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Abbreviations

AEP	Alberta Environment and Parks
KWBZ	Key Wildlife and Biodiversity Zone
LAA	local assessment area
PDA	project development area
PNP	Primary Nesting Period
RAA	regional assessment area
RAP	Restricted Activity Period
SAR	species at risk
SOMC	species of management concern
ZOI	zone of influence

11.0 ASSESSMENT OF POTENTIAL EFFECTS ON WILDLIFE AND BIODIVERSITY

11.1 SCOPE OF THE ASSESSMENT

The scope of the assessment and existing conditions for wildlife and biodiversity are described in Volume 3A, Section 11.1 and Section 11.2. This section assesses potential effects of the Springbank Off-stream Reservoir Project (the Project) on wildlife and biodiversity during flood and post-flood operations. The baseline for flood and post-flood operations is defined as the dry operations phase with major components of the Project in place and vegetation reclaimed after construction.

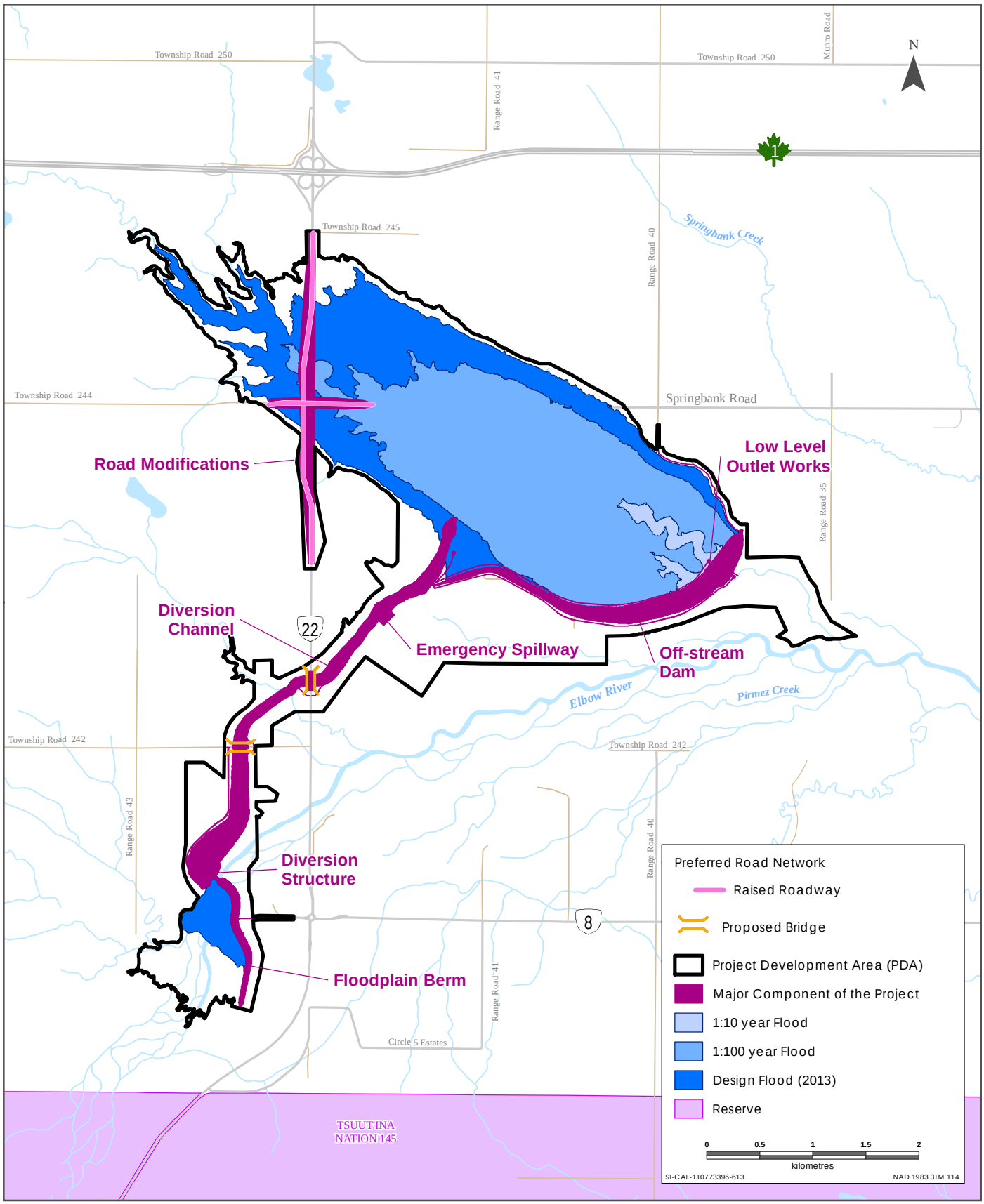
This assessment considers two phases of the Project: flood operations and post-flood operations.

