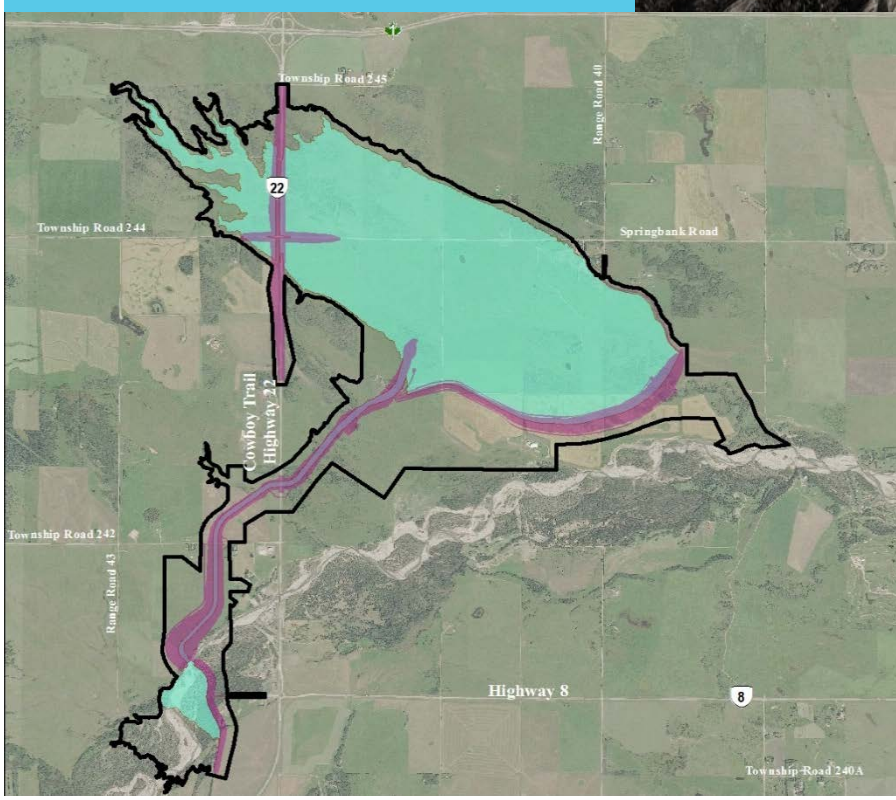
Springbank Off-stream Reservoir Project



Response to CEAA Information Request Package 1 June 29, 2018

May 2019

Alberta Transportation

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Abbreviations

AAAQO	Alberta Ambient Air Quality Objective
ACT	Alberta Culture and Tourism
ADAF	age-dependent adjustment factor
AEP	Alberta Environment and Parks
ATSDR	Agency for Toxic Substances and Disease Registry
BaP	benzo[a]pyrene
CCME	Canadian Council of Ministers of the Environment
CEA Agency	Canadian Environmental Assessment Agency
COPC	contaminants of potential concern
CWQG	Canadian Water Quality Guidelines
ECCC	Environment and Climate Change Canada
ECO Plan	Environmental Construction Operations Plan
ER	exposure ratio
ERAP	Emergency Response Assistance Plan
ERWP	Elbow River Management Plan
HEC-HMS	Hydrologic Engineering Center Hydrological Modeling System
HHRA	human health risk assessment
IDF	inflow design flood
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
LAA	local assessment area
MPOI	maximum point of impingement
NOEL	no observed effect level
PAH	polycyclic aromatic hydrocarbons
PDA	Project development area
PMF	probable maximum flood
Project	Springbank Off-stream Reservoir Project

RAP	restricted activity period
RfC	reference concentration
RsC	risk-specific concentration
SOMC	species of management concern
TCEQ	Texas Commission on Environmental Quality
TLRU	traditional land and resource use
TPE	toxic potency equivalent
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TRV	toxicological reference value
TSS	total suspended solids
US EPA	United States Environmental Protection Agency
VC	valued component
WMMP	Wildlife Mitigation and Monitoring Plan

Question IR1-01: Accidents and Malfunctions – Worst Case Scenarios

EIS Guideline reference: Part 2 Section 6.6.1
EIS reference: Volume 3D
Other references:
CEAA Annex 2: A) Early Technical Issues, December 19, 2017
Alberta Transportation Responses to CEAA Annex 2: A) Early Technical Issues, May 11, 2018

Context and Rationale

Part 2, Section 6.6.1 of the EIS Guidelines states that the proponent will identify the probability of potential accidents and malfunctions related to the project, including an explanation of how those events were identified, potential consequences (including the environmental effects as defined in section 5 of CEAA 2012, and the significance of these effects), the plausible worst case scenarios, alternative accident scenarios, and the effects of these scenarios.

In the EIS, the proponent does not describe in sufficient detail the potential environmental effects of accidents and malfunctions for worst case scenarios such as off-stream dam failure or breach, and diversion structure failure or breach. The proponent discusses the valued components that may be affected by an off-stream dam or diversion structure accident or malfunction, but does not explain how the valued components would be affected by the worst case scenarios, in particular the geographical and temporal extent of such effects.

CEAA Annex 2: A) Early Technical Issues Question 22(b) asks the proponent to provide further details on the worst case scenarios for a hazardous materials spill and pipeline rupture, such as how or when the events would occur, environmental consequences, and temporal and geographical extent.

Although the proponent's response includes a description of the potential worst case scenario for both a hazardous material spill and a pipeline rupture, the details such as location, volume, and type of material spilled are lacking. For the hazardous material spill, stating that "the extent of potential adverse effects would be a function of the volume, location, and type of material spilled" does not provide a clear picture of the potential environmental consequences.

Quantitative predictions (e.g. volumes) for all worst case scenarios should be estimated.

The EIS states: "Spills would have limited potential to affect groundwater, as they would be confined to the soils within the timeframe of a cleanup response and be appropriately contained and excavated before migrating to the groundwater table." Further information on plans to avoid and respond to spills, based on environmental severity (e.g. volume, location and type of spill), is required in order to understand potential effects to groundwater from a hazardous material spill.

Issue or Comment

a) For an off-stream dam failure or breach and diversion structure failure or breach, provide details on how the valued components would be affected by the worst case scenarios, the associated environmental consequences (such as potential species affected), and the temporal and geographical extents of the effects.

b) For a hazardous material spill and a pipeline rupture, provide details, such as volumes and locations, of the estimated worst case scenario.

c) Identify and describe contingency and response planning for hazardous material spills, including on-site response capacity and times, and spill notification procedures.

d) Considering the estimated worse case scenarios and response plans, update the assessment of potential effects to groundwater from a hazardous material spill or pipeline rupture.

Response IR1-01

a) The worst-case scenario for an off-stream dam failure or breach occurs when the off-stream reservoir is full (having a capacity of 77,771,000 m^3 of water). As described in Volume 1 Section 5.2, the scenario assumes a failure of the dam as the off-stream reservoir is being slowly drained. This scenario assumes a piping failure when the off-stream reservoir is filled to the emergency spillway at elevation 1,210.75 m, representing conditions immediately after a design flood, but before significant volume can be released from the off-stream reservoir.

The dam is classified as an "Extreme" consequence structure and therefore will be designed to the highest standards established by the Canadian Dam Association (CDA 2007). Because of these higher design standards, a dam failure or breach has a very low probability of occurrence and is considered very unlikely.

As presented in the Volume 3D, Section 1.4.1.2, the valued components that would be affected by a dam failure or breach are:

- hydrology, surface water quality, and aquatic ecology
- vegetation and wetlands, soils and terrain, and wildlife and biodiversity
- land and resource use (including federal lands), infrastructure and services, and employment and economy
- public health (including downstream community safety, drinking water quality and country foods) for Indigenous and non-Indigenous receptors
- traditional land and resource use (including heritage resources) downstream of the off-stream reservoir, where they exist

The associated environmental consequences, as presented in Volume 3D, Section 1.5.1, include effects on public safety including the potential for human injury or loss of life. In addition, the biophysical environment, lands used for traditional and non-traditional use, infrastructure and services (including property), and employment and economy would be affected. Effects on infrastructure and services could result due to a direct loss of infrastructure or a reduction in local services from emergency response efforts.

Changes in the hydrological regime, sediment transport dynamics, and surface water quality (e.g., turbidity, suspended sediment concentrations, herbicides) would occur. These changes could also alter or destroy fish habitat, which may result in the direct or indirect death of fish.

The velocity of the flood water could create erosion and sedimentation at and downstream of the breach location. A release of debris from within the off-stream reservoir would likely be more localized at the location of the failure or breach; however, depending on the velocity of water released, additional soil and vegetation could be swept up and carried downstream. Direct loss or alteration of vegetation and wetlands could occur from the release of water and sediment deposition during a breech. Flooding or infilling of wildlife habitat could occur, particularly at the location of the failure or breach and directly downstream. Mortality of wildlife (including migratory birds and species at risk) may also occur from the release of water, debris, and sediment.

An obstruction of use and access of land and water resources for recreation and traditional uses could occur from flooding of lands downstream on Elbow River. Effects on federal lands (i.e., the Tsuut'ina Nation Reserve lands) could occur by way of localized flooding, erosion, and sediment deposition within the Elbow River valley. The duration of the effects would remain until damage from flooding is repaired (where, and if possible).

As presented in Volume 1, Section 5.2, the worst-case scenario for a diversion structure failure or breach is a failure of the structure coincident with a 2013 flood equivalent. During this scenario, failure is assumed to occur in the auxiliary spillway by overtopping at the maximum head elevation of 1,217.8 m during the probable maximum flood (PMF).

Failure of the diversion structure auxiliary spillway during the PMF will have minimal impact downstream of the structure. Such a failure would increase the peak flow in Elbow River immediately downstream of the diversion structure from 2,770 m^3/s to a peak of 3,103 m^3/s for less than 30 minutes. The spike in flow corresponds to approximately a 0.2 m increase in the water surface elevation. At the Highway 22 bridge, which is located approximately 1 km downstream of the diversion structure, the increase in water surface elevation due to the breach is less than 0.1 m. Based on these results, there would be negligible change to inundation limits.

In such an event, flood water containing natural debris (e.g., suspended sediment, vegetation) would pass through the service spillway, over the auxiliary spillway or through a breach in the floodplain berm. The valued components affected and the effects of the event would be similar to those for the dam breach but over a lesser extent because the water flows back into the flooding Elbow River.

b) Hazardous material spills are addressed in Volume 3D, Section 1.5.4. The worst-case hazardous material spill would be an overturned tanker truck supplying diesel fuel to construction equipment near the Highway 22 bridge. A full fuel truck has the capacity to hold 50,000 litres of diesel. If it overturned on the bridge, fell into Elbow River and broke up, the diesel would spill into the river. Such a spill would result in injury or mortality of fish and wildlife species in the river, public health issues (water quality degradation of the river, country foods, public safety), potential destruction of traditional land and resource use, and obstruction of use of the river for recreation. The likelihood of this event happening is low. Highway 22 is a well maintained road with guard rails on the bridge. Fuel supply vehicles will be expected to maintain posted speed limits. Tanker trucks carry clean-up kits for small spills and are required by Alberta law to have an emergency response assistance plan (ERAP).

   The possibility of a pipeline rupture is addressed in Volume 3D, Section 1.5.6 using two mechanisms: a rupture of a third-party pipeline during retrofitting or re-location activities undertaken by the pipeline operator, and a rupture of a third-party pipeline during flood operations when there is water in the off-stream reservoir. The worst-case pipeline rupture would be the rupture of an oil pipeline within the northwest portion of the off-stream reservoir during the release of water associated with the retention of water from a design flood. Any spills from the pipelines crossing underneath the diversion channel would possibly flow along the channel into the reservoir. Spill cleanup could occur in the diversion channel or within the reservoir to contain the spill locally and preventing the proliferation of the oil contaminated water throughout the reservoir.

   In the event of a pipeline rupture during the release of water from the off-stream reservoir, the low-level outlet gates would be closed to contain the contaminated water within the reservoir and allow spill cleanup. Water would not be released back to Elbow River until it met the guidelines in GoA (2018). Environmental effects would be similar to those for a hazardous material spill with the addition of the potential for any remaining hydrocarbons after cleanup in the off-stream reservoir that might contaminate soil and vegetation, damage wildlife habitat and possibly cause wildlife mortality.

c) Contingency and response planning for hazardous material spills will be required from all contractors as part of their Environmental Construction Operations Plan (ECO Plan) that must be submitted by the contractor to Alberta Transportation prior to commencing work. The ECO Plan framework is provided in Volume 4, Supporting Documentation, Document 1. Section 6 presents environmental emergency procedures that must be addressed by contractors in the ECO Plan. The volumes and location of hazardous spills depends on the nature and location of any spill. Spills will be immediately reported to the Environmental Response Line 1-800-222-6514.

d) Considering the estimated worst-case scenarios and response plans for a hazardous material spill or pipeline rupture, the assessment of potential effects to groundwater will be as presented in Volume 3D.

Hazardous material spills would have limited potential to affect groundwater, as they would be confined to the soils within the timeframe of a cleanup response and be appropriately contained and excavated before migrating to the groundwater table.

The likelihood of released product reaching groundwater during a pipeline re-location and retrofitting is low. A product release could affect groundwater if the product (or water-soluble components) infiltrated into the soil and reached the water table. The ability of product or water-soluble constituents to reach the groundwater is influenced by the depth to groundwater, the permeability of the geological media, climatic conditions, release volume and rate, as well as time. high vapour pressure products would volatize to air and therefore would not be expected to affect groundwater quality. In the event of a high vapour pressure product release, the volume of the release is expected to be small, the product would be physically recovered, and remediation of soil would protect groundwater quality from potential degradation.

REFERENCES

CDA (Canadian Dam Association). 2007. Dam Safety Guidelines (Revised 2013). Canadian Dam Association. Toronto, Ontario.

Government of Alberta. 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta.

Question IR1-02: Surface Water Quality

EIS Guideline reference: Part 2, Section 6.2.2, Section 6.3.1, Section 8
EIS reference: Volume 1, Attachment A: Water Management Plan, Section A5
Volume 3C, Section 2.6
Other references:
CEAA Annex 2: A) Early Technical Issues, December 19, 2017
Alberta Transportation Responses to CEAA Annex 2: A) Early Technical Issues, May 11, 2018
Environment and Climate Change Canada (ECCC) Technical Review, June 18, 2018

Context and Rationale

Section A.5.1 of the Water Management Plan describes the proposed criteria that will determine when reservoir water will be released to the Elbow River, as follows:

1. **Flows in the Elbow River are below 20 m^3/second,**
2. **Criteria relating to the length of time required to drain the reservoir.**

The proponent provides different messaging in relation to its plans for water quality sampling. Volume 3C, Section 2.6 of the EIS states that, "prior to discharge from the reservoir, water samples will be collected at the low-level outlet channel and analyzed", while the Water Management Plan indicates that "water samples will be collected from the outlet channel at the confluence between the outlet channel and the Elbow River." Additionally, in the response to CEAA Annex 2, Question 5 the proponent states, "The follow-up and monitoring program for surface water quality (…) indicates that water sampling, including TSS, will be undertaken at the low-level outlet during water release from the off-stream reservoir." These three statements vary about how and where water sampling will occur (e.g. prior to discharge to the Elbow River, at the confluence of the low level outlet channel with the Elbow River, or during discharge).

The EIS states: "Spills would have limited potential to affect groundwater, as they would be confined to the soils within the timeframe of a cleanup response and be appropriately contained and excavated before migrating to the groundwater table." Further information on plans to avoid and respond to spills, based on environmental severity (e.g. volume, location and type of spill), is required in order to understand potential effects to groundwater from a hazardous material spill.

<u>Issue or Comment</u>

a) Explain how water quality sampling during post-flood operations will occur, including the timing and location of any sampling.

b) For a hazardous material spill and a pipeline rupture, provide details, such as volumes and locations, of the estimated worst case scenario.

Response IR1-02

a) Water quality monitoring will be done in the off-stream reservoir and in the low-level outlet prior to release to inform downstream water users and assist their water use treatment decisions. The draft surface water quality monitoring plan is provided in Appendix IR2-1; relevant details are in Section 9.5.3 (Turbidity and Suspended Solids) and Section 9.5.5, (Water Quality).

