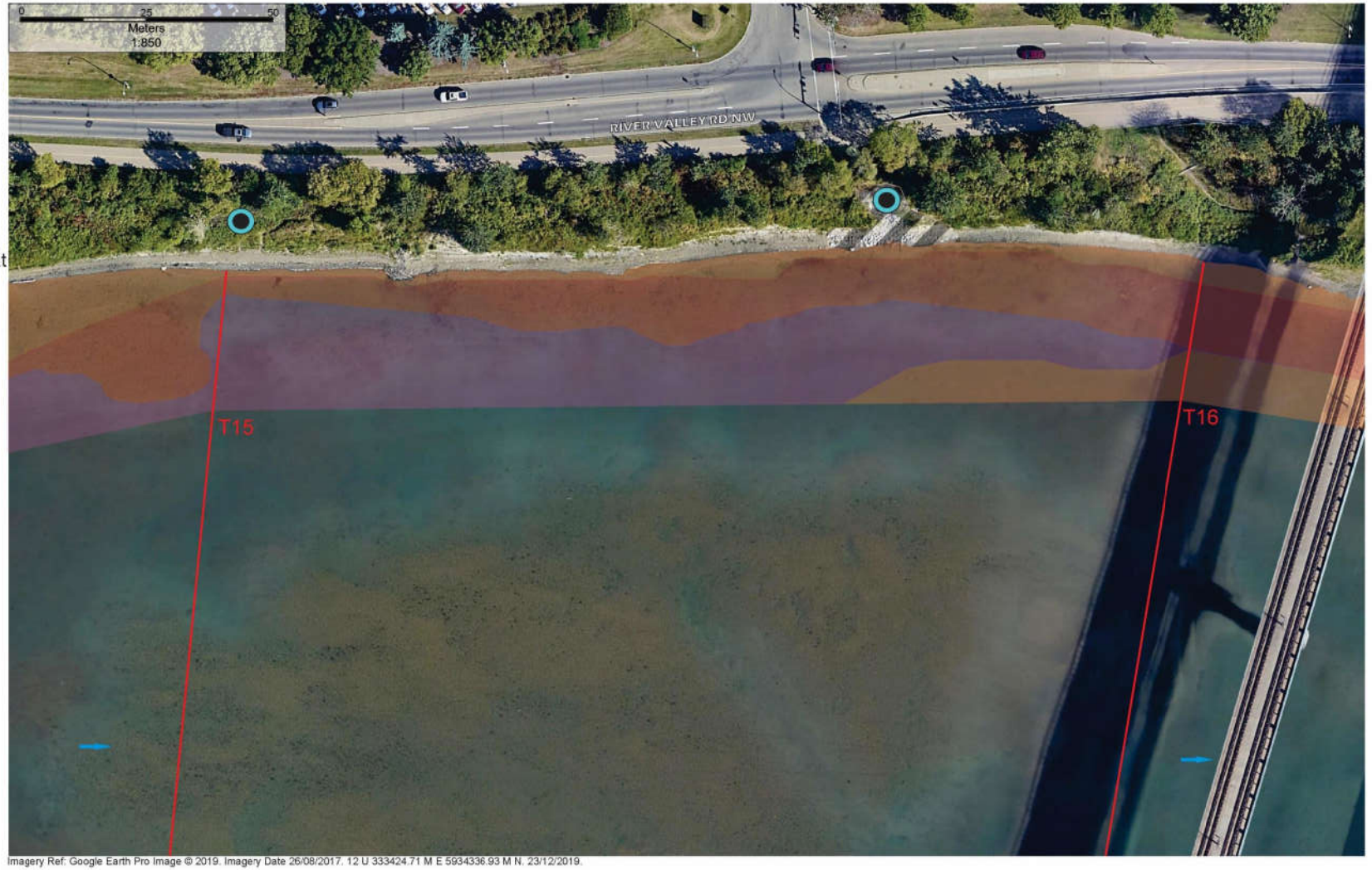

FIGURE E15.

Near-Shore Fish Habitat

LEGEND

General

- Flow Direction
- Transects
- T1 Habitat Transects Label

Water Depths

- < 0.5 m
- 0.5 m to 1.0 m
- > 1.0 m

Anthropogenic Bank Features

- Large Outfalls
- Small Outfalls
- Riprap
- Other Feature

Kingfisher Aquatics

Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 333424.71 M E 5934336.93 M N. 23/12/2019.