- Flood operations refers to the water diversion from the Elbow River to the diversion channel and off-stream reservoir (i.e., reservoir filling) and the draining of the reservoir. The assessment focuses on potential effects of the flooded diversion channel and off-stream reservoir on wildlife and biodiversity.
- Post-flood operations include sediment partial cleanup, and maintenance activities required on project infrastructure (e.g., the diversion channel, floodplain berm, off-stream dam, access roads and bridges). The assessment focuses on potential effects of these activities on wildlife and biodiversity.

The effects of flood and post-flood operations are assessed for three floods: design flood, 1:100 year and 1:10 year flood (Figure 11-1). The area and length of time required for the reservoir to fill and drain varies for each flood are listed in Table 11-1.

Table 11-1 Estimated Off-stream Reservoir Characteristics for Different Floods

Flood Magnitude	Area (ha)	Duration of Reservoir Filling (days)	Residence Time in Reservoir (days)	Estimated Time to Drain Reservoir (days)
Design	816	3.75	20	38
1:100 year	481	1.80	43	39
1:10 year	21	0.38	43	30



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Areas Covered by the Flood Scenarios

Stantec

11.1.1 Potential Effects, Pathways and Measurable Parameters

11.1.1.1 Wildlife

During flood operations, the Project would directly alter wildlife habitat as the flood waters temporarily render habitats inaccessible for terrestrial wildlife species. During flood and post-flood operations, the Project has potential to affect wildlife and biodiversity—including species at risk (SAR)—through direct habitat loss (e.g., grass and shrub mortality) and reduced habitat effectiveness (i.e., sensory disturbance). However, the extent of disturbance to specific habitat features would depend on the magnitude of the flood. The Project also has potential to affect wildlife movement, mortality risk, and wildlife health.

To characterize potential effects of the Project on wildlife and biodiversity, measurable parameters are used to evaluate predicted effects (e.g., direct habitat loss). In some cases, there are no defined, quantifiable parameters to measure effects; these are predicted qualitatively based on scientific literature, professional judgement, and past project experience. For example, increased mortality risk due to filling the off-stream reservoir is assessed qualitatively. Potential effects, effect pathways, and the measurable parameters used to characterize and assess effects on wildlife are listed in Table 11-2.

The criteria used to characterize residual effects are identical to those presented in Volume 3A (see Table 11-5), except for duration. In this assessment, duration is defined as short-term when a residual effect is limited to flood operations and long-term when a residual effect extends beyond flood operations.

Table 11-2 Potential Effects, Effect Pathways and Measurable Parameters for Wildlife

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in habitat	• Temporary alteration or inaccessibility of habitat during reservoir filling and reservoir draining as well as post-flood operations (i.e., presence of sediment and debris) • Direct loss of residences of wildlife including SAR during reservoir filling • Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities)	• Amount (ha) of wildlife habitat (e.g., land cover classes) directly affected or altered • Amount (ha) of high and moderate suitability habitat directly and indirectly affected or altered for key indicator species[1] • Number of formally defined SAR residences (e.g., northern leopard frog breeding wetlands) directly or indirectly affected. • Habitat loss resulting from reduced habitat effectiveness (e.g., sensory disturbance) is assessed qualitatively for species of management concern (SOMC). Setback distances provide a guide to help estimate indirect habitat loss.
Change in movement	• Flood and post-flood operations could result in changes to wildlife movement patterns (daily or seasonal) because of habitat change and sensory disturbance.	• Assessed qualitatively (e.g., effects of habitat change and sensory disturbance on wildlife movement).
Change in mortality risk	• Reservoir filling can result in increased mortality risk (i.e., because of flooding of active bird nests, dens, burrows, and hibernacula). • Vehicle and equipment movement and ground disturbance can result in accidental mortality of small, less-mobile species or individuals (e.g., amphibians) • Vehicle collisions • Wildlife-human conflict (i.e., removal of nuisance animals)	• Direct mortality risk is assessed qualitatively. • Mortality risk because of flooding of native vegetation that contains active nests (e.g., destruction or abandonment of nests, eggs, and young birds) • Mortality risk because of collisions with project vehicles • Risk of wildlife-human conflict

Table 11-2 Potential Effects, Effect Pathways and Measurable Parameters for Wildlife

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in wildlife health	• Reservoir filling and draining could result in increased exposure of wildlife to contaminants brought in by flood water and methylmercury production in the reservoir (see Section 8)	• Assessed qualitatively based on information from the surface water, hydrology, and soils assessments

NOTE:

[1] Habitat suitability models assessed potential indirect effects (i.e., sensory disturbance) on key wildlife indicators using zone of influence (ZOI) criteria. See Volume 4, Appendix H, Attachment 11A for a detailed discussion of habitat suitability model development and methods.

11.1.1.2 Biodiversity

During flood and post-flood operations, the Project has potential to affect biodiversity at a local scale through habitat loss or alteration (i.e., changes to plant communities). These changes might result in reduced plant and wildlife species diversity in the LAA.

Biodiversity indicators are assessed alongside other effects as part of the vegetation and wildlife assessments. Potential effects, effect pathways, and the measurable parameters used to characterize and assess effects on biodiversity are listed in Table 11-3. The table also identifies where effects on biodiversity are assessed in the vegetation and wildlife sections.