Water samples will be collected in the off-stream reservoir from a boat using a depth sampler (e.g., Kemmerer or similar) from about mid-depth. The boat will be transported by truck and deployed to the off-stream reservoir from a location that can be safely reached by truck. Monitoring staff will maintain a safe distance from the off-stream reservoir outlet when using the boat.

Water samples will be collected below the outlet gates at a distance from the gates where water released from the reservoir can be obtained at the safely. A pole sampler can be used to reach into and obtain release water. One monitoring staff will obtain the water sample while the second monitoring staff remains on standby with the safety throw bag.

Total suspended sediment (TSS), turbidity, dissolved oxygen and temperature levels will be sampled and measured in the unnamed creek during release back into Elbow River. Results will be compared with background levels in Elbow River upstream from the intake structure and diversion channel. If mass balance calculations indicate levels exceed regulatory guidelines when fully mixed in Elbow River flows, then AEP Fisheries Managers will be notified, and additional downstream monitoring of these parameters will occur.

Table IR2-1 lists the parameters that will be monitored for determining operational procedures (i.e., how to control the outlet gates and manage TSS levels and water quality released to Elbow River).

Table IR2-1 Water Quality Parameter Frequency and Location Monitoring

Monitoring Parameter	Frequency[1]	Location[2]
Total Suspended Sediments (TSS) and Turbidity	Daily	Res, O-C and u/s
Temperature	Daily	O-C and u/s
Dissolved Oxygen	Daily	O-C and u/s
Conductivity	Daily	O-C and u/s
pH	Daily	O-C and u/s
Water flow rate	Daily	O-C and u/s
Major ions	Weekly	Res, O-C
Total and Dissolved Metals	Weekly	Res, O-C
Nutrients	Weekly	Res, O-C
Methyl Mercury	Weekly	Res, O-C
Hydrocarbons	Weekly	Res, O-C

NOTES:
[1]Samples will be collected daily or weekly until the off-stream reservoir is drained.
[2] O-C – outlet channel (including in the unnamed creek); u/s – Elbow River upstream of the intake structure and diversion channel; Res – off-stream reservoir.

b) Potential environmental effects from accidents and malfunctions are assessed in Volume 3D, Section 1, which includes the scenarios of a hazardous materials spill and a pipeline rupture (see also the response to IR1-1). For each, the scenario is described, assessed, mitigation and emergency response measures described, and a significance conclusion provided. Details, such as volumes and location, are provided to the extent possible based on available information given the highly variable circumstances of any accident and malfunction event, specifically:

- Hazardous material spills are described in Volume 3D, Section 1.4.4, including potential released substances; assessed in Section 1.5.4 for effects on soils, vegetation, aquatics and wildlife, in consideration of mitigation and emergency response; and residual effects and significance discussed in Section 1.6.4.
- Pipeline ruptures are described in Volume 3D, Section 1.4.6, based on retrofitting or relocation during construction as conducted by the third-party pipeline operator; assessed in Section 1.5.6 for effects on air quality, vegetation, soils, wildlife, groundwater, public health and land use, based on release of certain constituents in consideration of mitigation and emergency response; and residual effects and significance discussed in Section 1.6.6.

Question IR1-03: Surface Water Quality

EIS Guideline reference: Part 2, Section 6.6.2 and 6.3.1
EIS reference: Volume 3B, Section 7
Other reference: ECCC Technical Review, June 18, 2018

<u>Context and Rationale</u>

Part 2, Sections 6.2.2 and 6.3.1 of the EIS Guidelines require that any changes to total suspended solids, turbidity, water temperature, pH, dissolved oxygen, ice regime, water quality including metals, methyl mercury, nutrients, dissolved/total organic carbon, biological oxygen demand, and carbonaceous biochemical oxygen demand, pesticides, aquatic indicators, and sediment quality that are predicted to occur as a result of the project be included in the EIS.

Water quality modelling predictions within the reservoir prior to discharge to the Elbow River have not been completed for all parameters listed in the EIS Guidelines. Only suspended sediment, temperature, dissolved oxygen, and methyl mercury are either qualitatively or quantitatively assessed to predict the concentrations that may be discharged back to the Elbow River post-flood.

The rationale provided for the exclusion of predicted concentrations include the lack of analogous measurements or surrogate parameters (temperature and dissolved oxygen) and that sediment associated parameters (metals) will behave like the modelled suspended

sediments. It is still unclear what the water quality in the reservoir will be at the time of discharge in comparison to the Elbow River.

While the EIS concludes that the discharge is not anticipated to cause effects to the aquatic environment, it does not provide discharge limits for relevant water quality sampling parameters, prior to being discharged to the Elbow River, along with an explanation for why these would mitigate adverse effects to the aquatic environment.

Issue or Comment

a) **Provide proposed discharge limits for relevant water quality sampling parameters in the off-stream reservoir, prior to being discharged to the Elbow River.**

b) **Provide flood/post-flood contingency monitoring and mitigation options to be employed in the event that water quality within the reservoir is not suitable for discharge.**

Response IR1-03

a) Water quality guideline threshold levels are provided in Volume 4, Appendix K, Section 2, Table 2-8 (see Table IR3-1). Objectives outlined in ERWP (2009) are also in Table IR3-1.

   Water released from the off-stream reservoir will not have suspended sediment levels that cause suspended sediments to increase in Elbow River above thresholds listed in Table IR3-2 (Volume 3B, Section 7.4.2, Page 7.21; Alberta Transportation 2011, 2017; GOA 2018).

b) The parameters and frequency for water quality monitoring in the off-stream reservoir, the low-level outlet and Elbow River are summarized in Table IR3-3. The amount of water released from the reservoir through the reservoir outlet gates will be reduced to a rate that water quality parameters will be diluted to below guideline levels once mixed in the Elbow River. Alternatively, the reservoir outlet gates will be closed completely until reservoir TSS concentrations and water quality is ameliorated to levels that can be accepted by Elbow River.

   Ongoing monitoring will be done to assess the off-stream reservoir water quality and constituent concentrations released to Elbow River (see draft surface water quality monitoring plan provided in the response to IR2, Appendix IR2-1). The calculated load of water quality constituents (i.e., mass balance of relevant water quality parameters) from the off-stream reservoir combined with the calculated load in the river will be used to determine the rate at which the Elbow River can receive off-stream reservoir water. These loading rates will be used to determine release rates from the reservoir for controlling downstream water quality.

Table IR3-1 Canadian Council of Ministers of the Environment and Alberta Water Quality Guidelines for the Protection of Aquatic Life and Elbow River Water Quality Objectives for the Off-Stream Reservoir and Elbow River (from Volume 4, Appendix K, Section 2, Table 2-8)

Parameter	Unit	CWQG acute	CWQG chronic	AB WQG short-term	AB WQG long-term	ER WQO central reach
Physical parameters						
Temperature	˚C	-	Narrative[a]	Narrative[a]	Narrative[a]	18
pH	S.U.	-	6.5-9.0	-	6.5-9.0	-
Alkalinity (as $CaCO_3$)	mg/L	-	-	-	Minimum 20	-
Dissolved oxygen (cold water biota)	mg/L	-	Minimum 6.5	Minimum 5	Minimum 6.5	Minimum 6.5
Total suspended sediment	mg/L	-	Narrative	Narrative	Narrative	Narrative
Total coliforms (irrigation guideline)	CFU/100 mL	-	1,000	-	-	20,000
Fecal coliforms (irrigation guideline)	CFU/100 mL	-	100	-	100	100
Ions and ion balance						
Chloride	mg/L	640	120	640	120	-
Fluoride	mg/L	-	0.12	-	-	-
Sulphate	mg/L	-	-	-	Varies[b]	-
Sulphide	mg/L	-	-	-	0.0019	-
Nutrients and carbon						
Nitrate (as N)	mg/L	124	3.0	124	3.0	-
Nitrite (as N)	mg/L	-	0.06	Varies[b]	Varies[b]	-
Nitrate+nitrite (as N)	mg/L	-	-	-	-	0.267
Nitrogen (total)	mg/L	-	Narrative	-	-	Narrative
Ammonia (total as N)	mg/L	-	Equation[c]	-	Equation[c]	0.04
Total dissolved phosphorus	mg/L	-	-	-	-	0.009

Table IR3-1 Canadian Council of Ministers of the Environment and Alberta Water Quality Guidelines for the Protection of Aquatic Life and Elbow River Water Quality Objectives for the Off-Stream Reservoir and Elbow River (from Volume 4, Appendix K, Section 2, Table 2-8)

Parameter	Unit	CWQG acute	CWQG chronic	AB WQG short-term	AB WQG long-term	ER WQO central reach
Phosphorus (total)	mg/L	-	-	-	Narrative	-
Total organic carbon	mg/L	-	-		-	5.0
Metals (dissolved)				6.5		
Aluminium	mg/L	-	-	0.1 or Equation[c] when pH <6.5	0.05 or Equation[c] when pH <6.5	-
Iron	mg/L	-	-	-	0.3	-
Metals (total)						
Aluminum	mg/L	-	0.005 at pH≤6.5; 0.1 at pH≥6.5	-	-	-
Arsenic	mg/L	-	0.005	-	0.005	-
Boron	mg/L	29	1.5	29	1.5	-
Cadmium	mg/L	Equation[c]	Equation[c]	Equation[c]	Equation[c]	-
Chromium (trivalent)	mg/L	-	0.0089	-	0.0089	-
Chromium (hexavalent)	mg/L	-	0.001	-	0.001	-
Cobalt	mg/L	-	-	-	0.0025	-
Copper	mg/L	-	Equation[c]	Equation[c]	0.007	-
Iron	mg/L	-	0.3	-	-	-
Lead	mg/L	-	Equation[c]	-	Equation[a]	-
Mercury	mg/L	-	0.000026	0.000013	0.000005	-
Methylmercury	mg/L	-	0.000004	0.000002	0.000001	-

Table IR3-1 Canadian Council of Ministers of the Environment and Alberta Water Quality Guidelines for the Protection of Aquatic Life and Elbow River Water Quality Objectives for the Off-Stream Reservoir and Elbow River (from Volume 4, Appendix K, Section 2, Table 2-8)

Parameter	Unit	CWQG acute	CWQG chronic	AB WQG short-term	AB WQG long-term	ER WQO central reach
Molybdenum	mg/L	-	0.073	-	0.073	-
Nickel	mg/L	-	Equation[c]	Equation[c]	Equation[c]	-
Selenium	mg/L	-	0.001	-	0.001	-
Silver	mg/L	-	0.00025	-	0.0001	-
Thallium	mg/L	-	0.0008	-	0.0008	-
Uranium	mg/L	0.033	0.015	0.033	0.015	-
Zinc	mg/L	-	0.03	-	0.03	-
Pesticides						
2,4-D	mg/L	-	0.004	-	-	Should not exceed lower of <1/10 of federal drinking water guidelines or < CCME guidelines for aquatic life
Mecoprop (MCPP)	mg/L	-	-	10	0.013	

Table IR3-1 CCME and Alberta Water Quality Guidelines for the Protection of Aquatic Life and Elbow River Water Quality Objectives for the Off-Stream Reservoir and Elbow River (from Volume 4, Appendix K, Section 2, Table 2-8)

NOTES:

CWQG = Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life by Canadian Council of Ministers of the Environment (CCME 2016).

AB WQG = Environmental Quality Guidelines for Alberta Surface Waters (GoA 2018).

ER WQO central reach = water quality objectives developed by ERWP (2009)

\- = no guideline

[a] Maximum Weekly Average Temperature: thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded.

- Short-term exposure to Extreme Temperature: thermal additions to receiving waters should be such that the short-term exposure to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species.

[b] Guidelines that vary based on other parameters were determined as per GOA (2018) and CCME (2016):

- Sulphate guideline varies from 128 mg/L to 429 mg/L based on hardness
- Nitrite-N ABWQG varies based on chloride concentrations from 0.02 mg/L to 0.20 mg/L

[c] Equations were used to calculate hardness, pH, and temperature-dependent guidelines as per ESRD (2014) and CCME (2016).

- Ammonia CWQG and AB WQG: guideline for total ammonia is based on temperature and pH, see table for values in CCME (2016).
- Dissolved aluminum AB WQG (µg/L) = $\{e^{(1.6-3.327(pH)+0.402(pH)^2)}\}$
- Total cadmium chronic/long-term CWQG and AB WQG: At hardness ≥ 17 mg/L and ≤ 280 mg/L (µg/L) = $10^{\{0.83[\log10(hardness)-2.46]\}}$
- Total cadmium acute/short-term CWQG and AB WQG: At hardness <5.3 mg/L, the guideline is 0.00011 mg/L. At hardness ≥ 5.3 mg/L and ≤ 360 mg/L (µg/L) = $10^{\{1.016[\log10(hardness)-1.71]\}}$. At hardness >360 mg/L, the guideline is 0.0077 mg/L.
- Total copper chronic CWQG: When the water hardness is 0 to < 82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated as CWQG (µg/L) = 0.2 * $e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.
- Total copper short-term AB WQG (µg/L) = $(e^{\{0.979123[\ln(hardness)]-8.64497\}})*1000$
- Total lead CWQG and AB WQG: When the hardness is 0 to ≤ 60 mg/L, the guideline is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the guideline is calculated as (µg/L)= $e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the guideline is 0.007 mg/L. If the hardness is unknown, the guideline is 0.001 mg/L.
- Total nickel CWQG: When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated as CWQG (µg/L) = $e^{\{0.76[\ln(hardness)]+1.06\}}$
- Total nickel long-term AB WQG (µg/L) = $e^{\{0.846[\ln(hardness)]+0.0584\}}$
- Total nickel short-term AB WQG (µg/L) = $e^{\{0.846[\ln(hardness)]+2.255\}}$

Table IR3-2 Maximum Allowable Increase of Total Suspended Solids

Site Conditions (Background TSS)	Exceedance Levels (TSS in Excess of Normal Background Levels)
TSS < 25 mg/L	• A maximum instantaneous increase of 25 mg/L over background levels at any time. • An average increase of >5 mg/L over background levels for greater than 24 hours.
TSS 25 mg/L – 250 mg/L	• A maximum instantaneous increase of 25 mg/L from background levels at any time.
TSS > 250 mg/L	• Maximum instantaneous increases of 10% of background levels at any time.

Table IR3-3 Water Quality Parameter Frequency and Location[1]

Monitoring Parameter	Frequency	Location[2]
Total Suspended Sediments (TSS) and Turbidity	Daily	Res, O-C and u/s
Temperature	Daily	O-C and u/s
Dissolved Oxygen	Daily	O-C and u/s
Conductivity	Daily	O-C and u/s
pH	Daily	O-C and u/s
Water flow rate	Daily	O-C and u/s
Major ions	Weekly	Res, O-C
Total and Dissolved Metals	Weekly	Res, O-C
Nutrients	Weekly	Res, O-C
Methyl Mercury	Weekly	Res, O-C
Hydrocarbons	Weekly	Res, O-C

NOTES:

[1] Water Quality threshold values are provided in Tables IR3-1 and IR3-2 above.

[2] O-C – outlet channel (including the unnamed creek); u/s – Elbow River upstream of the intake structure and diversion channel; Res – off-stream reservoir.

REFERENCES

Alberta Transportation. 2011. Erosion and Sediment Control Manual. Edmonton. 89 pages + appendices.

Alberta Transportation. 2017. Special Provision – Turbidity. 7 pages.

CCME (Canadian Council of Ministers of the Environment). 2016. Canadian Environmental Quality Guidelines website. Accessed December 2016 at http://ceqg-rcqe.ccme.ca/en/index.html

ERWP (Elbow River Watershed Partnership). 2009. Elbow River Basin Water Management Plan: a decision support tool for the protection of water quality in the Elbow River Basin. May 2008 (revised January 16, 2009).