0
25
50
Meters
1:850
RIVER VALLEY RD NW
RIVER VALLEY RD NW
T16
T17
DUDLEY B. MENZIES BRIDGE
109 St NW HIGH LEVEL BRIDGE
N
FIGURE E16.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 333592.05 M E 5934313.41 M N. 23/12/2019.


0
25
50
Meters
1:850
N
RIVER VALLEY RD NW
T17
T18
FIGURE E17.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transcects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 333788.60 M E 5934247.54 M N. 23/12/2019.


0
25
50
Meters
1:850
RIVER VALLEY RD NW
T18
T19
FIGURE E18.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
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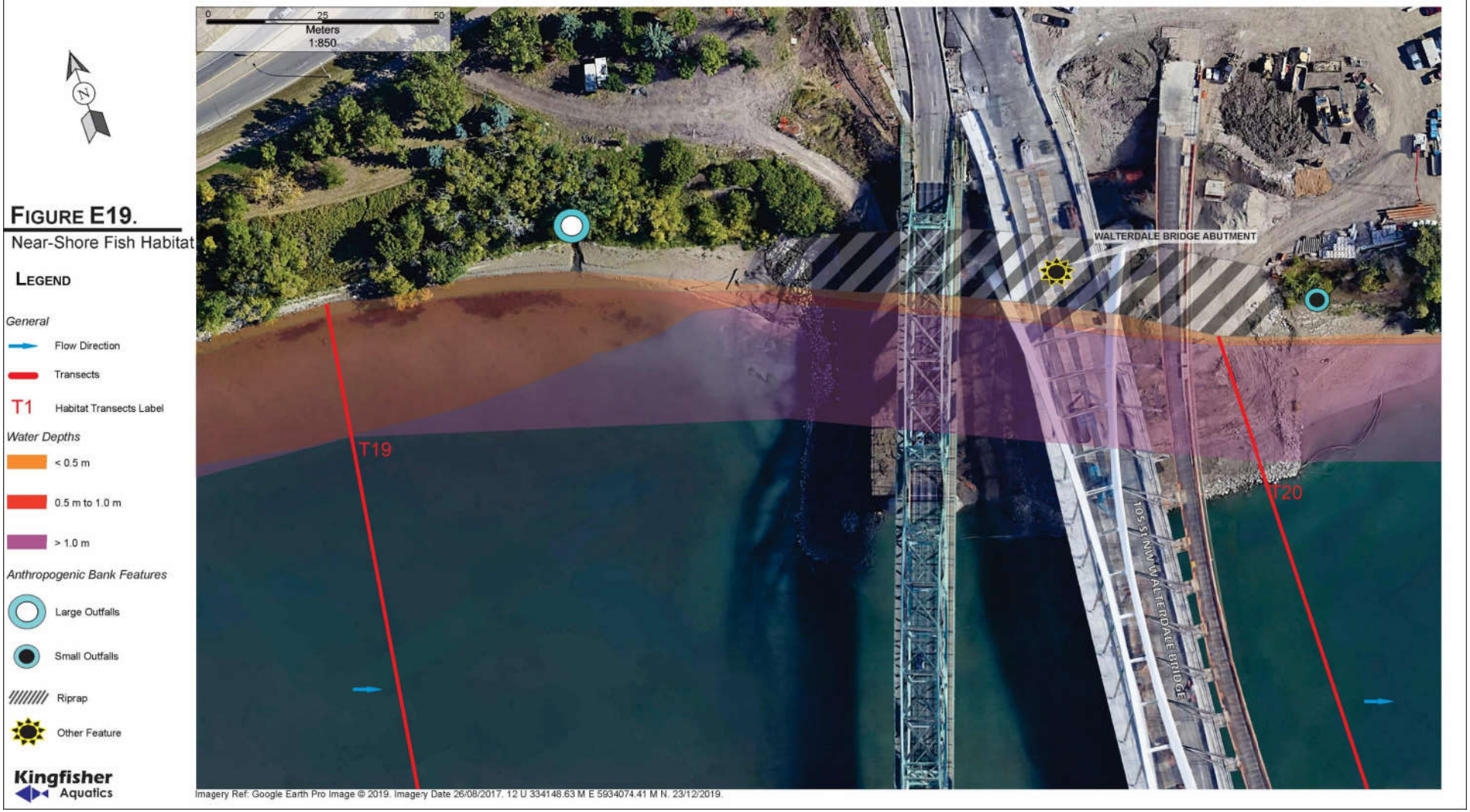
0
25
50
Meters
1:850
N
FIGURE E19.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
WALTERDALE BRIDGE ABUTMENT
T19
T20
105 St NW WALTERDALE BRIDGE
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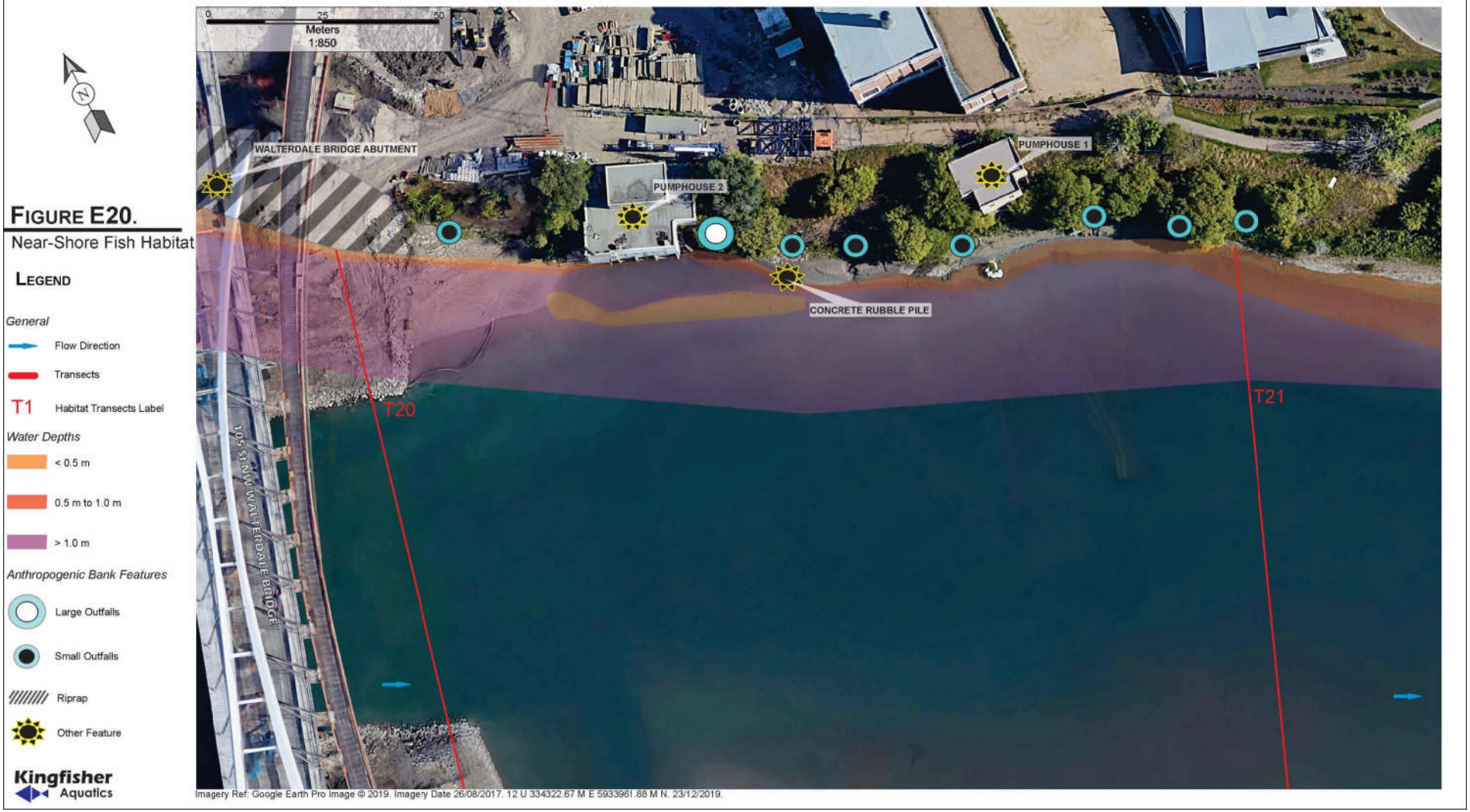

0
25
50
Meters
1:850
WALTERDALE BRIDGE ABUTMENT
PUMPHOUSE 2
PUMPHOUSE 1
CONCRETE RUBBLE PILE
T20
T21
105 ST NW WALTERDALE BRIDGE
FIGURE E20.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 334322.67 M E 5933961.88 M N. 23/12/2019.