The criteria used to characterize residual effects for Volume 3B are the same as those presented in Volume 3A (see Table 11-5), except for duration. In this assessment, duration is defined as short-term when a residual effect is limited to flood operations and long-term when a residual effect extends beyond flood operations. indefinitely

Table 11-3 Potential Effects, Pathways and Measurable Parameters for Biodiversity

Potential Effect(s)	Indicator	Effect Pathway and Justification	Spatial Scale	Measurable Parameter(s) and Units of Measurement	Assessment Location
Change in community diversity (vegetation)	Native upland cover	Direct loss or alteration of native upland habitat during flood events and maintenance.	local assessment area (LAA)	Area (ha) of upland native habitat (plant communities) lost or altered	Section 10.2.2
	Wetland cover	Direct loss or alteration of wetland cover (e.g., seasonal or temporary wetlands) from flood events and maintenance. These vegetation types provide habitat for several wildlife (e.g., amphibians) and plant SOMC.	LAA	Area (ha) of wetland lost or altered by wetland type	Section 10.2.2
Change in species diversity (vegetation)	Non-native Vascular Plants	Vegetation clearing and soil disturbances during post-flood maintenance activities facilitate the proliferation of non-native plants.	LAA	Occurrences of regulated weeds and non-native invasive species	Section 10.2.2
	Rare plant diversity	Loss of rare or traditional use plants during flood events. Vegetation species diversity is a key component to maintain healthy, functioning ecosystems. Rare plant species contribute to overall diversity and are particularly vulnerable to habitat alteration and loss.	LAA	Number of plant SOMC occurrences affected by the Project Occurrences of traditional use plants affected by the Project	Section 10.2.3 and 10.4
	Wildlife habitat diversity – breeding bird and amphibian diversity	Effect of flood events on breeding bird and amphibian species richness and abundance from baseline conditions	LAA	Combined metric based on area (ha) of vegetation community type that accounts for breeding bird and amphibian species richness, species overlap, and occurrence of SOMC	Volume 4, Appendix D, Wildlife and Biodiversity TDR [a]

NOTE:

[a] Because wildlife species diversity in the LAA is unknown at the time of dry operations, data from existing conditions is used to estimate potential effects of flood events on breeding bird and amphibian diversity.

11.2 PROJECT INTERACTIONS WITH WILDLIFE AND BIODIVERSITY

Table 11-4 identifies physical activities that might interact with wildlife and biodiversity during flood and post-flood operations. Interactions are discussed in detail in Section 11.3 in the context of effects pathways, standard and project-specific mitigation and residual effects. A justification for no interaction is provided following the table.

Table 11-4 Project-Environment Interactions with Wildlife and Biodiversity during Flood and Post-Flood Operations

Project Components and Physical Activities	Environmental Effects				
	Change in Habitat	Change in Movement	Change in Mortality Risk	Change in Biodiversity	Change in Wildlife Health
Flood Operations					
Reservoir filling	✓	✓	✓	✓	✓
Reservoir draining	✓	✓	✓	✓	✓
Post-flood Operations					
Reservoir sediment partial clean up	✓	✓	✓	✓	✓
Channel maintenance	✓	✓	✓	✓	–
Road and bridge maintenance	✓	✓	✓	✓	–

NOTES:
✓ = Potential interaction
– = No interaction

During a flood event, there is potential for contaminants to be present in the off-stream reservoir that could affect wildlife health. However, diversion channel, road, and bridge maintenance activities would not interact with wildlife health because none of these activities poses a direct or indirect health risk to wildlife though contaminants. Therefore, diversion channel, road, and bridge maintenance are not assessed further.

11.3 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON WILDLIFE AND BIODIVERSITY

11.3.1 Analytical Assessment Techniques

The analytical assessment techniques used to assess potential Project effects on wildlife and biodiversity during flood and post-flood operations are the same as those previously described in Volume 3A, Section 11.4.1. Key indicators used for this assessment are identical to those presented in Volume 3A, Section 11.1.2. The habitat suitability mapping used to assess potential effects on key indicators classifies the flooded area in the off-stream reservoir as a waterbody. This habitat type is rated very low to nil for all key indicators except northern leopard frog (*Lithobates pipiens*), which is rated low because of a lack of established marginal vegetation along the shorelines and the presence of fish. No zone of influence (ZOI) is applied to the flooded area. Wildlife health is qualitatively assessed using the results from the hydrology (Section 6), surface water quality (Section 7), and soils assessments (Section 9) completed for the Project.

If a residual effect is negligible in magnitude, all other criteria used to characterize effects are not assessed.

