Weaselhead/Glenmore Park
Southwest Calgary Ring Road Environmental Impact Study 2016-2022

Final Report

Environmental Impacts from the Southwest Calgary Ring Road Project on the Weaselhead Special Protection Natural Area:

Field Studies from 2016 through 2022 with Interpretations and Recommendations

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Please note that raw data not included in the report is available on request.

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EXECUTIVE SUMMARY

Situated in southwest Calgary, Alberta, Canada, the Weaselhead Natural Environment Area, designated as a Special Protection Natural Area by the City of Calgary is a widely used City Park that extends over a delta where the Elbow River flows into Glenmore Reservoir. The delta development followed the reservoir flooding in 1933 and includes a braided network of active and abandoned channels, with both oxbow ponds and wetlands. The Weaselhead includes a rich mosaic of aquatic, riparian, and upland habitats including willow shrub lands, balsam poplar, white spruce, and trembling aspen woodlands, which support abundant and diverse birds and other wildlife. The Weaselhead/Glenmore Park Preservation Society (Society) was established in 1994 to preserve and enhance biodiversity, protect the integrity of the Elbow River and to provide conservation education.

The outcomes from large-scale infrastructure projects have impacts on five major contemporary issues of wildlife conservation biology: habitat loss, sensory disturbance, habitat fragmentation, barriers to movement and reduced connectivity, and direct mortality. The Society conducted a seven-year environmental impact study (Study) on the Southwest Calgary Ring Road (SWCRR) Project (Project) from 2016-2022. Studies such as this, which include baseline data, cover the construction period, and continue monitoring into the operational period, allowing for direct comparison between conditions before and after road construction – are rare. This Study is used to inform an objective evaluation of the local impact on selected environmental components, as well as the success/failure of the mitigation measures that were adopted. The mitigation measures were agreed upon with the expectation that they would render the impacts on these components acceptable (as detailed in KGL Constructors, a joint venture partnership between Kiewit, Graham and Ledcor, contract with Alberta Transportation). The data from the Study allows the Society to present discussion for improved mitigation based upon verifiable and scientific evidence. The Society hopes that this long-term Study will also help improve global road mitigation efforts.

Sediment and erosion mitigation methodology currently in place failed repeatedly despite meeting policy standards. Sediment control failures have significant negative impacts on fish, amphibians and aquatic invertebrates. This Study found statistically significant increases in conductivity, nitrate, and phosphate over time in the Beaver Pond[3]. The Project's third-party water quality analysis found heavy metals persisting in the Beaver Pond including elevated concentrations of chromium, nickel, selenium, arsenic and uranium[4, 5]. Zinc concentrations were elevated from 2019 – 2022 returning to acceptable levels in 2023[5].

AMEC Environment and Infrastructure prepared an Environmental Impact Assessment (EIA) for Alberta Transportation in 2006, updated in 2014. The EIA predicted several impacts to be '*minor*' that the Society has concluded to have a larger negative impact in confirmed outcomes than predicted[1]. These effects include minor negative long-term effects impacting the hydrological regime of wetlands; and minor negative effects in terms of decreased wetland habitat[1]. The Society believes these impacts have been major with significant hydrological changes and decreased wetland habitat.

The Society undertook a breeding bird survey, with sound and sight observations at locations assessed during the EIA. The Society found bird species that were both 'sensitive' and 'may be at risk' in the Weaselhead Study Area[3]. Bird occurrences were reduced during the construction phase, as expected[3]. Subsequently, many species had returned or increased in 2021 and 2022, after the construction phase, suggesting a temporary

impact from the Project[3]. Further investigation is required to ensure that the SWCRR does not impact the long-term viability of these species to occur in the area.

The Society determined that noise levels significantly increased over the Project and into operation[3]. There was seasonal variation in noise accompanying the different construction activities, and pile driving was the loudest. Noise levels now reach an average of 65 dB which meets the Provincial requirement for sound wall installation in urban areas, however current policies do not require this for natural areas[3].

Wildlife movement was evaluated to be impeded during construction of the SWCRR with increased connectivity post construction being anticipated to improve with continued revegetation efforts[6, 7]. Lack of transparency regarding revegetation has made it difficult to evaluate what mitigation attempts were made, their success, or whether they met the requirements[2]. Visual observations indicate revegetation efforts have not met the standards outlined in the Technical Requirements and Eco Plan[2, 9]. Wildlife fencing Technical Requirements have not been met and have resulted in numerous vehicle collisions with wildlife in the Elbow River Valley along the SWCRR[2, 8].

EIA reports are required by the Province of Alberta, Canada for projects such as the construction of the SWCRR. The economic, social, and anticipated environmental impacts of the project (as completed with the proposed mitigation measures) are considered in this decision-making process. The Society applauds the Province of Alberta and AMEC for the in-depth EIA prepared for this Project. A primary concern identified by the Society is that the mitigation measures detailed in the Technical Requirements were not always implemented to specifications[2, 3].

The Society recommends the Province of Alberta develop and implement improved policy, accountability, and enforcement measures regarding mitigation requirements to ensure these policies are environmentally sufficient and are being met by contractors for all infrastructure projects.

Table 1. Report Summary. Bolded ecosystem components were directly studied in the WGPPS Study, while un-bolded components are additional areas of concern.

EIA Prediction	Technical Requirements	Study Outcome Assessment	Study Recommendation
Ecosystem Component: Vegetation			
Negative effects on vegetation to be minor, local, and isolated with some uncertainty regarding loss of rare plants[1]. Although the total footprint of permanent land disturbance is 1, 135 ha, disturbance related to road construction will be minor and localized [1].	Vegetation clearing at selected timing to avoid breeding birds and amphibian disturbance[2]. Rare plant surveys conducted prior to removal of vegetation[2].	Complete loss of vegetation is isolated to the TUC. Hydrological changes in the Beaver Pond impacting vegetation may have resulted from the SWCRR and KGL is already committed to investigating this. Species diversity increased over time with the drying soil.	Continued evaluation of the Beaver Ponds riparian vegetation to assess whether successional change towards upland habitat is occurring and determine the long-term viability of this wetland in response to hydrology changes.
Additional Considerations: Revegetation			
Low native shrubs and native grassland restoration to be undertaken between Anderson road and Elbow River Valley to mitigate effects of vegetation loss and aid in wildlife movement[1].	To be revegetated as soon as possible mimicking natural species profile and monitoring for 1 year for 85 – 90 % survival rate[2].	Revegetation does not appear to have been successful with limited woody plants visible in the wildlife corridor and around the stormwater ponds.	Improve revegetation policies to ensure success of revegetation efforts as well as wildlife management goals.
Additional Considerations: Invasive Plant Management			

Minor negative effects in terms of weed establishment with some uncertainty[1].	Develop a Weed Management Plan and control weeds to ensure compliance with the Alberta Weed Control Act[2].	Major negative effects have occurred with weed establishment including prohibited noxious weeds.	More aggressive weed management with frequent early detection, rapid response sweeps.
Ecosystem Component: Noise Pollution			
Predicted increase in noise resulting from both construction activities and traffic on the SWCRR once in operation[1]. Population reductions in songbird abundance and densities expected from highway noise disturbance. (EIA page 218). Noise levels predicted to exceed 65 dB (EIA page 506)	Use noise reduction equipment to muffle and reduce sensory disturbance to wildlife. No pedestrian pathways to be included in wildlife corridors[2]. Noise attenuation barriers installed adjacent to residential areas[2].	Noise level recordings over the Study revealed a statistically significant increase in noise[3]. The average noise level detected in 2016 was 40 dB and in 2022 was 65 dB[3].	Province to reconsider the sound mitigation requirement guidelines and update its policy to include Key Wildlife and Biodiversity Zones. Further consideration to install noise attenuation barriers in the Elbow Valley should be undertaken.
Ecosystem Component: Breeding Birds			
Concern over birds avoiding the area with increased disturbance and traffic noise with significant reductions in songbird abundance and densities around highway sources of noise pollution[1]. Concluding that enough habitat remains to support bird population[1].	Vegetation clearing not to occur between April 12 and August 30 of any given year to avoid breeding season for birds[2]. The nests of migratory birds are protected under the Migratory Birds Convention Act[2].	Vegetation clearing was done in the restricted time frame and nest boxes of migratory birds were removed during the nesting period[10, 11]. Fines were given for both violations[10, 11]. Our Study found a dip in species during the construction period that recovered[3].	Continued long term monitoring of bird species to take place with improved methodologies to also include surveying nocturnal species, and bird species with differing temporal behaviour and migratory patterns as well as comparing populations to noise pollution levels.
Ecosystem Component: Wildlife - Mammal Movement			
Habitat fragmentation and reduced connectivity with barriers to movement were predicted to be negative with minor to moderate, long-term impacts[1]. Species predicted to be most prone to the effects of movement obstruction are cougar, lynx, bobcat, black bear and moose[1].	To establish wildlife movement corridors under the Elbow River and Fish Creek bridges that would maintain movement from construction to the operational phase, revegetated as soon as possible to provide rest and cover[2].	Mitigation efforts appeared to have limited efficacy during the construction phase of the Project compared to during the operational phase[3, 6].	Revaluate revegetation needs to provide rest and cover opportunities to facilitate wildlife movement and connectivity. Alberta Transportation to work with wildlife organizations such as Western Transportation Institute, the Biodiversity Research Centre, and Miistakis Institute to better develop and implement effective mitigation efforts addressing wildlife movement during road construction.
Additional Considerations: Wildlife Fencing			
Effects of fragmentation will be highest in the Fish Creek and Elbow River valleys, realized primarily in barriers to movement[1]. Wildlife fencing to be constructed to direct wildlife to riparian wildlife passage areas thereby preventing wildlife vehicle collisions[1].	Fencing should incorporate a small mesh component directly above and below the ground surface[2, 12]. Maximum ground to fence gap and clearance between gate posts to be 75mm[12]. Designed to discourage animals from accessing the roadway and to funnel movement to underpass[2].	Fencing does not meet the Technical Requirements with a 3 foot gap in fencing observed to facilitate wildlife accessing the roadway and multiple collisions documented adjacent to that gap[2, 8, 12] . Fence to ground gaps exceed 75mm, in some areas up to 254 mm. Does not functionally direct wildlife to underpass as majority of collisions occurred where fencing ends just north of underpass[8].	Further investigation should be undertaken to determine the shortcomings in the wildlife fencing that was installed with improvements made to meet the requirements to ensure the safety of drivers using the SWCRR and animals that cross into and out of the park[12].
Ecosystem Component: Water Quality			

No residual effects to surface water quality from the construction or operation of the SWCRR as these impacts can be mitigated against with the Project design and ECOPlan[1, 9]. Assessed impacts to be minor and negligible[1].	Design to not negatively impact watercourses[2]. Maintain appropriate sediment and erosion controls such as silt fencing and align to Best Management Practices (BMP's Page 502)[2].	Significant increases in phosphate, nitrate and conductivity in the Beaver Pond over time observed[3]. Elevated concentrations of zinc, chromium, nickel, selenium, arsenic and uranium[4, 5]. Continued exploration of water quality will be conducted by Ausenco Sustainability Inc., Prepared for KGL Constructors[5].	Improve policies and standards regarding sediment and erosion control and road design concerns impacting water quality. Our recommendation regarding ongoing monitoring is already being met as water quality concerns have arisen by KGL resulting from the Project monitoring.
Ecosystem Component: Wetlands			
Decreased wetland area and alteration of hydrological function[1].	Continued exploration of water quantity and quality in the Beaver Pond will be conducted by Ausenco Sustainability Inc., Prepared for KGL Constructors[5]. Investigations of flow will be addressed to determine if the SWCRR Project contributed to the water decline[5].		
Additional Considerations: Sediment and Erosion Control			
Moderate concerns over soil erosion due to wind with soil and water erosion concerns rated as high within river valleys and slopes[1]. Minor, negative, subregional, short-term impacts from erosion and sedimentation during construction[1].	To prevent sediment from entering water bodies[2].	Repeated sediment and coarse infill slides into water bodies occurred resulting from failing mitigation efforts.	Policies and standards currently in place require updating. Alberta Transportations Best Management Practices failed during heavy rain events, thus need improvement.
Additional Considerations: Hydrology			
Minor negative long-term effects impacting the hydrological regime of wetlands with an alteration of wetland hydrological functions[1].	Spill management plans, implement standard erosion control techniques, maintain existing hydrological connections, and maintain surface flow[2]. If disrupted, develop wetland replacement plan[2].	Major hydrological changes. The Beaver Pond experienced significant water loss during and following construction. The rest of the Weaselhead flats experienced significant water inundation with the Glenmore dam improvement.	Continued monitoring of flow into the Beaver Pond will be conducted by Ausenco Sustainability Inc. on behalf of KGL. Recommended to monitor groundwater with piezometers.
Ecosystem Component: Aquatic Invertebrates			
Potential Project related impacts from construction and operation exist related to watercourses which can impact water quality, hydrology, and benthic invertebrates[1].	Efforts of BMPs to maintain water quality preventing sediment and deleterious substances from entering waterbodies[2].	Temporary loss of caddisfly larvae in the Beaver Pond, a bio indicator species intolerant of pollution during construction, returning in 2021[3].	Improved policies and BMPs related to controlling sediment and erosion. Alberta Transportations Best Management Practices failed during heavy rain events, thus need improvement to better protect aquatic invertebrate populations.
Ecosystem Component: Fish			
Potential Project related impacts from construction and operation exist related to watercourses which can impact fish and fish habitat, water quality and hydrology[1].	Realignment design and general design instructed to maintain fish habitat and movement while reducing sediment and deleterious substances from entering waterbodies[2].	The WGPPS Study did not adequately evaluate impacts to fish populations. However, sediment and erosion mitigation failures were observed on multiple occasions.	Improved policies and BMPs related to controlling sediment and erosion. Alberta Transportations Best Management Practices failed during heavy rain events, thus need improvement to better protect fish and fish habitat.
Ecosystem Component: Amphibians			
Decreased physical habitat for amphibians will be negative and long term[1].	Vegetation clearing will not occur between April 12 and August 30 of any given year to prevent disturbance to breeding amphibians[2].	Temporary absence of Boreal chorus frogs noted during construction activities as these are bioindicator species not tolerant of water pollution. Presence returned when the road became operational.	Improved policies and BMPs related to controlling sediment and erosion. Alberta Transportations Best Management Practices failed during heavy rain events, thus need improvement to better protect amphibians and their habitat.

SCOPE

This document describes the final findings and recommendations of the seven-year environmental impact study (Study) completed by the Weaselhead/Glenmore Park Preservation Society (Society) in relation to the implemented mitigation measures, and Alberta Transportation and Contractor agreement.

The Study's recommendations have been highlighted within each section or subsection, with evidence and research supporting these recommendations found in the text of the section.

Each subsection will include, where relevant, the importance of each ecosystem component; the predicted SWCRR Project impact as indicated in the Environmental Impact Assessment (EIA); a brief description of EIA methodology and comments on the implementation of the mitigation measures stated in the EIA; an overview of the methodology used in the Study; the Study findings; other supporting work, and our recommendations.

The Study's assessment of the mitigation measures has been highlighted in a table at the conclusion of each section with the mitigation measure required, and the Study's outcomes and evidence regarding the outcome.

The EIA measured the impacts of the SWCRR according to specific characteristics and definitions. The predicted residual effects and impact from the EIA are referenced throughout this report. "*Residual impacts are defined and rated as those impacts remaining following implementation of proposed mitigation*" (AMEC EIA, 2014, p. 28). The methodology used in rating impact characterizes effect by magnitude, direction, location and scale, duration, scientific confidence, nature, frequency, reversibility, and ecological context on valued environmental components (VECs)[1]. These definitions, taken from the EIA, have been included in Appendix I for clarity when discussing the impact ratings in relation to the Study.

The Society's comments on relevant parameters regarding efficacy and completion of the proposed mitigation measures can be found in Appendix ll. This includes mitigation measures from the EIA and further mitigation measures and details found in the DBFO[2] and the ECO plan[9]. This is a thorough compilation of the findings within this document, within the scope of our assessment and within the limitations of our access to sites and documents.

INTRODUCTION

Construction of the SWCRR Project (Project) started in fall 2016. The Project's Environmental Impact Assessment (EIA) - carried out by AMEC in 2006, updated in 2014 - predicted alterations to habitats, and impacts on the environment of the adjacent Weaselhead Special Protection Natural Area (herein referred to as Weaselhead) both during construction and later at the operational phase of the SWCRR[1]. In this context, the Society embarked upon a seven-year environmental impact study (Study) that would span the years from initiation to completion of the SWCRR. The Study aimed to quantify the SWCRR's impacts on biophysical components of the park and social impact on park users. The objective of the biophysical aspect of the Study is not to attempt a comprehensive survey of habitats and ecosystem components and their change over the period of the Study, but to assess the impacts of the Project on selected environmental indicators and compare these outcomes with those predicted in the EIA.

Mitigation requirements for environmental impacts are detailed in several documents critical to the Project. The following documents were reviewed, if made available, to guide the assessment of the success of the applied mitigation techniques:

- Environmental Impact Assessment (EIA)[1]

- Design, Build, Finance, and Operate (DBFO) agreement between Alberta Transportation and the contractor, KGL Constructors, a joint venture partnership between Kiewit, Graham and Ledcor (also referred to as the Contractor) including Schedule 18 (Technical Requirements) – DBFO Agreement EXECUTION VERSION[2]
- Wetland Assessment and Impact Report by Golder (WAIR)[13]
- The Wetland Protection Plan[14]
- Erosion and Sediment Control Plan (ESC Plan)[15]
- Environmental Construction Operation Plan (ECO Plan) (Partially available)[9]
- The Weed Management Plan (not made available)

Schedule 18 (Technical Requirements), under section 200, is the primary focus of the references made in the following Final Report as it concentrated on 'Project Specifics'. Extensive detail is given in this document to the importance and requirements of wildlife mitigation efforts to reduce the impacts on their populations, from fish to mammals to birds[2]. Extensive detail is also awarded to vegetation with specific attention to management of soils and replanting requirements[2]. The Society's Environmental Monitoring Reports[3] were designed in response to and based off the EIA[1].

The Society's seven annual Environmental Monitoring Reports from 2016-2022 on birds, noise, vegetation, wildlife movement, water quality, aquatic invertebrates, amphibians, and fish are incorporated into this Final Report which is intended to inform discussions about similar projects[3]. Collectively, we all benefit from protecting water quality and biodiversity. Environmental policy has been an evolving endeavour with the learnings gleaned from both applied concepts and academic research as an integral part of scientifically based policy development. Policies, even once lauded as progressive, historically have changed significantly to match modern scientific understandings through time. We hope that this unique Study will help to support a continued legacy of science-based environmental policy development. Improved environmental policy is achievable and a desirable goal for all governments.

The first SWCRR Impact Study Environmental Monitoring Report described baseline conditions in the Weaselhead Study Area in 2016 prior to the extensive disturbance of the Elbow River Valley. The 2017 Report described conditions at the start of the construction phase. The 2018, 2019 and 2020 Reports describe conditions during years of construction. The 2021 Report describes conditions in the first year of operation. The 2022 Report summarizes all the data over the seven-year Study (all reports are available on the Society's website [www.theweaselhead.com]).

Aerial images of the Weaselhead and Transportation Utility Corridor (TUC) in 2016 before construction started (Figure 1A) and the same area in June 2022 (Figure 1B) after the opening of the section of the SWCRR adjacent to the Weaselhead are below. Important site locations and their names referenced throughout this document can be found in Figure 1C. A timeline of construction events and sediment mitigation failures can be found in Figure 1D.

Figure 1A. An aerial image of the Weaselhead, September 8, 2016, before major construction of the SWCRR began. *(*Weaselhead boundary*: o*range line; Red line = 500 m scale, *Google Earth*)

Figure 1B. An aerial photo of the Weaselhead on July 22, 2022, with the SWCRR project complete. (*Weaselhead boundary; orange line; Red line = 500 m scale; Google Earth)*.

Figure 1C. Aerial image of the Weaselhead showing key Study locations by name. The upstream reference wetland sampling location used in the Study is outside the region shown in this map. *(Google Earth;* August 6, 2022*)*

Figure 1D. Construction and sediment spill timeline (timeline not to scale). The dates of sediment slides resulting from failed mitigation efforts impacting the Beaver Pond are highlighted with a red dot.

1.0 TERRESTRIAL HABITATS

Terrestrial habitats benefit diverse flora and fauna providing food, shelter, and space to live, as well as providing ecosystem services such as storing and cycling water, various nutrients, and carbon. The Societies' Study collected data on vegetation, wildlife presence and movement, bird populations and noise measurements. While the Study only directly collected vegetation data from transect research, concerns regarding revegetation and invasive plant management arose alongside observations regarding wildlife fencing, revegetation in the wildlife corridor, and bridge design.

1.1 Vegetation

Studying vegetation and habitat structure is important in creating a baseline metric of what species inhabit the various ecosites found within the Biophysical Study Area of the EIA. This information is used to confirm ecosite delineations and determine their species richness, guide replanting and remediation plans, determine whether rare habitats will be damaged to inform routing decisions, and to determine the locations of rare species to take additional actions to transplant or avoid the rare plants. The Society's Study allowed for the observation of changing ecological conditions and health through time of a directly adjacent wetland to the TUC to examine the direct impacts of the SWCRR construction and operation on this wetland.

1.1.1 SWCRR Project EIA Discussion

The EIA predicted negative effects on vegetation to be minor, local, and isolated with some uncertainty regarding loss of rare plants[1]. The vegetation component included assessing species, diversity, vertical structure and diversity, as well as specific wildlife habitat attributes. The information from the vegetation sampling was used in the mapping and modeling of ecosite importance for selected wildlife species, native plant integrity, and structural and compositional diversity. This data was also used to inform revegetation measures.

Vegetation transect methodology differed from that used by the Society in the Study, however the EIA similarly collected data on the total number of plant species found in the sampling plots to assess species richness in each ecosite, while the Society examined the species richness in one ecosite[1, 3].

1.1.2 WGPPS Study Findings

The Society's Study collected data on species composition, diversity, and species richness within a consistent transect location found along a wetland immediately adjacent to SWCRR construction. Baseline information was collected in 2015 and 2016 to describe the riparian vegetation by the Beaver Pond in the Weaselhead. This wetland was chosen as its upstream edge is bordered by the SWCRR and represents riparian habitat in immediate proximity to the SWCRR (Figure 2). The same site was used in all studies from 2015 to 2022[3].

Figure 2. Green line of the inset shows the location of the 50 m transect used for vegetation survey on the north bank of the east Beaver Pond. The orange line indicates the Weaselhead boundary. (*Google Earth*, June 2, 2022).