GoA (Government of Alberta). 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks, Edmonton, Alberta

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Question IR1-04: Hydrology – Reservoir Retention, Draw Down, and Suspended Sediments

EIS Guideline reference: Part 2, Section 6.3.1
EIS reference: Volume 3B, Section 7.4.4
Volume 3B, Section 6.4.3.3
Volume 1, Section 3.2.4 Table 3-3
Other references:
DFO ANNEX 2 Technical Review, June 19, 2018

Context and Rationale

In Volume 3B Section 6.5.2, the EIS states, "Water would be in the reservoir from the start of diversion to the end of emptying for the following durations:

- **62 days (design flood)**
- **84 days (1:100 year flood)**
- **74 days (1:10 year flood)"**

The time it takes to draw down the reservoir post flood is shorter for the design flood volume of 77,800 dam^3 than it is for the 1:100 year flood volume of 30,100 dam^3 and only 8 days longer than the 1:10 volume of 500 dam^3. The proponent states, "… release rates may be increased if two back-to-back floods are forecast, or decreased to reduce potential effects on mobilization of sediment in the low-level outlet and remobilization of sediment in Elbow River downstream." Clarity and rationale for draw down times for each flood scenario is needed in order to

determine potential effects to fish, and inform minimum residence time in the reservoir which could be used to potentially mitigate serious harm to fish.

<u>Issue or Comment</u>

a) Clarify and provide a rationale for the residence time and draw down time for each flood scenario.

b) Provide the minimum draw down time for each flood scenario (mobilization of sediment aside).

<u>Context and Rationale</u>

Volume 3B, Section 6.4.3.3 of the EIS states, "There would be a much higher output of suspended sediment mass from the reservoir, compared to the design flood, despite a lower discharge rate from the reservoir. For the 1:100 year flood, there is very little change in suspended sediment mass as a result of erosion within the low-level outlet. The high sediment yield released from the reservoir is likely due to remobilization and suspension of material deposited at the low-level outlet. Because there is a large amount of sediment deposited in this area, sediment supply is not limited. The modelled peak and average concentrations are higher for the 1:100 year flood than for the design flood (Table 6-7 and Table 6-8)."

The proponent provides different messaging in relation to whether suspended sediment offsets the material remaining in the reservoir or if it is a negligible amount. The proponent states "Up to 0.2 kt of suspended sediment material may be mobilized and transported from the low-level outlet, which would increase the suspended sediment yield from 89.5 kt to 89.7 kt before the confluence with the Elbow River. Flow and storage effects in Elbow River dilutes this suspended sediment input to 68.6 kt, a 25% decrease, by approximately 1.0 km downstream of the confluence with the low-level outlet. This addition of new suspended sediment partially offsets the material remaining in the reservoir that would have been transferred downstream in the absence of active diversion. This addition effectively reduces the sediment yield loss for the design flood by a negligible amount."

Given that section 6.4.3 of the EIS states, the "longer the residence time, the greater the deposition", clarity is needed on the concentrations of suspended sediment for each flood scenario to assist in determining potential effects to fish habitat downstream of the low-level outlet channel.

<u>Issue or Comment</u>

c) Clarify why the modelled peak and average suspended sediment concentrations are higher for the 1:100 year flood than for the design flood, despite a lower discharge rate from the reservoir, and more than twice the residence time in the reservoir.

Response IR1-04

a) Residence time and release time from the off-stream reservoir are correlated by the relationship of hydraulic dynamics between the condition of Elbow River flow and the optimization (to reduce effects) of release of water from the reservoir. This means that the faster that Elbow River returns to “normal” flows (i.e., seasonal flows as in a non- flood year), the sooner water can be released from the off-stream reservoir. The behaviour of each flood is based on a specific hydrograph, each with its unique shape (i.e., rate at which Elbow River stream-flows increase and decrease through the spring and summer) (Volume 3B, Section 6.4.1.1 and Section 6.4.1.4, Figure 6-4 to Figure 6-6). Differences among these hydrographs affect the predicted date when water can be released from the off-stream reservoir and, subsequently, how long the reservoir residence time is. The following summarizes important aspects of these dynamics.

The residence times for retained water in the off-stream reservoir are presented in Volume 3B, Section 6, Table 6-4 (reproduced here as Table IR4-1) for the three floods: a 1:10 flood, a 1:100 flood and the design flood. The rationale for the off-stream reservoir residence time is discussed in Volume 3B, Section 6.4.1.4 (page 6.17). In summary, it states that flow rates in the river must be less than 20 m^3/s in order to accept a maximum design release rate from the low-level outlet of 27 m^3/s and to have flows remain below the 1:2 year flow frequency of 47 m^3/s. This is the effective flow rate in the river for sediment transport, which is between 35 m^3/s and 50 m^3/s. In other words, 47 m^3/s is the maximum flow in this section of Elbow River that can be maintained without suspending and remobilizing sediments, which would cause changes to channel morphology in the river downstream of its confluence with the unnamed creek.

The rate at which Elbow River returns to a flow of 20 m^3/s depends on the shape of the river's hydrograph: the greater the declining slope after the peak, the faster the river returns to a flow rate of 20 m^3/s. The hydrographs used to model each flood are derived as follows (Volume B, Appendix J, Section 2.4.2, Page 2.31):

- The design flood is derived from the 2013 flood and seasonal flow hydrograph.
- The 1:100 year flood is modelled, generated using the Hydrologic Engineering Center Hydrological Modeling System (HEC-HMS) model and the 1:100 year precipitation and runoff excess as a volumetric time series.
- The 1:10 year flood is based on the 2008 flood and seasonal flow hydrograph.

Table IR4-1 Volumes Diverted, Retained in the Off-stream Reservoir and Released back to the Elbow River (from Volume 3B, Section 6, Table 6-4)

Volume Diverted (dam³)	Elbow River Volume Reduction During Diversion (%)	Diverted Volume / Annual Volume[4] (%)	Diversion Time (days)	Residence Time in Reservoir (days)	Release Time (days)	Total Time the Reservoir is Inundated (days)	Volume Released[5] (dam³)	Diverted Volume Remaining in the Reservoir (%)
55,138 (design flood)	48	11.2	3.75	20	38	62	54,380	1.4
33,014 (1:100 year flood)	56	5.4	1.8	43	39	84	32,680	1.0
790 (1:10 year flood)	14	0.2	0.38	43	30	73	654	17

NOTES:

[1] Period of diversion: 06/20/2013 04:00 h to 06/23/2013 22:00 h; Residence time: 06/24/2013 to 07/14/2013

[2] Period of diversion: 05/31/2100 05:00 h to 06/02/2100 02:00 h: Residence time: 06/02/2100 to 07/15/2100

[3] Period of diversion: 05/24/2008 15:00 h to 05/24/2008 23:00 h; Residence time: 05/25/2008 to 07/07/2008

[4] Based on actual WSC Record at Sarcee Bridge for design flood and 1:10; modelled annual data for 1:100. Calculated annual flow volumes are 2013, 490,136 dam³; 1:100 year flood, 613,411 dam³ ; and 1:10 year flood, 380,797 dam³

[5] Does not include evaporated volume

Figure IR4-1 presents the relevant hydrographs. The 2013 hydrograph used to model the design flood is more "peaky" than the hydrograph used to model 1:100 year flood. In other words, flows in Elbow River returned to normal much faster for the design flood than for the modelled 1:100 year flood. Therefore, for a design flood, water can be released back into Elbow River after 20 days rather than the 43 days needed for the 1:100 year and 1:10 year floods.

The actual operational release rates from the off-stream reservoir will vary depending on the circumstances at the time of the diversion and the release, such as the flow conditions in Elbow River. Release rates will be varied to minimize mobilization of sediment in the unnamed creek and remobilization of sediment in the river.

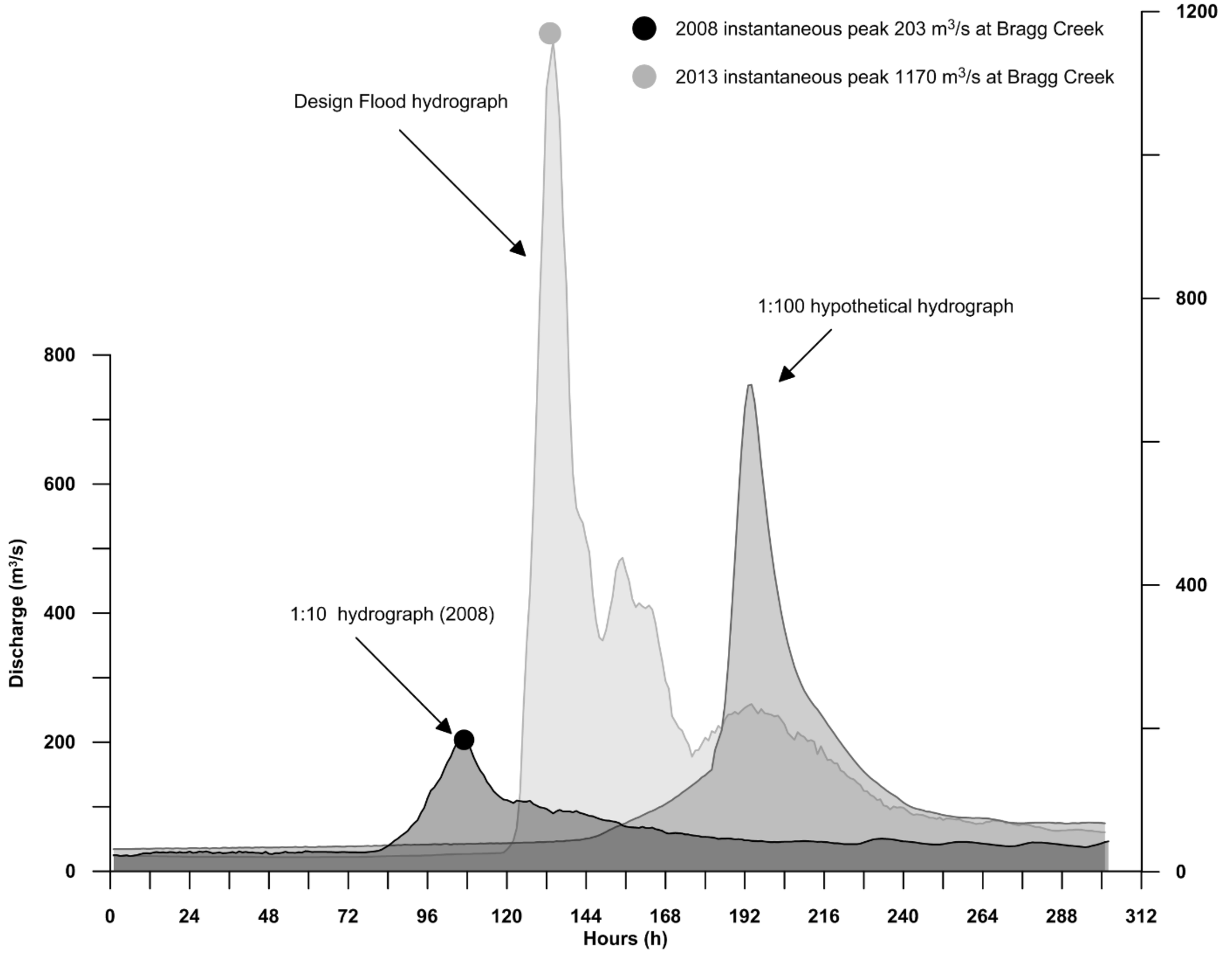


Figure IR4-1 The 1:10 Year, 1:100 Year and Design Flood Hydrographs used in Modeling (from Volume B, Appendix J, Section 2, Figure 2-4)

b) The low-level outlet has the operational flexibility to release the retained water in the off-stream reservoir at a range of rates. The rates will be executed at the discretion of the AEP Operations.

c) Further to the response to (a), the explanation for why sediment peak and mass for the design flood is less than the 1:100 flood is provided in Volume 3B, Section 6.4.3.1, page. 6.2.7, reproduced below.

"Model results for the 1:100 year flood suggest that up to 65% of the suspended sediment in Elbow River would be diverted into the reservoir. After retention, approximately 220 kt are estimated as being released into the low-level outlet. This is larger than for the design flood because of differences in the sediment deposition pattern in the reservoir for the 1:100 year flood. This is due to the smaller water volume and different circulatory patterns in the reservoir for a smaller diversion volume. Volumetrically, the deposited sediment remaining in the reservoir after release is estimated as 0.5% of the full-service volume (Table 6-6)."

Question IR1-05: Surface Water Quality – Suspended Sediment

EIS Guideline reference: Part 2, Section 6.2.2; Section 6.3.1; and Section 6.4.4
EIS reference: Volume 3B, Section 7
Other references:
CEAA Annex 2: A) Early Technical Issues, December 19, 2017
Alberta Transportation Responses to CEAA Annex 2: A) Early Technical Issues, May 11, 2018
ECCC Technical Review, June 18, 2018

<u>Context and Rationale</u>

Volume 3B, Section 7.4.2 indicates that peak total suspended sediment (TSS) concentrations exiting the low level outlet at the Elbow River confluence are estimated as 1,798 mg/L (1:10 year flood), 20,692 mg/L (1:100 year flood), and 17,955 (design flood). Using these pre- mitigation concentrations of TSS, the proponent has concluded that the "effect of the Project on water quality is not significant because the change in water quality is not anticipated to cause acute or chronic toxicity or change the trophic status of the Elbow River." With respect to suspended sediments specifically, no rationale or evidence is provided to support the statement that the modelled concentrations are not acutely or chronically toxic to fish.

Toxicity of TSS in the water column is related to both concentration and duration of exposure. The proposed upper limit TSS concentrations during discharge could contribute to acute toxicity of larval life stages via smothering or chronic toxicity by clogging of the gills. In addition, since the reservoir will not be discharged until the flood event has sufficiently subsided, the aquatic biota in the Elbow River will undergo prolonged TSS related stress due this additional discharge period as compared to a flood event alone.

In response to CEAA Annex 2 Question 5, the proponent states that "given that significant effects are not predicted, the use of sediment control measures are not anticipated to be necessary" and "should TSS levels be significantly greater than predicted, adaptive management measures would be implemented." While the proponent maintains that the increase in suspended sediment concentrations can be mitigated with the operation of the low level outlet and with physical sediment barriers, the EIS does not indicate what the expected concentrations post-mitigation may be.

Concentrations of TSS that are "significantly greater" than the modelled discharge concentrations would result in further impacts to aquatic life, not the beginning of impacts to aquatic life (as implied in response to CEAA Annex 2 Question 5). The proponent has not sufficiently described an approach for addressing the potential adverse environmental effects associated with increased concentrations of TSS in the receiving environment that may affect fish or fish habitat.

ECCC noted that subsection 36(3) of the Fisheries Act prohibits the discharge of deleterious substances to waters frequented by fish, or to a place where those substances might enter such waters.

Issue or Comment

a) Identify measures to mitigate the predicted high levels of TSS concentrations in the discharge and demonstrate that these measures would mitigate potential adverse effects to water quality.

b) Assess residual effects to water quality, after the application of mitigation measures. Describe the uncertainty of the effectiveness of these mitigation measures and identify a monitoring and follow-up program for water quality.

Response IR1-05

a-b) The purpose of the Project is not to reduce sedimentation and improve water quality in Elbow River; rather the purpose is to control hydrology in Elbow River to reduce the severity of floods. This controlling of hydrology, by temporary retention of diverted flood water in the off-stream reservoir, will reduce total suspended solids (TSS) in the water prior to its release back into the river to levels far below the TSS concentrations when the flood water was diverted. The off-stream reservoir will act as a settling pond to settle out suspended sediment. This is a widely used and proven mitigation method to reduce TSS levels in sediment-laden water before release back into a natural waterbody.

The modelled peak concentrations for the 1:10 year, 1:100 year and design floods are between 1,798 mg/L to 20,692 mg/L. These peaks occur at the end of the release period from the reservoir when sediment in the off-stream reservoir could be disturbed and be re-suspended into the water. It does not represent a sustained concentration over the full post-flood drawdown period. For comparison, without the Project in place, these floods have peak concentrations in Elbow River of 4,818 mg/L, 77,649 mg/L and 139,682 mg/L for the 1:10 year, 1:100 year and 2013 floods, respectively (Volume 3B, Section 7.4.2, page 7.21).