11.3.2 Change in Habitat

11.3.2.1 Project Pathways

Flood operations have the potential to directly affect wildlife habitat in the LAA through the temporary diversion of flood waters into the off-stream reservoir. The deepest part of the off-stream reservoir would be near the low-level outlet channel and would be approximately 25 m deep for the design flood, 17 m deep for the 1:100 year flood, and 5 m deep for the 1:10 year flood. The depth and extent of flood water would temporarily render habitat inaccessible in the flooded area for most terrestrial wildlife species (e.g., elk [*Cervus canadensis*], grizzly bear [*Ursus arctos*]) and for non-aquatic bird species that depend on grassland, shrubland, and forested areas (e.g., Sprague's pipit [*Anthus spragueii*] and olive-sided flycatcher [*Contopus cooperi*]), reducing habitat suitability. This change in habitat would be temporary and is expected to last up to 45 days and extend approximately up to 39 more days for the reservoir to recede and post-flood maintenance activities to occur (see Table 11-1).

During post-flood operations, potential direct effects on wildlife habitat would include sediment deposition that would result in covering vegetation and reducing habitat suitability for wildlife in the drained reservoir as well as revegetation of the diversion channel, off-stream dam, and floodplain berm, which might be damaged or eroded during a flood event

Sensory disturbance caused by maintenance equipment might contribute to temporary indirect effects on wildlife (i.e., habitat avoidance or displacement).

The additional time for vegetation, and thus habitat, to return to baseline conditions (i.e., dry operations) following a flood event would depend on the magnitude of the flood. The flood tolerance of plants varies with species and age, frequency and duration of floods, water quality, and site characteristics (Kozlowski 1997; Casanova and Brock 2000). Wetlands in the off-stream reservoir are likely to tolerate flood events (Casanova and Brock 2000, and see this Volume 3B, Section 10.2.3); however, upland vegetation and tame pasture in the off-stream reservoir are not adapted to prolonged flooding compared to wetland or floodplain vegetation (van Eck et al. 2004) and are unlikely to survive prolonged flooding (see Section 10.2.3).

Other wildlife species, however, might benefit from flood events. For example, draining the off-stream reservoir would create pools of water and soft soil that is attractive to wading birds such as Wilson's snipe (*Gallinago delicata*), which feed on macroinvertebrates (Ausden et al. 2001). In addition, any fish left in the off-stream reservoir after draining might be scavenged by wildlife such as bald eagle (*Haliaeetus leucocephalus*).

During a flood event, diversion of flood water to the off-stream reservoir might also limit potential changes in habitat on the Elbow River floodplain downstream of the diversion structure. For example, natural flood events of moderate magnitude can help maintain riparian habitat (Bayley 1995; Swanson et al. 1998; Beechie et al. 2006; Biswas and Mallik 2010); however, extreme events with higher flow rates are more likely to be destructive (Swanson et al. 1998; Beechie et al. 2006).

11.3.2.2 Mitigation

Post-flood operations have the potential to affect wildlife habitat for SOMC including migratory birds and SAR through sensory disturbance (i.e., during sediment partial cleanup and debris removal in the off-stream reservoir); the following is mitigation to reduce these effects:

- Maintenance activities will be restricted to the reservoir footprint to reduce the area of disturbance during post-flood operations.
- If sediment partial cleanup and debris removal in the off-stream reservoir occurs more than seven days following reservoir draining, and during the Restricted Activity Period (RAP) for nesting migratory birds and raptors, nest searches will be conducted by qualified wildlife biologist. If an active nest or den is found, it will be subject to a provincial or federal disturbance setback buffer and site-specific mitigation (see Volume 3A, Section 11, Table 11-10 and Table 11-11).

- Maintenance activities will be reduced as much as possible in the Key Wildlife and Biodiversity Zone (KWBZ) identified along the Elbow River from December 15 to April 30. This would reduce potential sensory disturbance to wintering ungulates (ESRD 2015a).
- Weed propagation will be reduced by using appropriate equipment cleaning protocols.
- Areas of sediment deposition where wind erosion might be an issue will be hydroseeded with native plant species to reduce erosion potential. AEP will have an operation and maintenance plan for the reservoir that would include sediment stabilization and debris removal.

11.3.2.3 Project Residual Effects

Table 11-5 lists potential areal changes in vegetation and wetland cover types, which are also wildlife habitat, during temporary inundation relative to baseline conditions. Table 11-6 quantifies the change (ha) in habitat for key indicator species in the LAA predicted for each flood scenario relative to the baseline. Habitat suitability models are used to assess 1) temporarily inaccessible habitat in the 4,860 ha LAA during flooding and 2) indirect loss of habitat from sensory disturbance. Changes in wildlife habitat during post-flood operations are assessed qualitatively.

Changes in habitat are also considered on a regional scale for each key indicator species. The amount of each regional habitat type and disturbance in the regional assessment area (RAA) uses baseline conditions, which is defined as the dry operations phase with major components of the Project in place and vegetation reclaimed after construction.