Figure 3 compares eudicots species richness per square meter between sampling campaigns over the Study period. A statistically significant trend of increasing species richness in the studied habitat from 2015 to 2022 was observed.

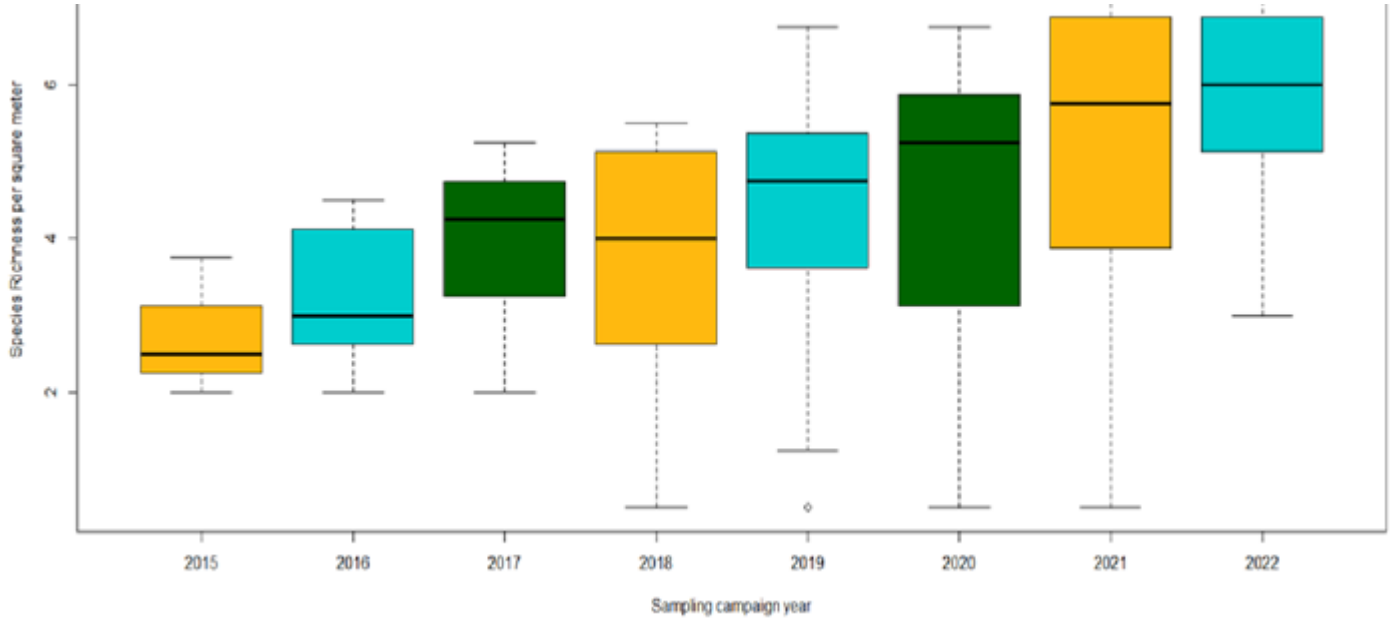


Figure 3. Eudicot species richness per square meter from 2015 to 2022 sampling campaigns conducted in the Weaselhead. Different colours have been used for visual ease in reading the graph.

An increasing species richness indicates that the Weaselhead Study Area is gradually increasing in number of species over time[3]. The species richness in a riparian zone is often limited by the presence of water or periodic inundations[16]. Under these conditions, only species tolerant to water saturated soils would thrive.

An increase in plant species richness is consistent with the lowering of average water levels in the Beaver Pond as discussed in the hydrology section of this report, producing drier soil conditions, allowing the colonization of upland generalist species to increase in the Weaselhead Study Area with riparian specialist species decreasing. This trend may indicate natural succession processes from a riparian habitat towards an upland terrestrial habitat resulting from hydrological changes, may lead to a loss of the wetland habitat.

1.1.3 Additional Considerations

While predictions regarding the effect of the SWCRR on hydrological functions were not included in the vegetation section of the EIA, the Society's Study was able to obtain data on hydrological changes through its vegetation transect analysis, therefore AMEC's predictions are included in this section.

AMEC predicted the "*alteration of wetland hydrological functions*" in the updated December 2014 EIA[1]. Overall, the impacts were expected to be minor (AMEC EIA, 2014, pp.123, 127)[1].

The Society's Study allowed for the yearly assessment of the riparian conditions and vegetation composition of the Beaver Pond, a wetland directly adjacent to and partially within the TUC, indirectly measuring alterations to wetland hydrological function. The transition of the wetland into a different ecosystem type cannot be considered minor. Though it is not clear if the hydrological change is resultant to the SWCRR construction directly.

Analysis to determine the changing presence of facultative wetland and upland species in proportion to obligate wetland species may assist in answering the question of whether successional species change towards that of upland habitat is occurring. **The Society recommends that continued evaluation is conducted to assess whether successional change towards upland habitat is occurring along the riparian vegetation transect and determine the long-term viability of this wetland in response to hydrology changes.**

1.1.3.1 Revegetation

Ecological restoration through revegetation is important in mitigating numerous consequences of disturbance[17]. Revegetation is often initiated as early as possible for erosion control, protecting water quality in adjacent riparian habitats, increasing site suitability for desired species, preventing colonization by invasive species and initiating successional restoration to achieve close to pre-disturbance ecological characteristics.

Access to the TUC and stormwater ponds is restricted, thus, it is difficult to verify if revegetation activities occurred to the contractual specifications and survived to the 85-90% threshold as required[1, 2, 9]. The Society was not certain on when and what revegetation efforts were made. It was difficult to evaluate and make conclusions if specific mitigation efforts were made or worked. This lack of clarity prevents adequate assessment of the success or suitability of mitigation measures or standards. **It is recommended that the one-year time frame of survival rate monitoring be evaluated and adjusted to better support long-term successful revegetation**, **as the time frame for checking survival rates and replanting may be too short to properly evaluate the establishment of newly planted vegetation.**

Table 2 summarizes revegetation mitigation measures with evaluation comments.

Table 2. Revegetation Mitigation Measures Evaluation

Ecosystem Component: Revegetation			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
"Disturbed areas are to be revegetated as soon as possible"	KGL ECO Plan Page 25	Unsuccessful	Major construction was completed in 2019. It is unclear if planting has occurred, as it appears that no woody plants are established on the north side of the Elbow River under the bridges. Spruce trees were planted in the interior between the north and southbound lanes but may not have survived to the 85-90% survival rate. Willow shrub staking was observed and recorded in the Monthly Wildlife Monitoring Reports and "landscaping" was recorded on the work schedules. Recommend increasing third party review to ensure work is completed as agreed upon and to ensure 85-90% survival rate.
"Revegetation of disturbed and cleared areas to be undertaken as soon as possible"	Technical Requirements		
"Planting will occur along terraces to mimic the natural species profile in adjacent areas. All vegetation planting will be monitored to ensure 85-90% survival rate for the first year. If planting does not meet that level, the area will be addressed."	KGL ECO Plan Page 27		
"Stormwater management facility wet ponds shall have vegetation for water quality enhancement, and erosion control. Shrub staking shall be installed along the disturbed margins of the wetland or around selected constructed wetlands or stormwater ponds to stabilize disturbance, reduce the potential for sediment introduction and restore habitat function where shrubs were present prior to construction and were directed by the environmental inspector. It is preferred that plant species selected for revegetation within constructed wetlands be sourced from local materials, either salvaged from naturally occurring wetlands that may be disturbed within the Road Right of Way or from known donor wetlands. If salvaged or donor material is not available, the Contractor shall source out native plant species adapted to wetland conditions (bare root stock preferred). Sourced plant species shall include: - Submerged plant species to be planted within deep pools. - Emergent plant species accustomed to fluctuations in water level to be planted just below to partially above the normal water level; and - Riparian plant species, both shrub and herbaceous species, accustomed to slightly drier conditions but can tolerate occasional flooding to be planted just above the ordinary high-water level."	Technical Requirements Page 89	Unsuccessful	The stormwater ponds do not appear to have been revegetated from visual observation. The ponds were not built to the specifications of the Technical Requirements for both straight line distances and curved alignment specifications in addition to replanting requirements.
Monitor revegetation success within the TUC and the Road Right of Way and undertake remedial measures as appropriate.	Technical Requirements	Successful	Golder Associates monitored the revegetation of the wildlife corridor until 2021 when conducting monthly wildlife surveys. However, no details reported in the monitoring to improve on and to meet revegetation requirements.
Monthly vegetation inspections shall occur to identify areas where re-seeding is required to meet the requirements in Section 200.2.9.		Unsuccessful	

Verification that mitigations implemented for wildlife movement corridors (e.g., vegetation plantings and seeding) are viable and functioning as intended		Unsuccessful	Monthly Wildlife Monitoring Reports verified stating "Mitigations developed to reduce barriers to wildlife movement during construction are implemented and functioning as intended."[6] However, in contrast, their data shows little to no wildlife utilizing the intended movement corridor during construction, stating "mitigations appear effective, with reduced sign of wildlife use under the bridges." [6] As well, vegetation is not visibly established.

1.1.3.2 Invasive Plant Management

Invasive species have a history of producing substantial economic impacts related with significant damage to agriculture, forestry, urban infrastructures, and transmission of diseases to humans, resulting in the creation of the prohibited noxious weeds list associated with the Alberta Weed Control Act[18, 19, 20]. A large proportion of invasive species result from disturbed habitats such as transportation and communication corridors, and developments, resulting in attention to weed management in both the EIA, Technical Requirements and ECO Plan (Table 3)[1, 2, 9, 21]. Canada, as a signatory to the international Convention on Biological Diversity, has made a commitment to prevent, control, and eradicate invasive alien species[22, 23].

The Project's EIA predicted minor negative effects in terms of weed establishment with some uncertainty[1]. KGL's ECO Plan states "*Contractor will control weeds on site as required to ensure compliance with the Alberta Weed Control Act and its regulations as well as City requirements*." (KGL ECO plan, 2017, p. 20); and states "*Noxious weeds shall be controlled, prohibited noxious weeds must be destroyed*" (KGL ECO Plan, 2017, p. 28)[9].

It appears that desired vegetation has not yet been established, consequently increasing risk of invasive plant establishment which has already been observed. **The Society recommends examination of replanting needs and aggressive weed management.**

Multiple species of noxious weeds have been identified and can be visible in the TUC including most prominently Spotted Knapweed and Black Henbane. Both are relatively new to establish within the Weaselhead and surrounding area and do not have a long history of detection in the local area. Spotted Knapweed was first noticed in the Weaselhead in 2016.

Spotted Knapweed (*Centaurea stoebe*) is a prohibited noxious weed under the Alberta Weed Control Act and thus is required to be destroyed[19, 20]. A single plant produces between 1000 and 140 000 seeds, with seeds remaining viable in the soil for five or more years even after management activities[24]. The flowering stage is short[24]. After the flowering period the plant dies before seeding, often making observations and assessment of infestation size significantly more difficult outside of the blooming window[24]. Alberta Highway Services Ltd. (AHS Ltd.) had taken over the KGL contract in October 2021. Unfortunately, a significant number of the plants had gone to seed within the TUC as observed in an August 2022 organized site visit by the Society.

As of December 2023, Black Henbane (*Hyoscyamus niger*), which is provincially designated as 'noxious' has been observed in large quantities within the TUC[25]. This poisonous plant will be required to be removed according to the Alberta Weed Control Act and KGL's ECO Plan which states "*Weed control in disturbed areas to be utilized until desired vegetation is established*." (KGL ECO Plan, p. 25)[9, 20]. The Society removed 465.4 kg. of Black Henbane along the east boundary of the TUC on July 19, 2023. Impacts of the soil fill introducing invasive species should be examined.

Black Henbane and Spotted Knapweed were not found in the original EIA surveys; however, they appear to be a considerable issue post construction. This is evidence of the significant vulnerability of disturbed habitats to the colonization of invasive plants and the high importance of a clear weed management plan and consistent invasive plant management activities for early detection and rapid response.

Table 3. Invasive Plant Species Mitigation Measures Evaluation

Ecosystem Component: Weed and Invasive Species Establishment			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
"Contractor will control weeds on site as required to ensure compliance with the Alberta Weed Control Act and its regulations as well as City requirements."	KGL ECO Plan Page 20	Unsuccessful	Spotted Knapweed and Black Henbane in TUC. Retaining wall weed establishment observed.
"Site inspections for weeds during the growing season will be conducted"		Unsuccessful	Informed that monthly site inspections took place, but the data was not made available. Informed that in 2019 there was no Spotted Knapweed discovered, but that seems to be unlikely. If monthly inspections occurred, when did they stop? Current observations of the TUC reflect a failure of this process resulting in extensive Black Henbane and Spotted Knapweed presence.
"Weed control in disturbed areas to be utilized until desired vegetation is established"	KGL ECO Plan Page 25	Unsuccessful	Desired vegetation does not appear to have been established and weed control appears to be absent.
"Monthly inspections including vegetation inspections and weed inspections"		Unsuccessful	See comment above.
"Noxious weeds shall be controlled, prohibited noxious weeds must be destroyed"	KGL ECO Plan Page 28	Unsuccessful	Spotted Knapweed and Black Henbane observed in TUC.
"Develop a weed management plan to address long-term weed issues within the TUC and the Road Right of Way during the PNI Operating Period and the Operating Period for "prohibited noxious" or "noxious weeds" in accordance with the Weed Control Act (Alberta) and Weed Control Regulations. Establish priorities regarding the most problematic weed species."	Technical Requirements Page 117	Unsuccessful	The Weed Management Plan was not made available for our review. However, even if it was developed, it was unsuccessfully implemented as proved by the presence of noxious weeds and the absence of control efforts.
"By Construction Completion, the Contractor shall have installed a fence separating the Road Right of Way from the remaining utility components of the TUC (the "TUC Outside the ROW"). At that time, the Department of Infrastructure will desire to reassign the TUC Outside the ROW as lease areas. The Contractor will be relieved of its maintenance responsibility for those portions of the TUC Outside the ROW that the Contractor had responsibility, if the state of this land is acceptable to the Department of Infrastructure. Conditions for the handover back to the Department of Infrastructure shall require that these areas are fully vegetated and in a healthy and vigorous weed-free growing condition in accordance with the Contractor's Environmental Management System."	Technical Requirements Page 148	Unsuccessful	See comments above. The Contractor was relieved of its maintenance responsibilities; however, the state of this land did not meet the requirements listed for this handover as the TUC was not in a 'fully vegetated and in a healthy and vigorous weed-free growing condition".

1.2 Wildlife: Mammal Movement

Most of Earth's mammals are suffering from significant reductions to habitat and habitat connectivity, resulting in population declines[26]. This reality directed significant attention to wildlife connectivity and movement in the EIA and Technical Requirements[1, 2].

1.2.1 Wildlife Movement Surveys and Camera Studies

Wildlife movement surveys and camera studies provide information on the usage of wildlife corridors and consequently measures impacts to habitat connectivity. Habitat connectivity is important for sustainable and healthy populations as many mammals require large habitats and may move regions in response to resource availability and competition as well as for mating purposes. Both habitat loss and reduced connectivity are prominent issues in ecological health and resilience and are critical themes in conservation work.

1.2.1.1 SWCRR Project EIA Discussion

The Project's EIA predicted moderate level negative and long-term impacts resulting from decreased physical habitat for wildlife[1]. The EIA acknowledges sensory disturbances from tree clearing and heavy equipment operation and excavation to operational road traffic as having negative long-term impacts on wildlife[1]. Elevated and damaging stress levels, susceptibility to predation as well as habitat loss were the main predicted negative effects on wildlife of concern[1]. Habitat fragmentation and reduced connectivity with barriers to movement were predicted to be negative with minor to moderate, long-term impacts[1]. Contractors were required to establish wildlife movement corridors under the Elbow River and Fish Creek bridges[2].

The inclusion of a functional wildlife corridor near the Elbow River bridge for the facilitation of wildlife movement was a high priority for the Society. This favorable bridge and corridor design is lauded by the Society as well as the City of Calgary as they have placed extensive emphasis on this topic through their Calgary Connect partnership with Miistakis Institute, Friends of Fish Creek Provincial Park Society, Government of Alberta, and the Weaselhead/Glenmore Park Preservation Society[3, 6, 7, 27].

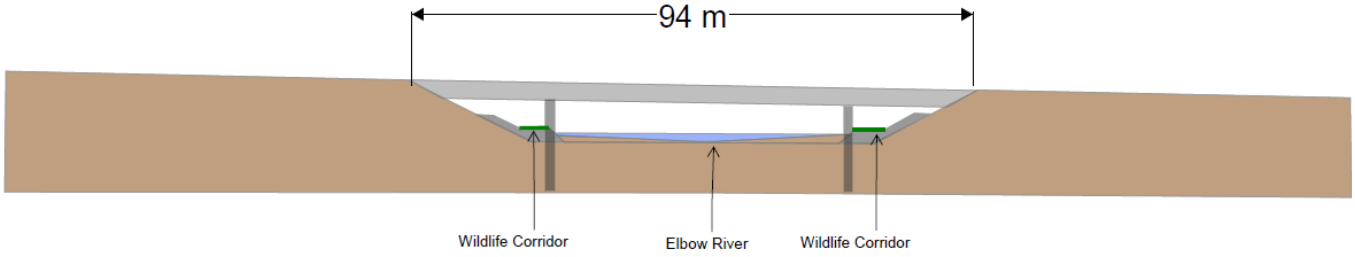
The Society influenced the expansion of the bridge decks over the Elbow River to include a wildlife corridor (Figure 4). This wildlife corridor was absent from the initial 2006 bridge design. The Society also influenced the Province of Alberta to adopt the City of Calgary's bridge design for the crossing over Fish Creek. Initial designs only included culverts for wildlife movement with little room for wildlife under the bridges[28].

The corridors had a considerable impact in reducing habitat fragmentation and in maintaining habitat connectivity. Included in the design is a large wildlife riverbank corridor and a dedicated small animal corridor above the high-water level at the north bridge abutment (Figure 4).

On June 18, 2014, the Province of Alberta announced the bridge improvement noting that data from the 2013 flood was being used to evaluate the bridge designs, to ensure they would accommodate future flooding events of a similar magnitude[29]. The resulting updated design doubled the length of the bridge, thereby negating the potential for flood waters to back-up behind the crossing berm and fail when the water became too high[28]. The Klohn Crippen Berger, November 2015, Assessment of Elbow River Upstream Bridge Structures Impact on Glenmore Dam, Hydrotechnical Assessment Report analyzes and compares the two designs[28].

SWCRR Bridge Crossings over Elbow River

Initial Design Concept



Current Design Concept

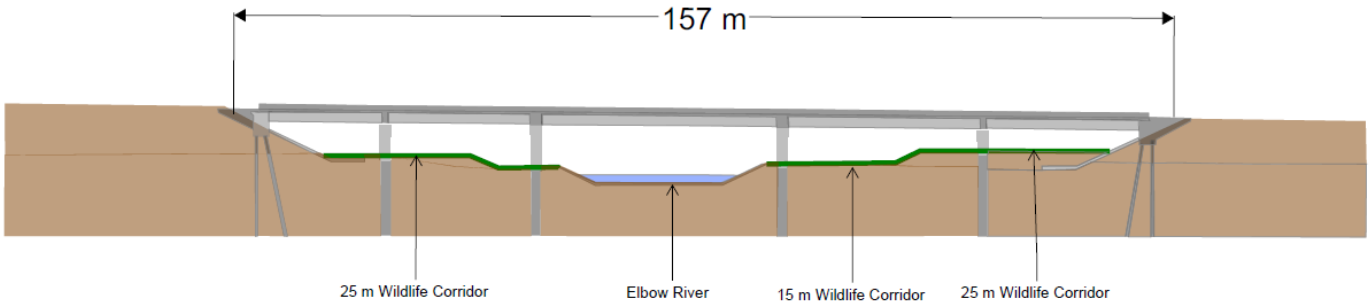


Figure 4. The Elbow River bridge crossing design for the SWCRR (from KGL's website[30]). Designed to accommodate small mammal passage in the 25m Wildlife Corridor and large mammal passage in the 15m Wildlife Corridor.

In a separate study for KGL, Golder Associates monitored the use of the wildlife underpasses[6]. Each bank of the river was checked for signs of use (e.g., tracks, scat) monthly from 2018 to 2021[6]. The corridor under the road itself was examined as well as the regions just outside of the corridor, called buffer regions[6]. The reports showed large mammal presence (domestic dog, beaver, mink, cougar, bear, deer, coyote) to the east and west of the Elbow River Crossing using the buffer regions but had limited evidence of corridor use (observation of tracks) under the bridges themselves[6].

The wildlife reports showed that over the construction period cougar (*Puma concolor*) would enter the buffer regions, but there was no evidence of the cougar traveling under the bridges through the intended corridor (Figure 5) [31]. However, the implemented design is a significant improvement from the original design and use will likely increase with time as vegetation is established, as indicated by usage patterns of other wildlife corridors. Two cougars were captured by wildlife cameras utilizing the wildlife corridor underpass on May 29, 2023.

Figure 5. Cougar track observed in bend of Elbow River realignment in the buffer zone, January 2020. (KGL, Monthly Wildlife Report[31]).

It was acknowledged that revegetation is necessary to provide rest and cover opportunities to facilitate wildlife movement and connectivity[1]. The rendering (Figure 6), current state (Figure 7), and revegetation plans (Figure 8) are sparsely vegetated and do not provide suitable rest and cover opportunities. **The Society recommends that the revegetation plans are evaluated to meet these needs.**

Figure 6. KGL's rendering of the Elbow River Crossing[32].

Figure 7. View of the wildlife corridor from the east boundary of the TUC on the north side of the Elbow River. Revegetation along the south side of the Elbow River can be seen along the shore, with limited replanting visible along the north side of the Elbow River wildlife corridor (August 26, 2023).