0
25
50
Meters
1:850
N
FIGURE E21.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
T21
T22
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 12 U 334491.53 M E 5933873.11 M N. 23/12/2019.

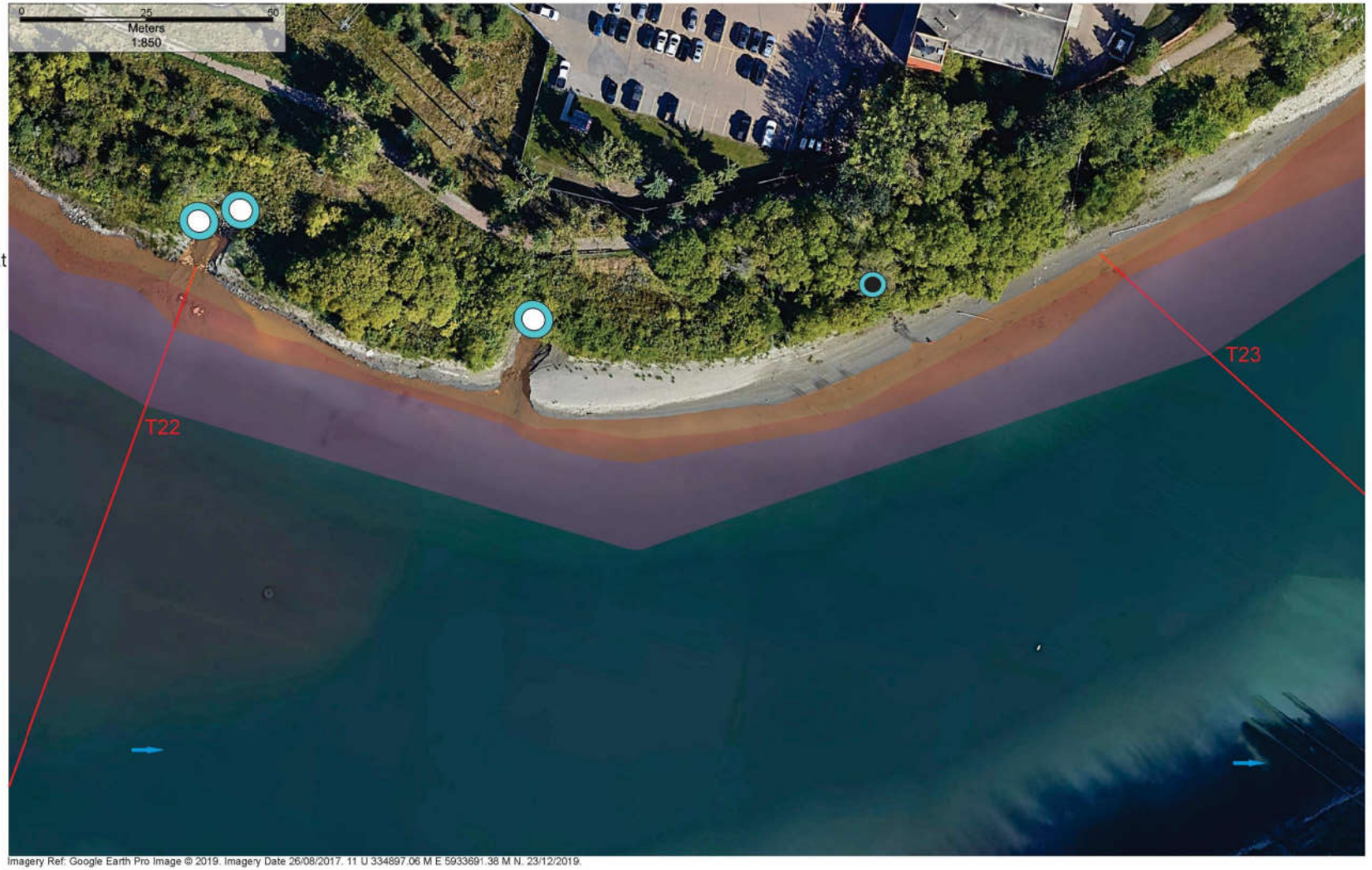


FIGURE E22.