Table 11-5 Change in Vegetation and Wetland Cover Types Temporarily Inundated by Floods

Cover Type	Land Unit [a,b]	Area of Vegetation and Wetland Cover Types in the LAA (ha)				Change from Baseline					
						Design Flood		1:100 Year Flood		1:10 Year Flood	
		Baseline	Design Flood	1:100 Year Flood	1:10 Year Flood	ha	%	ha	%	ha	%
Broadleaf forest	b2 Hairy wild rye Aw	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
	d1 Pine grass Aw	21.3	21.3	21.3	21.3	0.0	0.0	0.0	0.0	0.0	0.0
	e1 Snowberry-silverberry Aw-Pb	88.6	88.6	88.6	88.6	0.0	0.0	0.0	0.0	0.0	0.0
	f2 Red osier dogwood Pb-Aw	65.3	58.2	61.8	65.3	-7.1	-10.9	-3.5	-5.4	0.0	0.0
	g2 Horsetail Aw-Pb	73.4	73.4	73.4	73.4	0.0	0.0	0.0	0.0	0.0	0.0
Coniferous forest	b4 Hairy wild rye Sw	59.1	59.1	59.1	59.1	0.0	0.0	0.0	0.0	0.0	0.0
	d3 Pine grass-Sw	6.8	6.8	6.8	6.8	0.0	0.0	0.0	0.0	0.0	0.0
	g1 Horsetail Sw	168.3	165.2	168.3	168.3	-3.1	-1.9	0.0	0.0	0.0	0.0
Mixed forest	b3 Hairy wild rye Aw-Sw-Pl	101.0	101.0	101.0	101.0	0.0	0.0	0.0	0.0	0.0	0.0
	d2 Pine grass-Sw-Pl-Aw	2.5	2.5	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0
	e2 Snowberry-silverberry Sw	79.0	79.0	79.0	79.0	0.0	0.0	0.0	0.0	0.0	0.0
	e4 Snowberry-silverberry Sw-Aw	9.6	8.1	9.6	9.6	-1.6	-16.1	0.0	0.0	0.0	0.0
	f1 Red osier dogwood Sw	69.1	68.1	69.1	69.1	-0.9	-1.3	0.0	0.0	0.0	0.0
Shrubland	e3 Shrubland - mesic/rich	81.9	75.0	78.3	81.1	-6.9	-8.4	-3.6	-4.4	-0.9	-1.1
	f3 Shrubland - subhygric/rich	243.1	163.4	204.0	242.4	-79.7	-32.8	-39.0	-16.1	-0.6	-0.3

Table 11-5 Change in Vegetation and Wetland Cover Types Temporarily Inundated by Floods

Cover Type	Land Unit [a,b]	Area of Vegetation and Wetland Cover Types in the LAA (ha)				Change from Baseline					
						Design Flood		1:100 Year Flood		1:10 Year Flood	
		Baseline	Design Flood	1:100 Year Flood	1:10 Year Flood	ha	%	ha	%	ha	%
Grassland	b5 Grassland - submesic/medium	41.9	35.5	36.5	40.3	-6.3	-15.2	-5.4	-13.0	-1.6	-3.8
	c1 Rough fescue	372.9	294.9	360.7	372.9	-78.0	-20.9	-12.2	-3.3	0.0	0.0
	d0 Grassland - mesic/medium [c]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	e0 Grassland - mesic/medium [c]	21.8	9.8	15.1	19.8	-12.0	-55.1	-6.7	-30.7	-2.1	-9.4
	f4 Grassland - subhygric/rich	70.3	35.1	55.4	68.2	-35.2	-50.0	-14.9	-21.2	-2.2	-3.1
	g0 Grassland - hygric/rich [c]	8.7	5.4	8.7	8.7	-3.3	-37.7	0.0	0.0	0.0	0.0
Upland Subtotal		***1,584.8***	***1,350.6***	***1,499.4***	***1,577.5***	***-234.2***	***-14.8***	***-85.4***	***-5.4***	***-7.3***	***-0.5***
Open water	Open Water	279.9	218.8	227.1	270.6	-61.2	-21.8	-52.8	-18.9	-9.4	-3.3
Open Water Subtotal		***279.9***	***218.8***	***227.1***	***270.6***	***-61.2***	***-21.8***	***-52.8***	***-18.9***	***-9.4***	***-3.3***
Ephemeral waterbody	Ephemeral waterbody	4.9	4.5	4.6	4.9	-0.4	-8.0	-0.3	-6.7	0.0	0.0
Graminoid marsh	Temporary graminoid marsh	87.4	63.7	76.1	86.4	-23.7	-27.1	-11.3	-12.9	-1.1	-1.2
	Seasonal graminoid marsh	98.1	66.4	80.9	98.1	-31.7	-32.3	-17.2	-17.6	0.0	0.0
	Semi-permanent graminoid marsh	30.4	17.1	18.2	30.4	-13.3	-43.7	-12.2	-40.1	0.0	0.0

Table 11-5 Change in Vegetation and Wetland Cover Types Temporarily Inundated by Floods