To reduce elevated TSS concentrations in the released water at the end of the release period, the flow rate can be controlled by the low-level outlet gates to allow further settling of sediment prior to release. A turbidity curtain can also be employed in the off-stream reservoir to slow velocities and promote additional settling during drawdown, if adaptive mitigation reveals it is necessary.

A TSS monitoring program will be developed, based on approval conditions and approved operating conditions for the Project (see draft surface water quality monitoring plan provided in the response to IR2, Appendix IR2-1). The monitoring program will include suspended sediment monitoring in Elbow River. The TSS–turbidity relationship for the river will be established and used to determine suspended sediments at any given time.

Monitoring stations will be located as follows:

- Elbow River upstream at Bragg Creek (long term Alberta Environment and Parks [AEP] hydrology monitoring location 05BJ004) to provide background TSS/turbidity levels for comparative purposes
- low-level outlet to determine the TSS/turbidity levels of the retained water and to aid in managing release rates to control suspended sediment concentrations
- Elbow River at Sarcee Bridge (monitoring location 05BJ010) to assess management of release rates from the off-stream reservoir and to monitor TSS levels in Elbow River.

Question IR1-06: Surface Water Quality – Methylmercury

EIS Guideline reference: Part 2, Section 6.2.2; Section 6.3.1; and Section 6.4.4
EIS reference: Volume 3B, Section 7
Other references:
CEAA Annex 2: A) Early Technical Issues, December 19, 2017
Alberta Transportation Responses to CEAA Annex 2: A) Early Technical Issues, May 11, 2018
ECCC Technical Review, June 18, 2018

Context and Rationale

In section 6.3.1, the EIS Guidelines require the identification of any potential adverse effects to fish and fish habitat, including the potential risk of production, increase, interaction, and accumulation of contaminants, including methylmercury.

The proponent has not provided adequate information on the potential for methylmercury to be released downstream after a flood event or on the potential accumulation of methylmercury in the food web of the reservoir or downstream environment. The proponent states that after release of water into the Elbow River, the reservoir area would not contribute methylmercury; however ECCC is of the view that the proponent has not demonstrated this with the data presented.

The study "Future Impacts of Hydroelectric Power Development on Methylmercury Exposures of Canadian Indigenous Communities" does not appear to be used in the proponent's analyses (Calder et al. 2016). This study sheds light on the relationship between methylmercury production and the organic carbon content of flooded soils in new reservoirs. This study includes analyses of the Experimental Lakes Area studies cited by the proponent, and thus should be included in the proponent's assessment.

It is well documented that regions with organic soil carbon content, and especially wetlands, produce methylmercury at greater rates and/or for longer durations post-flooding than low organic carbon landscapes. It is therefore important that the full range of landscape types in the potentially flooded area is captured by total mercury, methylmercury, and organic carbon sampling to predict the potential impacts on methylmercury production.

Methylmercury bioaccumulates through food webs to levels that may be harmful to top predatory fishes, wildlife, and human consumers. A relatively small increase in methylmercury concentrations in the water of an aquatic ecosystem can result in increased methylmercury in the top predatory organisms of an aquatic food web. The proponent's projected water methylmercury concentrations in the reservoir of 0.00028 to 0.002 µg/L are higher than those recently reported in a multitude of lakes across Canada (0.00007 ± 0.0001 µg/L) and approximately double or triple those in unimpacted Canadian freshwater systems, which are typically <0.0001 µg/L (ECCC, 2016). ECCC is of the view that comparison of projected methylmercury levels in the Springbank reservoir to the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guideline for the Protection of Aquatic Life is not a sufficient method to determine if effects on aquatic life can be expected from the Project.

The proponent states that after release of water into the Elbow River, the reservoir area would not contribute methylmercury because microbial decomposition processes would cease in the reservoir. ECCC notes that it is well documented that in addition to increased methylmercury production following the initial flooding of reservoirs, ongoing wetting and drying cycles and reservoir draw down can continue to stimulate methylmercury production (Orem et al. 2011; Eckley et al. 2015; Hsu-Kim et al. 2018). Reservoir water-level fluctuations have also been shown to increase sediment erosion and resuspension of mercury in the water column, which may make it more available for methylation (Mucci et al. 1995).

The proponent states that mercury methylation currently occurs during floods on the Elbow River without the presence of the Project and that this is supported by "the higher methylmercury concentrations in the Elbow River sediment and Glenmore Reservoir sediment compared to the

existing condition of soils in the off-stream reservoir." No baseline total and methylmercury monitoring information for the Elbow River and Glenmore Reservoir is provided in the EIS Volume 3B. Data is required to support the above statement, including the number of samples and sampling locations. Baseline methylmercury data in water of the Elbow River and Glenmore Reservoir are needed to predict effects of the Project.

Issue or Comment

a) **Incorporate results of the study "Future Impacts of Hydroelectric Power Development on Methylmercury Exposures of Canadian Indigenous Communities" (Calder et al. 2016), in relation to organic carbon content of flooded soils in new reservoirs, into the assessment of methyl mercury production.**

b) **Provide information on the sampling of total and methylmercury, including data on the number of samples, location of sampling sites, and if the sampling sites span the full geographical extent and all soil/terrain types of the proposed reservoir.**

c) **Estimate potential increases in methylmercury in the food web of the reservoir area and downstream ecosystems.**

d) **Describe the potential impact of drying of the reservoir area between flood events on methylmercury production and export downstream over the long-term (i.e. 5-40 years) to assess potential impacts of methylmercury releases.**

e) **Describe the potential impact of drying of the reservoir area between flood events on methylmercury production and export downstream over the long-term (i.e. 5-40 years) to assess potential impacts of methylmercury releases.**

f) **Provide baseline methylmercury data in water of the Elbow River or describe a plan to collect such data prior to proceeding with the Project.**

Response IR1-06

a) The study by Calder et al. (2016) is focused exclusively on large, permanently flooded hydroelectric reservoirs. The conditions in the Calder et al (2016) report are specific to northerly conditions, and modelled results reflect permanent impoundment conditions where methylation processes have years for methylmercury to accumulate in the environment and resident food chain. Calder et al. (2016) reviewed environmental studies from planned hydroelectric facilities across Canada from northern Quebec to the Yukon territory situated in the zones of the boreal forest on the Canadian Shield. Detailed modeling work by Calder et al. (2016) was done for a location near Muskrat Falls, Labrador.

   Environmental conditions for these projects are considerably different than conditions for the Project in the arid foothills of Alberta. Flood operations will hold water in the off-stream reservoir for a maximum of 84 days (Volume 1, Section 3.1, page 3.2).

b) Locations of soil samples are provided in Table 2-7, page 2.13, provided here as Table IR6-1. The analytical results are provided below in Table IR6-2 (the same as in Volume 4, Appendix K, Table A-4).

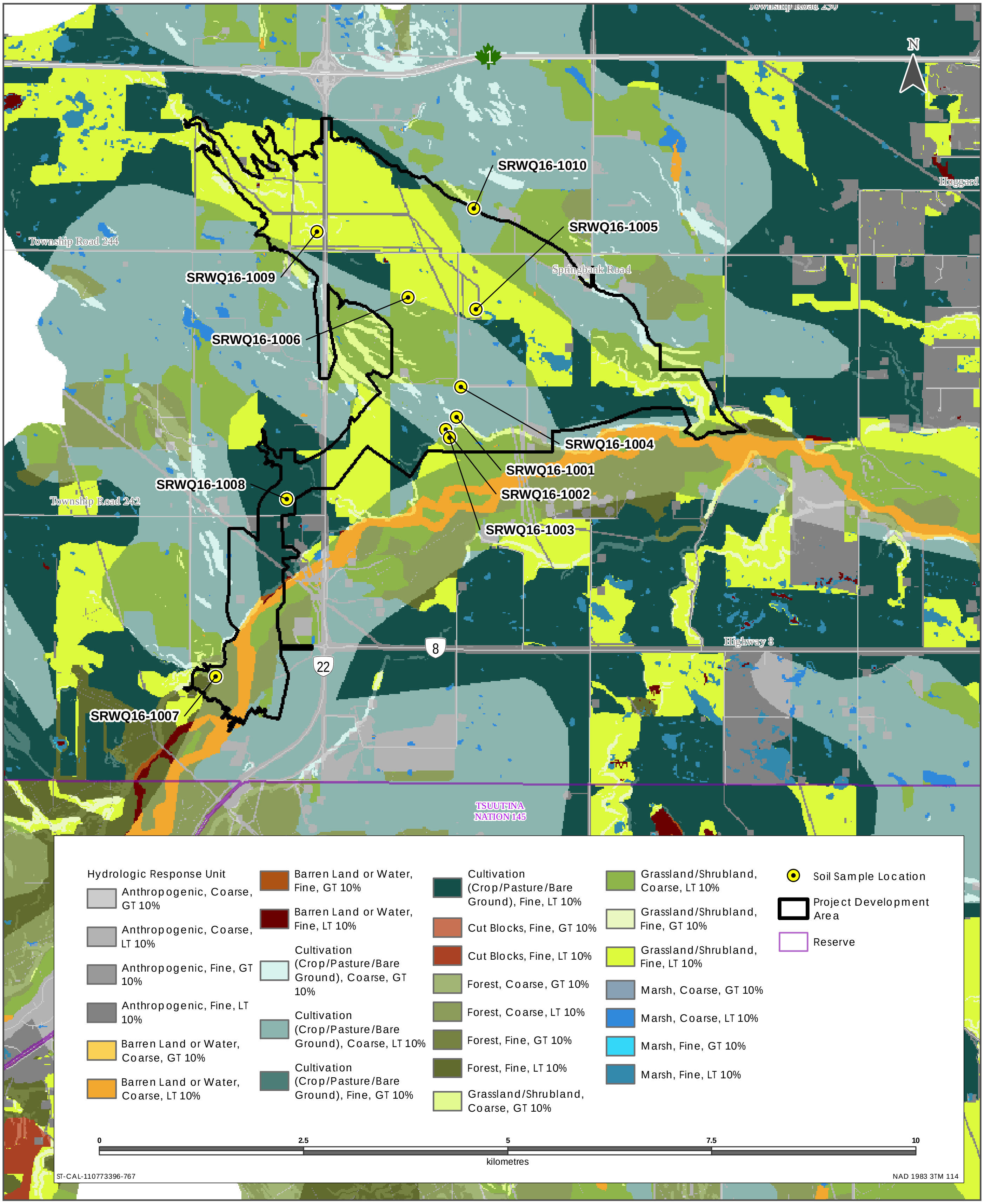
Soil samples were collected in 2016 from ten locations within the off-stream reservoir; see Table IR6-2, Table IR6-3 and Figure IR6-1. At least one soil sample was taken for each hydrologic response unit type.

The following is the description of soil sampling from Volume 4, Appendix K, Section 2.2.3.3: "Ten soil quality sampling locations were chosen across soil types with different organic carbon content ranges. Composite soil samples of the top 20 cm of topsoil were taken from a minimum of three spot digs at each soil quality sampling location. Each composite soil sample was thoroughly mixed and distributed among three glass jars and two large ziploc bags and labelled accordingly with site name, date, and time of collection. The samples were kept in a cooler at 4 ºC until the end of day, at which time they were taken to the lab accompanied with the corresponding Chain of Custody forms. Samples were analyzed at ALS Laboratory. Crew members each wore a new pair of nitrile gloves at each location, and all equipment was washed with deionized water between sampling locations."

Table IR6-1 Soil Quality Sampling Locations in the Off-Stream Reservoir (from Table 2-7 in Volume 4, Appendix K)

Site ID	Longitude	Latitude	Hydrologic Response Unit	Soil Classification
SRWQ16-1001	-114.444	51.04882	Cultivated (crop/pasture/bare ground) coarse, GT 10%	Mesa Butte (MSTB1)
SRWQ16-1002	-114.446	51.04748	Cultivated (crop/pasture/bare ground) coarse, LT 10%	Dunvargan (DVFS1)
SRWQ16-1003	-114.445	51.04655	Grassland/Shrubland Coarse, LT 10%	Gleysols, coarse textured (ZGC1)
SRWQ16-1004	-114.443	51.05215	Cultivated (crop/pasture/bare ground) coarse, LT 10%	Dunvargan (DVFS2)
SRWQ16-1005	-114.440	51.06073	Grassland/Shrubland, Fine, LT 10%	Pothole Creek (Pot2)
SRWQ16-1006	-114.452	51.06196	Grassland/Shrubland, Fine, GT 10%	Pothole Creek (Pot7)
SRWQ16-1007	-114.485	51.02015	Forest, Coarse, LT 10%	Twin Bridges (TBSR1)
SRWQ16-1008	-114.473	51.03968	Cultivated (crop/pasture/bare ground) Fine, LT 10%	Dunvargan (DVG1)
SRWQ16-1009	-114.468	51.06914	Grassland/Shrubland, Fine, LT 10%	Fish Creek (FSH1)
SRWQ16-1010	-114.441	51.07185	Marsh, Coarse, LT 10%	Dunvargan (DVG1)

NOTES:
The hydrologic response unit for each soil sample location is taken from Figure IR6-1.
Hydrologic response unit definitions are from Volume 4, Appendix J, Section 2, Table 2-4.



Sources: Base Data - ESRI, Natural Earth, Government of Alberta, Government of Canada
Thematic Data - ERBC, Government of Alberta, Stantec Ltd

Sediment and Soil Quality Sampling Sites

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Figure IR6-1

Table IR6-2 Mercury and Methylmercury Analytical Results for Soil Samples Collected in the Off-Stream Reservoir (from Table A-4 in Volume 4, Appendix K, Attachment A)

Parameter	Units	Detection Limit	SRWQ16-1001	SRWQ16-1002	SRWQ16-1003	SRWQ16-1004	SRWQ16-1005
			8-Nov-2016	8-Nov-2016	8-Nov-2016	8-Nov-2016	8-Nov-2016
Mercury	mg/kg	0.005	0.0315	0.0371	0.0301	0.0310	0.0229
Methylmercury	mg/kg	0.00005	0.000308	<0.000050	<0.000050	0.000058	0.000160
Total Organic Carbon	%	0.05-1.3	4.86	9.25	26.6	6.25	7.35

Table IR6-3 Mercury and Methylmercury Analytical Results for Soil Samples Collected in the Off-Stream Reservoir (from Table A-4 in Volume 4, Appendix K, Attachment A)

Parameter	Units	Detection Limit	SRWQ16-1006	SRWQ16-1007	SRWQ16-1008	SRWQ16-1009	SRWQ16-1010
			8-Nov-2016	9-Nov-2016	9-Nov-2016	9-Nov-2016	9-Nov-2016
Mercury	mg/kg	0.005	0.0242	0.0282	0.0285	0.0256	0.0372
Methylmercury	mg/kg	0.00005	<0.000050	0.000153	0.000060	<0.000050	0.000089
Total Organic Carbon	%	0.05-1.3	3.4	5.26	8.04	6.96	2.94

c) Effects of the Project on methylation of mercury are related to two factors: 1) change in concentrations of methylmercury related to inundation of soils within the off-stream reservoir and 2) change in structure of the food web in the downstream environment (Wiener and Suchanek 2008). The following discussion provides details on these two factors.

CHANGE IN CONCENTRATIONS OF METHYLMERCURY IN THE OFF-STREAM RESERVOIR

Based on predictions in Volume 3B, Section 7.4.4, page 7.29 regarding methylmercury flux between soil and reservoir water, and a revised starting water concentration of 0.0004 µg/L (derived as discussed below), updated predictions for methylmercury concentrations in the water retained in the off-stream reservoir for the three floods are as follows:

- design flood, 0.00068 to 0.0017 µg/L
- 1:100 year flood, 0.00080 to 0.0024 µg/L
- 1:10 year flood, 0.00085 to 0.0024 µg/L

These estimated low and high methylmercury concentrations are below the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guideline for the Protection of Aquatic Life (0.004 µg/L methylmercury, CCME 2003), but the estimated high concentrations are greater than the Environmental Quality Guidelines for Alberta Surface Waters (0.001 µg/L long-term level, and 0.002 µg/L short-term level; GoA 2018). The following describes derivation of the revised values and the conservatism incorporated in the assessment. The predicted upper methylmercury concentrations are overestimates because:

- Soil conditions are based on literature for sites with higher soil mercury and methylmercury than for the Project and in ecological zones expected to have higher soil carbon content (e.g., Experimental Lakes Area in Boreal zone in southwest Ontario, Hall et al 2005).
- A range of predictions is provided, based on the literature for methylation flux rates (Hall et al. 2005).
- A methylmercury/mercury ratio in water is used at the upper end of the observed literature range (1% to 15% methylmercury), which is typical of wetland soils, not the arid soils of the PDA.
- Baseline mercury concentrations are likely overestimated because baseline values are below the detection limit.