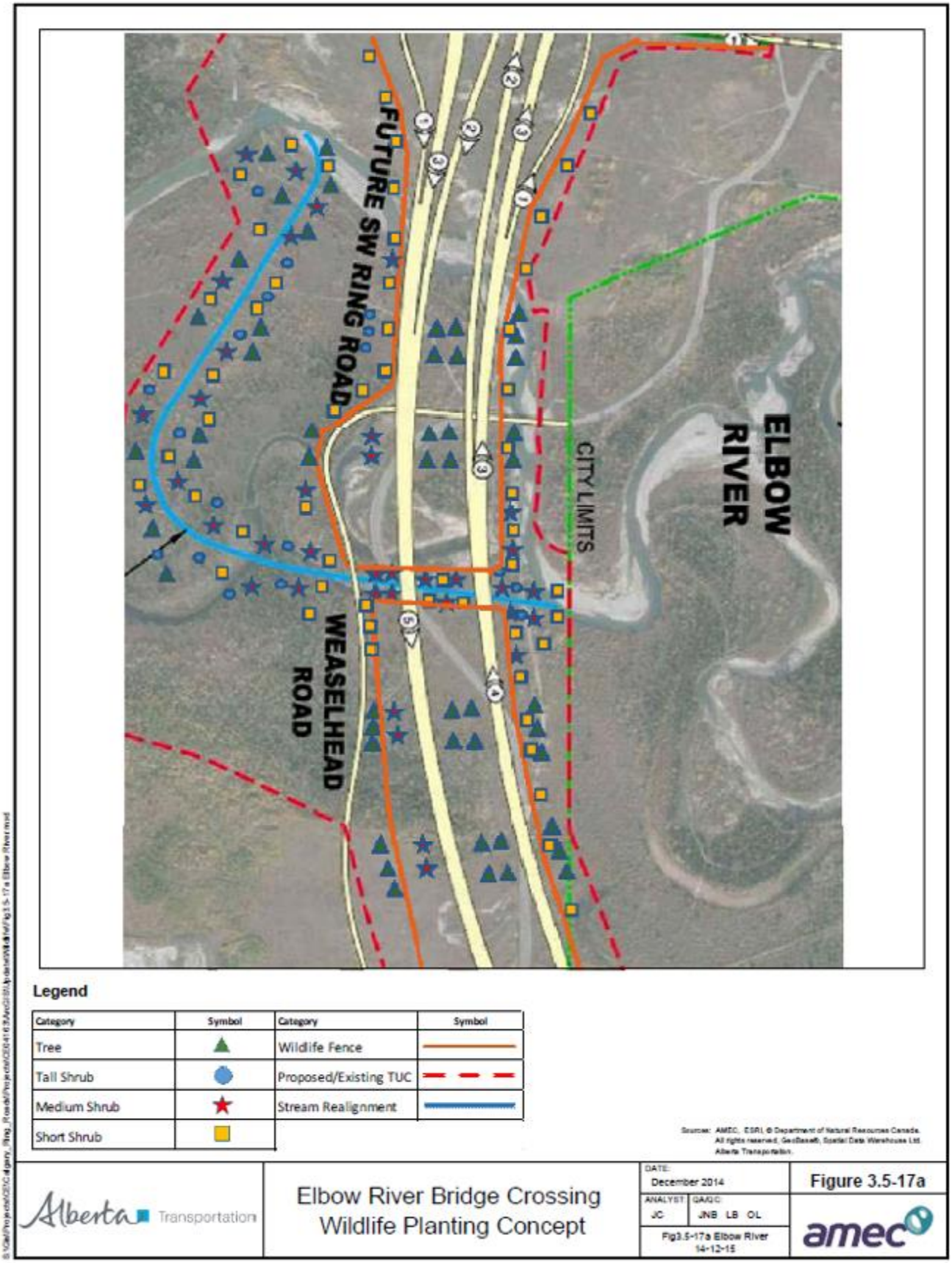


Figure 8. Elbow River Bridge Crossing Wildlife Planting Concept (AMEC EIA, 2014, p. 214)

Mitigation efforts towards connectivity and wildlife movement appeared to have limited efficacy during the construction phase of the Project compared to during the operational phase. According to the Monthly Wildlife Reports, "*mitigations appear effective along the north portion of the realigned river to the west of the bridges, with lesser signs of wildlife use near, under and east of the bridges"*[6]. While there is room for continued improvement in future designs, the implemented design represents a huge environmental win and effort by Alberta Transportation that substantially reduces habitat fragmentation.

1.2.1.2 WGPPS Study Findings

In November 2018, the Society partnered with the Miistakis Institute in the project '*Calgary Captured*' [33]. The goals of this project are to better understand wildlife occurrence in Calgary's natural areas and to identify key infrastructure associated with roads that wildlife use to move around the urban environment[33]. In 2020 and 2021, Miistakis placed cameras at three road mitigation sites, the Weaselhead and Fish Creek Ring Road crossings and Bow River South at Deerfoot Trail (Figure 9)[34]. They also placed reference cameras within 500 m of these sites and found that not all the species present in the area were using the wildlife corridors[34]. The locations of *Calgary Captured* cameras at the time of writing are shown in Figure 9.

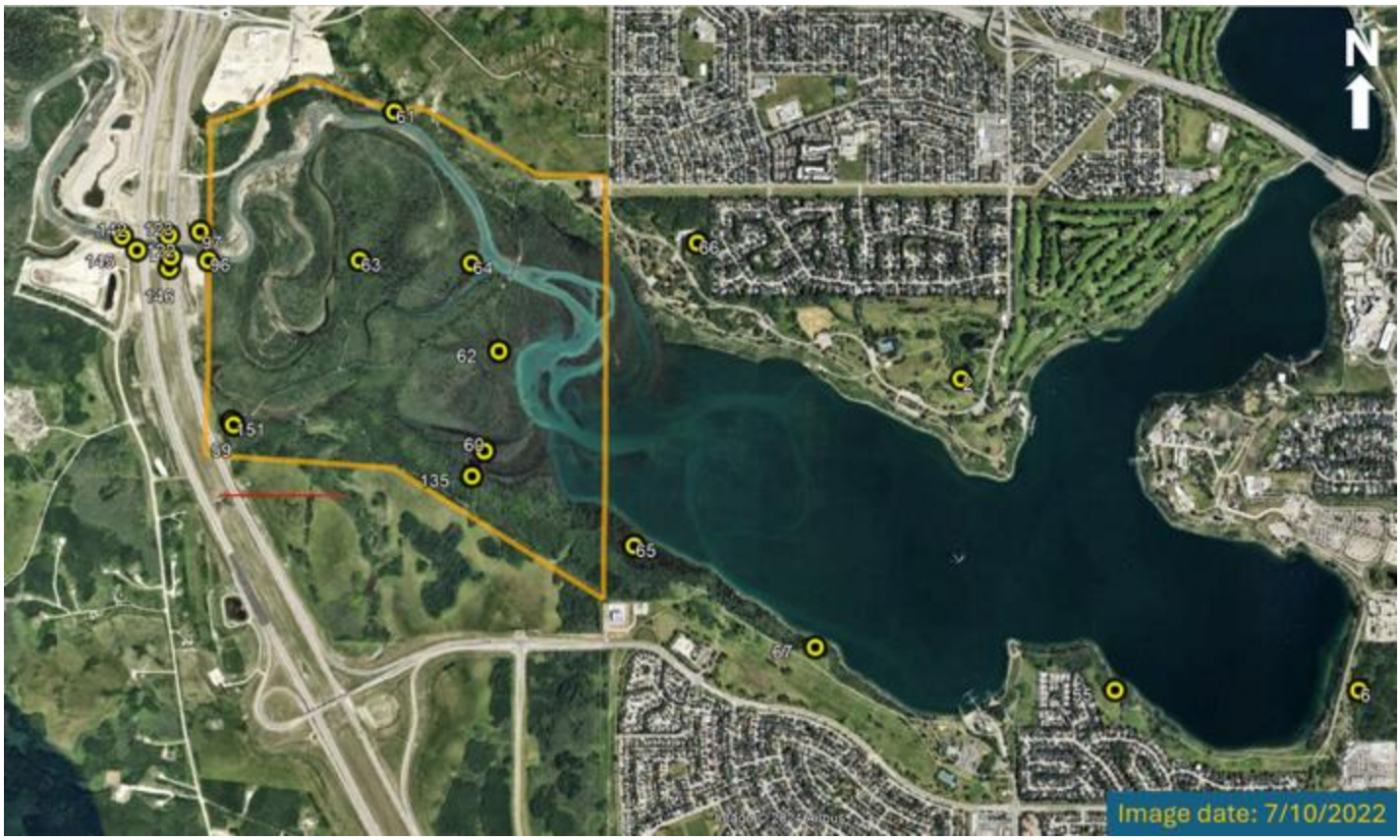


Figure 9. The location of past and current '*Calgary Captured*' cameras (yellow numbered tags) in the Weaselhead area as of 2024 overlaid on aerial imagery from July 10th, 2022 (*Google Earth).*

These cameras captured white-tailed deer, mule deer, coyote, beaver, cougar, and moose using the underpass in the Weaselhead[34].

The 2023 Calgary Captured Technical Report concludes that "road mitigation sites' *support wildlife movement in and out of the city; however, their benefit and use can be improved. Suggestions for increasing their use include:*

• *Add and maintain vegetative cover to create a more seamless habitat corridor across roadways.*

• *Mitigate wildlife movement along corridors that they currently use. Stoney Trail currently has mitigation sites at two wildlife corridors on the west end of the city: along Fish Creek and the Elbow River in the Weaselhead. "* (Calgary Captured Technical Report, 2023, p. 55).

Data from a similar study of wildlife in the Weaselhead also using motion-activated cameras that was sponsored by the Society and run by SAIT from 2016 to 2018 has been incorporated where possible into the Calgary Captured dataset[35]. The SAIT data was the initial data utilized in the Study until the program came to an end because the SAIT wildlife cameras were stolen[3].

The Monthly Wildlife Monitoring Reports indicated observations of large mammal presence in the buffer regions but limited evidence of the corridor itself, however 'Calgary Captured' cameras have been able to confirm wildlife use under the bridges, including deer and cougar use (Figures 10 and 11)[6, 34, 35]. Clevenger et al. found in Banff that cougars easily travelled the various wildlife crossing structures and used open-span bridge underpasses more than expected[36]. Other wildlife crossing structures in Banff were used less than expected by cougars, suggesting that the existing wildlife corridor in the Elbow River valley may be the best option for cougars[36].

Figure 10. '*Calgary Captured'* photo of cougars moving wes under the bridge in the wildlife corridor. May 29, 2023, 10:37pm, camera #145, see Figure 9 for location.

Figure 11. '*Calgary Captured'* photo of deer under the SWCRR Elbow River bridge in the wildlife corridor. July 25, 2021, 6:20pm, camera #123, see Figure 9 for location.

Figure 12. August 2020. Two moose browsing caught on *Calgary Captured* camera #63, see Figure 9 for location.

Figure 13. May 16, 2023. Black bear caught on *Calgary Captured* camera #63, see Figure location.

Human activities, such as infrastructure projects, deprive wild animals from obtaining their basic needs[37], and wildlife mitigation efforts are often flawed with ineffective criteria[38]. An overall lack of attention to animal welfare science is common[39, 40]. Even with significant mitigation measures for wildlife impacts in the EIA and Technical Requirements, there is room for improved overall success when applying these measures into infrastructure projects. In addition, invasive plant species impact the integrity of the wildlife corridor and surrounding habitat which further places pressure on wildlife[41, 42]. **The Society urges Alberta Transportation to work with wildlife organizations such as the Western Transportation Institute, the Biodiversity Research Centre, and Miistakis Institute to better develop and implement effective mitigation efforts addressing wildlife movement during road construction.**

Table 4. Wildlife Mitigation Measures Evaluation

Ecosystem Component: Wildlife			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
"*The Contractor's design and construction execution shall not inhibit wildlife passage along this corridor*."	Technical Requirements Page 48	Unsuccessful	KGL's Monthly Wildlife Reports data directly shows wildlife use in the buffer regions east and west of the bridges with very minimal evidence of wildlife moving through the intended wildlife corridor during construction[6]. Reports state that they "*verify that mitigation to reduce barriers to wildlife movement had been implemented, identify deficiencies in the implementation of mitigation (if any), and confirm wildlife movement is not impeded during construction*." [6] Also stating, "**ACTION:** *Maintain buffer at Elbow River - mitigations appear effective along the south portion of the realigned river east and west of the bridges, with reduced sign of wildlife use under the bridges*." [6] This statement coupled with the data indicates that the mitigation in the bridge underpasses was ineffective and wildlife movement was inhibited.
"*Temporary passageways shall be available during construction to maintain ability for wildlife passage during construction. The ground surface of the passageways shall be approximately level (allowing for appropriate drainage) and shall have a generally smooth walking surface that closely matches the natural valley substrate (e.g. no riprap or large boulders) and vegetated to meet the requirements of the Environmental Assessment for the Southwest Calgary Ring Road (Updated December 2014) Elbow River Bridge Crossing Wildlife Planting Concept*"		Unsuccessful	Temporary passage was made available, evidence shows it was not utilized by wildlife during construction (see above). Riprap and large boulders were in the wildlife corridor during construction and now. The Society acknowledges the need for erosion mitigation using these mitigation tools and observes the boulders and rip rap are not inhibiting wildlife movement during road operation.
Permanent dedicated large wildlife passage shall be provided beneath the bridges at both the north and south bridge abutments as well as a dedicated small wildlife passage at the north bridge abutment. The small wildlife passage shall be above the high-water level. The Contractor shall extend the wildlife passage corridors on either side of the bridge to provide a contiguous corridor of varying width through the disturbed area.		Successful	The Society celebrates the inclusion of the wildlife corridors.
The Contractor shall retain a professional biologist (a member in good standing with the Alberta Society of Professional Biologists) to ensure wildlife movement is not impeded		Successful	Golder Associates was contracted to conduct monthly wildlife monitoring and reports between 2018-2021[6]. However, wildlife movement has been impeded.

during operations at both the Elbow River and Fish Creek crossings. Monitoring shall commence following the completion of construction and last for a period of 36 months.			

1.2.3 Additional Considerations

A significant component in the success of wildlife movement was the design of the bridge and wildlife corridors. Other key components influencing the success of wildlife movement during construction and into the operational phase of the SWCRR include wildlife fencing, revegetation of the wildlife corridor and invasive plant management. These components were not directly studied as part of the Society's Study, however incidental observations and findings regarding these mitigation measures are presented here.

1.2.3.1 Revegetation of the Wildlife Corridor

Considerable importance was placed on replanting vegetation as detailed in the EIA and Technical Requirements for aiding in maintaining wildlife movement, yet it appears from observation that replanting efforts may not have met the 85-90% survival rate as outlined in the ECO Plan and Technical Requirements (Figures 10, 11 and 12)[1, 2, 9]. **The Society recommends policy related to revegetation is assessed to ensure wildlife management goals can be met, ensuring continued connectivity and movement.**

The EIA predicted a wildlife corridor along the realigned Elbow River channel that "*will be enhanced to mimic the existing channel and habitat characteristics. Passage of large and small mammals will be maintained along these corridors under the bridges and will be vegetated with native grasses and shrub plantings to provide rest and cover habitat."* (AMEC EIA, 2014, Executive Summary section, para. 10)[1]. Evidence supports that wildlife are now utilizing the desired corridor. **The Society recommends improved replanting of vegetation to provide the intended rest and cover habitat with native grasses and shrub plantings**[1, 2, 3, 6, 34]. The 2023 Calgary Captured Technical Report advises that for road mitigation sites to improve wildlife movement they should be "*Adding and maintaining vegetative cover to create a more seamless bridge between habitats on either side of the road."* (Calgary Captured Technical Report, 2023, p. 55).

'*Landscaping*' was conducted by KGL in 2022 as indicated by Alberta Highway Services Ltd.'s work schedules and while not indicated directly this landscaping may have also included the replanting work[43, 44, 45, 46]. In May 2021, Golder employees noted workers using heavy equipment to plant willow stakes during their May tracks survey (Figure 14)[6]. The planting of these willow stakes will serve to stabilize the shore as well as provide habitat and cover for animals using the corridor. It is unknown if they survived to the required survival rate.

The January 2020 Monthly Wildlife Monitoring Report noted that "*Mitigations to facilitate wildlife movement during operations (e.g., vegetation plantings and seeding) are installed in accordance with the Technical Requirements*?", ending the statement with a question mark. Following this, is it also stated that there were deficiencies identified *"to the Technical Requirements as they relate to wildlife considerations and description of corrective actions taken*", suggesting that the professional biologist preparing the January 2020 report was also concerned that the revegetation efforts do not support wildlife needs (Monthly Wildlife Monitoring Reports, January 2020, p. 7). It appears that there are very few woody plants establishing (Figure 7).

Figure 14. View looking Northwest, from the south bank of the Elbow River over the SWCRR showing the wildlife corridors in May 2021. Workers can be seen on the south bank using heavy equipment along the realignment corridor for willow staking. (Photo taken by Golder during the May 2021 Monthly Wildlife Monitoring Report[6]). Green fencing visible on both sides of the river is erosion control fencing and is not a part of temporary or permanent wildlife fencing.

1.2.3.2 Wildlife Fencing

Wildlife fencing is a mitigation measure that is important for both driver and wildlife safety with economic and ecological consequences. The Elbow River valley is a recognized wildlife corridor and animal movement through this region is especially high. Wildlife fencing guides animals through the corridors that were created for safe passage[47].

Wildlife fencing installation took place from December 1-17, 2021, by the subcontractor, Wilco[48]. Fencing repairs, landscaping and cleanup was conducted by KGL June 4 - July 16, 2022[49, 43, 44]. The Technical Requirements drawing for wildlife fencing are shown in Figure 15[12]. It is noted in the EIA that "*Fence end treatments (e.g., Boulder fields) should be designed and implemented to discourage wildlife accessing the roadway area at fence ends and should direct wildlife back to vegetated areas away from the roadway*." (AMEC EIA, 2014, p. 210) and that "*Fencing should incorporate a small mesh component directly above and below the ground surface to discourage small mammals from burrowing underneath the fence and accessing the roadway*." (AMEC EIA, 2014, p. 210). Wildlife fencing has not been completed to the specifications of the EIA and to the Technical Requirements at the time of this report [1, 2, 12] (Figures 15-22).

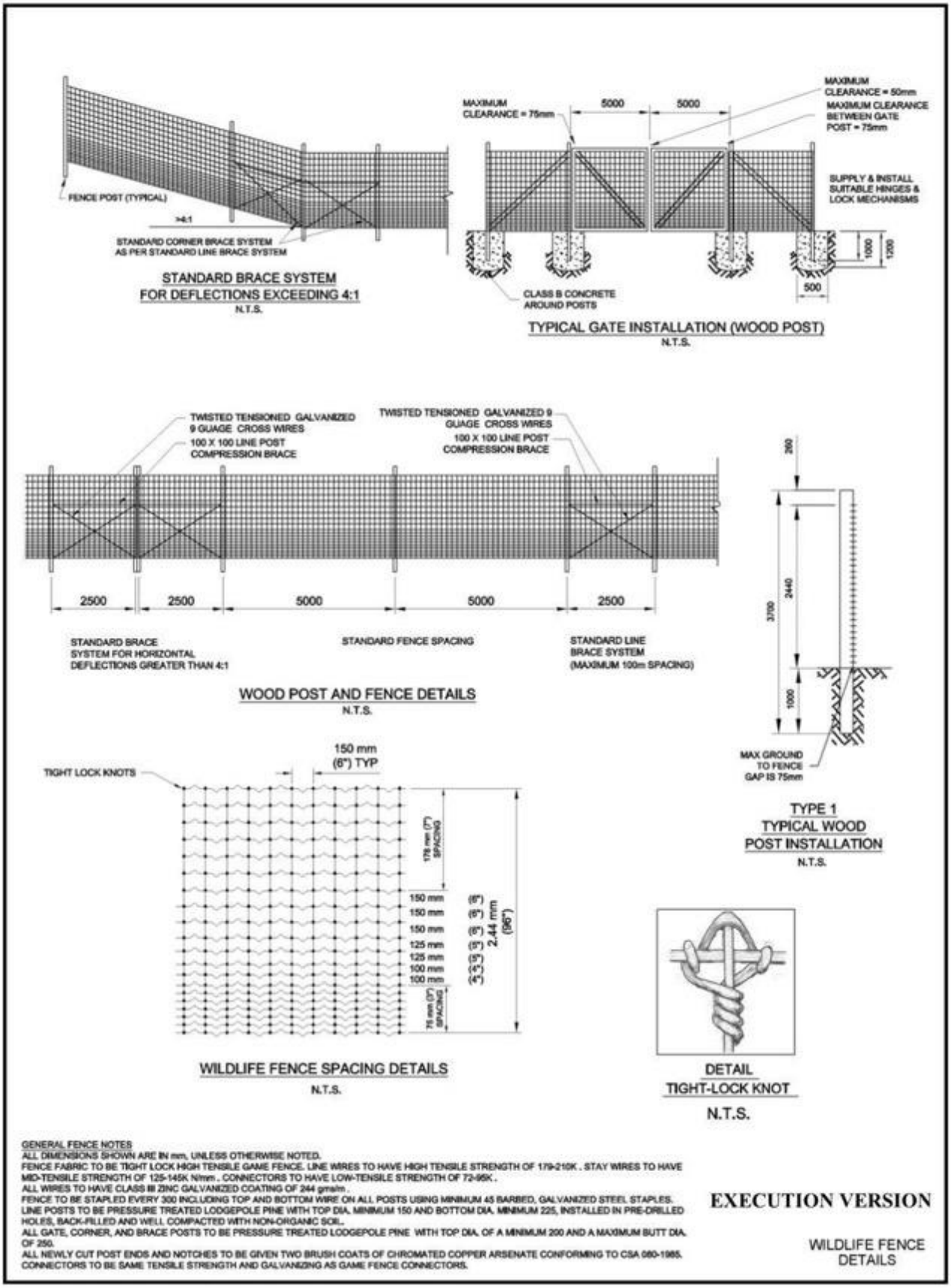


Figure 15. Wildlife Fence Details from Schedule 18 Technical Requirements, DBFO Agreement Appendix B [12].