Cover Type	Land Unit [a,b]	Area of Vegetation and Wetland Cover Types in the LAA (ha)				Change from Baseline					
						Design Flood		1:100 Year Flood		1:10 Year Flood	
		Baseline	Design Flood	1:100 Year Flood	1:10 Year Flood	ha	%	ha	%	ha	%
Shallow open water	Shallow open water with submersed and/or floating aquatic vegetation	7.2	7.0	7.2	7.2	-0.2	-2.1	0.0	0.0	0.0	0.0
	Saline shallow open water with submersed and/or floating aquatic vegetation	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Shrubby swamp	Seasonal shrubby swamp	5.0	3.9	3.9	5.0	-1.1	-21.9	-1.1	-21.9	0.0	0.0
Wooded mixedwood swamp	Seasonal wooded mixedwood swamp	20.3	20.3	20.3	20.3	0.0	0.0	0.0	0.0	0.0	0.0
Shrubby Fen	Moderate-rich shrubby fen	41.8	41.8	41.8	41.8	0.0	0.0	0.0	0.0	0.0	0.0
Graminoid Fen	Moderate-rich graminoid fen	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wetland Subtotal		***296.3***	***226.0***	***254.1***	***295.2***	***-70.3***	***-23.7***	***-42.2***	***-14.2***	***-1.1***	***-0.4***
Agricultural	Annual crop	408.6	408.6	408.6	408.6	0.0	0.0	0.0	0.0	0.0	0.0
	Dugout	1.9	1.5	1.5	1.9	-0.4	-21.0	-0.4	-21.0	0.0	0.0
	Hayland	386.6	386.6	386.6	386.6	0.0	0.0	0.0	0.0	0.0	0.0
	Tame pasture	1,488.1	1,115.0	1,210.2	1,485.4	-373.1	-25.1	-277.9	-18.7	-2.7	-0.2

Table 11-5 Change in Vegetation and Wetland Cover Types Temporarily Inundated by Floods

Cover Type	Land Unit [a,b]	Area of Vegetation and Wetland Cover Types in the LAA (ha)				Change from Baseline					
						Design Flood		1:100 Year Flood		1:10 Year Flood	
		Baseline	Design Flood	1:100 Year Flood	1:10 Year Flood	ha	%	ha	%	ha	%
Disturbed Land	Disturbed land [d]	413.7	336.9	391.9	412.7	-76.8	-18.6	-21.8	-5.3	-1.0	-0.2
	Flood	0.0	816.0	480.5	21.4	816.0	-	480.5	-	21.4	-
Anthropogenic Subtotal		***2,699.0***	***3,064.6***	***2,879.3***	***2,716.7***	***365.7***	***13.5***	***180.3***	***6.7***	***17.7***	***0.7***
Grand Total		**4,860**	**4,860**	**4,860**	**4,860**						

NOTES:

Calculations completed on non-rounded numbers. Values presented in table have been rounded.

Aw – aspen (*Populus tremuloides*)

Pb – balsam poplar (*Populus balsamifera*)

Pl – lodgepole pine (*Pinus contorta*)

Sw – white spruce (*Picea glauca*)

[a] Upland land units (ecosites) were classified using Range Plant Communities and Range Health Assessment Guidelines for the Foothills Parkland Subregion of Alberta (ESRD 2012c).

[b] Wetland land units classified using the Alberta Wetland Classification System (ESRD 2015b).

[c] A zero ecosite phase indicates that the overstorey vegetation has been cleared, but ecosite moisture and nutrient regime remain unchanged.

[d] Disturbed land includes industrial facilities, disturbed land, transportation and rural residential land unit types.

Table 11-6 Change in Habitat for Key Indicators in the LAA

Key Indicators	Habitat Suitability Rating	Baseline	Design Flood	1:100 Year Flood	1:10 Year Flood	Change from Baseline					
						Design Flood		1:100 Year Flood		1:10 Year Flood	
		ha	ha	ha	ha	ha	%	ha	%	ha	%
Olive-sided Flycatcher	High	5.1	5.1	5.1	5.1	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate	134.4	134.1	134.4	134.4	-0.3	-0.3	0.0	0.0	0.0	0.0
	Low	263.2	259.2	263.2	263.2	-4.0	-1.5	0.0	0.0	0.0	0.0
	Very Low to Nil	4,457.2	4,461.6	4,457.2	4,457.2	4.3	0.1	0.0	0.0	0.0	0.0
Sprague's Pipit	High	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low	817.7	621.8	731.7	814.2	-195.9	-24.0	-86.0	-10.5	-3.5	-0.4
	Very Low to Nil	4,042.2	4,238.1	4,128.2	4,045.7	195.9	4.8	86.0	2.1	3.5	0.1
Northern Leopard Frog	High	49.6	36.6	38.9	49.6	-13.0	-26.2	-10.7	-21.6	0.0	0.0
	Moderate	93.7	90.8	98.0	93.7	-2.9	-3.1	4.3	4.6	0.0	0.0
	Low	192.0	618.9	462.0	195.8	426.8	222.3	270.0	140.6	3.8	2.0
	Very Low to Nil	4,524.6	4,113.6	4,261.0	4,520.8	-411.0	-9.1	-263.6	-5.8	-3.8	-0.1
Elk - Summer	High	198.4	174.1	200.9	198.5	-24.3	-12.2	2.5	1.2	0.1	0.1
	Moderate	590.3	520.4	555.4	594.2	-69.9	-11.8	-35.0	-5.9	3.9	0.7
	Low	700.2	576.6	629.4	690.8	-123.6	-17.7	-70.8	-10.1	-9.4	-1.3
	Very Low to Nil	3,371.0	3,588.8	3,474.3	3,376.4	217.8	6.5	103.2	3.1	5.4	0.2