The methylmercury predictions are updated here to assess the potential for methylmercury concentrations below detection limits to affect water quality in the off-stream reservoir. The upper predicted methylmercury concentrations may potentially exceed the Alberta guidelines (0.001 µg/L long term and 0.002 µg/L short term), but they are not predicted to exceed the CCME guideline (0.004 µg/L). Because of the conservativism in the results, these guideline exceedances are considered unlikely.

Mercury flux from soils was assessed for the Project assuming methylmercury flux from flooded soils into water would range from 27–122 ng/m^2/day, using work by Bodaly et al. (2004) and Hall et al (2005). This is discussed in Volume 3B, Section 7.4.1.3, page 7.19 and Section 7.4.4, page 7.27. Of the reported release rates available in the literature, 27 ng/m^2/day was selected as the low release rate estimate and 122 ng/m^2/day as the high release rate estimate for this assessment. These rates are conservative and higher than reported in some studies (St. Louis et al. 2004). Methylmercury flux rates in the off-stream reservoir are assessed using the assumption that methylation processes would begin immediately as water is diverted; this is consistent with work reported by Schartup et al. (2015) and cited in Calder et al. (2016).

Bodaly et al. (2004), Hall et al. (2005), and St. Louis et al. (2004) conducted their studies in boreal wetlands and upland forest environments with variable amounts of carbon content from low to high. As stated in Volume 3B, Section 7.4.4, page 7.28:

"The existing condition of the reservoir is predominantly grass-dominated pasture lands with topsoil mercury (15.6 ng/g –37.2 ng/g) and methylmercury (0.05 ng/g –0.31 ng/g) content. The three experimental reservoirs in the Hall et al. (2005) study had topsoil mercury of 39.2 ng/g –89.1 ng/g and methylmercury of 0.20 ng/g –1.13 ng/g. The values cited for Hall et al. (2005) are for the humic/fungal layer of soil, which is comparable to the top 20 cm soil samples collected from the reservoir footprint."

Water samples collected in 2016 at Highway 22 and Elbow River that were analyzed for total and dissolved mercury. Total mercury analysis (from AEP data) was limited to a single value from 1988. Reported concentrations from samples collected in 2016 were below analytical detection limits (Volume 4, Appendix K, Attachment A, Table A-1), making it challenging to calculate a baseline mercury concentration for the analysis. Water quality data distributions are generally assumed to be lognormal (Helsel and Hirsch 2002). Depending on how the data are distributed, the shape and symmetry of the lognormal curve can vary. However, based on how data are distributed above the reported detection limit, the distribution of censured data (i.e., values below the analytical detection limit) can be inferred. When most, or all, of the data are censured, it is assumed the distribution will still be lognormal. Due to the potential variability in the shape of the lognormal distribution, mean and standard deviation will be impossible to infer. However, if it is assumed the distribution is somewhat symmetrical, arranged between zero and the reported detection limit, percentiles can be estimated, and the median will be roughly half the detection limit.

Total mercury analysis results for samples collected from Elbow River (ER H22) in 2016 were below the detection limit of 0.005 µg/L. Using the logic described above, a lognormal distribution for data from Elbow River between 0 µg/L and 0.005 µg/L implies that the median value is approximately 0.003 µg/L. Because there are no total mercury analysis results above the reported detection limit, the assumption is that the maximum value in the distribution is near the detection limit; this is a conservative assumption. Thus, the median total mercury values estimated here are likely higher than the actual values.

Ratios of methylmercury to total mercury in surface water reported by Balogh et al (2005), Dittman et al. (2010), Schuster et al. (2008) and Shanley et al. (2008) ranged between 1% and 15%. Higher ratios of methylmercury to total mercury are associated with watersheds having a higher proportion of landcover in wetland habitat. Using a conservative methylmercury-to-total mercury ratio of 15%, and median total mercury concentrations estimated as 0.003 µg/L, the estimated methylmercury concentration in Elbow River is 0.0004 µg/L.

Methylmercury concentrations predicted here will be short term (up to 84 days of inundation for a 1:100 year flood) and occur infrequently (based on the assessed flood frequencies). The exposure and hazard risk of these events to aquatic life is not predicted to result in methylmercury accumulating in the food chain and higher trophic organisms in the off-stream reservoir.

CHANGE IN STRUCTURE OF THE FOOD WEB IN THE DOWNSTREAM ENVIRONMENT OF ELBOW RIVER

Methylmercury is not expected to accumulate in lower trophic levels and move through the food web to upper trophic levels (i.e., fish). A structured food web is not anticipated to establish in the off-stream reservoir. The off-stream reservoir is predicted to hold water for less than 84 days (the inundation time for a 1:100 year flood); this time is too short for lower trophic levels (i.e., microbes, aquatic invertebrates, small fish) to establish. Thus, the Project will not affect the trophic structure in the off-stream reservoir.

Water released from the off-stream reservoir is not expected to result in methylmercury levels in Elbow River high enough the affect food webs. Based on work by Trudel and Rasmussen (2006), mercury uptake and accumulation from water exposure is only approximately 0.1% of the mercury accumulation from diet and water together (this included both elemental mercury and methylmercury). Dilution rates in Elbow River (Volume 3B, Section 7.4.3, page 7.25) are predicted to be as follows:

- For the design flood, associated release of water would contribute 29% to 59% of total flow in Elbow River (i.e., dilution would result in reduction of reservoir constituent concentrations of 40% to 70%)
- For the 1:100 year flood, associated release of water would contribute 5% to 35% of total flow in Elbow River (i.e., dilution would result in reduction of reservoir constituent concentrations of 65% to 95%)
- For the 1:10 year flood, associated release of water would contribute less than 5% of total flow in Elbow River (i.e., dilution would result in reduction of reservoir constituent concentrations greater than 95%)

As discussed above, methylmercury levels are predicted to be low, water released from the will occur infrequently, reservoir water will be diluted through mixing with Elbow River water, and most of the reservoir water will be released to the river prior to methylmercury concentration reaching their higher predicted concentrations. Therefore, food webs in Elbow River are not predicted to be affected by methylmercury from water released back into Elbow River from the reservoir.

d-e) The change in methylmercury soil levels is a result in the net difference in methylation and demethylation processes. Methylation rates and methylmercury levels are predicted to increase in anoxic conditions. As stated in Volume 3B, Section 7.4.4, page 2.27, mercury methylation is a chemical process that occurs in soil that is inundated by water, such as in a reservoir. Flooded organic carbon in soil and vegetation decomposition results in microbial activity causing the methylation of inorganic mercury (Hg [II]) to methylmercury (CH_3Hg_+).

Demethylation is predicted to reduce net methylmercury levels during the intervening years when soils in the off-stream reservoir are dry. During this period, soils will remain well drained and not inundated; therefore, methylation processes will not be occurring. As such, methylmercury levels are anticipated to decrease during dry periods and increases over time are, therefore, not expected.

f) Total and dissolved mercury concentrations in water samples from one site in Elbow River (ER22) were measured in May, June, and July 2016; concentrations were below the analytical detection limit of 0.005 µg/L. These results are provided in Table IR6-3. Methylmercury was not analyzed in these samples; however, concentrations would be lower than total mercury concentrations (values typically range from 1% to 15% of total mercury; Balogh et al. 2005, Dittman et al. 2010, Schuster et al. 2008, and Shanley et al. 2008). Therefore, as discussed in response (c), methylmercury concentrations are assumed to be about an order of magnitude lower that total mercury concentrations.

Mercury and methylmercury concentrations in sediment were measured in six samples from Elbow River in November 2016 and five samples from Glenmore Reservoir in October 2016. Data are provided in Table IR6-4, Table IR6-5, and Table IR6-6 (duplicated from Table A-3 in Volume 4, Appendix K, Attachment A). Concentrations of mercury ranged from 0.0204 mg/kg to 0.0414 mg/kg and of methylmercury ranged from 0.000107 mg/kg to 0.000898 mg/kg.

Table IR6-4 Mercury and Methylmercury Analytical Results for Water Samples Collected in Elbow River (from Table A-1 in Volume 4, Appendix K, Attachment A)

Parameter	Units	Detection Limit	ER H22	ER H22	ER H22
			20-May-2016	23-Jun-2016	19-Jul-2016
Total Mercury	mg/L	0.0000050	<0.0000050	<0.0000050	<0.0000050
Dissolved Mercury	mg/L	0.0000050	<0.0000050	<0.0000050	<0.0000050

Table IR6-5 Mercury and Methylmercury Analytical Results for Sediment Samples Collected in Elbow River (from Table A-3 in Volume 4, Appendix K, Attachment A)

Parameter	Units	Detection Limit	ER-100	ER-102	ER-104	ER-105	ER-108A	ER-111
			3-Nov-2016	4-Nov-2016	4-Nov-2016	7-Nov-2016	8-Nov-2016	15-Nov-2016
Mercury	mg/kg	0.005	0.0414	0.0283	0.0204	0.0308	0.0289	0.0300
Methylmercury	mg/kg	0.00005	0.000255	0.000276	0.000482	0.00148	0.00107	0.00202

Table IR6-6 Mercury and Methylmercury Analytical Results for Sediment Samples Collected in Glenmore Reservoir (from Table A-3 in Volume 4, Appendix K, Attachment A)

Parameter	Units	Detection Limit	GR-HEAD POND	GR-MID LAKE	GR-HERITAGE COVE	GR-WEASELHEAD	GR-MOUTH
			27-Oct-2016	27-Oct-2016	27-Oct-2016	28-Oct-2016	28-Oct-2016
Mercury	mg/kg	0.005	0.0401	0.0349	0.0389	0.0343	0.0236
Methylmercury	mg/kg	0.00005	0.000197	0.000647	0.000898	0.00164	0.00206

Methylmercury concentrations in Elbow River are low and generally not detectable. Methylation processes in the off-stream reservoir are expected to minimally increase the concentration and availability of methylmercury in retained water and downstream in Elbow River. The upper predicted methylmercury concentrations may potentially exceed the Alberta guidelines (0.001 µg/L for long-term and 0.002 µg/L for short-term), but they are not predicted to exceed the CCME guideline (0.004 µg/L). However, because of the conservativism in the assumptions, these guideline exceedances are considered unlikely. As such, risks to the aquatic food web are not anticipated. No additional sampling of water or sediment, or of fish tissue, is planned.

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Question IR1-07: Migratory Birds and Species at Risk – Risks During Operations

EIS Guideline reference: Part 2, Section 6.3.2; Section 6.3.3; Section 6.4
EIS reference: Volume 3B, Section 11.3.4.1; Section 11.3.4.2
Other reference: ECCC Technical Review, June 18, 2018

<u>Context and Rationale</u>

In section 6.3.2, the EIS Guidelines require the proponent to identify any potential direct and indirect adverse effects to migratory birds or their habitat, including staging and nesting areas, foraging grounds, and landing sites.

The proponent notes that the Project is predicted to increase bird and wildlife mortality risk in the project development area during a flood. Most of the flooded area would encompass wetlands and reclaimed vegetation that might be suitable breeding habitat for amphibians and ground-nesting migratory birds, respectively. Rising flood waters in the off-stream reservoir would remove migratory bird residences (e.g. nests) and young (e.g. eggs, nestlings, or fledglings), change the conditions required for amphibian larvae to develop, and introduce predatory fish that can prey on amphibians (e.g. eggs, larvae, or adults).

The Migratory Birds Convention Act protects migratory birds and their nests from destruction. In most years, the off-stream reservoir will provide habitat for nesting birds. Flood events can occur during the spring and summer, as evidenced by the 2013 flood which occurred in late June through early July. The Project will purposefully divert water into areas where migratory birds are likely to be nesting, resulting in potential incidental take, contrary to the provisions of the Migratory Birds Convention Act. The proponent has acknowledged that there may be mortality associated with a flood event, but has not put forward any mitigation measures to avoid incidental take on nesting birds. When there is advanced notice of a pending flood, there may be opportunity to undertake mitigation measures.

Several Species at Risk Act (SARA) listed amphibian species such as the northern leopard frog, western tiger salamander, and western toad may occur within the project area. The proponent has not identified any surveys undertaken to confirm the presence or absence of these species within the off-stream reservoir. Any wetlands within the perimeter of the off-stream reservoir could be entirely flooded during a flood event. SARA listed amphibian species occupying these wetlands would have their habitat inundated and individuals could be swept away into open water where they would be vulnerable to mortality by drowning.

Issue or Comment

a) **Identify and describe mitigation measures that would be undertaken during operation (flooding of the reservoir) to address the increase in mortality risk to birds listed under the *Migratory Birds Convention Act*. Provide a plan to avoid incidental take of nesting migratory birds in the offsite reservoir, given there is sufficient advanced notice of an impending flood. This could include, but not be limited to, deterrents, salvage of nestlings, etc. Include advanced surveys to identify important areas for nesting.**

b) **Identify and describe mitigation measures that will be undertaken during operation (flooding of the reservoir) to address the increase in mortality risk to species listed under the *Species at Risk Act*. Provide a mitigation plan to avoid the potential mortality to northern leopard frog, western tiger salamander and western toad within the off-stream reservoir as a result of flooding. Include surveys for the potential presence of amphibian species at risk to be completed in advance of flooding and describe plans for amphibian salvage of individuals, given there is sufficient advanced notice of an impending flood.**

Response IR1-07

a) There are no mitigation measures proposed during flood operations to reduce mortality risk to migratory birds. Salvage of eggs and nestlings in the off-stream reservoir immediately before flooding will not be possible because it is a safety concern to do so.

Based on weather and river forecasts, there will be limited advance warning for potential flooding, which is estimated to be between 30 and 49 hours. At that time, public warnings will be issued and, as part of the emergency response procedures, human access to the PDA will be limited to AEP Operations and staff. Flow rates in Elbow River can change rapidly during rain or other flooding events; therefore, the decision to open the diversion inlet gates will occur quickly.

The off-stream reservoir is located in an area where migratory birds can nest. The mortality risk to nesting birds will increase during flood operations, but the probability of floods occurring is relatively low. A 1:10 year flood has a 10% probability of occurring in any given year. Such a flood would cover approximately 60 ha of suitable nesting habitat for migratory birds in the off-stream reservoir. The probability of a design flood, which would cover 730 ha of nesting habitat, is expected to be less than 0.5% in any given year. Placing deterrents (e.g., decoys, decals, noise makers) in the off-stream reservoir during dry operations as suggested by ECCC would reduce the availability of suitable nesting and foraging habitat for migratory birds in the PDA during non-flood years, which could extend for relatively long time periods, given the probability of floods.

Riparian habitat along Elbow River is important for nesting. With the Project, severe flood waters of the river would be diverted to a new area (the off-stream reservoir) rather than flooding riparian habitat and migratory bird nests along that area. Without the Project, there is an existing risk to bird mortality from flooding for ground and shrub nesting birds along the river. This risk will be mitigated by the Project through the diversion of water into the off-stream reservoir.

Based on existing conditions, breeding bird survey results showed that species richness and abundance were highest in mixed forest habitat (Volume 4, Appendix H, which occurs mainly along Elbow River, of which only 2.5 ha would be inundated during a design flood (with the Project). Within the off-stream reservoir, a majority of habitat inundated would include grassland and shrubland. These habitats contain common species such as savannah sparrow, clay-colored sparrow, and house wren; however, no migratory bird species at risk were observed in the reservoir during the breeding bird survey.

b) There are no mitigation measures proposed during flood operations to reduce mortality risk to species at risk. Similar to migratory birds, salvage of amphibian species at risk in the off-stream reservoir immediately before flooding is a safety concern. Based on proposed operating procedures and uncertainty with flood magnitudes, as discussed in (a), it is not recommended that personnel are within the off-stream reservoir just prior to or during flood operations.