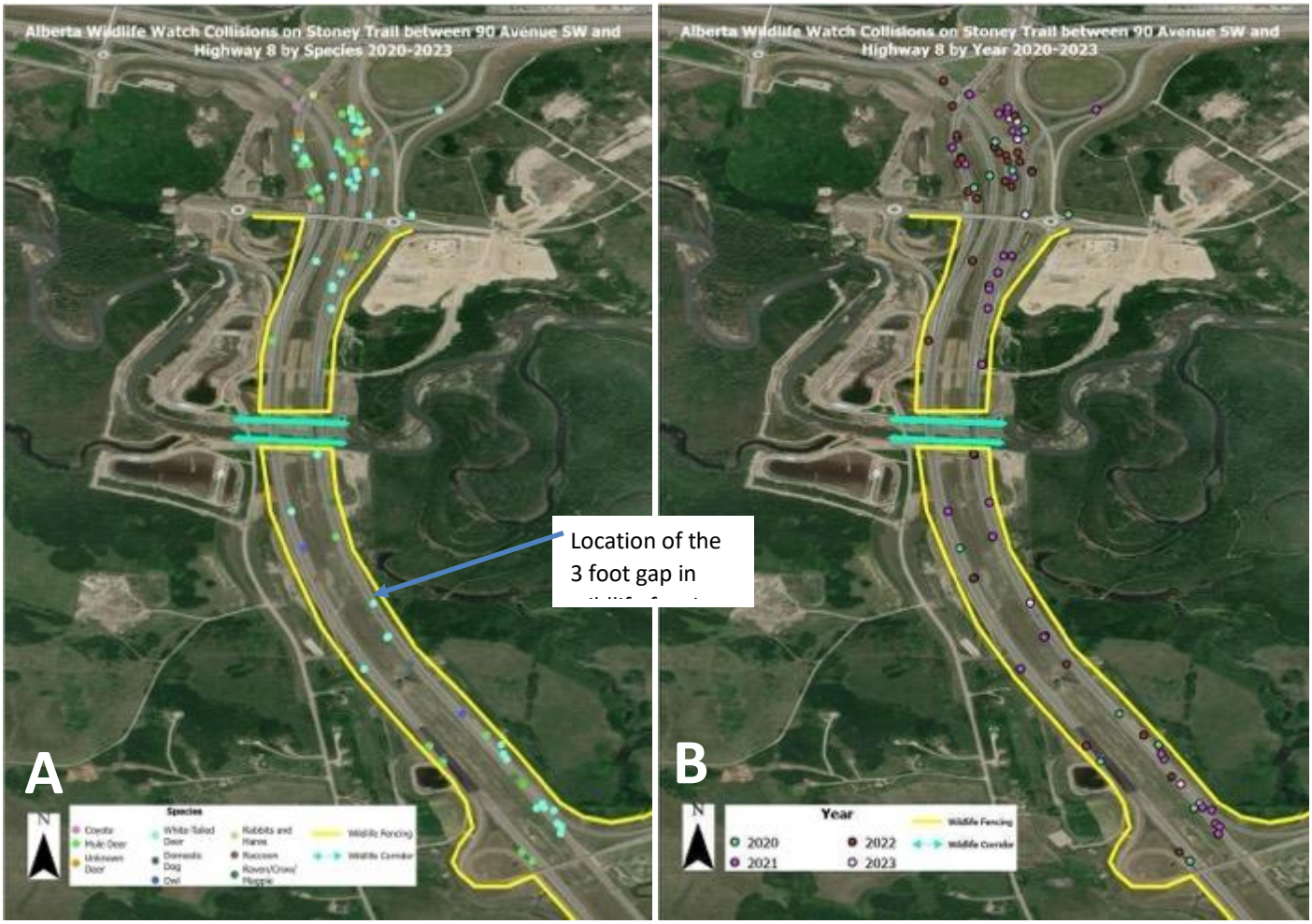


Figure 16A and B. Alberta Wildlife Watch Collision Data from 2020 - 2023[8]. Legend: purple - coyote, bright green - mule deer, orange - deer unknown, turquoise - white-tailed deer, deep blue - domestic dog, dark blue - owl, yellow - rabbits/hares, brown - raccoon, dark green - raven/crow/magpie. Location of 3 foot gap**. B.** Annual Collisions[8]. Wildlife fencing approximate location.

Animal vehicle collision (AVC) data was collected, as required, and mapped by the Society using Alberta Wildlife Watch Collision data between 90th Ave. and Highway 8 from 2020 – 2023 (Figures 16A and B)[2, 8]. Figure 16A shows the provincial data by species killed and figure 16B by year since the opening of the road October 2, 2020[8].

The fencing does not extend across the complete expanse to functionally direct wildlife to the intended corridor for movement under the bridge overpasses (Figures 15-20). A gap three feet wide exists west of the Beaver Pond where the fence approaches the retaining wall. It is possible that similar gaps also exist in other areas (Figures 17-19). The aforementioned gap was checked on December 15, 2023, with a snow-covered ground confirming both ungulates and canines utilizing it visible by track patterns, likely consisting mainly of white-tailed deer and coyote (Figures 18A and B). Figure 16 A shows that deer have been struck and killed several times near that gap. Closing this gap could reduce wildlife movement onto the TUC and have preventative value in reducing the likelihood of wildlife-vehicle collisions, creating a safer roadway for both wildlife and humans.

The fence does not extend to the ground with several areas high enough to allow small mammals such as a fox and coyotes to easily pass under the barrier (Figures 20A and B). Ground gaps were measured ranging from 100 mm to 254 mm in height (Figure 20A), while instructed by the Technical Requirements to have a maximum

ground to fence gap of 75 mm (Figure 15)[12]. Coyote fur was discovered caught under one of these gaps and tracks were observed going under the fence in several spots (Figure 20B). Similarly, specifications for a gate installed in wildlife fencing indicates a maximum clearance from the bottom of the fence to the ground of 75 mm, a maximum spacing of 50 mm between both sides of the gate and a maximum spacing of 75 mm between the gate and the gatepost (Figure 15)[12]. The access gate located at the west end of the Beaver Pond also does not meet the standards set in the requirements. **The Society recommends that further investigations to determine the shortcomings in the wildlife fencing installed take place and improvements are made to meet the Technical Requirements to ensure both the safety of drivers using the SWCRR as well as that of animals that cross into and out of the park[12].**

Figure 17. A visible gap at the fencing end exits at the start of the retaining wall, highlighted by the yellow arrow, was first observed in early 2022 west of the Beaver Pond and south of the retaining wall. Green fencing in the photo is erosion control fencing.

Figures 18A and B. Photographs showing wildlife tracks mainly of ungulate and canine species leading up to and around the fence gap at the west end of the Beaver Pond where fence ending meets the retaining wall. (Photos taken December 15, 2023. Same location as seen in Figure 20).

Figures 19A and B. Photographs taken at the 3-foot gap show the gap is utilized by wildlife, with both ungulate and canine tracks heavily overlapping in the snow reflecting common use patterns. Figure 20A shows the gap facing south and 20B shows the view through the gap north, towards the retaining wall. (Photos taken December 15, 2023).

Figures 20A and B. Photograph of the fencing along the west end of the Beaver Pond on the eastern edge of the SWCRR, which displays a large 10.5" gap between the bottom edge of the fencing and the ground surface. Animal tracks are visible passing under fencing suggesting that this area is utilized for animal movement. (Photos taken December 15, 2023).

Table 5. Wildlife Fencing Mitigation Measures Evaluation

Ecosystem Component: Wildlife Fencing			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
"*Fencing should incorporate a small mesh component directly above and below the ground surface to discourage small mammals from burrowing underneath the fence and accessing the roadway*".	EIA Page 210	Unsuccessful	There is no small mesh component directly above and below the ground surface to discourage small mammals from going under the fence. Tracks in the snow as well as coyote fur caught under the fencing confirms wildlife are traveling underneath the fence.
"Max ground to fence gap is 75mm"	Wildlife Fence Details from Technical Requirements Appendix B [51] (Figure 19)	Unsuccessful	Gaps under the fence extend up to 254mm, more than three times the requirement. Tracks in the snow as well as coyote fur caught under the fencing confirms wildlife are traveling underneath the fence.
"Maximum clearance between gate posts is 75mm"			The access gate located on the east side of the TUC, south of the Beaver Pond has gaps both between the gate posts and the ground that exceed 75mm.
"*Fence end treatments (eg. Boulder fields) should be designed and implemented to discourage wildlife accessing the roadway area at fence ends and should direct wildlife back to vegetated areas away from the roadway*."	EIA Page 210	Unsuccessful	A 3-foot gap exists at the fence end located on the west side of the Beaver Pond and tracks in the snow show that canines (likely both coyote and red fox) as well as ungulates (White-tailed deer) are using this as an access point to the roadside of the fence.
"*By Construction Completion, the Contractor shall have installed a fence separating the Road Right of Way from the remaining utility components of the TUC (the "TUC Outside the ROW"). At that time, the Department of Infrastructure will desire to reassign the TUC Outside the ROW as lease areas. The Contractor will be relieved of its maintenance responsibility for those portions of the TUC Outside the ROW that the Contractor had responsibility, if the state of this land is acceptable to the Department of Infrastructure. Conditions for the handover back to the Department of Infrastructure shall require that these areas are fully vegetated and in a healthy and vigorous weed-free growing condition in accordance with the Contractor's Environmental Management System*."	Technical Requirements Page 148	Unsuccessful	The SWCRR Opened to traffic on October 2, 2020. Fence installation began December 1, 2021. The fence was not built by construction completion, and remains incomplete in accordance with the Technical Requirements. The TUC has not reached a "*fully vegetated and in a healthy and vigorous weed-free growing condition*". However, the Contractor was still relieved of its maintenance responsibilities. Alberta Highway Services Ltd. (AHS Ltd) had taken over the KGL contract in October 2021.
Develop and implement an animal-vehicle collision (AVC) Plan that records the dates, locations, and types of animals involved in AVCs during construction and operations. AVC reports are to be submitted to the Department every six months.	Technical Requirements Page 79	Successful	Available on the government of Alberta's website https://open.alberta.ca/opendata/alberta-wildlife-watch-animal-carcass-records Despite fencing, wildlife collisions remain, further advocating for installation requirements to still be met.
Report AVCs to the nearest Alberta Environment office in cases where an animal is injured or poses a threat to public safety			

1.3 Breeding Birds

Breeding bird surveys are included in environmental impact assessments to describe the relative abundance, species present and habitat use. This information helps in both predicting the impacts of the planned project and in proposing suitable mitigation techniques to prevent or minimize these impacts.

The EIA and the Society expressed concern over birds avoiding the area with increased disturbance and traffic noise with significant reductions in songbird abundance and densities around highway sources of noise pollution[1, 3].

1.3.1 SWCRR Project EIA Discussion

Sixty bird species at risk were identified in the EIA to have the potential to occur and breed within the Biophysical Study Area and through their surveys the presence of numerous species at risk were confirmed[1].

The EIA concluded that despite the high percentage of habitat loss and documented species at risk present in the Biophysical Study Area, that enough suitable habitat remains in the surrounding larger regional context to support bird populations. This conclusion was based on a 1993 study. It is unknown if more recent data on regional ecodistrict habitat type composition was available to provide a more relevant regional context for habitat loss impacts.

1.3.2 WGPPS Study Findings

Our research followed the methodology of the fixed-radius point count survey conducted in 2011 for the 2014 EIA, which was then repeated each year over the Study period, with additional observations collected from eBird for the Weaselhead Study Area each year[1, 3, 50]. These annual surveys were conducted at the same survey points as identified in the EIA (Figure 21)[1, 3]. These points were used as the noise survey sampling locations (Figure 21)[3]. The protocol was repeated annually, and methodology and results are detailed in the annual Environmental Monitoring Reports from 2016 – 2022[3].

Figure 21. Location of breeding bird survey points in the Weaselhead. The survey points are colour coded to the bird survey teams. *(*Weaselhead boundary*: o*range line; red line = 500 m scale; *Google Earth*; July 10, 2022*)*

Over the Study period, a total of six 'sensitive' species (Alberta Wild Species General Species Status Listing) were seen or heard during the survey within 100 m of survey points (not including those seen flying overhead (Table 6)[51, 52].

Table 6. Alberta Wild Species General Species Status Listing of species found in the WGPPS Studies surveys[51, 52].

Common Name	Species Name	Alberta Wild Species General Species Status Listing	Species At Risk Act – status
Bank Swallow	***Riparia riparia***	**Sensitive**	**Threatened**
Pileated Woodpecker	***Dryocopus pileatus***	**Sensitive**	**Not listed**
Sora	***Porzana Carolina***	**Sensitive**	**Not listed**

Common Yellowthroat	***Geothlypis trichas***	**Sensitive**	**Not listed**
Baltimore Oriole	***Icterus galbula***	**Sensitive**	**Not listed**
Olive-sided flycatcher	***Contopus cooperi***	**Sensitive**	**Special Concern**
Western Wood Peewee	***Contopus sordidulus***	**May be at risk**	**Not listed**
Alder Flycatcher	***Empidonax alnorum***	**Previously listed as Sensitive Species during the study period**	**Not listed**
Least Flycatcher	***Empidonax minimus***	**Previously listed as Sensitive Species during the study period**	**Not listed**

The number of birds of 'sensitive' or 'may be at risk' status was notably decreased during the construction phase however a number of these species appear to have returned in 2021 and 2022 following completion of the SWCRR and start of the operational phase[3]. This is in alignment with the predicted outcome of the EIA[1].

While the increased repetitions and data sourcing do allow for greater certainty in the data, this methodology does not allow for collection of data that accurately captures bird species at risk that are present at different times of the year, are nocturnal or are highly human-adverse. The question remains of how the operation of the SWCRR has affected species that were not accurately studied using this methodology. Several species known to be particularly sensitive to anthropogenic impacts such as noise pollution are nocturnal, and their presence could not be accurately determined by the Study's methodology[53]. This is especially critical considering the noise level outcomes resulting from the SWCRR operation as observed in our research [3, 54].

Evidence of species of risk returning to the Weaselhead Study Area following the completion of the construction phase is a good indicator of the ability of these species to return and a potential improvement in habitat condition from the construction phase. However, it does not indicate whether the habitat condition is favourable to long-term re-establishment or population support. **The Society recommends that continued monitoring is required to ensure that these species are not just able to return temporarily, but in a sustained manner.**

1.3.3 Additional Considerations and Enforcement Actions

"*Vegetation clearing will not occur between April 12 and August 30 of any given year to avoid breeding season for non-migratory and migratory birds; prevent disturbance to breeding amphibians*" (KGL ECO Plan, 2017, p. 23). EllisDon was fined $5,000 in 2019 for removing bird boxes during the nesting period along the SWCRR route and ordered to pay a minimum mandatory fine of $100,000 on October 4th, 2021. This occurred after pleading guilty for removing bird nesting boxes in June along the West Ring Road TUC without a permit in violation of section 6(a) of the *Migratory Birds Regulations* and in accordance with the *Migratory Birds Convention Act, 1994*[10, 11]. EllisDon was also ordered to develop educational materials on migratory birds for on-site review and during staff orientation for staff and subcontractors.

Environment and Climate Change Canada (ECCC) reports confirm that Tree Swallows, a protected migratory bird species, were actively using these nesting boxes as they were removed from the fencing and discarded with eggs and chicks inside[11]. KGL was also fined $5,000 in July 2020 for clearing of vegetation in an area with active bird nests near the south stormwater pond[55].

It appears that fines may not be an effective deterrent for companies when enforcing environmental regulations, with other Enforcement Actions noted in this Final Report related to sediment laden water entering The Beaver Pond[56, 57].

The Society recommends the development and implementation of improved monitoring and enforcement of mitigation requirements. While enforcement and fines are urged to remain, alternative behaviours should be explored to improve compliance with regulations.

Table 7. Breeding Bird Mitigation Measures Evaluation

Ecosystem Component: Breeding Birds			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
Vegetation clearing will not occur between April 12 and August 30 of any given year to avoid breeding season for non-migratory and migratory birds; prevent disturbance to breeding amphibians; reduce sensory disturbance unless permission has been given to the Contractor to do so by a professional biologist (a member in good standing with the Alberta Society of Professional Biologists) upon the results of relevant surveys, and contact with the appropriate regulatory agency for permitting requirements.	Technical Requirements	Unsuccessful	Ellis Don was fined $5,000 in 2019 for removing bird boxes during the nesting period along the SWCRR route, and $100,000 in 2021 for removing bird nesting boxes in June along the West ring road TUC without a permit[10, 11]. Mountain bluebirds and American Tree Swallows were actively using these nesting boxes as they were discarded to the ground with eggs and chicks inside[11]. KGL was fined $5,000 in July 2020 for clearing of vegetation in an area with active bird nests near the south stormwater pond[55].
The dens of specified animal species are protected under the Wildlife Act (Alberta). The nests of migratory birds are protected under the Migratory Birds Convention Act (Canada). If an active den or bird nest is identified within the corridor prior to or during clearing or construction activity, consult with Alberta Environment to determine the appropriate mitigation. Avoidance or mitigation measures may be required and may include monitoring the den or nest and/or modifying the construction schedule to avoid activity until the den or nest is inactive.			
"Vegetation clearing will not occur between April 12 and August 30 of any given year to avoid breeding season for non-migratory and migratory birds; prevent disturbance to breeding amphibians"	ECO Plan Page 23		

1.4 Noise Pollution

Sensory disturbance from noise pollution is shown to have significant impacts of the viability of habitats for animals, making this a key study parameter to both predict and understand the effects of large-scale infrastructure projects such as the SWCRR and should be considered in mitigation measures designed and implemented[53, 58, 59, 60, 61, 62].

Anthropogenic noise is a serious form of environmental change and pollution as it affects both aquatic and terrestrial species in all taxonomic groups [53, 58, 59, 60, 61, 62]. The World Health Organization (WHO) recognizes noise as a hazardous form of pollution for humans that can lead to a wide range of health issues[62].

1.4.1 SWCRR Project EIA Discussion

The sensory disturbance from traffic volumes has a considerable impact with negative consequences on wildlife, as discussed in the EIA[1]. Traffic noise appeared to be the emphasized factor for birds avoiding natural areas in a vast number of studies highlighted in the Project's EIA[1]. SWCRR traffic volumes were anticipated to climb over time to a predicted volume of between 170,000 to 200,000 vehicles per day in approximately 50 years[1]. The EIA concluded that there is little information in the literature on the sensory effects of this level of traffic.[1]

The EIA predicted an increase in noise resulting from both construction activities and traffic on the SWCRR once in operation[1]. Noise data was collected as part of the EIA, however the sample sites used were chosen by proximity to residential areas only, as noise concerns were a less significant design consideration where the ring road was adjacent to natural areas and thus not collected[1].

It was noted in the EIA that "*Details of the noise attenuation measures along residential areas as well as within the Elbow River and Fish Creek valleys will be determined during detailed road design*", also indicating that "*monitoring would be conducted over time to….evaluate the effects of the roadway's noise on animal movements*." (AMEC EIA, 2014, Executive summary). The lowered vertical profile of the bridge was successfully implemented and is intended to achieve increased noise attenuation through sound absorption and dispersal through mature trees adjacent to the TUC. This lowered profile will be a more successful measure once revegetation has progressed, and trees planted in the cleared areas mature.

Data is available from the Alberta Transportation traffic volume data map for the SWCRR up to the end of November 2023, at the time of writing[63]. The monthly average daily traffic volume for November 2023 was 59319 vehicles per day, which is within the traffic volume ranges studied in the reported literature from the EIA[1, 63]. More direct comparisons can be drawn to the conditions studied in the literature reported in the EIA, with the current conditions at the time of writing and similar outcomes in bird population impacts may be anticipated.

1.4.2 WGPPS Study Findings

Noise data was collected as part of the Study, with the songbird fixed radius point count survey site locations used as the noise survey sample locations. Detailed methodology on the noise survey can be found in the annual Environmental Monitoring Reports from 2016 – 2022[3]. A regression analysis was conducted with the average sound pressure recorded between 2016 and 2022 (Figure 22). A significant positive slope was found, revealing an increasing average sound pressure on the monitored stations between 2016 and 2022.

As was predicted in the EIA, noise pollution has significantly increased in the park, attributed to traffic volumes[1] (Figure 22). Figures 23 and 24 illustrate the increase in sound pressure shown in Figure 22[3, 64].

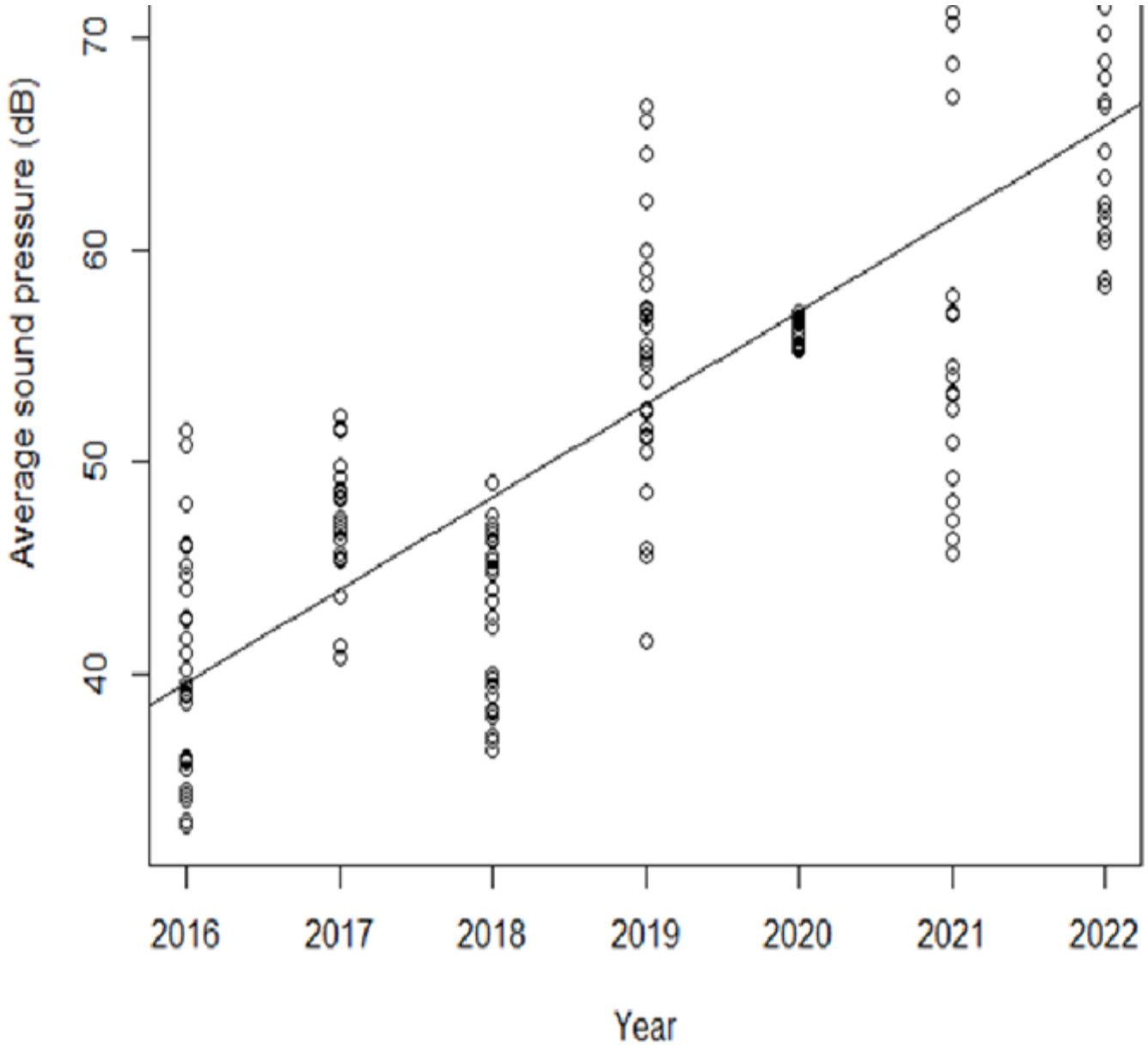


Figure 22. Average sound levels recorded in the Weaselhead and Glenmore Park Stations between 2016 to 2022. (Linear regression, d.f.=187, R2= 0.639, p<0.05)

Figure 23. Average noise reading at each noise sampling station in 2019 overlaid on Google Earth Imagery. Still taken from WGPPS Noise Measurement 2016 - 2022 video which shows changing noise averages at each station over time from 2016 to 2022[64].