Table 11-6 Change in Habitat for Key Indicators in the LAA

Key Indicators	Habitat Suitability Rating	Baseline	Design Flood	1:100 Year Flood	1:10 Year Flood	Change from Baseline					
						Design Flood		1:100 Year Flood		1:10 Year Flood	
		ha	ha	ha	ha	ha	%	ha	%	ha	%
Grizzly Bear - Spring	High	191.9	182.4	184.4	193.6	-9.5	-5.0	-7.5	-3.9	1.7	0.9
	Moderate	153.1	121.2	138.1	151.3	-31.9	-20.8	-15.0	-9.8	-1.8	-1.2
	Low	831.6	699.8	787.0	830.4	-131.8	-15.8	-44.6	-5.4	-1.2	-0.1
	Very Low to Nil	3,683.3	3,856.5	3,750.4	3,684.7	173.2	4.7	67.1	1.8	1.4	0.0
Grizzly Bear - Summer	High	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate	51.0	51.0	51.0	51.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low	200.0	199.5	199.3	199.9	-0.5	-0.2	-0.7	-0.3	-0.1	-0.1
	Very Low to Nil	4,609.0	4,609.4	4,609.6	4,609.1	0.5	0.0	0.7	0.0	0.1	0.0

NOTE:
Due to the seasonal timing of floods (e.g., spring or summer) elk winter feeding habitat was not assessed for flood operations.

Flood Operations

During a flood, reservoir filling would result in temporarily inaccessible habitat for some SOMC. The extent of this change would depend on the flood magnitude (see Table 11-1).

The design flood is predicted to cover 816 ha in the reservoir. Flood operations during the design flood would temporarily reduce 14.8% (234.2 ha) of breeding and foraging habitat in native upland vegetation, and 23.7% (70.3 ha) of wetland habitat in the LAA (Table 11-5) for wildlife species, including key indicators. Land unit types most affected by flood water diversion during the design flood include upland communities such as 26.2% (134.9 ha) of native grasslands, 26.6% (86.6 ha) of shrublands, and 25.1% (373.1 ha) of tame pasture (Table 11-5). The most affected wetland type includes 21.9% (1.1 ha) of seasonal shrubby swamp (Table 11-5). Although these habitats would be temporarily unavailable to wildlife, the RAA provides grassland, shrubland, tame pasture, and wetland habitat in other locations. Overall, the design flood would cover less than 3% of available native grassland (27,916 ha) and tame pasture (9,716 ha), and less than 1% of available wetland habitat (973 ha) in the RAA. Forest habitat in the LAA would be relatively less affected, between 1-3% (Table 11-5). The effect on wildlife habitat would be less during lower-magnitude floods (Table 11-5).

Overall, the magnitude of the residual effect on wildlife habitat is moderate during a design flood and 1:100 year flood because a measurable change in the abundance and distribution of wildlife in the LAA is possible, but a measurable change in the abundance of wildlife in the RAA is unlikely. In contrast, for a 1:10 year flood, the residual effect would be low because a measurable change in the abundance of wildlife in the LAA is unlikely, although temporary local shifts in distributions might occur. Flood operations would be relatively short in duration and irregular occurrence. Timing is seasonal because a flood is limited to the spring and summer months.

Post-flood Operations

During a design flood, sediment modeling predicts that 3.7% (192.6 ha in the reservoir) of the LAA would be covered by sediment that is less than 3 cm deep, and 0.8% (37.4 ha) would be covered by sediment between 3 cm and 10 cm. The quality of vegetation and wetlands post-flood would differ from baseline conditions, however, changes to overall wildlife habitat abundance and suitability would be minor under these conditions. Sediment less than 3 cm deep would have little to no effect on vegetation and wetlands, whereas sediment 3-10 cm deep could result in small shifts in plant species composition within upland and wetland ecosites, but complete changes to different communities would not be expected (see Section 10.2).

Sediment deposition of more than 10 cm is predicted for a design flood at 3.0% (145.4 ha in the reservoir) of the LAA. It is anticipated that a design flood would cover 0.8% (40.8 ha in the reservoir) of the LAA in sediment greater than 1 m deep. Although the areal extent of sediment deposition is lower than for sediment less than 10 cm deep, higher sediment depths would have greater effects on the suitability of wildlife habitat. Changes to habitat suitability would occur through the loss of vegetation in the herb, shrub, and/or tree strata, depending on sediment depth. These areas would eventually be recolonized by vegetation from the surrounding area (see Section 10.2.2.2). Using the 10-100 cm sediment category, the most affected wildlife habitats during post-flood operations would be tame pasture (3.1% in the LAA, or 45.8 ha in the reservoir), native grassland (4.1% in the LAA, or 21.2 ha in the reservoir) and wetlands (3.6% in the LAA, or 10.7 ha in the reservoir) (see Table 10-9 in Section 10.2.2.2). Residual effects of sediment deposition for lower magnitude floods would likely be less.