Due to the off-stream reservoir being located in an area where species at risk can occur, the mortality risk to species at risk increases during flood operations. However, the probability of floods occurring is relatively low. A 1:10 year flood has a 10% probability of occurring in any given year. Such a flood would cover approximately 1.1 ha of suitable wetland habitat in the off-stream reservoir for amphibian species at risk, such as northern leopard frog, western tiger salamander, and western toad. The probability of a design flood, which would cover 70.3 ha of wetland habitat in the off-stream reservoir, is expected to be less than 0.5% in any given year. With the Project, flood waters would be diverted to the off-stream reservoir rather than flooding out potential amphibian breeding habitat along Elbow River (e.g., snye, wetlands within floodplain). Without the Project, there is still a mortality risk to amphibian species at risk, during floods in Elbow River.

Question IR1-08: Species at Risk – Mitigation Measures

EIS Guideline reference: Part 2, Section 6.3.3; Section 6.4; Section 7; Sections 8.0, 8.1, 8.2
EIS reference: Volume 3A, Section 11
Volume 3B, Section 11
Volume 4, Appendix H
Other references:
CEAA Annex 2: A) Early Technical Issues, December 19, 2017
Alberta Transportation Responses to CEAA Annex 2: A) Early Technical Issues, May 11, 2018

Context and Rationale

Part 2, Section 6.3.3 of the EIS Guidelines requires the proponent to identify the potential effects of the Project on federally listed species at risk and those species classified by the Committee on the Status of Endangered Wildlife in Canada as extirpated, endangered, threatened or of special concern (flora and fauna) and their critical habitat; and to identify any potential direct or indirect effects on those identified species at risk.

Species at risk with use or potential to occur in the project development area may be affected by Project components and activities that are located at closer than recommended distances to nesting/breeding areas or important habitat features, or that are scheduled to occur during periods of greater risk (breeding seasons). CEAA Annex 2: A) Early Technical Issues (CEAA Annex 2), Question 8, asks the proponent to provide additional site specific mitigation, follow-up and monitoring commitments for those construction activities anticipated to be located within provided setback distances for known locations associated with species at risk (e.g., colonial nest sites for bank swallow, barn swallow).

In response to CEAA Annex 2, Alberta Transportation references site and species-specific mitigation measures that will be developed in the future to address effects to species at risk as a result of project activities, where compliance is not possible with timing or setback distance advice of federal and provincial regulators. Further elaboration of these yet to be planned mitigation measures is required to support the identification of key mitigation measures to avoid adverse effects to species at risk, as outlined in Section 7 of the EIS Guidelines.

Issue or Comment

a) Where proponent commitments are to the future development of site-specific and species-specific mitigation measures (e.g. as noted for barn swallow, bank swallow, horned grebe, rusty blackbird, western tiger salamander, western toad, little brown myotis), describe the plan including schedule/timing for development of acceptable mitigation measures in consultation with regulators (ECCC and Alberta Environment and Parks, as identified by the proponent).

b) Confirm proponent commitments to additional actions and mitigation measures that would be triggered if the presence of a wildlife feature (e.g. nests, breeding wetlands) or individual is identified and reported.

c) Where mitigation commitments for species at risk include reference to pre-construction surveys, describe how pre-construction surveys will be scheduled with each project component and activity and/or included in the Environmental Construction Operations plans directing construction contractors.

Response IR1-08

a) An Environmental Construction Operations Plan (ECO Plan) as well as a wildlife mitigation and monitoring plan will be developed following Project approval. The ECO Plan (Volume 4, Supporting Documentation, Document 10) and the wildlife mitigation and monitoring plan (see the response to IR9, Appendix IR9-1 for a draft wildlife mitigation and monitoring plan) will include site-specific and species-specific mitigation measures that will be applied during construction and where applicable, during dry operations. The wildlife mitigation and monitoring plan will be developed in consultation with provincial and federal regulators.

b) If a wildlife feature or animal is identified, the discovery will be assessed and reported to the environmental inspector on site. Appropriate site-specific mitigation will be implemented, which may include temporary delays in construction, placing a timing and distance setback buffer around the wildlife feature, allowing an individual to pass through, or placing silt fences around breeding wetlands for amphibian species of management concern, including amphibian species at risk. Mitigation measures will be developed in consultation with the applicable regulatory agency (i.e., AEP and/or Environment and Climate Change Canada [ECCC]) as required. This protocol will be included in the draft wildlife mitigation and monitoring plan and integrated with the ECO Plan.

c) Pre-construction surveys for species at risk will be conducted at the species-specific appropriate time of year prior to start of construction, where necessary (i.e., depending on the construction schedule). Surveys will be conducted to identify new or confirm previously identified wildlife features (i.e., raptor stick nests, wetlands) that might require mitigation. Examples of pre-construction surveys designed to protect wildlife features include:

- bird nest searches to identify active raptor stick or migratory bird nests, targeting species at risk and migratory birds such as olive-sided flycatcher, barn swallow and bank swallow if construction activities (e.g., vegetation removal) are planned during the breeding bird nesting period (February 15 to August 31)
- nocturnal or diurnal amphibian surveys (mid-April to mid-June) designed to confirm presence of amphibian species at risk breeding wetlands
- mammal den and mineral lick searches conducted in early spring to identify active dens and ungulate mineral licks in the wildlife LAA

Wildlife features and mitigation measures for each feature will be included in the Project specific ECO Plan and the wildlife mitigation and monitoring plan prior to start of construction.

Question IR1-09: Follow-up and Monitoring

EIS Guideline reference: Part 2, Sections 8.0, 8.1, 8.2
EIS reference: Volume 3C: Effects Assessment (Cumulative Effects, Follow-up and Monitoring), Section 2.0 Preliminary Follow up and Monitoring Programs

Context and Rationale

In the EIS, the proponent presents information related to its Preliminary Follow-up and Monitoring Program, noting that "Final follow-up and monitoring plans will rely on approval conditions (both provincial and federal), future refinement of Project planning and design, and the results of ongoing consultation with Indigenous groups and public stakeholders. Final follow- up and monitoring plans will include further details and guidelines for preparing monitoring reports (e.g., number, content, frequency and format)." However, migratory birds and species at risk are not included in the Preliminary Follow-up and Monitoring Programs described by the proponent in the EIS.

Throughout the EIS and in the response to CEAA Annex 2, the proponent includes commitments for the future development of site- and species-specific mitigation measures to address project effects to birds protected under the *Migratory Birds Convention Act* and to species at risk in those places and times of year where planned construction and operation activities may be non- compliant with standard avoidance best practices. Given the uncertainty in proposed mitigation measures, particularly in the case of modifications from standard mitigation measures, follow-up and monitoring is required to verify the effectiveness of the measures.

Issue or Comment

a) Provide information, including site- and species-specific mitigation measures, purpose, objectives, and actions, for the Project follow-up and monitoring programs for the following valued components of the environment, and describe how the effectiveness of these mitigation measures will be monitored and evaluated:

- ***i.*** **birds listed under the *Migratory Birds Convention Act***
- ***ii.*** **birds listed under the *Species at Risk Act***
- **iii. amphibian species at risk**
- **iv. wildlife species at risk**

Response IR1-09

a) Following Project approval, the draft wildlife mitigation and monitoring plan will be finalized in consultation with provincial and federal regulators. The monitoring plan will identify mitigation to reduce potential Project effects on wildlife species at risk including migratory birds and amphibians as well as provide monitoring objectives and protocols to determine the effectiveness of specific mitigation measures (e.g., vegetated side slopes along section of the diversion channel). See Appendix IR9-1 for the draft wildlife mitigation and monitoring plan.

Question IR1-10: Alternative Means

EIS Guideline reference: Part 2, Section 2.2
EIS reference: Volume 1, Section 2.2.6
Other references:
CEAA Annex 2: A) Early Technical Issues, December 19, 2017
Alberta Transportation Responses to CEAA Annex 2: A) Early Technical Issues, May 11, 2018

Context and Rationale

The EIS Guidelines require the proponent to complete the assessment of alternative means according to the Agency's Operational Policy Statement entitled *Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012.*

The responses to CEAA Annex 2: A) Early Technical Issues Question 1, describe the environmental constraints considered for the alternative road realignments, such as wetland and riparian areas, native prairie and rare plants, wildlife constraints, and sections of historical interest. However, the proponent did not include an assessment of potential effects to each valued component in its determination of preferred alternatives for Realignments and Modifications to Public Roads.

Issue or Comment

a) Update the assessment of alternative means for Realignments and Modifications of Public Roads to include consideration of the potential effects of the alternatives considered on valued components.

Response IR1-10

a) The alternative realignments and modifications of public roads are identified as interacting with the following environmental features:

- wetland and riparian areas
- native prairie and rare plants
- wildlife
- sites of historical interest

The potential effects on these features, which would be similar for each of the alternatives, are described below and mitigation measures presented.

Wetland and Riparian Areas; Native Prairie and Rare Plants

From Volume 3A, Section 10.4, wetland ecological function (i.e., wildlife habitat and plant diversity) would be altered due to vegetation clearing for the roads, resulting in the loss of wetland area. Onsite wetland restoration or offsite wetland replacement can be used to offset loss of wetland functions; therefore, effects are expected to be medium-term and reversible.

Changes in species diversity because of loss of species of management concern (SOMC) along the road alternatives and modifications is not anticipated to be a concern because no SOMC were noted in the PDA during field surveys. Effects on plant SOMC may still occur because unidentified plant SOMC may be present in the PDA. If SOMC are encountered along the alternatives, their removal may be irreversible because the re-establishment of such species is not always successful. However, significant effects on SOMC are not predicted because any effects would be limited to the PDA and would not result in the loss of abundance of plant species in the vegetation LAA. Areas along all the alternatives consist of more than 30% upland native prairie. Road realignments would result in the reduction of the area of this community in the vegetation LAA.

The following are mitigation for effects on vegetation and wetlands:

- restricting construction activities to the approved construction footprint
- reducing the removal of vegetation in wetlands to the extent possible
- conducting ground level cutting/mowing/mulching of wetland vegetation instead of grubbing, where possible
- developing and implementing a site-specific erosion and sediment control plan in accordance with Alberta Transportation (2011)
- reclaiming temporary disturbed wetland areas using an appropriate native seed mix that is suitable for wetlands

- directing grading/drainage away from wetlands, where possible
- where access roads need to cross wetlands, maintaining cross drainage to allow water to move freely from one side of the road to the other
- using a cover crop seed mixture to assist in weed and erosion control on exposed soils where warranted.

As discussed in Volume 3A, Section 10.6, with the implementation of mitigation measures, residual effects on vegetation and wetlands are not significant.

WILDLIFE

From Volume 3A, Section 11.4, potential effects on wildlife include changes in habitat, movement, mortality risk and biodiversity. These changes would also be caused by construction of the road realignments and modifications and the restrictions on movement because of the presence of the roads.

The following are mitigation for effects on wildlife:

- conducting pre-construction surveys to identify wildlife features (e.g., nests, dens) and develop appropriate site-specific mitigation
- avoiding vegetation removal during the restricted activity period (RAP) for nesting migratory birds and raptors
- avoiding or reducing, where possible, construction activities during the RAP for the key wildlife biodiversity zone identified along Elbow River (December 15 to April 30)
- avoiding wildlife features, as identified by the appropriate signage and/or fencing
- confirming all construction traffic adhere to safety, road closure regulations, and other access measures and guidelines for the construction area and associated access roads
- prohibiting harassment and feeding of wildlife or livestock
- storing waste in wildlife-proof containers
- providing wildlife awareness training to staff on site to reduce human-wildlife conflict

Residual Project effects on wildlife, as discussed in Volume 3A, Section 11.5, are not significant.

SITES OF HISTORICAL INTEREST

The potential effect of realignments and modifications of public roads on historical resources is the loss of or alteration to historical resource site contents or site contexts. Road construction could disturb sites of historical interest. Alberta Culture and Tourism (ACT) considers documentation of the site locations, photography, and collection of a sample of artifacts as sufficient mitigation for sites of low to moderate heritage value. For sites of moderate to high heritage value, avoidance or additional mitigation, such as detailed recording and excavation to retrieve a larger sample of artifacts and obtain an improved understanding of the cultural affiliation may be required by ACT. Construction monitoring could also be required, depending upon the results of excavations.

With the application of regulatory standards (including application of chance-find protocols required by ACT during construction), the Project effects on historical resources is predicted to be not significant.

PREFERRED ROAD REALIGNMENTS

The effects on any of the environmental features used in the comparison of road alignment alternatives are assessed as being not significant. As presented in Alberta Transportation's response to CEAA's Annex 2, Question 1 (Alberta Transportation 2018) the choice of preferred road realignments was based on the option of having the fewest number of environmental constraints. This comparison is presented in Table IR10-1, incorporating data from Alberta Transportation (2018).

Table IR10-1 Environmental Ranking of Road Realignment Options

Option	Number of Quarter Sections Crossed by Each Option				
	Wetland and Riparian Areas	Native Prairie and Rare Plants	Wildlife	Sites of Historical Interest	Total
Highway 22					
Option 1	**1**	**0**	**2**	**1**	**4**
Option 2	2	3	2	1	8
Springbank Road					
Option 1	2	3	3	4	12
Option 2	**1**	**4**	**1**	**1**	**7**
Option 3	2	4	4	0	10
Township Road 242					
For the Township Road 242 options, the environmental evaluation was based on the overall effects on undisturbed land, where a higher potential for environmental effects exists. As a result, the construction of the bridge crossing over the channel diversion on the existing Township Road 242 alignment (Option 1) has less potential environmental effects than Option 2 and 3 that traverses undisturbed land.					
NOTE: Numbers refer to the number of quarter sections of land with environmental constraints. The preferred option is in bold. The lowest total reflects the preferred option.					

REFERENCES

Alberta Transportation. 2018. Letter from Landon Reppert to Jennifer Howe regarding Springbank Off-Stream Reservoir Project (SR1) – Annex 2: A) Early Technical Issues and B) Technical Advice to the Proponent, dated May 11, 2018.

Alberta Transportation. 2011. Erosion and Sediment Control Manual. Alberta Transportation, Edmonton, Alberta.

Question IR1-11: Cumulative Effects

EIS Guideline reference: Part 2, Section 6.6.3
EIS reference: Volume 2, Section 7.2
Volume 3C, Section 1

Context and Rationale

The EIS separates the assessment of cumulative effects of the Project into two scenarios: construction and dry operations, and flood and post-flood. In combination, the two scenarios constitute the total project phases and physical activities associated with the Project. By separating the assessment, the proponent may have underestimated the cumulative effects of the Project. For example, some residual effects from construction may not be restored to baseline conditions (e.g. re-vegetation of cleared areas, implementation of fish habitat offsetting) prior to the flood and post-flood scenario beginning.

The EIS Guidelines, the Agency's Operational Policy Statement on *Assessing Cumulative Environmental Effects under CEAA 2012* and the Agency's Technical Guidance on *Assessing Cumulative Environmental Effects under CEAA 2012* all require a scoping step to identify temporal boundaries for the cumulative effects assessment. This should include clear, well supported documentation of the chosen temporal boundaries for each valued component for the consideration of cumulative effects. Although the proponent has described past, present and future projects, temporal boundaries were not identified or described in sufficient detail to understand both the past and future temporal boundaries of the cumulative effects assessment.

Issue or Comment

a) Update the cumulative effects assessment for each valued component to include an analysis of the cumulative effects of the Project as a whole.

b) Describe how temporal boundaries were scoped and how the chosen temporal boundaries will adequately capture the expected cumulative effect.

c) As necessary, update the cumulative effects assessment to address any changes to the temporal boundaries or list of past, present and future physical activities.

Response IR1-11

a-b) The cumulative effects assessment does not need to be updated by assessing the Project "as a whole" because use of the two assessment scenarios is appropriate and necessary. The following provides the basis of this conclusion, which, in summary, provides clarification of Project phases and temporal boundaries.