Figure 24. Average noise reading at each noise sampling station in 2022 overlaid on Google Earth Imagery. Still taken from WGPPS Noise Measurement 2016 - 2022 video which shows changing noise averages at each station over time from 2016 to 2022[64].

The average noise level detected in 2016 was 40 dB ± 0.98 and in 2022 was 65 dB ± 0.89[3]. For reference, 40 dB is about the volume in a library; 65 dB is approximately the volume of a handheld mixer. 65 dB is the noise level that Alberta Transportation has adopted as the provincial guideline to install a sound wall in urban areas[65]. However, these provincial standards do not apply to natural areas, despite the literature indicating the harm to wildlife resulting from anthropogenic noise [53, 58, 59, 60, 61, 62]. The EIA acknowledges that the Biophysical Study Area is within a number of "*provincial Sensitive Wildlife Zones including the Sharp-tailed Grouse Range, the Sensitive Raptor Range and the Key Wildlife and Biodiversity Zone*" (AMEC EIA, 2014, p.177). **The Society urges the Province of Alberta to reconsider the sound mitigation requirement guidelines and update its policy to include Key Wildlife and Biodiversity Zones.**

Mitigation efforts and their evaluation is summarized in Table 8.

Table 8. Noise Pollution Mitigation Measures Evaluation

Ecosystem Component: Noise Pollution			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
Population reductions in songbird abundance and densities expected from highway noise disturbance.	EIA Page 218	Likely	Further attention to long term monitoring of populations is recommended by the Society.
To decrease sensory disturbance, "Recreational pathways will not be constructed at the Elbow River or Fish Creek crossings in order to minimize interactions between humans and wildlife"	Technical Requirements Page 119	Successful	Pedestrian pathways will not be included in any future plans in the bridge underpasses. Current City Park legal trails do not extend to the area; however, an illegal trail network does lead to the river beach east of the overpasses and is commonly used by members of the public.
Instructed to use noise reduction equipment to muffle and reduce sensory disturbance to wildlife using either vibratory pile driving, or impact pile drivers fitted with enclosures around the hammer to substantially reduce noise impacts.		Unknown	Elevated 2019 Noise levels which included pile driving (Figure 5).

2.0 AQUATIC HABITATS

The Weaselhead Natural Environment Area borders the west boundary of the Glenmore Reservoir, the source of drinking water for approximately 40% of Calgarians[66]. Wetlands within the Weaselhead naturally filter and clean this drinking water as they assimilate nutrients, filter sediments, and remove suspended solids from polluted waters prior to it entering the reservoir[67]. These wetlands are extremely important to the health and wellbeing of Calgarians reaching beyond the recreational and aesthetic values they offer. Highways are known to impact the ecological value of wetlands as even a single impact on one living or non-living component may disrupt the function of the entire wetland; it is difficult to evaluate these impacts that highways pose as the factors are so complex with extending interactions[67].

The Study collected and analyzed data on water quality, aquatic macroinvertebrates, fish and amphibians. These components were assessed individually and as a whole, providing significant insights into the health and changes in the studied wetlands.

The initial 2006 plan in the SWCRR Project involved partially filling in the west side of the Beaver Pond. This changed in 2015 with pressure from the Society.

2.1 Water Quality and Wetlands

Water quality is an important study parameter of environmental impact assessments and monitoring programs as it can identify potential sources of contamination and indicate when habitat health is impacted, leading to less suitable and lower quality aquatic and adjacent ecosystems. This ultimately helps to protect water quality, as well as to preserve biodiversity in aquatic ecosystems by facilitating the identification and prompt responsive corrective actions to mitigate these contaminant sources. Water quality parameters are important to the suitability of aquatic habitats to organisms that rely on these ecosystems and studying these parameters indicates when certain parameters change or exceed thresholds of tolerance for these organisms.

2.1.1 SWCRR Project EIA Discussion

Wetland classification and delineation was conducted as part of the EIA and used to assess wetland compensation and potential SWCRR alignment options. Comments were made in the EIA regarding water quality monitoring for assessing the project impacts on fish or fish habitat, benthic invertebrates and of the functioning of stormwater facilities. The potential effects were anticipated to be resultant from habitat disruption or the release of deleterious substances.

The Project's EIA predicted minor negative effects in terms of decreased wetland habitat[1]. The SWCRR is responsible for the complete destruction of 22 wetlands between Highway 22 and Highway 8 for the development, with further impacts on two more wetlands in the area, which were partially saved in 2017 by the efforts of YYC Cares[14, 68]. Initially approved "*to permanently disturb (in-fill) 24 wetlands and dewatering of the wetlands on the lands.*" (Environment and Parks Enforcement Actions, 2019-2020, p. 14). The EIA image shows the Beaver Pond and nearby watercourses impacted by the SWCRR Project and planned wetland loss[1] (Figure 25).

Hemmera Envirochem Inc. and Ausenco Sustainability Inc. were tasked to monitor water quality from 2018-2021 and 2022-2023 respectively[4, 69] . Both discovered elevated zinc concentrations in the Beaver Pond attributed to SWCRR Project impacts[4, 69]. Ausenco concluded the elevated zinc levels are likely to have come from a galvanized culvert running under Tsuut'ina Trail[4]. Additional elevated concentrations of chromium,

nickel, selenium, arsenic and uranium were detected in 2022 triggering Ausenco to recommend "*increased diligence*" in regard to subsequent monitoring. (Wetland 06 Monitoring Report, 2024, p. 15)

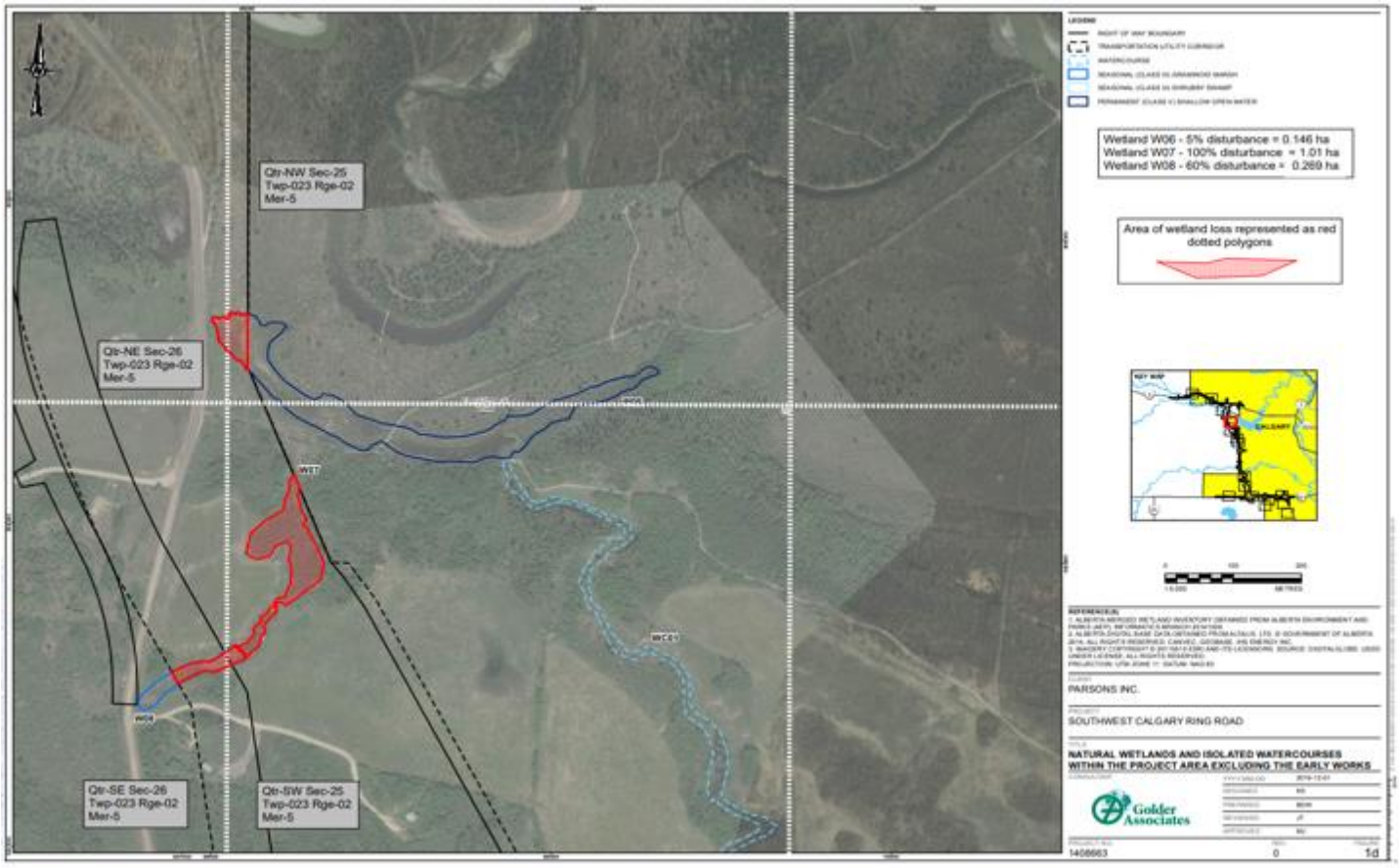


Figure 25. Image prepared by Golder Associates for the EIA shows the planned losses to the wetland area of the Beaver Pond and nearby watercourses. Area of wetland loss is represented as red dotted polygons[1].

The lower red polygon in Figure 25 is the Spring Brook wetland which has been built over by the SWCRR and much of the water flow redirected to the south stormwater pond west of the highway as seen in the bypass drainage system (Figure 26). This plan aimed to maintain surface flow to the stormwater ponds prior to discharge into the Elbow River, including redirecting the flow from Spring Brook that previously fed into Beaver Pond. This impact to surface flow and change to water catchment could have also impacted the hydrology of the Beaver Pond.

The Society recommends that upgrades be made to the stormwater pond to align with the specifications for naturalization enhancements found on page 89-92 of the DBFO Agreement[2]. These requirements that were not met, would help clean the storm water before entering the Elbow River, and thus aid in reducing water contamination issues.

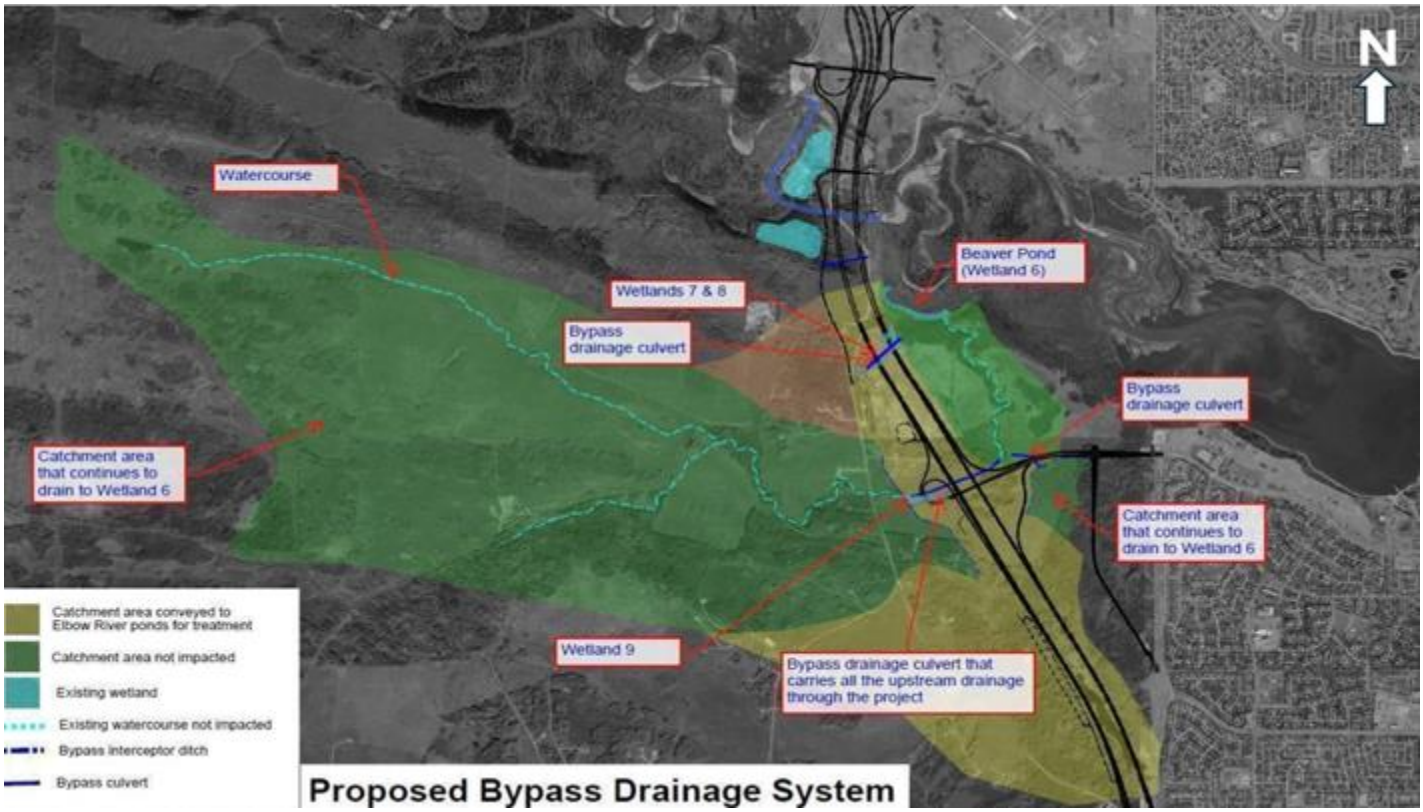


Figure 26. Bypass drainage for Spring Brook (northern culvert) and Ravine Creek (southern culvert) intended to maintain surface flow across the Transportation Utility Corridor into the Beaver Pond. Image courtesy of KGL.

2.1.2 WGPPS Study Findings

Water sampling and in-situ assessments were performed annually in late August and mid-October. A YSI® Pro DSS Multimeter was employed to measure field temperature, turbidity, conductivity, pH, and dissolved oxygen; a turbidity tube was used to measure transparency; and a YSI 9300 Photometer to measure phosphate, chloride, and nitrate. Conductivity, chloride, nitrate and phosphorus all showed statistically significant changes over the study period, with chloride returning to acceptable levels by the end of 2022. The other water quality indicators tested stayed within predicted parameters. All parameters can be viewed in the 2022 Environmental Monitoring Report[70].

The Study obtained information on water quality in two wetlands in the Weaselhead: The Beaver Pond and Beaver Lagoon (Figures 1C, 27 and 28 for locations), both considerably important wetlands as they clean and feed into the city drinking water supply[66]. The Beaver Pond in particular, was considerably impacted by five documented sediment control mitigation failures into the wetland[3, 71] (Figures 1D, 34A, B, 35A, B, 36A and B).

Water quality in an additional wetland, Clearwater Pond, was also assessed in the Elbow Valley, upstream of the SWCRR construction zone and not located in the Weaselhead (Figures 27 and 29). It is intended to represent a reference site against which to compare changes observed in the Weaselhead wetlands. The Beaver Pond is in immediate proximity to the SWCRR (Figure 28). The Beaver Lagoon with which it is hydrologically connected, is further downstream (Figure 28).

Statistically significant increases in conductivity, nitrate, and phosphate have been observed over time in the Beaver Pond (Figures 30-32). The stability of groundwater and surface water sources to the Beaver Pond may also have been impacted by the Ring Road as water levels in this wetland have been observed to have dropped considerably over the Study period. This is discussed further in the 'Hydrology' section. The Beaver Pond sampling locations during the 2022 field season were altered due to a significant change in the surface water

levels in Ravine Creek and Beaver Pond. Alternate sampling sites nearby were used where appropriate, but several October 2022 samples were not able to be obtained for all locations as surface water was no longer near these sites[3] (Figure 28).

These wetlands are upstream of the Glenmore Reservoir and Glenmore Dam. In September 2020 the City of Calgary completed updates to the dam to increase the storage capacity of the reservoir. This resulted in significantly higher June to late fall water levels in the reservoir compared to previous years. The dam improvement has resulted in the Beaver Lagoon water level increasing by approximately 1.5 m.

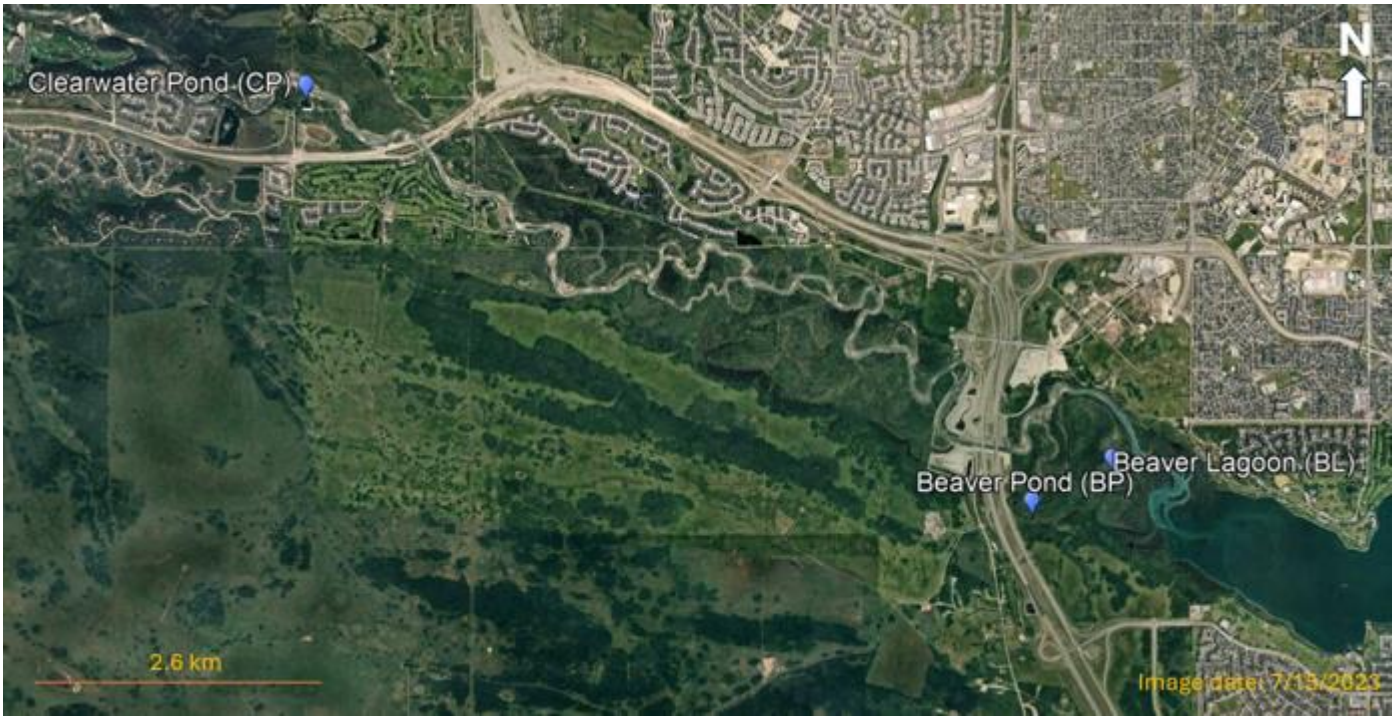


Figure 27. Aerial photograph of the Weaselhead and Glenmore reservoir indicating the location of monitored wetlands. (*Google Earth*; July 15, 2023)

Figure 28. Location of sampling sites at the Beaver Pond (BP), Beaver Lagoon (BL), Spring Brook (SB), Ravine Creek (RC) and Elbow River (ELR); within the Weaselhead area (white lines: edges of permanent wetlands; red line: 500 m scale bar; *Google Earth*)

Figure 29. Location of 3 sampling sites at Clearwater Pond; (blue symbols: site locations; red line: 100 m scale bar; *Google Earth*)

2.1.2.1 Conductivity

Conductivity of water is a key parameter for providing early warning of contamination by inorganic pollution (e.g., salts) which can release ions in the water increasing its electric conductivity[72]. Baseline information on the natural range and fluctuations of the conductivity in the studied water body is necessary for distinguishing between natural and disturbed levels of conductivity.

Regression analysis for the Beaver Pond for the period between 2015 and 2022 revealed a significant increase in conductivity over time (linear regression, d.f.=56 (Beaver Pond), R2 = 0.162, $p<0.05$). The reciprocal transformation (1/x) of the Beaver Pond conductivity data was necessary for achieving assumptions of normality and homoscedasticity.

During the same period, the reference wetland (Clearwater Pond) and the Beaver Lagoon have not shown any association between conductivity and time (linear regression, $p>0.05$) (Figure 30).

Conductivity fluctuations in the Beaver Pond between 2015 and 2022 shows the average conductivity levels were typically below 600 µS/cm until 2018 when they had a first peak, and that averages in both Weaselhead wetlands have remained above 600 µS/cm until summer 2020. A drop to values below 600 µS/cm was observed in fall 2020. The conductivity values increased dramatically again in 2022, however this time a comparable magnitude of increase was not observed at the reference site or at the Beaver Lagoon.