Near-Shore Fish Habitat

LEGEND

General

Flow Direction

Transects

T1 Habitat Transects Label

Water Depths

< 0.5 m

0.5 m to 1.0 m

> 1.0 m

Anthropogenic Bank Features

Large Outfalls

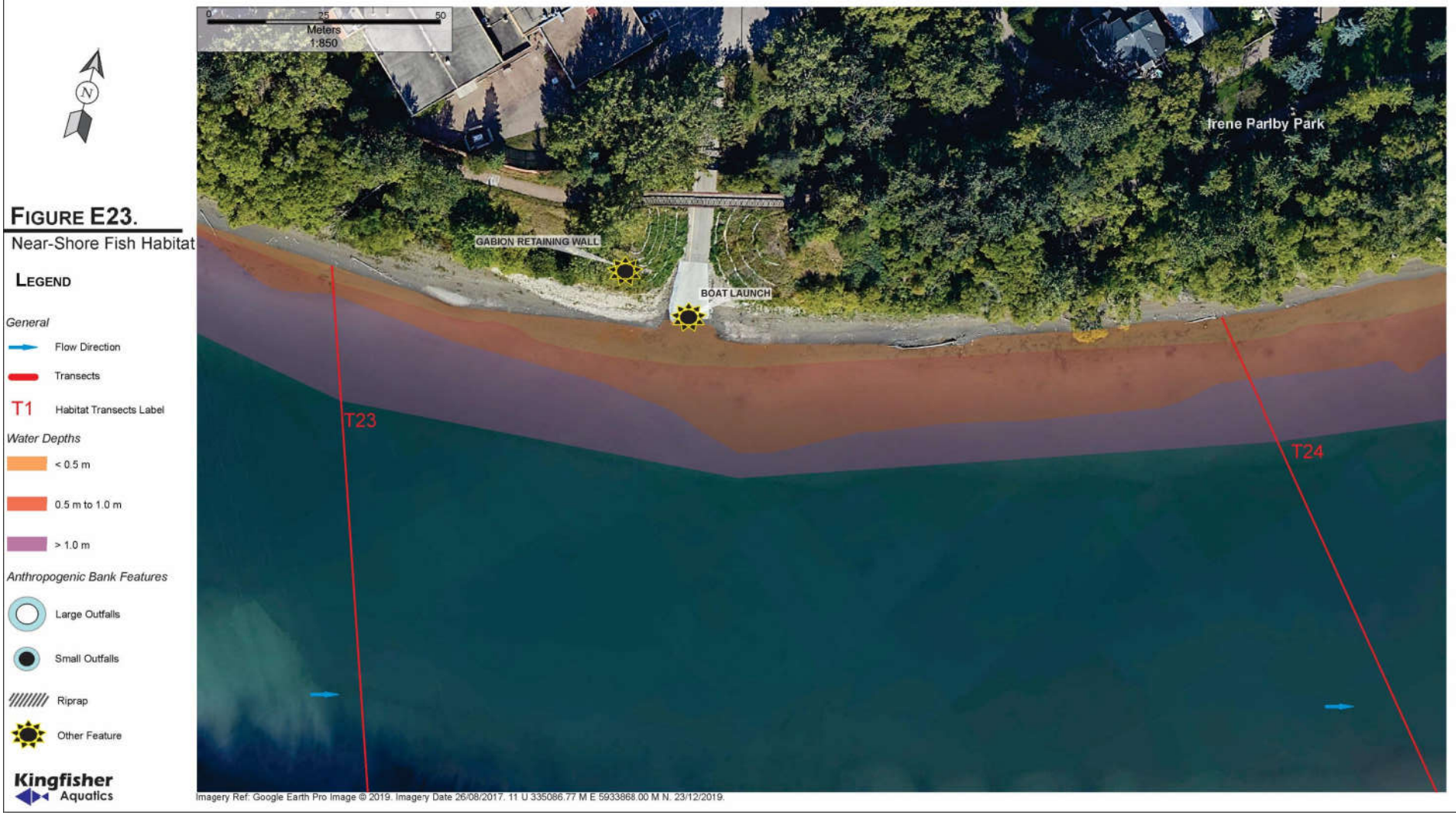
Small Outfalls

Riprap

Other Feature

Kingfisher Aquatics

Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 11 U 334897.06 M E 5933691.38 M N. 23/12/2019.