The three most common assessed project phases in general assessment practice, and those recognized in the Project's Guidelines (Part 2, Section 3.2 Project Activities), are construction, operations and decommissioning. The nature of effects during these phases are unique enough to warrant assessments specific to each phase. Regarding cumulative effects, typically the phase of most importance and interest is operational and when Project effects are a maximum (e.g., by area of disturbance, frequency of mobile physical activities, emissions from production).

Certain aspects of the proposed Project differ from conventional projects, making the typical approach inappropriate for the Project. Specifically, most projects, once constructed, operate on a well-defined basis for an anticipated project life (followed by decommissioning). Such operations include certain intended engineered actions and physical activities, such as excavation for a surface mine or transport of product, which continue on an ongoing and repeated basis. The descriptive nature of these actions and their timing are relatively well understood.

This flood mitigation Project, however, has a very different active operational profile. Which only occurs at unpredictable times for flood operations and post-flood operations. This operational profile differs in two ways. First, it lacks predictability. Second, the uncertain intensity of operation. The following discusses these two points further.

First, once constructed, aside from occasional maintenance activities, the Project has no consistent, designed, intended and repeatable actions (the Project essentially "sits there" with nothing happening). The only effects are from constructed physical works and, for the applicable duration recovery of certain valued components following mitigation. This state of relative inactivity of Project operation (referred to as dry operations) is in stark contrast to the state of substantial activity during a flood, dominated by partial diversion of Elbow River water and the filling of the reservoir.

Second, natural floods are the triggering mechanism to commence partial diversion of flood waters into the reservoir for temporary retention (flood operations). To place the magnitude of such events into context, given the average long-term flow in Elbow River in June (the highest flow month of the year) of 25.8 m^3/s (Volume 3A, Section 6, Table 6-5), the volume flow rates during the 1:10 year flood, 1:100 year flood, and design flood (see Table 3-1 Volume 1, Section 3) are about 8, 30 and 48 times greater, respectively. After an uncertain delay (depending on timing, conditions in Elbow River, suspended sediment concentrations, and protection of downstream infrastructure), water is returned to Elbow

River from the reservoir (post-flood operations). Unlike most projects, considerable uncertainty exists regarding characterization of a flood, including the timing (frequency) of floods, the duration (e.g., hours or days), and the magnitude (expressed by water volume and flow rate). Project engineering design accommodates these uncertainties.

Based on historical record, more than one flood is anticipated over the multiple decades the Project continues to be ready for such operation. Though considered unlikely, more floods are also possible in a given year and possibly in immediately adjacent years. The Project will be able to handle back-to-back floods up to its capacity of 77,771,000 m^3.

It is not appropriate, given the substantial differences between the operational profiles to combine them into one. Therefore, the cumulative effects assessments (Volume 3C, Section 1) are separated by the operational characteristics.

Regarding some other specific points raised in the Context and Rationale:

- Residual effects from construction for some valued components may not be fully mitigated through recovery prior to a flood, depending on timing and duration of a flood. However, as discussed above, the timing and nature of floods are not known beyond statistical inference. As such, a flood could occur the year after completion of construction, or many years after. The latter could increase the likelihood of recovery. However, even if full recovery occurs for some valued components, additional floods may once again cause disturbance requiring recovery to begin again.
- Operational characteristics of this flood mitigation Project are:
  - construction
  - be fully operational (i.e., ready for a design [2013] flood) approximately 36 months following commencement of construction. There is no specific timing (as discussed above) when the Project will change from dry operations to flood operations. What is known is that, once flood waters in Elbow River have receded, post-flood operations (i.e., draining of the reservoir) would occur for a length of time dependent on a variety of factors.
  - Project life is “in perpetuity”, hence there is no specific life and, hence, no description and assessment of decommissioning.

- Temporal boundaries reflect a timeline, from past to future, within which Project effects are assessed:
  - The past temporal boundary is the same as present (baseline), representing conditions as known in 2018. Given the regional context (Volume 3C, Section 1.1.5), reflective of substantial anthropogenic change for more than a century, dominated by agricultural land use, and that the majority of current land use in the PDA is also agriculture, current regional conditions provide a reasonable representation of historical change both regionally and locally.
  - The future temporal boundary is indefinite given the indefinite operational life of the Project. As discussed in Volume 3C, Section 1.1.6.2, most future reasonably foreseeable projects during the Project construction will have been built, with the balance of such future projects uncertain regarding timeline.

c) An update to the cumulative effects assessment is not required because a change in the temporal boundaries is not required, as described in the responses to (a) and (b).

Question IR1-12: Human Health Risk Assessment

EIS Guideline reference: Part 2, Section 6.3.4 Aboriginal Peoples
EIS reference: Volume 4, Appendix O, Section 3.4, Figure 3-2, pp. 3.13

Context and Rationale

In section 6.3.4, the EIS Guidelines require the proponent to provide a description and analysis of how changes to the environment caused by the project will affect each Indigenous group's human health. When risks to human health are anticipated, a complete Human Health Risk Assessment (HHRA) is to be completed.

Dustfall poses a risk to Indigenous health through the gathering and consumption of traditional plants. The conceptual site model under the post-flood operation phase contains the exposure pathway *Dustfall -> Garden Produce and Traditional Plants* by Dispersion and Settling of Dust on Plants. However, this pathway is not included in the construction phase of the conceptual site model.

The conceptual site model does not include exposure to indoor settled dust. The exclusion of this route of exposure may underestimate risk to residents nearby the project site during the construction phase of the assessment. Health Canada has published guidance on this topic: Supplemental Guidance On Human Health Risk Assessment Of Indoor Settled Dust (2018).

Issue or Comment

a) Consider the Dispersion and Settling of Dust on Plants pathway in the construction phase as it has the potential to result in increased exposure. If this pathway is not included in the construction phase, provide a rationale for its exclusion.

b) Determine whether indoor settled dust is an operable exposure pathway in the human health risk assessment. Based on this determination, include the indoor settled dust as an operable exposure pathway in the Human Health Risk Assessment or provide rationale why this exposure route was not included.

Response IR1-12

a) Volume 3A, Section 15.3.2 states, "Dust generated by earthworks during construction is essentially inert earthen material and would have a similar chemical composition as the surrounding soil in the construction area. Dust deposition to the surrounding plants would only apply during construction, and very close to construction activity, when public access to the area would be limited due to safety factors. Dust on plants would be removed by precipitation and wind on a regular basis."

Dust from earthworks is localized and the PDA is mostly grass that is cultivated for livestock grazing. The Project is located predominantly on private lands and although some land owners currently permit access to Indigenous groups for traditional land and resource use activities, opportunities for harvesting country foods are not expected to be extensive within the PDA. Additionally, opportunities for harvesting country foods during construction will not be permitted in the PDA, due to safety factors. Based on these considerations, effects on human health through the consumption of country foods is expected to be negligible.

b) Volume 3A, Section 15.3.2 states, "Dust generated by earthworks during construction is essentially inert earthen material and would have a similar chemical composition as the surrounding soil in the construction area".

This means that the dust that settles during the construction phase will be primarily of the same quality as the dust settling under current conditions (e.g., from wind or farming/ranching activities). As indicated in Health Canada (2018), the assessment of the indoor dust pathway is not dependent on the quantity of dust, but rather on the contaminants of potential concern (COPC) concentration in the dust. The recommended considerations for further screening or assessment of the indoor settled dust pathway are based on COPC concentrations in the dust and the concentrations of COPC in the dust compared to baseline dust concentrations (Health Canada 2018). Because Project activities will not alter the current COPC concentrations in soil-derived dust, indoor settled dust is not considered an operable exposure pathway.

REFERENCES

Health Canada. 2018. Supplemental Guidance on Human Health Risk Assessment of Indoor Settled Dust ($HHRA_{DUST}$). Prepared by: Contaminated Sites Division Safe Environments Directorate.

Question IR1-13: Human Health Risk Assessment

EIS Guideline reference: Part 2, Section 6.3.4 Aboriginal Peoples
EIS reference: Volume 4, Appendix O, Section, pp. 3.2 & Appendix B – COPC Screening, Table B-1

Context and Rationale

The HHRA carried forward contaminants of potential concern (COPC) via secondary pathways if the COPC had a:

- **half-life in soil greater than or equal to six months (measure of persistence) or;**
- **Log K_{OW} greater than or equal to 5 (measure of potential to bioaccumulate).**

As there is little discussion supporting the use of these screening criteria, it is unclear why these COPCs were screened out. All COPCs that pose a potential health risk need to be considered.

Issue or Comment

a) Provide references and supporting information for the numerical values used in the screening for persistence and bioaccumulation of COPCs.

b) Provide a rationale for the approach taken to carrying forward COPC via secondary pathways due to the criteria mentioned above. Discuss uncertainty associated with exposures using this approach and how exclusion of contaminants on this basis is protective of human health.

Response IR1-13

a) The screening criteria stated with respect to half life and Log K_{ow} is from the *Canadian Environmental Protection Act*, 1999. *Persistence and Bioaccumulation Regulations*. SOR/2000-107.

That reference supports the understanding that not all contaminants of potential concern (COPC) are relevant to the multi-media pathway assessment. This is due to the physical-chemical properties of the COPC; specifically, not all COPC released from the Project will persist or accumulate in the environment. To identify the COPC for consideration in the multi-media pathway risk assessment, the physical-chemical properties of each of the COPC were screened according to the *Canadian Environmental Protection Act.*

b) As noted in Alberta Health and Wellness (2011), not all pathway–receptor combinations should necessarily be carried forward to a detailed risk assessment, and further screening may be undertaken to exclude pathways whose contribution to exposure for a particular chemical and exposure route are expected to be not significant.

The human health risk assessment used the *Canadian Environmental Protection Act* criteria for persistence and bioaccumulation to screen air emissions for (secondary) oral exposure pathways because such chemicals have a limited potential for secondary exposure pathways (i.e., those other than inhalation). In other words, that chemical has negligible potential to persist or bioaccumulate in the environment and, therefore, only limited opportunity exists for exposure through secondary pathways. The potential health risks associated with exposure to these chemicals were assessed for the inhalation exposure pathway (i.e., the primary pathway). As such, the uncertainty associated with elimination of these chemicals from secondary exposure pathways using this screening approach is negligible and would not affect the conclusions of the human health risk assessment.

REFERENCES

Alberta Health and Wellness. 2011. Guidance on Human Health Risk Assessment for Environmental Impact Assessment in Alberta.

Canadian Environmental Protection Act, 1999. Persistence and Bioaccumulation Regulations. SOR/2000-107. Available at: https://laws-lois.justice.gc.ca/PDF/SOR-2000-107.pdf

Question IR1-14: Human Health Risk Assessment

EIS Guideline reference: Part 2, Section 6.3.4 Aboriginal Peoples
EIS reference: Volume 4, Appendix O, Section 4.2.3, Figure 3-2, pp. 4.15

Context and Rationale

Non-carcinogenic polycyclic aromatic hydrocarbons were not carried forward in the assessment of human health with the exception of naphthalene. Other non-carcinogenic polycyclic aromatic hydrocarbons may affect Indigenous health through inhalation or ingestion and need to be considered in the Human Health Risk Assessment.

Although Health Canada may not have toxicological reference values (TRVs) published for all non-carcinogenic polycyclic aromatic hydrocarbons, TRVs developed by other jurisdictions may be acceptable with justification and supporting data.

Health Canada has published guidance on this topic: Supplemental Guidance on Human Health Risk Assessment of Air Quality (2017).

Issue or Comment

a) Provide an updated assessment of human health, which carries forward COPCs that were screened out of the HHRA due to lack of a Health Canada TRV.

b) With the inclusion of additional COPCs, update the assessment of residual effects and include additional mitigation measures to address these effects.

Response IR1-14

a-b) The non-carcinogenic polycyclic aromatic hydrocarbons (PAHs; acenaphthene, anthracene, fluorene, phenanthrene, and pyrene) were not screened out of the assessment because of a lack of toxicological reference values. Rather, these PAHs were screened out for a quantitative inhalation assessment because there is a lack of evidence that these substances are toxic through the inhalation exposure route. They were not carried forward for the oral exposure pathways, based on a secondary screening, which indicated that deposition of these parameters is negligible.

Additional details and supporting rationale are provided as follows.

Inhalation toxicological reference values (TRVs) for these individual PAHs are not available from regulatory agencies recommended by Health Canada (2010a):

- Health Canada (2010b)
- other Health Canada sources (e.g., TRVs developed in support of the Guidelines for Canadian Drinking Water)
- U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) for the inhalation exposure route (IRIS 1990a, 1990b, 1990c, 1991)
- the World Health Organization
- Netherlands National Institute of Public Health and the Environment
- Agency of Toxic Substances and Disease Registry
- California Environmental Protection Agency

Other potential sources for inhalation TRVs, including Ontario Ministry of the Environment and Parks and the Texas Commission on Environmental Quality were also reviewed. Studies related to the toxic effect of these substances are related to oral exposures; however, as noted by US EPA (2009), comparison of inhalation exposures to oral TRVs is generally not appropriate because the hazard may be misrepresented when data from one route of exposure are substituted for another route of exposure without consideration of the pharmacokinetics differences between routes. Therefore, such a substitution might not be appropriate, even for use during screening.

Although inhalation TRVs were not available for the specific noncarcinogenic PAHs, a TRV representative of aromatic hydrocarbons ranging from C9 to C16 (which would include PAHs such as acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) was identified by TPHCWG (1997).

The TPHCWG (1997) acknowledges that data for this group of compounds is limited; however, of the available information the TPHCWG (1997) selected an inhalation study using rats (Clark et al. 1989) as the key study to set a chronic reference concentration (RfC) of 200 µg/m³. This chronic RfC is based on a no observed effect level (NOEL) of 900,000 µg/m³ for increased liver and kidney weights in male rats. This NOEL was adjusted to account for continuous exposure (rats were only exposed for 6 hrs/d, 5d/week for 1 year) and applied a 1,000 fold uncertainty factor (including an uncertainty factor of 10 to account for sensitive subpopulations, a factor of 10 to account for animal to human extrapolation, and a factor of 10 to account for converting a subchronic exposure to a chronic exposure).

The chronic RfC of 200 µg/m³ developed by the TPHCWG (1997) was selected as the chronic TRV for the HHRA. Exposure ratios (ERs) for the sum of acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene were compared to the selected chronic TRV of 200 µg/m³ for aromatic hydrocarbons C9 to C16 are shown in Table IR14-1. The ERs for annual total concentrations of these PAHs are less than 1.0.