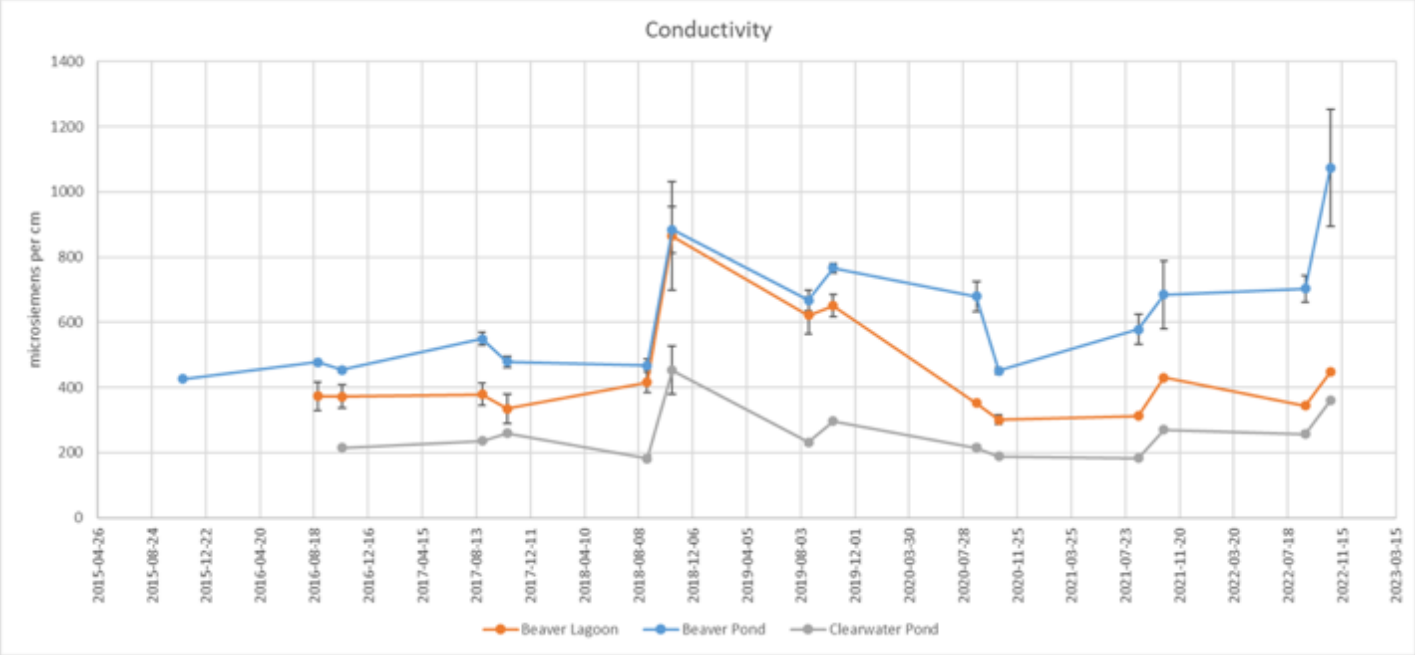


Figure 30. Conductivity measured from 2015 to 2022 in the monitored habitats in three areas at the Weaselhead: Clearwater Pond (CP), Beaver Lagoon (BL) and Beaver Pond (BP).

2.1.2.2 Nitrate

Excess nitrates can cause significant water quality issues, and combined with the increase in phosphorus can lead to eutrophication. A regression analysis for the Beaver Lagoon and Beaver Pond for the period between 2019 and 2022 revealed a significant increase in nitrate over time (linear regression, d.f.=22, R2 = 0.1915

(Beaver Lagoon), R2 = 0.3489 (Beaver Pond), $p<0.05$). A square root transformation of the nitrate data was necessary for achieving assumptions of normality and homoscedasticity.

During the same period, the reference Clearwater Pond has not shown any association between nitrate and time (linear regression, $p>0.05$) (Figure 31).

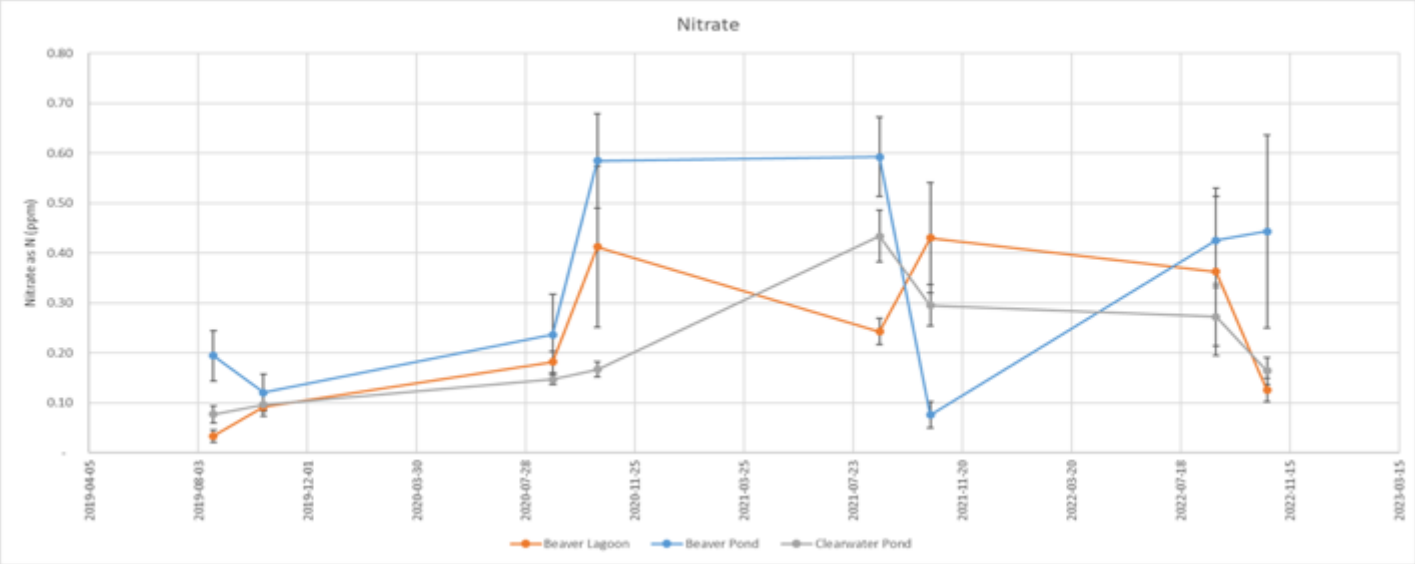


Figure 31. Nitrate recorded in the monitored habitats (Clearwater Pond (CP), Beaver Lagoon (BL) and Beaver Pond (BP) between 2019 and 2022.

2.1.2.3 Phosphorus

Phosphorus is one of the most important limiting nutrients in aquatic ecosystems[72]. The introduction of phosphorus into a water body can lead to an exponential increase in algal and cyanobacterial productivity, accelerating the rate of eutrophication[73]. The resultant low levels of dissolved oxygen can cause fish and invertebrate mass mortality or decreased fertility[74]. The phosphorus content in the environment has been measured as phosphate concentration. Regression analyses for all sites for the period between 2015 and 2022 revealed a significant increase in phosphate over time.

Two peaks can be distinguished, in 2019 and 2021/2022, which are observed in all sampling sites, including the reference wetland, Clearwater Pond (Figure 32). This data indicates that a further upstream impact has influenced this spike.

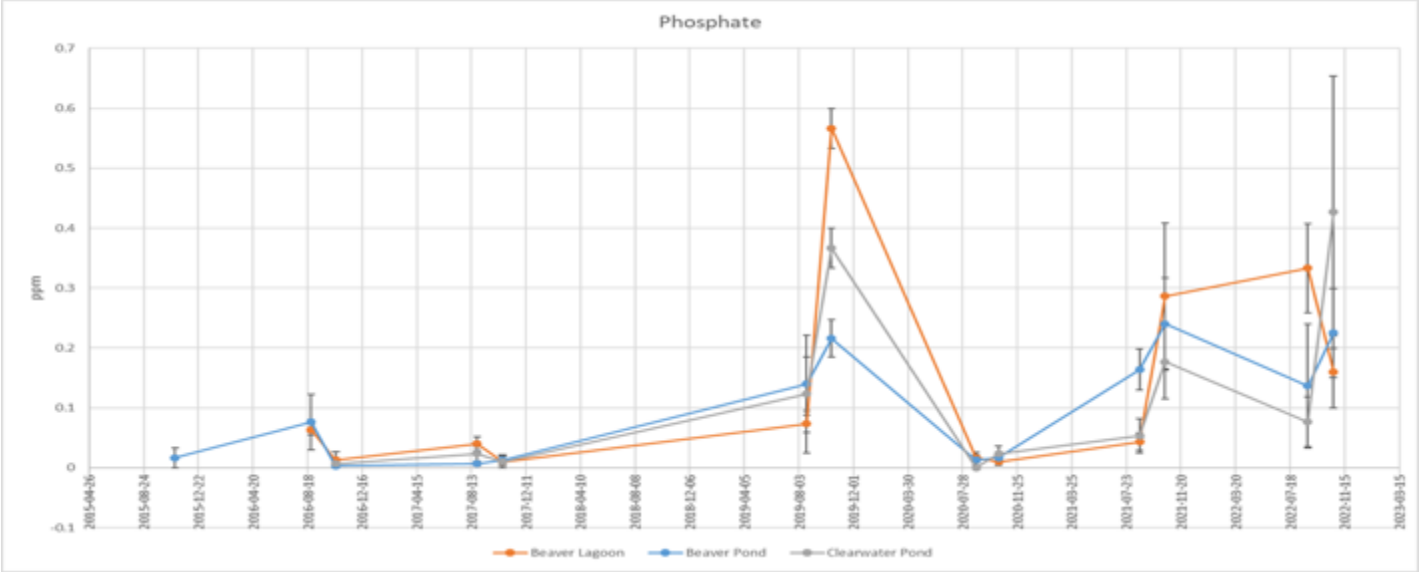


Figure 32. Phosphate recorded in the monitored habitats (Clearwater Pond (CP), Beaver Lagoon (BL) and Beaver Pond (BP)) between 2015 and 2022.

2.2 Aquatic Wildlife

Aquatic invertebrates, and amphibians often serve as bioindicator species alerting contamination of water bodies by their sudden absence while their presence informs healthy aquatic ecosystems[75]. Fish sampling is a way of monitoring the ichthyofauna diversity in key habitats. The Elbow River is home to the Threatened species, bull trout and cutthroat trout[51].

2.2.1 Aquatic Macroinvertebrates

The proportion of number of taxa from pollution-sensitive groups relative to total number of taxa is often used as a bioindicator parameter. The number of taxa from Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) relative to the total number of taxa, known as EPT taxa richness %, is an example of such a parameter. The EPT group contains a relatively high proportion of species intolerant to water pollution. For this reason, the Society embarked on an intensive aquatic invertebrate monitoring program in the Study[3].

2.2.1.1 SWCRR Project EIA Discussion

No information was found referencing aquatic invertebrates in the EIA, nor Technical Requirements. However, effective sediment and erosion control mitigation measures all directly benefit aquatic invertebrates, especially the EPT taxa.

2.2.2.2 WGPPS Study Findings

The Study found a shift in the type of species present, with new species noted as well as prominent species that had previously been recorded, absent in the 2021 and 2022 samples. Smaller invertebrates in the Beaver Pond were noted in the samples in 2022 with much of the specimen belonging to only two taxonomic groups in the August sampling, *Daphnia* and *Calanoida*, and the majority belonging to only one taxonomic in the October sampling, *Daphnia*. This is likely associated with the lower water levels in the Beaver Pond. The Simpson's Diversity Index showed an accentuated drop in diversity was observed in October 2022 for the Weaselhead sites (Beaver Pond and Beaver Lagoon), which was not detected in the reference site (Clearwater Pond)[70]. This may be attributed to the drop in water levels and resulting changes in water quality parameters such as dissolved oxygen levels and temperature as well as changes in availability of habitat and food.

EPT represents pollution intolerant species of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). While the regression analysis of data has not revealed any significant statistical association between EPT taxa richness percentage and time, we remained concerned about the absence of Caddisfly larvae found in the Beaver Pond. They were a species that consistently existed there prior to the construction period's sediment spills. On September 7, 2021, a group of students were conducting an educational pond study and discovered one individual caddisfly. This is a positive indication that caddisfly larvae may still be present or may be returning to the site.

2.2.2 Amphibians

Breathing through their porous skin, many amphibians are sensitive to changes in environmental conditions and water quality[76]. It is important to document their presence when conducting infrastructure projects adjacent to wetlands, as well as to mitigate potential impacts.

2.2.2.1 SWCRR Project EIA Discussion

Passive call surveys for amphibians were conducted in 2012 and 2014 following protocols used by the Alberta Amphibian Monitoring Program (ACA and ESRD 2013) and ESRD Sensitive Species Inventory Guidelines (ESRD 2013)[1, 77, 78].

Mitigation considerations were granted to amphibians through restricted vegetation removal times to avoid disturbance to breeding amphibians[2]. However, these measures were not always followed as shown in Table 9, Amphibian Mitigation Measure Evaluation.

2.2.2.2 WGPPS Study Findings

Nocturnal amphibian call surveys were done at two locations in the Weaselhead from 2017 to 2022 (Figure 33). Only boreal chorus frogs, *Pseudacris maculata* and wood frogs, *Lithobates sylvaticus* were detected. The locations match two used in 2012 and are close to one used in 2014 for the EIA. Surveys were carried out between 9pm and 11pm for 20 minutes, following a protocol developed by the Miistakis Institute for *'Call of the Wetland'*, a three-year study (2017 to 2019) into amphibians in the Calgary area[78].

Boreal Chorus Frogs were not detected in the park from 2018-2021 (apart from 2 individuals heard in late June of 2020) outside of the Study survey period), with data confirming their return in 2022. Amphibians are a bioindicator species as they are very sensitive to human disturbance. AMEC's EIA noted Boreal Chorus Frog as the most common amphibian when surveyed in 2014[1].

Following a spill of infill material from the construction site into the Beaver Pond in August 2019 and remedial action in November 2019, Alberta Environment and Parks (AEP) had ordered KGL to monitor amphibians in the Beaver Pond for two years. It was hoped that the results of this monitoring would be available for inclusion in this report but unfortunately these results have not been made available.

Table 9. Amphibian Mitigation Measure Evaluation

Ecosystem Component: Amphibians			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
Vegetation removal timing restriction of April 15th to August 15th will also prevent disturbance to breeding amphibians. In the event clearing or construction activities occur within this period, obtain the appropriate permit if amphibians may need to be moved off the construction footprint during construction and/or an amphibian salvage from a breeding pond is required. Contact the appropriate regulatory agency for permitting requirements and discuss the salvage plan with Alberta Environment prior to this activity.	Technical Requirements	Unsuccessful	KGL was fined $5,000 in July 2020 for clearing of vegetation in an area adjacent to a wetland near the South stormwater Pond[12].

Figure 33. Locations of amphibian call survey monitoring sites from 2017 to 2022 indicated by green circles. *(*Weaselhead boundary*: o*range line; Red line = 500 m scale, *Google Earth*)

2.2.3 Fish

The Fisheries Act prohibits the deposit of deleterious substances to enter fish habitat such as the sediment and contamination caused by the multiple coarse infill slides into the various water bodies during the construction of the road[79]. The wetlands studied are home to fish classified in the category of forage fish, defined as a species lower in the aquatic food chain who are important sources of food for at least some predators experiencing high predation mortality[80]. In general forage fish such as brook stickleback or fathead minnows, are resilient to a larger range of environmental conditions and are less sensitive to distresses in water quality, such as temperature and turbidity[80].

2.2.3.1 SWCRR Project EIA Discussion

AMEC faced challenges due to environmental conditions in obtaining their desired goals for baseline data and fish surveys[1]. Schedule 18 instructed that the Contractor's designs of the realigned Elbow River, Cullen Creek and Fish Creek channels to not result in negative effects to the watercourses or fish habitat (e.g., erosion, scour, sedimentation, etc.) upstream or downstream of the proposed realignments, including for lands outside of the TUC, noting that runoff of deleterious substances and sediment can negatively impact fish habitat altering water temperature[2].

2.2.3.2 WGPPS Study Findings

The Society conducted research to assess fish species present throughout the study, using minnow traps and dip netting. A Fish Research License was obtained from AEP for the purpose of this research. We determined the sample methods used earlier in the study were insufficient given the species present in the sample regions are small minnows and may have been swimming in and out of the minnow traps used, thus modifications to methodology were made to rely on dip netting[3]. Further detailed information on methodology can be found in the Society's Annual Environmental Monitoring Reports[3].

Species of fish caught in minnow traps and with dip nets from 2017-2022 include: Fathead minnow (*Pimephales promelas*), Brook stickleback (*Culaea inconstans*), White suckers (*Catostomus commersonii)*. These fish are categorized as 'Feeder fish' and are typically resilient to environmental changes[79].

Our Study does not adequately deliver enough data to comment on overall impacts to fish, as shown in Table 10.

Table 10. Fish Mitigation Measures Evaluation

Ecosystem Component: Fish			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
The Contractor's design of the realigned Elbow River/Cullen Creek/Fish Creek channels shall not result in negative effects to the watercourses or fish habitat (e.g., erosion, scour, sedimentation, etc.) upstream or downstream of the proposed realignments, including for lands outside of the TUC.	Technical Requirements	Unsuccessful	Reported failures in sediment and erosion control efforts along the Elbow River and Fish Creek are documented in the Contractor's 2019 Wildlife Reports (Figures 39-42). As well as 5 documented sediment control failures resulting in sediment contamination into the Beaver Pond (Figure 1D).
Install and maintain appropriate erosion and sediment control methods to prevent sediments from disturbed areas from being transported into watercourses. This should include the management of slopes adjacent to each watercourse.			
Prevent construction materials and debris from entering watercourses.			
During construction and until revegetation is sufficient to prevent sediment erosion, ensure effective sediment and erosion control measures are in place, functioning properly, and are maintained and/or upgraded as required to prevent sediment from entering fish habitat.			
Soil stockpiles must be located away from watercourses and slopes.			
Crossings at fish-bearing watercourses will be designed to always allow for fish passage and a monitoring plan during construction shall be developed and implemented.		Successful	Assumed successful, as the Society has no evidence to conclude otherwise.

Disturbance of riparian vegetation shall be kept to a minimum.		Unsuccessful	The entire riparian area was destroyed and altered within the TUC with 100% disturbance.
Revegetation of realignments to occur a minimum of one year prior to construction or as regulatory requirements dictate (the more stringent shall apply).		Unsuccessful	Revegetation does not appear to have been completed as of yet or has not survived to the 85-90% survival rate.
A water quality monitoring plan shall be developed by a QAES to monitor turbidity (e.g., documenting nephelometric turbidity units) and total suspended solids (TSS) concentrations during construction activities in or near water. This plan should be used to direct construction activities, and to inform decisions about timing and sequencing of construction. If monitoring reveals construction activities are causing potentially harmful sediment events, additional mitigation will be required or construction activities will be halted until turbidity and TSS levels return to background.		Successful for Wetland 06, Beaver Pond Unsuccessful for the Elbow River or Fish Creek	Water quality monitoring took place in the Beaver Pond, but we have not seen any documentation of water quality monitoring from the Elbow River or Fish Creek.

3.0 SOCIAL SURVEY

3.1 SWCRR Project EIA Discussion

The EIA predicted moderate short-term effects on recreational users "*related to sensory disturbance resulting from construction activities*" (AMEC EIA, 2014, p. 432) and a minor positive effect owed to increased access to the park, with the overall effects on recreational services considered to be negligible.

3.2 WGPPS Study Findings

A social survey was designed as an element of this Study to evaluate the human perspective, values, and user ship of the park before, during and after construction. Social surveys started July 1, 2016, conducted until 2018 and then repeated from March until November in 2023. The objective of the social survey is to quantify the impact of the SWCRR on the services provided by the Weaselhead to the community, establish the validity of the EIA predictions[1], and provide objective data upon which to base any requests for additional mitigation measures to be included in the Elbow River Crossing[81].

The social survey was made up of two parts, a participant and non-participant survey. The participant survey contains a total of 18 questions. Its purpose is to help understand the social value of the Weaselhead and what attracts visitors to the park. This survey gathers qualitative data through a variety of question types including multiple-choice, short answer, yes/no questions, and scale questions[81]. The non-participant observation records the number of people participating in specific activities in the park. The survey gathers quantitative data through a simple tally record[81]. A total of 390 participant surveys were conducted over the course of the Study.

Prior to the SWCRR construction, a significant percentage (31%) of people surveyed were 'not sure' whether the SWCRR would have an impact on the park. 'Peace and quiet' and 'a nature experience' were the main reasons people gave for choosing to visit the Weaselhead[82].

During construction, when asked about the Ring Road, most believed it will have a negative impact with respect to their experience and usage of the park (59%). The next highest percent was the '*not sure'* category (28%)[81]. In 2023, most survey participants said there was *'no effect'* on their park usage in relation to the ring road. When asked what they liked most about the Weaselhead, most replies fell within the following

categories; (1) nature and natural environment (2) peace and quiet (3) 'doesn't feel like you're in the city' (4) birds (5) trails (6) trees and forest[81].

In 2016, when asked 'What do you like *least* about the Weaselhead?' 40% of respondents said 'nothing', indicating that they enjoyed their time at the Weaselhead and/or have no complaints about the park[81].
In our post construction surveys many people surveyed stated that what they liked least about the Weaselhead was the bikes and the amount of off leash dogs.

Our prediction that the noise effects of the highway would be one of the main dislikes of the park was not correct, while some people did comment on the traffic noise, they also indicated that bikes would be the main negative factor impacting their park experience. Our survey does have limitations in that the people that participated in this survey were mostly pedestrians (i.e. not cyclists, rollerbladers etc.) so results represent primarily only this sub-set of park-users[82].

While the data from the surveys could be more deeply analyzed, it appears that the EIA was correct in the prediction of moderate short-term effects on recreational users "*related to sensory disturbance resulting from construction activities"* (AMEC EIA, 2014, p. 432). However, there were little to no responses that indicated a positive effect owed to increased access to the park as the EIA predicted[1].

4.0 LIMITATIONS AND ADDITIONAL CONSIDERATIONS

The Study did not adequately collect fish, groundwater, light pollution monitoring or soil data to properly evaluate impacts. The Breeding Bird Survey with increased repetitions and data sourcing do allow for greater certainty in the data, however this methodology does not allow for collection of data that accurately captures bird species at risk that are present at different times of the year, are nocturnal or are highly human-adverse.

4.2 Erosion Control and Sediment Spills

With multiple sediment and erosion mitigation failures, this issue requires immediate attention and provincial improvement.

4.2.1 Impact on Wetlands

Several parameters were studied by the Society to assess the success of mitigation measures and impacts of the SWCRR construction and operation on aquatic habitat health. Continual observation of these habitats allowed for the Society to notice and report quickly on incidents where sediment and erosion control measures failed. The timeline of these sediment spills is recorded in Figure 1D. These sediment spills represent instances when the mitigation measures used during construction have clearly failed and were not suitable to the environmental conditions. **The Society recommends a review of the measures implemented as well as the policy governing sediment and erosion control measures.**

One mitigation measure required by KGL's contract with Alberta Transportation is to *"install and maintain appropriate erosion and sediment control methods to prevent sediments from disturbed areas from being transported into watercourses"* (KGL ECO Plan, 2017, p. 124).