0
25
50
Meters
1:850
N
Irene Parlby Park
GABION RETAINING WALL
BOAT LAUNCH
T23
T24
FIGURE E23.
Near-Shore Fish Habitat
LEGEND
General
Flow Direction
Transects
T1
Habitat Transects Label
Water Depths
< 0.5 m
0.5 m to 1.0 m
> 1.0 m
Anthropogenic Bank Features
Large Outfalls
Small Outfalls
Riprap
Other Feature
Kingfisher Aquatics
Imagery Ref: Google Earth Pro Image © 2019. Imagery Date 26/08/2017. 11 U 335086.77 M E 5933868.00 M N. 23/12/2019.

Appendix F

Photographs

Plate 1: Looking at the RUB at Transect 1.

Plate 2: Looking at the RUB at Transect 2.

Plate 3: Looking at the RUB at Transect 3.

Plate 4: Looking at the RUB at Transect 4.

Plate 5: Looking at the RUB at Transect 5.

Plate 6: Looking at the RUB at Transect 6.

Plate 7: Looking at the RUB at Transect 7.

Plate 8: Looking at the RUB at Transect 8.

Plate 9: Looking at the RUB at Transect 9.

Plate 10: Looking at the RUB at Transect 10.

Plate 11: Looking at the RUB at Transect 11.

Plate 12: Looking at the RUB at Transect 12.

Plate 13: Looking at the RUB at Transect 13.

Plate 14: Looking at the RUB at Transect 14.

Plate 15: Looking at the RUB at Transect 15

.

Plate 16: Looking at the RUB at Transect 16.

Plate 17: Looking at the RUB at Transect 17.

Plate 18: Looking at the RUB at Transect 18.

Plate 19: Looking at the RUB at Transect 19.

Plate 20: Looking at the RUB at Transect 20.

Plate 21: Looking at the RUB at Transect 21.

Plate 22: Looking at the RUB at Transect 22.

Plate 23: Looking at the RUB at Transect 23.

Plate 24: Looking at the RUB at Transect 24.

Plate 25: Looking at the Groat Ravine outfall and adjacent riprap at Government House Park.

Plate 26: Looking at the north pier of the Groat Road Bridge

Plate 27: Looking at concrete riprap on the RUB between Transect 7 and Transect 8

Plate 28: Looking at the upstream end of the island side channel.

Plate 29: Looking downstream of the upstream end of the island side channel.

Plate 30: Looking downstream from the downstream end of the island side channel.

Plate 31: Looking at the north end of the High Level Bridge between Transect 16 and Transect 17.

Plate 32: Looking at the north end of the LRT Bridge between Transect 16 and Transect 17.

Plate 33: Looking at the Walterdale Bridge riprap at the downstream end of the Project Area.

Plate 34: Looking at upstream at Pumphouse 2.

Plate 35: Looking at the downstream side of Pumphouse 1

Plate 36: Looking at the downstream at the Edmonton Fire and Rescue boat launch.

Appendix E: Environmental Regulatory Requirements

Table 1. Summary of Potential Environmental Approvals for City of Edmonton Projects in the North Saskatchewan River Valley

Legislation or Policy	Regulatory Agency	Relevance to Project	Potential Authorization/Approval/ Permit Required	CoE Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
Federal					
Fisheries Act	Fisheries and Oceans Canada (DFO)	The *Fisheries Act* requires that projects occurring in or near water avoid causing the death of fish and the harmful alteration, disruption or destruction (HADD) of fish habitat. If there are aquatic species at risk in the area, proponents must also avoid harming, harassing, capturing or taking those species pursuant to the *Species At Risk Act (*SARA*)*. DFO has developed a series of standards and codes of practice for common works, undertakings and activities. These provide guidance on how to avoid and mitigate impacts to fish and fish habitat and comply with the *Fisheries Act* and *Species at Risk Act.* In cases where impacts to fish and fish habitat cannot be avoided, and the project does not fall within waterbodies where DFO review is not required or the scope of the project is not covered under standards and code of practice, proponents should submit a request for review to their region's Fish and Fish Habitat Protection Program office. If death of fish, the harmful alteration, disruption or destruction (HADD) of fish habitat will likely result from a project, the proponent is required to obtain an authorization from the Minister of	Review and/or Authorization	It is anticipated that: • A QAES will be required to conduct a site visit to confirm potential for HADD. If no serious harm to fish is anticipated, then only best management practices required as directed by QAES, or • QAES to consult with DFO regarding if an Authorization is required.	Schedule potentially impacted only if Authorization is required. Request for Review has no specific time limits, anticipate a minimum of three months. Authorization can take up to 150 days (60 days to determine if application is complete and 90 days to issue authorization). Amendments to the application will restart the review schedule.