Table IR14-1 Exposure Point Concentrations and Exposure Ratios for Annual C9-C16 Aromatics (Construction)

Human Receptor Location	Annual C9-C16 Aromatics (TRV = 200 µg/m³)					
	Exposure Point Concentration (µg/m³)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	8.3E-02	4.2E-02	1.0E-01	4.2E-04	2.1E-04	5.1E-04
SR1	5.8E-02	7.1E-03	6.5E-02	2.9E-04	3.6E-05	3.3E-04
SR2	5.9E-02	2.4E-03	6.1E-02	3.0E-04	1.2E-05	3.1E-04
SR3	5.9E-02	2.2E-03	6.1E-02	2.9E-04	1.1E-05	3.0E-04
SR4	5.8E-02	4.4E-03	6.2E-02	2.9E-04	2.2E-05	3.1E-04
SR5	5.8E-02	4.3E-03	6.2E-02	2.9E-04	2.2E-05	3.1E-04
SR6	5.8E-02	2.1E-03	6.0E-02	2.9E-04	1.0E-05	3.0E-04
SR7	5.8E-02	1.5E-03	5.9E-02	2.9E-04	7.6E-06	3.0E-04
SR8	5.8E-02	1.8E-03	6.0E-02	2.9E-04	8.8E-06	3.0E-04
SR9	5.8E-02	4.8E-03	6.3E-02	2.9E-04	2.4E-05	3.1E-04
SR10	5.8E-02	3.7E-03	6.1E-02	2.9E-04	1.8E-05	3.1E-04
SR11	6.1E-02	6.0E-03	6.7E-02	3.1E-04	3.0E-05	3.3E-04
SR12	5.8E-02	6.7E-03	6.4E-02	2.9E-04	3.4E-05	3.2E-04
SR13	5.8E-02	5.9E-03	6.4E-02	2.9E-04	2.9E-05	3.2E-04
SR14	5.8E-02	8.0E-03	6.6E-02	2.9E-04	4.0E-05	3.3E-04

Table IR14-1 Exposure Point Concentrations and Exposure Ratios for Annual C9-C16 Aromatics (Construction)

Human Receptor Location	Annual C9-C16 Aromatics (TRV = 200 µg/m³)					
	Exposure Point Concentration (µg/m³)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
SR15	5.8E-02	8.3E-03	6.6E-02	2.9E-04	4.1E-05	3.3E-04
SR16	5.7E-02	6.2E-03	6.3E-02	2.9E-04	3.1E-05	3.2E-04
SR17	5.7E-02	2.3E-03	5.9E-02	2.9E-04	1.1E-05	3.0E-04
SR18	5.8E-02	7.3E-03	6.5E-02	2.9E-04	3.7E-05	3.3E-04
SR19	5.8E-02	1.6E-02	7.4E-02	2.9E-04	8.0E-05	3.7E-04
SR20	5.8E-02	8.1E-03	6.6E-02	2.9E-04	4.1E-05	3.3E-04
SR21	5.7E-02	3.0E-03	6.0E-02	2.9E-04	1.5E-05	3.0E-04
SR22	5.7E-02	3.0E-03	6.0E-02	2.8E-04	1.5E-05	3.0E-04
SR23	5.7E-02	2.8E-03	6.0E-02	2.8E-04	1.4E-05	3.0E-04
SR24	5.7E-02	2.7E-03	6.0E-02	2.8E-04	1.4E-05	3.0E-04
SR25	5.8E-02	1.0E-02	6.9E-02	2.9E-04	5.0E-05	3.4E-04
SR26	5.8E-02	9.9E-04	5.9E-02	2.9E-04	5.0E-06	2.9E-04
SR27	5.8E-02	9.4E-04	5.9E-02	2.9E-04	4.7E-06	3.0E-04
SR28	5.8E-02	9.4E-04	5.9E-02	2.9E-04	4.7E-06	3.0E-04
SR29	5.8E-02	1.0E-03	5.9E-02	2.9E-04	5.0E-06	3.0E-04
SR30	6.2E-02	1.1E-03	6.3E-02	3.1E-04	5.5E-06	3.2E-04
SR31	6.2E-02	1.1E-03	6.3E-02	3.1E-04	5.5E-06	3.2E-04
SR32	6.0E-02	1.2E-03	6.1E-02	3.0E-04	6.2E-06	3.0E-04
SR33	5.8E-02	1.4E-03	5.9E-02	2.9E-04	7.0E-06	3.0E-04
SR34	5.8E-02	1.6E-03	5.9E-02	2.9E-04	7.9E-06	3.0E-04
SR35	5.8E-02	1.6E-03	5.9E-02	2.9E-04	7.9E-06	3.0E-04
SR36	5.7E-02	5.0E-03	6.2E-02	2.9E-04	2.5E-05	3.1E-04
SR37	5.7E-02	2.7E-03	6.0E-02	2.8E-04	1.4E-05	3.0E-04
SR38	5.9E-02	4.2E-03	6.3E-02	2.9E-04	2.1E-05	3.1E-04
SR39	5.8E-02	2.5E-03	6.0E-02	2.9E-04	1.3E-05	3.0E-04
SR40	5.7E-02	4.9E-03	6.2E-02	2.9E-04	2.4E-05	3.1E-04
SR41	5.7E-02	1.0E-02	6.8E-02	2.9E-04	5.2E-05	3.4E-04
SR42	6.0E-02	1.8E-03	6.2E-02	3.0E-04	9.2E-06	3.1E-04
SR43	6.7E-02	1.5E-03	6.8E-02	3.3E-04	7.6E-06	3.4E-04
SR44	5.9E-02	9.4E-04	6.0E-02	2.9E-04	4.7E-06	3.0E-04

Table IR14-1 Exposure Point Concentrations and Exposure Ratios for Annual C9-C16 Aromatics (Construction)

Human Receptor Location	Annual C9-C16 Aromatics (TRV = 200 µg/m³)					
	Exposure Point Concentration (µg/m³)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
SR45	5.8E-02	4.5E-04	5.8E-02	2.9E-04	2.3E-06	2.9E-04
SR46	5.8E-02	3.6E-04	5.9E-02	2.9E-04	1.8E-06	2.9E-04
SR47	5.9E-02	3.7E-04	5.9E-02	2.9E-04	1.9E-06	3.0E-04
SR48	5.8E-02	2.4E-04	5.8E-02	2.9E-04	1.2E-06	2.9E-04
SR49	5.9E-02	2.6E-04	6.0E-02	3.0E-04	1.3E-06	3.0E-04
SR50	5.7E-02	6.3E-04	5.7E-02	2.8E-04	3.1E-06	2.9E-04
SR51	5.7E-02	2.0E-03	5.9E-02	2.8E-04	9.8E-06	2.9E-04
SR52	5.7E-02	4.1E-04	5.8E-02	2.9E-04	2.1E-06	2.9E-04
SR53	5.7E-02	2.2E-04	5.8E-02	2.9E-04	1.1E-06	2.9E-04
SR54	5.7E-02	2.2E-04	5.7E-02	2.9E-04	1.1E-06	2.9E-04
SR55	5.8E-02	1.5E-04	5.8E-02	2.9E-04	7.3E-07	2.9E-04
SR56	5.7E-02	1.0E-04	5.7E-02	2.8E-04	5.0E-07	2.8E-04
SR57	5.9E-02	8.5E-04	6.0E-02	3.0E-04	4.2E-06	3.0E-04
SR58	5.7E-02	1.2E-04	5.7E-02	2.8E-04	5.9E-07	2.8E-04

With respect to oral exposures, an exposure pathway screening was completed for potential secondary exposures related to deposition: deposition and accumulation in soil, plant uptake from soil, uptake to birds and mammals by ingestion of plants, soil invertebrates and incidental ingestion of soil.

The non-carcinogenic PAHs were included in this screening, as shown in Volume 4, Appendix O, Attachment B and are summarized in Table IR14-2. Project-related changes in soil chemistry are considered negligible because predicted concentrations are less than health-based screening levels.

Table IR14-2 Maximum Predicted Change in Soil Concentration for Non-carcinogenic PAHs

COPC Non-carcinogenic PAHs	Soil Concentration (mg/kg)				
	Background [2]	Maximum Predicted Change at MPOI	Maximum Predicted Application at MPOI	Human Health Screening Level [1]	Ecological Health Screening Level [1]
Acenaphthene	0.05	0.0298	0.08	3900	21.5
Acenaphthylene	0.093	0.0361	0.13	0.45 [2]	---
Anthracene	0.05	0.0048	0.05	24000	2.5
Fluoranthene	0.24	0.0050	0.25	3500	15.4
Fluorene	0.05	0.0379	0.09	2700	15.4
Naphthalene	0.05	0.2211	0.27	2.2	8.8
Phenanthrene	0.19	0.0614	0.25	17 [2]	43
Pyrene	0.19	0.0044	0.19	2100	7.7

NOTES:

1 Alberta Government 2019; Table A-2, unless otherwise noted.

2 Ontario Ministry of Environment 2011; Table 2.

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Question IR1-15: Human Health Risk Assessment

EIS Guideline reference: Part 2, Section 6.3.4 Aboriginal Peoples
EIS reference: Volume 4, Appendix O, Section 6.0

Context and Rationale

Exposure to some carcinogenic substances during early life stages may be associated with higher risk of cancer for those carcinogens that act through a mutagenic mode of action. For these substances, Health Canada recommends that age-dependent adjustment factors are applied. Due to residents located within close proximity to the Project and land use by individuals of all ages, the sensitivity associated with exposure of carcinogenic substances needs to consider age as a factor.

Issue or Comment

a) Within the Human Health Risk Assessment, include age-dependent adjustment factors to adjust for the different sensitivities of earlier life stages when determining incremental lifetime cancer risk of carcinogens acting through a mutagenic mode of action.

Response IR1-15

a) The approach in the human health risk assessment in Volume 4, Appendix O is considered protective of all age groups, including early life stages exposed to carcinogens that act through a mutagenic mode of action. Project-related emissions associated with potential carcinogenic effects were limited to air emissions (specifically, chemicals related diesel exhaust) during construction. These chemicals are 1,3-butadiene, acetaldehyde, benzene, formaldehyde, carcinogenic polycyclic aromatic hydrocarbons (PAHs) (assessed as benzo[a]pyrene (BaP) toxic potency equivalent (TPE)), arsenic, chromium, and nickel. Of these, only carcinogenic PAHs and hexavalent chromium are identified as acting through a mutagenic mode of action by US EPA (2018).

Consistent with Alberta Government (2011), inhalation risks for carcinogens were assessed using a risk-specific concentration (RsC), which was calculated using the inhalation slope factor and a target incremental lifetime cancer risk (ILCR) of 1-in-100,000 or 1E-05. Maximum annual average concentrations were compared directly to the RsC, resulting in Project-related calculated exposure ratios of 0.031 for BaP TPE (Volume 4, Appendix O, Table 6-7, page 6.16) and 4.5E-05 for hexavalent chromium (see response to CEAA IR3-32, Table IR32-2), which are equivalent to an ILCR of 3.1E-07 for BaP TPE and 4.5E-10 for hexavalent chromium. An implicit assumption with this approach is that receptors will be exposed to the carcinogen for 100% of their lifetime; whereas, air emissions during construction will be limited to three years of an assumed 80-year lifetime (i.e., less than 4% of their lifetime).

Health Canada (2013) provides guidance on calculating ILCRs for less than chronic exposures, as well as the application of age-dependent adjustment factors (ADAFs) for these less than lifetime exposures. Assuming that a receptor could be exposed to carcinogenic PAHs and hexavalent chromium for the first three years of life, the ILCR can be calculated as:

$$ILCR = \sum_{0\ to\ <3\ years} (C_{air} * TR * UR * ADAF)$$

Where

ILCR	=	Incremental Lifetime Cancer Risk (unitless)
C_{air}	=	Concentration in air (µg/m³)
TR	=	Fraction of time exposed (yr/80 yr; unitless)
UR	=	Adult Cancer Unit Risk $(\mu g/m^3)^{-1}$
ADAF	=	Age-Dependent Adjustment Factor (unitless)

For this scenario, an ADAF representative of the first three years of life is considered: an infant from birth to six months of age, and a toddler from six months up to three years of age. Because the exposure period (0 to 3 years) does not align with Health Canada's typical lifestages, a Project-specific ADAF of 7.667 is calculated following the approach recommended by Health Canada (2013) using ADAF values established by US EPA (2005 a,b):

$$ADAF_{0\ to<3} = ADAF_{0\ to\ <2} * \frac{D_{0\ to\ <2}}{D_{0\ to\ 3}} + ADAF_{2\ to\ <3} * \frac{D_{2\ to\ <3}}{D_{0\ to\ 3}}$$

$$ADAF_{0\ to<3} = 10 * \frac{2}{3} + 3 * \frac{1}{3} = 7.667$$

Where

$ADAF_{0\ to\ <3}$	=	ADAF for first three years of life (unitless)
$ADAF_{0\ to\ <2}$	=	ADAF for first two years of life (unitless)
	=	10 (US EPA 2005a,b)
$ADAF_{2\ to\ <3}$	=	ADAF for children aged 2 to 12 (unitless)
	=	3 (US EPA 2005a,b)
D	=	Exposure duration (years)

The resulting ILCRs for BaP TPE and hexavalent chromium at their respective maximum point of impingements (MPOIs) are 8.05 E-09 and 1.25E-10, respectively, which are lower than the health risks calculated in the HHRA. These results demonstrate that the approach used in the human health risk assessment is protective and that the incorporation of ADAFs would not affect the conclusions of the HHRA.

A sample calculation for the calculation of the ILCR for BaP TPE is provided below:

$$ILCR = \sum_{0\ to\ <3\ years} (C_{air} * TR * UR * ADAF)$$

$$ILCR = 2.8 \text{ x } 10^{-5} \frac{ug}{m^3} * 0.0375 * 0.001(\frac{ug}{m^3})^{-1} * 7.667 = 8.05\text{x } 10^{-9}$$

Where

ILCR	=	Incremental Lifetime Cancer Risk (unitless)
C_{air}	=	Concentration in air (µg/m^3)
	=	Benzo(a)pyrene TPE: 2.8 x 10^{-5} µg/m^3 (Volume 4, Appendix O, Table A-35)
TR	=	Fraction of time exposed (yr/80 yr; unitless)
	=	Infant/Toddler (0 up to 3 years of age): 3 yr/80 yr = 0.0375
UR	=	Adult Cancer Unit Risk (µg/m^3)$^{-1}$
	=	0.0011 (µg/m^3)$^{-1}$ (Volume 4, Appendix O, Section 4.2.3)
ADAF	=	Age-Dependent Adjustment Factor (unitless)
		Infant/Toddler (0 up to 3 years of age): 7.667 (as shown above)

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Question IR1-16: Human Health Risk Assessment

EIS Guideline reference: Part 2, Section 6.3.4 Aboriginal Peoples
EIS reference: Volume 4, Appendix O, Attachment 15A, Table 15A-1 & Section 4.2.2, pp. 4.12

<u>Context and Rationale</u>

Inhalation of ethylbenzene can result in respiratory effects and needs to be reported in order to assess the potential effects to human and wildlife health.

In Table 15A-1 the health-based screening guidelines for acute inhalation of ethylbenzene is a 1-hour concentration of 2,000 µg/m^3. The toxicity assessment in Appendix O states the 1-hour exposure level of ethylbenzene is 86,000 µg/m^3.

<u>Issue or Comment</u>

a) Explain the discrepancies in the 1-hour acute inhalation values for ethylbenzene.

Response IR1-16

a) Volume 4, Appendix O, Attachment 15A is titled Alberta Ambient Air Quality Objectives and Canadian Ambient Air Quality Standards. Table 15A-1 correctly identifies the Alberta Ambient Air Quality Objective (AAAQO) for 1-hour ethylbenzene as 2,000 µg/m³ from Alberta Government (2019). As noted in the text above Table 15A-1, "some air quality objectives are not used in the human health risk assessment". The AAAQO was adopted from Texas (Alberta Government 2019) and based on potential odour nuisance (Cantox 2004). As a result, the AAAQO was not used in the human health risk assessment

A discussion of the ambient air quality objective and toxicological reference values for ethylbenzene is provided in Volume 4, Appendix O, Section 4.2.2. That section provides the rationale for the selection of a 1-hour exposure limit of 86,000 µg/m³, which is based on TCEQ (2015). Both the TCEQ (2015) and ATSDR (2010) acknowledged the potential for acute exposures to ethylbenzene to result in respiratory effects but, based on a review of the scientific literature, concluded effects to the central nervous system (i.e., hearing loss) were the critical effect. Although the ATSDR (2010) of 22,000 µg/m³ is lower than the TCEQ (2015) value, the TCEQ (2015) value was used in the human health risk assessment since it was developed more recently. The 1-hour exposure limit of 86,000 µg/m³ is protective of the critical effect to the central nervous system and, by extension, is considered protective of potential respiratory effects. The 1-hour exposure limit of 86,000 µg/m³ is used in Volume 4. Appendix O, Section 4, Table 4-1 and Volume 4, Appendix O, Attachment A, Table A-24.

As indicated in Table A-24, the maximum predicted 1-hour concentration of ethylbenzene within the HHRA LAA is 1.8 µg/m³, while concentrations at the human receptor locations are less than 0.53 µg/m³. Based on these concentrations, modelled 1-hour exposures to ethylbenzene are well below levels associated with adverse effects, whether in comparison to ATSDR (2010) acute exposure limit of 22,000 µg/m³ or the TCEQ (2015) exposure limit of 86,000 µg/m³.

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