The measures adopted during the construction phase of the Project have proven to be ineffective on multiple occasions. Spills documented by the Society are as follows:

- Two separate spills of sediment into the Beaver Pond occurred in 2018, one directly from the adjacent construction site and one via a creek, Spring Brook, that feeds into the wetland[83].

- Another spill of 'coarse infill' (C. Pipher, personal communication, August 2019) directly into the Beaver Pond occurred in August of 2019[3].
- Again, on June 30, 2020, sediment entered the Beaver Pond via a feeder creek because of a failure of erosion control in the SWCRR construction zone following heavy rain[3].
- Another erosion control measure failure occurred July 2, 2021, after the opening of the SWCRR and therefore had potential for carrying road contaminants into the wetlands[3, 71].

The engineering failure on July 2 2021, is well documented in the 2021 Environmental Monitoring Report[74] and the WAIR[65] where an overwhelming volume of water running off the impermeable pavement surface of the Ring Road inundated the SWCRR design intended to capture road runoff and direct it along a drainage system to the stormwater ponds for filtering before entering the river[3, 71, 84]. This mitigation effort had not been completed to design specification when the rain event occurred, and major erosion of drainage channels occurred (Figure 34A and B). Heavy volumes of turbid water entered Spring Brook draining into the Beaver Pond[3, 71, 84] (Figure 35A and B). Further evidence of these sediment control failures in July 2021 in the Beaver Pond can be seen in Figures 36A and B.

This event may have contributed to the increase in chloride and other pollutants found in the wetlands water quality assessments by both our Society and Hemmera Envirochem Inc. [4, 71, 84]. In addition the failure of the drainage systems resulted in the temporary closing of the SWCRR on July 2, 2021, as the road was overcome with water[4, 71].

Improvements were made and thus far have been effective during precipitation events. Erosion control matting was placed on the slope to stabilize the sediment (Figures 37A and B). **The Society recommends that these locations and other similar sites continue to be monitored and mitigation measures improved where necessary following any future mitigation failures.**

Figure 34A and B Silt inundation of western culvert berm (A) and channel erosion within ditch alignment (B) after rain event. (Taken From Hemmera WAIR[65])

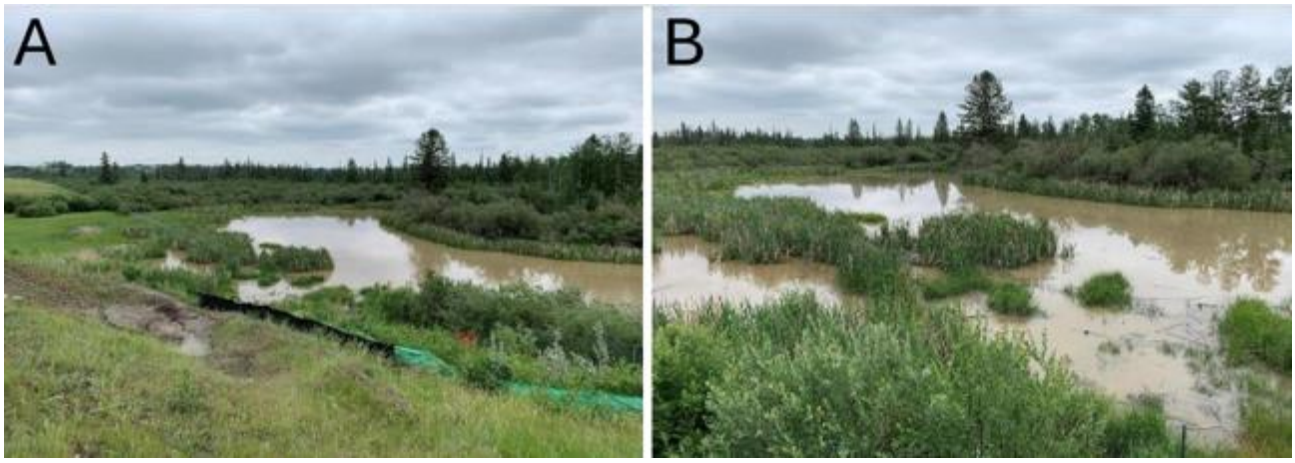


Figure 35A and B. View of Beaver Pond and increased turbidity on July 5, 2021. Green sediment fence adjacent to Beaver Pond (A) and the sediment plume observed in Beaver Pond (B). (Photos from WAIR - Hemmera Envirochem Inc. [65])

Figures 36A and B. Photographs of the Beaver Pond in the Weaselhead, identified as 'Environmental Sensitive Area', following sediment and course infill mitigation failure resulting in contamination of the wetland. Note the same failed mitigation measure used on top of the buried sediment fencing. (Taken July 3, 2021)

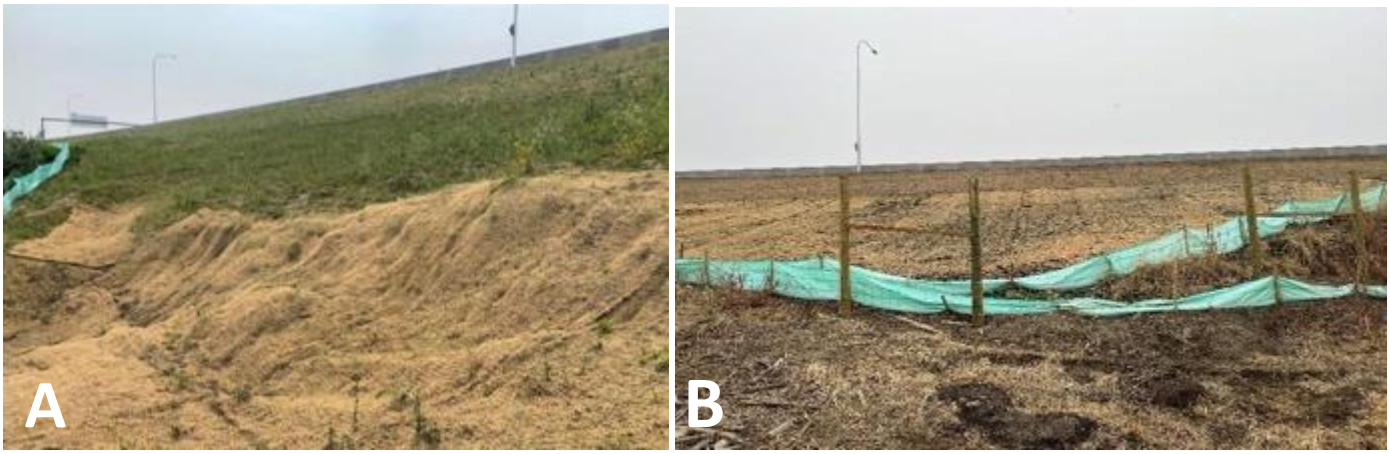


Figure 37A and B. Photo A shows the installation of the erosion control matting on the slope adjacent to the Beaver Pond in 2021 following the July 2nd, 2021, rain event (Photo taken from Hemmera WAIR[71]). Image B was taken April 19, 2022, of the erosion control matting and fencing.

4.2.1.1 Additional Enforcements Actions

KGL fined $11,000 in July 2020 for '*contravened clauses 3.1, 3.4, 4.1 and 2.0 of Approval No. 00386018 when it failed to undertake the activity in accordance with report no. 00386018R002, specifically the care of water plan required for dewatering the work area. It released water from the construction site to Fish Creek that was not of equal or better water quality; failed to implement the Siltation and Erosion Control Plan and failed to immediately report contraventions of the Approval'*[55].

KGL was fined $7,500 in December of 2020 for '*contravened clause 9.1 of its approval when it allowed sediment and sediment laden water to enter into Wetland 06 during the construction of the Southwest Calgary Ring Road Project'*[56].

On October 31, 2019, an Enforcement Order was delivered to KGL by stating '*The Company was issued Approval 388473-00-00 (as amended) to permanently disturb (in-fill) 24 wetlands and dewatering of the wetlands on the lands. On August 6, 2019, the Company reported that siltation of a wetland had occurred due to construction activities. Inspection of the lands confirmed that remediation of the siltation would be required. The Company shall remove sedimentation material from the wetland; carry out the remediation works as described in the approved Restoration Plan; submit a Wetland Reclamation Monitoring Report after a minimum of two years of growing seasons following completion of the remediation works, and after three years of growing seasons, submit a Verification Report signed and stamped by an authenticating professional'* (Environment and Parks Enforcement Actions, 2019-2020, p. 14).

4.2.2 Impact on Elbow River:

The Project's EIA predicted effects of stream alterations, changes to bank and bed substrate, stream flow parameter changes, erosion, and changes to hydrological flow patterns[1].

Golder Associates reported several failures in sediment and erosion control efforts along the Elbow River and Fish Creek in their 2019 Monthly Wildlife Monitoring Reports (Figures 37-38) [6]. While expected, this indicates that existing control measures are not adequate for continued application in similar river and stream crossings. **The Society strongly recommends improvements be made to existing sediment and erosion control protocols for effective mitigation.**

Figure 38A and B. Photo A taken facing eastward showing the erosion observed on the south side of the Elbow River diversion. (Photo from KGL July 2019 Monthly Wildlife Monitoring Report[6]). Photo B Photo taken facing northward showing an area of additional erosion control measures along the Elbow River diversion. (Photo from KGL September 2019 Monthly Wildlife Monitoring Report[6])

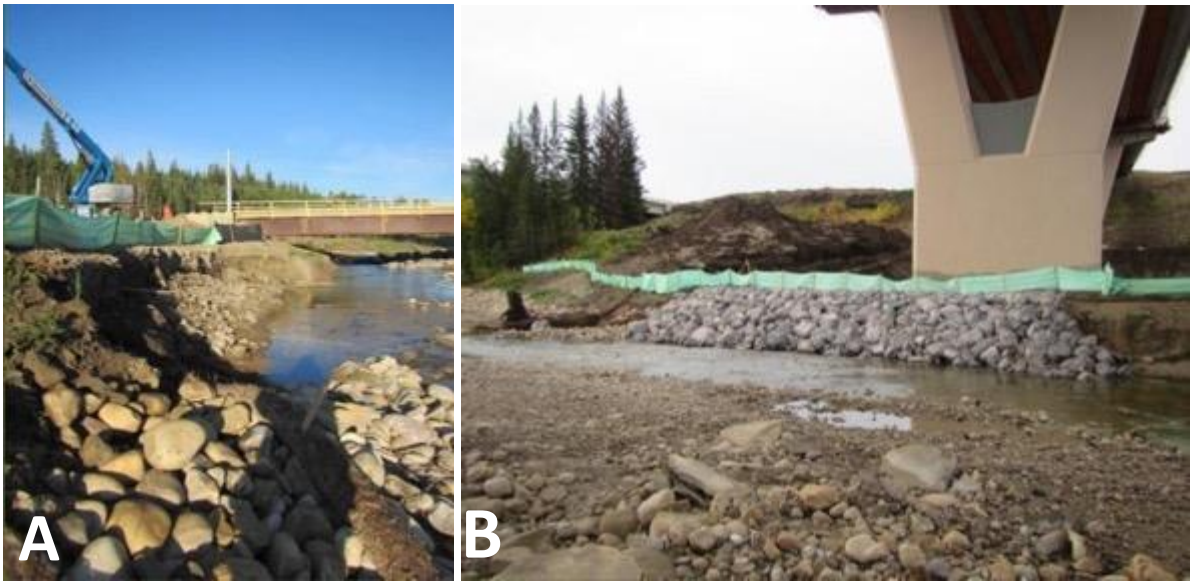


Figure 39A and B. Photo A is taken facing westward showing the erosion on the southern back of Fish Creek, under and east of the local bridge. (Photo from KGL August 2019 Monthly Wildlife Monitoring Report[6]). Photo B is taken facing southeast under the bridge showing repaired erosion south of Fish Creek diversion. (Photo from KGL September 2019 Monthly Wildlife Monitoring Report[6]).

4.3 Hydrology

Significant changes to hydrology occurred during the study period. While this was not a metric in the Society's Study, these changes are considerable and have implications on our results. The lowering water levels observed in the Beaver Pond and the Glenmore Dam infrastructure upgrades resulting in raising water levels in the reservoir are discussed in this section.

4.3.1 Lowering Water Levels in Beaver Pond

The Project's EIA predicted minor negative long-term effects impacting the hydrological regime of wetlands[1]. Figures 40A, B and C shows the progression of water loss over the time of the Study, SWCRR construction and operation. The open body of water seen in Figure 40A is reduced to a series of channels visible in Figure 40C. This reduction can be seen in the aerial imagery in Figure 41.

Confounding factors that could contribute to the water decline hydrological changes in the Beaver Pond include:

- Being in a multi-year drought.
- Hydrological impacts predicted for the Elbow River crossings included surficial and sub-surficial flow patterns which may have impacted water supply to the Beaver Pond[1].
- Surface flow re-direction to the stormwater ponds.
- Changes in beaver dam and den locations. Beavers appear to have abandoned the wetland moving upstream into Ravine creek.
- Compaction from roadway reducing permeability of subsurface flow.

The most important water resource on Earth is groundwater, and its availability is limited due to permeability of surficial and bedrock geology[85, 86]. Compaction reduces permeability and impacts subsurface flow[87].

Construction and operation of roadways involves compaction and can therefore impact permeability and groundwater flow.

Limiting factors and knowledge gaps exist in knowing for certain the Beaver Ponds recharge areas and groundwater subsurface flow prior to construction. The roadway system substantially altered the watersheds for the Spring Brook and Ravine Creek, which outflow into the west and east portions of the wetlands. The Beaver Ponds connection to its groundwater and surface water sources may have been disrupted by a construction element of the SWCRR. Further investigation into this is necessary to prevent future similar hydrological impacts on other road and construction projects. Monitoring groundwater in this area can be done with piezometers. **The Society recommends that the Province of Alberta and contractors evaluate the changing hydrological regime and impact on groundwater.**

Figures 40A, B, and C. Photographs of the Beaver Pond in the Weaselhead, showing progressive water loss from 2017-2022. (A) is taken by Yves Dansereau on May 27, 2017 (B) is taken on Sept 23, 2017, and (C) is taken on Oct. 21, 2022 all taken from survey point 21, facing east.

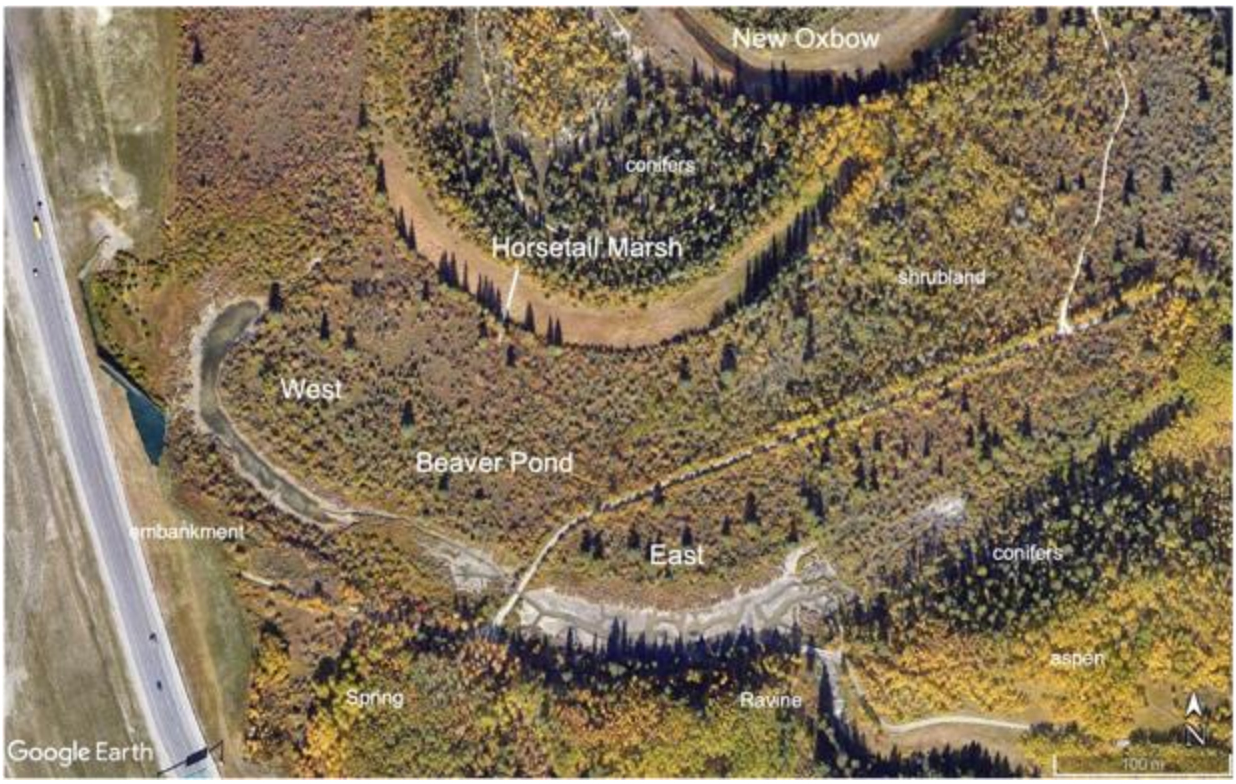


Figure 41. An aerial view of the Beaver Pond in the Weaselhead and adjacent features following the warm and dry summer of 2021 (*Google Earth)*.

4.3.2 Raising of Water Levels in Glenmore Reservoir

The City of Calgary improved the Glenmore Dam with restoration efforts completed by September 2020. Water levels were raised by approximately 1.5 m resulting in significant changes to the riparian vegetation and banks along the reservoir and Weaselhead Flats. This is an additional factor that influences our aquatic invertebrate data due to terrestrial plants submerged at sample sites. The raised reservoir results in substantial flooding of the willows on the Elbow River Delta. The inundation and especially submergence will result in mortality of the willows, dogwood, and other riparian shrubs (Figure 42). Dr. Stewart Rood of the University of Lethbridge hypothesizes that: "*The repetitive and prolonged flooding will lead to progressive mortality of the extensive riparian willows (Salix spp.) in the delta zone where the Elbow River flows into Glenmore Reservoir. This might be followed by some upward transitions of willows and alders (Alnus spp.) and some localized die-back of spruce (Picea glauca). Unlike the Bow River through Calgary, the Elbow River valley has more limited balsam poplars (Populus balsamifera)*." (S. Rood, personal communication, September 6, 2021). Willow and spruce mortality are visible near the reservoir and the dieback is expected to be extensive. These alterations are independent from the SWCRR Project, the timing is coincidental though there may be cumulative impacts from the roadway and reservoir projects. This development raises several questions regarding the engineering of the SWCRR Elbow River valley crossing. Is the SWCRR Project engineered to accommodate this change in the reservoir level? Are there any engineering concerns with the change in groundwater levels and the stability of the structure foundations during a flood event?

Figure 42. A southwest-facing overlook of the Elbow River Delta in Weaselhead Flats, with the pathway bridge on the right. The tall shrubs displayed in the photo extending up to the regional pathway are expected to have major die off and habitat changes. Die off has been more noticeable in spring 2024 (Photo by Stewart Rood, September 3, 2021).

4.4 Night Sky Quality

Light pollution is a critical issue impacting organisms, altering migration, reproductive and life history, bloom and senescence timing. In 2019 the Society began to collect night sky quality measurements as part of work to have the Weaselhead recognized as a Nocturnal Sanctuary, a designation assigned by the Royal Astronomical Society of Canada (RASC)[85]. These measurements collected baseline data prior to construction lighting being used and roadway lighting installation revealing the level of change in artificial light at night in the Weaselhead due to the SWCRR Project.

Though the significance of light pollution is becoming much more widely recognized there are few regulations or standards that meet ecological needs. While light pollution is a very important impact to mitigate, it is a growing field and integration of these learnings into construction standards and legislation had not occurred by the time of the SWCRR Project.

Lighting was a consideration in the EIA[1]. The anticipated residual effect with mitigation was negative, minor, local and long-term[1]. No data was collected to assess lighting impacts or the presence of species particularly susceptible to light pollution in the Biophysical Study area. No mention of the known harms of light pollution on healthy ecosystems were reported in the EIA lighting section[1], however considerations to reduce light trespass into areas adjacent to the TUC were made.

Mitigation measures listed included:

- Lighting would be included for driver safety, mitigating harm to roadway users.
- Using low-dispersion lighting fixtures where feasible and where light trespass is of concern such as in river valleys.
- The use of directional high mast lighting to reduce light dispersion at interchanges where feasible.

Light abatement will benefit the organisms that live and use the area and increase opportunities for local communities to enjoy dark skies. Recognition as a Nocturnal Sanctuary will help to preserve the natural night environment of the Weaselhead (which currently has no artificial lighting), encourage light abatement in the surrounding communities (through a required outreach component), and help protect nocturnal species.

While the SWCRR Project appears to meet all current lighting requirements, the Society recommends that the Province of Alberta examines and updates its lighting requirement guidelines to align with current scientific understandings about light pollution and its impacts.

Figure 43. Nighttime working Sept 2020, showing construction lighting similar to those observed in Aug 2020. (Image provided by KGL[89])

5.0 CONCLUSIONS

The Society has a number of recommendations to reduce the environmental impact of large infrastructure projects. In construction of the SWCRR the Contractor and Alberta Transportation agreed to impressive mitigation measures, however these were not always successfully implemented. In some cases, the standards were not sufficient to mitigate impacts on the environment and in other cases they were not carried out to specification. In acknowledgement of the Province of Alberta's vision statement "*Proudly working together to build a stronger province for current and future generations*." improvements must be made to ensure that protecting water quality and biodiversity is a top priority. Current and future generations of Albertans are inextricably dependent on these. To align with the Provincial values of "*Respect, Accountability, Integrity and Excellence*", improvements must be made[90].