Legislation or Policy	Regulatory Agency	Relevance to Project	Potential Authorization/Approval/ Permit Required	CoE Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
		Fisheries, Oceans and the Canadian Coast Guard as per Paragraph 34.4(2)(b) or 35(2)(b) of the *Fisheries Act Regulations*. DFO recommends that an application for authorization only be pursued after a project review has been completed. If harm, harassment, capture or take of an aquatic species at risk will likely result from your project, but not death of fish, nor the harmful alteration, disruption or destruction of fish habitat, then proponents are required to apply for a SARA permit. Failure to abide by the terms and conditions of the permit is a contravention of the Act and may result in fines.			
Canadian Navigable Waters Act (CNWA)	Transport Canada	The *CNWA,* brought into force late August 2019, authorizes and regulates interferences with the public right of navigation. The Act identifies scheduled and non-scheduled navigable waters. Scheduled (listed) waters are those navigable waters for which regulatory approval is required for works that risk a substantial interference with navigation. The Act creates a new category for "major" works that are likely to substantially interfere with navigation. These works will always require approval from Transport Canada whether the affected navigable waters are on the schedule or not. Major works include fixed span bridges with one or more piers below the ordinary high-water mark. The North Saskatchewan River is a Scheduled waterway.	Approval	Consultation with Transport Canada to determine if Approval is required.	Schedule may be impacted if Approval is required

Legislation or Policy	Regulatory Agency	Relevance to Project	Potential Authorization/Approval/ Permit Required	CoE Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
		Temporary works that are installed for a period of at least 30 consecutive days for the construction, placement, alteration, rebuilding, removal, decommissioning, repair or maintenance of a bridge, are designated as major works, unless they are installed during a period when navigation is not possible.			
Migratory Birds Convention Act (MBCA)	Environment and Climate Change Canada	This Act prohibits the disturbance of nests and individuals of most migratory bird species and prohibits release of deleterious substances into waters or areas frequented by migratory birds. Project may require 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 MBCA 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*)	Nest sweeps undertaken between 20 April and 20 August have potential to result in findings that delay clearing.
Species At Risk Act (SARA)	Environment and Climate Change Canada	This Act prohibits disturbance to listed species and, in some instances, listed species' habitat on federal lands. On non-federal lands, the Act applies to disturbance of listed aquatic species and listed migratory birds.	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 construction 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.
Provincial					
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 or Clearance from ACMSW.	*Historical Resources Act* Approval or Clearance.	CoE to submit *Historical Resources Act* application to ACMSW. ACMSW will determine if an Historical Resources Impact Assessment (HRIA) is required.	~3 months for ACMSW review of application
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.	Department License of Occupation (DLO) approval(s) and/or Temporary Field Authorization (TFA)	City to submit DLO and TFA (if required) applications to AEP.	+/- 1 year for DLO approval - a few weeks to several months for a TFA approval

Legislation or Policy	Regulatory Agency	Relevance to Project	Potential Authorization/Approval/ Permit Required	CoE Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
			required if watercourses are claimed by Crown and trail crossings and/or construction impacts bed and shore of watercourses		
Water Act	Alberta Environment and Parks (Water Approvals Branch)	This Act is the primary piece of legislation governing the use and management of Alberta's water resources, including water held in permanent and temporary wetlands. Approval is required for many activities affecting water and, in some cases, for placement of infrastructure on watercourse banks. The *Water Act* also contains provisions to prevent deposition of deleterious substances (including sediment and other contaminants) into watercourses. Some activities affecting watercourses are regulated through Code of Practice Notifications.	*Water Act* Approval and/or Code of Practice Notification	CoE to submit *Water Act* approval application or CoP Notification. Specifications and recommendations of a Qualified Aquatic Environment Specialist (QAES) may be required.	~3 -6 months for *Water Act* Approval - CoP Notification submission at least 14 days prior to construction commencement.
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.	Although permitting for clearing is not required under the Act, violations of Act, e.g., disturbances of breeding wildlife such as flying squirrels, 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 between 16 February and 20 April, undertake a sweep for active owl nests.	Not applicable if vegetation clearing is completed outside of the period 16 February to 20 August. Nest sweeps undertaken between 16 February and 20 August have potential to result in findings that delay clearing.