5.1 Recommendations

The Society recommends the Province of Alberta:

- Update Alberta Transportation's '*Erosion and Sediment and Control Manual'*. Mitigation efforts that appeared to be designed and implemented to provincial standards, were observed failing on multiple occasions during very heavy rain events. Such events (more than 25mm in 24hrs) are predicted to increase dramatically in Alberta in the future due to climate change.
- Include sound mitigation measures for areas recognized by the Province as 'Key Wildlife and Biodiversity Zones' in Alberta Transportation's '*Noise Attenuation Guidelines for Provincial Highways'*.
- Further consideration to be given to installation of a sound barrier along the SWCRR in the Elbow Valley.
- Improve the functioning of the wildlife underpasses and reduce vehicle collisions on the SWCRR by ensuring (as detailed in the contract to build the SWCRR)
    - vegetation is planted along the underpasses to provide rest and cover habitat;
    - wildlife fencing that guides wildlife to these underpasses and prevents animals accessing the highway is brought up to contractual specification.
- Work with wildlife organizations such as Western Transportation Institute, the Biodiversity Research Centre, and Miistakis Institute to develop effective mitigation measures to address wildlife movement during road construction (before more permanent measures are functional).
- Implement weed management plans including frequent early detection sweeps.
- Upgrade the stormwater pond to align with the specifications for naturalization enhancements found on page 89-92 of the DBFO Agreement.
- Evaluate the changing hydrological regime and impact on groundwater and continue to investigate sources of the observed hydrological changes to the Beaver Pond. Monitor groundwater with piezometers.
- Continued evaluation to assess whether successional change towards upland habitat is occurring along the Beaver Ponds riparian area and determine the long-term viability of this wetland in response to hydrology changes.
- Continued long term monitoring of bird species to take place with improved methodologies to also include surveying nocturnal species, and birds species with differing temporal behaviour and migratory patterns.
- Additional behaviours should be explored to provide compliance with regulations, with enforcement and fines to remain.

- All locations where operational mitigation or engineering has failed continue to be monitored and mitigation measures improved where necessary following any future mitigation failures.
- Develop and implement improved policy and procedures to ensure environmental mitigation requirements are met by contractors for all infrastructure projects.

6.0 NEXT STEPS

While this study is now completed there are considerations for how this data could be used and analyzed further as well as additional studies that may provide insights and clarity into confounding factors and complex situations where needed.

The City of Calgary is in the process of developing a Habitat Management Plan for the Weaselhead Natural Environment Area[91]. The Society is working with the City of Calgary to determine if some of the methodologies and survey sites adopted for the SWCRR Impact Study might be repeated in the long-term habitat monitoring. Having the baseline data from both AMEC's initial 2006 EIA and the Society's Study would be valuable for comparisons while managing the natural area. Potentially, aspects of the Study could be repeated every five years for long-term monitoring and used in future management plan evaluations. Future studies are funding dependent and would be modified to include improved bird survey methodologies as well as comparing noise levels with bird populations. Many of the Study parameters can also be adapted as Citizen Science activities. Long-term data will be valuable to further understand the impacts of the SWCRR, climate change, park use and park management practices. Future monitoring by the Weaselhead/Glenmore Park Preservation Society is pendant on funding.

The most important next step will be improved policy ensuring mitigation measures are implemented for Alberta infrastructure projects. When Technical Requirements are not being met, the consequences are decreased water quality and loss of biodiversity. Ecosystem services that we all depend on are damaged through ineffective environmental mitigation making it a critical piece in sustainable development.

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APPENDICES

APPENDIX I - EIA ENVIRONMENTAL IMPACT CHARACTERISTICS AND DEFINITIONS

Magnitude

Negligible: Measured or estimated impact results in no apparent change to the VEC (quality, quantity or other attribute) compared to baseline conditions. Such impacts are not characterized with respect to direction, extent, duration or confidence. Effect can be mitigated by implementing industry best practices.
Minor: Measured or estimated impact results in a noticeable effect on individuals of a population or on features of the VEC, but does not affect local populations, and effects are within the natural limits of variation. Effect can generally be mitigated using industry best practices.
Moderate: Measured or estimated impact results in a noticeable effect on populations or on features of the VEC. Effects are within the natural limits of variation and can generally be mitigated using industry best practices and/or other specialized measures.
Major*:* Measured or estimated impact results in an obvious effect on populations or on features of the VEC. Effects are beyond the natural limits of variation and generally require specialized and/or extensive mitigative and/or compensation measures.

Direction

Positive: Measured or estimated impact represents a real or potential increase in abundance, quality or other attribute of the receptor.
Negative: Measured or estimated impact represents a real or potential decrease in abundance, quality or other attribute of the receptor.

Location & Scale

With respect to the location and extent of the project shown in Vol.1, Fig. 2.1-1:

Local: Within the boundaries of the project's ROW or TUC (approx. 300 m width).
Subregional: Extending within an area including the ROW or TUC and a 1000 m buffer zone on either side of the ROW.
Regional: Extending beyond the boundaries of the subregional area, into the Ecodistrict encountered by the project (as defined by Strong 1992).

Duration

Short-term: Effect is measurable only during the construction phase.
Medium-term: Effect persists during the construction phase and up to two years of the reclamation/restoration phase.
Long-term: Effect persists through the reclamation/restoration phase and into operations and maintenance.

Scientific Confidence

Predictable: Effect on VEC is well understood through study of the interaction and application of mitigations on projects that are similar in nature and environmental setting.
Uncertain: Effect on VEC is not well understood due to lack of knowledge regarding the project-VEC interaction within a similar environmental setting.

Nature

Direct: A direct causal relationship exists between a project activity and/or component and its effect on the VEC (eg. the loss of fisheries as a direct result of the construction of a project). This typically represents environmental effects; direct positive socio- economic effects (eg. increased employment) may be considered as mitigation to offset environmental effects.

Indirect: An indirect effect on the VEC ultimately occurs due to an intermediate direct environmental effect(s) of the project (eg. the loss of income experienced by commercial fisherman due to the direct effect of loss of fisheries).

Cumulative: A measurable change in the environment resulting from the project in combination with other projects or activities that have been or will be carried out.

Frequency

Isolated: Effects confined to a specific time period and occurring only once (e.g., clearing).

Intermittent: Effects likely to occur periodically over the life of the project.

Frequent: Effects likely to occur continuously over the life of the project.

Accidental: Effects associated with unplanned, accidental events.

Seasonal: Effects likely to occur seasonally.

Reversibility

High: Effect can likely be reversed in 2 years or less.

Moderate: Effect can likely be reversed within 2 to 30 years.

Low: Effect is likely to extend beyond 30 years or may be permanent.

Ecological Context:

Refers to the sensitivity of the environment (e.g., wildlife habitat, terrestrial habitat, aquatic species) that will be affected by the project. Indicators include:

-% of population affected;

-importance of population; and

-number of generations to recovery

The ecological context of residual effects is described as appropriate for VECs within the respective effects assessment sections in the EA.

APPENDIX II - ECOSYSTEM COMPONENT MITIGATION MEASURES, OUTCOMES AND COMMENTS

Table 2. Revegetation Mitigation Measures Evaluation

Ecosystem Component: Revegetation			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
"Disturbed areas are to be revegetated as soon as possible"	KGL ECO Plan Page 25	Unsuccessful	Major construction was completed in 2019. It is unclear if planting has occurred, as it appears that no woody plants are established on the north side of the Elbow river under the bridges. Spruce trees were planted in the interior between the north and southbound lanes, but may not have survived to the 85-90% survival rate. Willow shrub staking was observed and recorded in the Monthly Wildlife Monitoring Reports and "landscaping" was recorded on the work schedules. Recommend increasing third party review to ensure work is completed as agreed upon and to ensure 85-90% survival rate.
"Revegetation of disturbed and cleared areas to be undertaken as soon as possible"	Technical Requirements		
"Planting will occur along terraces to mimic the natural species profile in adjacent areas. All vegetation planting will be monitored to ensure 85-90% survival rate for the first year. If planting does not meet that level, the area will be addressed."	KGL ECO Plan Page 27		
"Stormwater management facility wet ponds shall have vegetation for water quality enhancement, and erosion control. Shrub staking shall be installed along the disturbed margins of the wetland or around selected constructed wetlands or stormwater ponds to stabilize disturbance, reduce the potential for sediment introduction and restore habitat function where shrubs were present prior to construction and where directed by the environmental inspector. It is preferred that plant species selected for revegetation within constructed wetlands be sourced from local materials, either salvaged from naturally occurring wetlands that may be disturbed within the Road Right of Way or from known donor wetlands. If salvaged or donor material is not available, the Contractor shall source out native plant species adapted to wetland conditions (bare root stock preferred). Sourced plant species shall include:	Technical Requirements Page 89	Unsuccessful	The stormwater ponds do not appear to have been revegetated from visual observation. The ponds were not built to the specifications of the Technical Requirements for both straight line distances and curved alignment specifications in addition to replanting requirements.

- Submerged plant species to be planted within deep pools; - Emergent plant species accustomed to fluctuations in water level to be planted just below to partially above the normal water level; and - Riparian plant species, both shrub and herbaceous species, accustomed to slightly drier conditions but can tolerate occasional flooding to be planted just above the ordinary high water level."			
Monitor revegetation success within the TUC and the Road Right of Way and undertake remedial measures as appropriate.	Technical Requirements	Successful	Golder Associates monitored the revegetation of the wildlife corridor until 2021 when conducting monthly wildlife surveys. However, no details reported in the monitoring to improve on and to meet revegetation requirements.
Monthly vegetation inspections shall occur in order to identify areas where re-seeding is required to meet the requirements in Section 200.2.9.		Unsuccessful	
Verification that mitigations implemented for wildlife movement corridors (e.g., vegetation plantings and seeding) are viable and functioning as intended		Unsuccessful	Monthly Wildlife Monitoring Reports verified stating "Mitigations developed to reduce barriers to wildlife movement during construction are implemented and functioning as intended."[6] However, in contrast, their data shows little to no wildlife utilizing the intended movement corridor during construction, stating "mitigations appear effective, with reduced sign of wildlife use under the bridges." [6] As well, vegetation is not visibly established.

Table 3. Invasive Plant Species Mitigation Measures Evaluation

Ecosystem Component: Weed and Invasive Species Establishment			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
"Contractor will control weeds on site as required to ensure compliance with the Alberta Weed Control Act and its regulations as well as City requirements."	KGL ECO Plan Page 20	Unsuccessful	Spotted Knapweed and Black Henbane in TUC. Retaining wall weed establishment observed.
"Site inspections for weeds during the growing season will be conducted"		Unsuccessful	Informed that monthly site inspections took place, but the data was not made available. Informed that in 2019 there was no Spotted Knapweed discovered, but that seems to be unlikely. If monthly inspections occurred, when did they stop? Current observations of the TUC reflect a failure of this process resulting in extensive Black Henbane and Spotted Knapweed presence.
"Weed control in disturbed areas to be utilized until desired vegetation is established"	KGL ECO Plan Page 25	Unsuccessful	Desired vegetation does not appear to have been established and weed control appears to be absent.
"Monthly inspections including vegetation inspections and weed inspections"		Unsuccessful	See comment above.
"Noxious weeds shall be controlled, prohibited noxious weeds must be destroyed"	KGL ECO Plan Page 28	Unsuccessful	Spotted Knapweed and Black Henbane observed in TUC.
"Develop a weed management plan to address long-term weed issues within the TUC and the Road Right of Way during the PNI Operating Period and the Operating Period for "prohibited noxious" or "noxious weeds" in accordance with the Weed Control Act (Alberta) and Weed Control Regulations.	Technical Requirements Page 117	Unsuccessful	The Weed Management Plan was not made available for our review. However, even if it was developed, it was unsuccessfully implemented as proved by the presence of noxious weeds and the absence of control efforts.

Establish priorities regarding the most problematic weed species."			
"By Construction Completion, the Contractor shall have installed a fence separating the Road Right of Way from the remaining utility components of the TUC (the "TUC Outside the ROW"). At that time, the Department of Infrastructure will desire to reassign the TUC Outside the ROW as lease areas. The Contractor will be relieved of its maintenance responsibility for those portions of the TUC Outside the ROW that the Contractor had responsibility, if the state of this land is acceptable to the Department of Infrastructure. Conditions for the handover back to the Department of Infrastructure shall require that these areas are fully vegetated and in a healthy and vigorous weed-free growing condition in accordance with the Contractor's Environmental Management System."	Technical Requirements Page 148	Unsuccessful	See comments above. The Contractor was relieved of its maintenance responsibilities, however, the state of this land did not meet the requirements listed for this handover as the TUC was not in a 'fully vegetated and in a healthy and vigorous weed-free growing condition".

Table 4. Wildlife Mitigation Measures Evaluation

Ecosystem Component: Wildlife			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
"*The Contractor's design and construction execution shall not inhibit wildlife passage along this corridor*."	Technical Requirements Page 48	Unsuccessful	KGL's Monthly Wildlife Reports data directly shows wildlife use in the buffer regions east and west of the bridges with very minimal evidence of wildlife moving through the intended wildlife corridor during construction[6]. Reports state that they "*verify that mitigation to reduce barriers to wildlife movement had been implemented, identify deficiencies in the implementation of mitigation (if any), and confirm wildlife movement is not impeded during construction*." [6] Also stating, "**ACTION:** *Maintain buffer at Elbow River - mitigations appear effective along the south portion of the realigned river east and west of the bridges, with reduced sign of wildlife use under the bridges*." [6] This statement coupled with the data indicates that the mitigation in the bridge underpasses was ineffective and wildlife movement was inhibited.
"*Temporary passageways shall be available during construction to maintain ability for wildlife passage during construction. The ground surface of the passageways shall be approximately level (allowing for appropriate drainage) and shall have a generally smooth walking surface that closely matches the natural valley substrate (e.g. no riprap or large boulders) and vegetated to meet the requirements of the Environmental Assessment for the Southwest Calgary Ring Road (Updated December 2014) Elbow River Bridge Crossing Wildlife Planting Concept*"		Unsuccessful	Temporary passage was made available, evidence shows it was not utilized by wildlife during construction (see above). Riprap and large boulders were in the wildlife corridor during construction and now. The Society acknowledges the need for erosion mitigation using these mitigation tools and observes the boulders and rip rap are not inhibiting wildlife movement during road operation.
Permanent dedicated large wildlife passage shall be provided beneath the bridges at both the north and south bridge abutments as well as a dedicated small wildlife passage at the north bridge abutment. The small wildlife passage shall be above the high water level.		Successful	The Society celebrates the inclusion of the wildlife corridors.

The Contractor shall extend the wildlife passage corridors on either side of the bridge to provide a contiguous corridor of varying width through the disturbed area.			
The Contractor shall retain a professional biologist (a member in good standing with the Alberta Society of Professional Biologists) to ensure wildlife movement is not impeded during operations at both the Elbow River and Fish Creek crossings. Monitoring shall commence following the completion of construction and last for a period of 36 months.		Successful	Golder Associates was contracted to conduct monthly wildlife monitoring and reports between 2018-2021[6]. However, wildlife movement has been impeded.

Table 5. Wildlife Fencing Mitigation Measures Evaluation

Ecosystem Component: Wildlife Fencing			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
"*Fencing should incorporate a small mesh component directly above and below the ground surface to discourage small mammals from burrowing underneath the fence and accessing the roadway*".	EIA Page 210	Unsuccessful	There is no small mesh component directly above and below the ground surface to discourage small mammals from going under the fence. Tracks in the snow as well as coyote fur caught under the fencing confirms wildlife are traveling underneath the fence.
"*Max ground to fence gap is 75mm*"	Wildlife Fence Details from Technical Requirements Appendix B [51] (Figure 19)	Unsuccessful	Gaps under the fence extend up to 254mm, more than three times the requirement. Tracks in the snow as well as coyote fur caught under the fencing confirms wildlife are traveling underneath the fence.
"*Maximum clearance between gate posts is 75mm*"			The access gate located on the east side of the TUC, south of the Beaver Pond has gaps both between the gate posts and the ground that exceed 75mm.
"*Fence end treatments (eg. Boulder fields) should be designed and implemented to discourage wildlife accessing the roadway area at fence ends, and should direct wildlife back to vegetated areas away from the roadway*."	EIA Page 210	Unsuccessful	A 3 foot gap exists at the fence end located on the west side of the Beaver Pond and tracks in the snow show that canines (likely both coyote and red fox) as well as ungulates (White-tailed deer) are using this as an access point to the road side of the fence.
"*By Construction Completion, the Contractor shall have installed a fence separating the Road Right of Way from the remaining utility components of the TUC (the "TUC Outside the ROW"). At that time, the Department of Infrastructure will desire to reassign the TUC Outside the ROW as lease areas. The Contractor will be relieved of its maintenance responsibility for those portions of the TUC Outside the ROW that the Contractor had responsibility, if the state of this land is acceptable to the Department of Infrastructure. Conditions for the handover back to the Department of Infrastructure shall require that these areas are fully vegetated and in a healthy and vigorous weed-free growing condition in accordance with the Contractor's Environmental Management System*."	Technical Requirements Page 148	Unsuccessful	The SWCRR Opened to traffic on October 2, 2020. Fence installation began December 1, 2021. The fence was not built by construction completion, and still remains incomplete in accordance with the Technical Requirements. The TUC has not reached a "*fully vegetated and in a healthy and vigorous weed-free growing condition*". However, the Contractor was still relieved of its maintenance responsibilities. Alberta Highway Services Ltd. (AHS Ltd) had taken over the KGL contract in October 2021.
Develop and implement an animal-vehicle collision (AVC) Plan that records the dates, locations, and types of animals involved in AVCs during construction and operations. AVC reports are to be submitted to the Department every six months.	Technical Requirements Page 79	Successful	Available on the government of Alberta's website https://open.alberta.ca/opendata/alberta-wildlife-watch-animal-carcass-records Despite fencing, wildlife collisions remain, further advocating for installation requirements to still be met.
Report AVCs to the nearest Alberta Environment office in cases where an animal is injured or poses a threat to public safety			

Table 7. Breeding Bird Mitigation Measures Evaluation

Ecosystem Component: Breeding Birds			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
Vegetation clearing will not occur between April 12 and August 30 of any given year to avoid breeding season for non-migratory and migratory birds; prevent disturbance to breeding amphibians; reduce sensory disturbance unless permission has been given to the Contractor to do so by a professional biologist (a member in good standing with the Alberta Society of Professional Biologists) upon the results of relevant surveys, and contact with the appropriate regulatory agency for permitting requirements.	Technical Requirements	Unsuccessful	Ellis Don was fined $5,000 in 2019 for removing bird boxes during the nesting period along the SWCRR route, and $100,000 in 2021 for removing bird nesting boxes in June along the West ring road TUC without a permit[10, 11]. Mountain bluebirds and American Tree Swallows were actively using these nesting boxes as they were discarded to the ground with eggs and chicks inside[11]. KGL was fined $5,000 in July 2020 for clearing of vegetation in an area with active bird nests near the south stormwater pond[55].
The dens of specified animal species are protected under the Wildlife Act (Alberta). The nests of migratory birds are protected under the Migratory Birds Convention Act (Canada). If an active den or bird nest is identified within the corridor prior to or during clearing or construction activity, consult with Alberta Environment to determine the appropriate mitigation. Avoidance or mitigation measures may be required and may include monitoring the den or nest and/or modifying the construction schedule to avoid activity until the den or nest is inactive.			
"Vegetation clearing will not occur between April 12 and August 30 of any given year to avoid breeding season for non-migratory and migratory birds; prevent disturbance to breeding amphibians"	ECO Plan Page 23		

Table 8. Noise Pollution Mitigation Measures Evaluation

Ecosystem Component: Noise Pollution			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
Population reductions in songbird abundance and densities expected from highway noise disturbance.	EIA Page 218	Likely	Further attention to long term monitoring of populations is recommended by the Society.
To decrease sensory disturbance, "Recreational pathways will not be constructed at the Elbow River or Fish Creek crossings in order to minimize interactions between humans and wildlife"	Technical Requirements Page 119	Successful	Pedestrian pathways will not be included in any future plans in the bridge underpasses. Current City Park legal trails do not extend to the area, however an illegal trail network does lead to the river beach east of the overpasses and is commonly used by members of the public.
Instructed to use noise reduction equipment to muffle and reduce sensory disturbance to wildlife using either vibratory pile driving or impact pile drivers fitted with enclosures around the hammer to substantially reduce noise impacts.		Unknown	Elevated 2019 Noise levels which included pile driving (Figure 5).

Table 9. Amphibian Mitigation Measure Evaluation

Ecosystem Component: Amphibians			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
Vegetation removal timing restriction of April 15th to August 15th will also prevent disturbance to breeding amphibians. In the event clearing or construction activities occur within this period, obtain the appropriate permit in the event that amphibians may need to be moved off the construction footprint during construction and/or an amphibian salvage from a breeding pond is required. Contact the	Technical Requirements	Unsuccessful	KGL was fined $5,000 in July 2020 for clearing of vegetation in an area adjacent to a wetland near the South stormwater Pond[12].

appropriate regulatory agency for permitting requirements, and discuss the salvage plan with Alberta Environment prior to this activity.			

Table 10. Fish Mitigation Measures Evaluation

Ecosystem Component: Fish			
Mitigation measure statement	**Source**	**Outcome**	**Comment**
The Contractor's design of the realigned Elbow River/Cullen Creek/Fish Creek channels shall not result in negative effects to the watercourses or fish habitat (e.g., erosion, scour, sedimentation, etc.) upstream or downstream of the proposed realignments, including for lands outside of the TUC.	Technical Requirements	Unsuccessful	Reported failures in sediment and erosion control efforts along the Elbow River and Fish Creek are documented in the Contractor's 2019 Wildlife Reports (Figures 48, 49, 50 and 51). As well as 5 documented sediment control failures resulting in sediment contamination into the Beaver Pond (Figure 1D).
Install and maintain appropriate erosion and sediment control methods to prevent sediments from disturbed areas from being transported into watercourses. This should include the management of slopes adjacent to each watercourse.			
Prevent construction materials and debris from entering watercourses.			
During construction and until revegetation is sufficient to prevent sediment erosion, ensure effective sediment and erosion control measures are in place, functioning properly, and are maintained and/or upgraded as required to prevent sediment from entering fish habitat.			
Soil stockpiles must be located away from watercourses and slopes.			
Crossings at fish-bearing watercourses will be designed to allow for fish passage at all times and a monitoring plan during construction shall be developed and implemented.		Successful	Assumed successful, as the Society has no evidence to conclude otherwise.
Disturbance of riparian vegetation shall be kept to a minimum.		Unsuccessful	The entire riparian area was destroyed and altered within the TUC with 100% disturbance.
Revegetation of realignments to occur a minimum of one year prior to construction or as regulatory requirements dictate (the more stringent shall apply).		Unsuccessful	Revegetation does not appear to have been completed as of yet or has not survived to the 85-90% survival rate.
A water quality monitoring plan shall be developed by a QAES to monitor turbidity (e.g., documenting nephelometric turbidity units) and total suspended solids (TSS) concentrations during construction activities in or near water. This plan should be used to direct construction activities, and to inform decisions about timing and sequencing of construction. If monitoring reveals construction activities are causing potentially harmful sediment events, additional mitigation will be required or construction activities will be halted until turbidity and TSS levels return to background.		Successful for Wetland 06, Beaver Pond Unsuccessful for the Elbow River or Fish Creek	Water quality monitoring took place in the Beaver Pond, but we have not seen any documentation of water quality monitoring from the Elbow River or Fish Creek.