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Environmental Protection and Enhancement Act (EPEA)	Alberta Environment and Parks	Under EPEA, the release of deleterious substances, including hazardous materials from spills or from erosion, are reportable incidents. If a release occurs, it is the duty of the Contractor to report releases of substances into the environment that may cause an adverse effect and to take reasonable remediation measures. EPEA also regulates stormwater drainage and management facilities. There is some potential that the daylighted creek would pass through areas of known contamination, which could introduce the need for a detailed Environmental Site Assessment (ESA) and potentially the development of a risk management plan or other remedial actions. EPEA would also apply if stormwater ponds and other stormwater infrastructure are constructed or modified as part of the daylighting project. Consultation with Alberta Environment and Parks during the design phase of the project is recommended to further determine information needs and permitting requirements pursuant to EPEA.	No permits/approvals required; compliance only.	CoE to collaborate with EPCOR and Alberta Environmental and Parks	Schedule will likely be impacted if an ESA is required
Municipal					
North Saskatchewan River Valley Area Redevelopment	City Planning	Bylaw regulates all activities on City lands in the North Saskatchewan River Valley. The proposed project falls within the Bylaw 7188 area. Construction of a new recreational trail in the river valley is considered a "major facility" pursuant to Bylaw 7188 and requires completion	EIA and SLS will require City Council approval and for City Council to deem the project's location in the river valley as essential.	City Planning has confirmed the need for an Environmental Impact Assessment (EIA) and Site Location Study (SLS) for City Council approval.	Completion of an EIA and SLS and acquisition of City Council approval generally takes

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Plan (Bylaw 7188)		of an Environmental Impact Assessment (EIA) and a Site Location Study (SLS).			approximately 6-8 months.
Corporate Tree Management Policy C456	City Forestry	Policy provides protection for City tree/shrub inventory and a mechanism for monetary compensation for lost canopy. Prior to removal, trees are assessed by City's Urban Forestry Department.	None, but compensation for lost canopy must be arranged with CoE.	The proponent will meet with City of Edmonton's Urban Forester to assess shrubs and trees to be removed, if required, and an appropriate project-specific compensation program will be developed accordingly.	Compensation to be realized as part of the project as a whole. Contract tender will ensure compliance regarding protection of retained trees.
City of Edmonton Parkland Bylaw 2201	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.	Applies to construction phase. City or contractor responsibility.
City of Edmonton Bylaw 18100 Epcor Drainage Services Bylaw	EPCOR	Bylaw regulates use of the sewer system and contractor must consult with EPCOR regarding use of sewer to dewater site. Application for a permit and payment of fees.	No prohibited, restricted or hazardous waste may be released into the sewerage system without written consent from EPCOR.	Application for a permit to discharge to sewer system may be required.	Applies to construction phase. City or contractor responsibility.
Drainage Bylaw 18093	City of Edmonton	The purpose of this bylaw is to regulate surface drainage on public and private land and to foster the well-being of the environment by prohibiting the release of dangerous or hazardous matters into the sewerage system. Part III of this Bylaw prohibits the release of hazardous materials and materials that produce a colour value greater than or equal to 50 true colour units. The release of any material other than that permitted in this Bylaw may result in penalties. Compliance will be achieved through spill prevention measures,	No permits/approvals required; compliance only.	None	Applies to construction phase. Contractor responsibility.

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		erosion and sedimentation control measures, and adherence to the City of Edmonton's "Contractor's Environmental Responsibilities Package".			
City of Edmonton Community Standards Bylaw 14600	City of Edmonton	No approval or application	No permits/approvals required; compliance only	None	Proponent responsibility.
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.	• 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	• Proponent to implement process as project is underway. • Checklist to be completed by City prior to tender.	Proponent responsibility.