Based on the amount of available habitat in the RAA, the magnitude of the residual effect on wildlife habitat during post-flood operations is moderate because a measurable change in the abundance and distribution of wildlife in the LAA is possible, but a measurable change in the abundance of wildlife in the RAA is unlikely. Post-flood operations would be relatively short in duration and irregular in occurrence; however, the long-term effect of deeper sediment (i.e., greater than 1 m) on vegetation left behind after draining would increase the recovery time for habitat to become suitable again for wildlife. Timing is seasonal and regulatory because post-flood operations would have greater potential to affect some SOMC at different times than others, but also might occur during a restricted activity period.

Olive-sided Flycatcher

Most high and moderate suitability habitat in the LAA exists along the Elbow River. At design flood conditions, 0.3 ha (0.3%) of moderate suitability olive-sided flycatcher habitat would be affected relative to baseline (Table 11-6) as a result of backflow from the Elbow River flooding the area upstream of the diversion structure and floodplain berm (Figure 11-1). No high suitability habitat would be affected (Table 11-6). Olive-sided flycatcher nests have been recorded at various heights above ground (ranging from 1.5 m to 34 m), although nests in the western mountain ranges tend to be higher (Altman and Sallabanks 2012). In British Columbia, 52% of nests were observed between 6 m and 12 m (Campbell et al. 1997). Depending on the depth of the flood water, shrubs and the lower portions of trees would be temporarily inaccessible for nesting. During the 1:100 year and 1:10 year floods, no high or moderate suitability habitat would be affected.

There is potential for olive-sided flycatcher to be displaced during post-flood maintenance after a design flood. Displacement might occur because of sensory disturbance resulting from maintenance activities; however, mitigation (i.e., nest search and setback buffers) during the breeding bird RAP for SOMC is expected to reduce residual effects.

Overall, the magnitude of the residual effect during flooding on olive-sided flycatcher breeding habitat is considered low because less than 1% of high and moderate suitability habitat in the LAA would be affected. The magnitude of the residual effect on this habitat during post-flood operations would be negligible because no measurable change in olive-sided flycatcher, or other forest songbirds, abundance and distribution would be expected. Residual effects on olive-sided flycatcher habitat would be relatively short in duration and irregular in occurrence. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect olive-sided flycatcher habitat during the breeding season, but also might occur during a restricted activity period.

Sprague's Pipit

Most grassland habitat in the PDA is in the off-stream reservoir, which would be flooded. However, there is no high or moderate suitability Sprague's pipit habitat in the LAA. For design flood conditions, 195.9 ha (in the reservoir), 24.0% in the LAA, of low suitability Sprague's pipit habitat would be affected relative to baseline (Table 11-6). The extent of filling would be reduced during the 1:100-year and 1:10-year floods, reducing the amount of low suitability habitat affected (Table 11-6).

During post-flood operations, draining of the off-stream reservoir would leave sediment behind, covering vegetation and reducing the suitability of grassland habitat. Mitigation during the breeding bird RAP for sediment partial cleanup and debris removal is expected to reduce potential sensory disturbance during post-flood operation maintenance activities.

Overall, the magnitude of the residual effect on Sprague's pipit breeding habitat is considered low during flood and post-flood operations as no high or moderate habitat suitability in the LAA would be affected. Residual effects on grassland habitat would be relatively short in duration and irregular in occurrence. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect Sprague's pipit habitat during the breeding season, but also might occur during a restricted activity period.

Northern Leopard Frog

Based on the design flood, there would be a temporary reduction in high suitability northern leopard frog breeding habitat by 13.0 ha in the reservoir (26.2% of the LAA) and moderate habitat by 2.9 ha in the reservoir (3.1% in the LAA), relative to baseline (Table 11-6). During a 1:100 year flood, the extent of filling would be less, which would decrease the amount of high suitability habitat affected; however, a greater amount of moderate habitat would be available relative to baseline (Table 11-5). This is because certain disturbances (e.g., roads) would be covered by flood water, thereby removing a ZOI around this disturbance. Removing a ZOI would

increase the suitability value of any northern leopard frog habitat previously in that ZOI. No high or moderate habitat would be affected during a 1:10 year flood (Table 11-6).

Although wetland vegetation is more tolerant to flooding, wetlands with sediment greater than 10 cm in depth left behind in the reservoir after draining would be altered. During a design flood, 3.9% (11.7 ha) of wetlands in the LAA (Section 10, Table 10-11), or 1.2% of wetlands in the RAA (973 ha available at baseline), would be altered during post-flood operations.

Overall, the magnitude of the residual effect on northern leopard frog breeding habitat is considered high for the design flood and 1:100 year flood because more than 10% of high and moderate habitat suitability in the LAA would be affected. Residual effects during post-flood operations would be moderate because a measurable change in the abundance and distribution of amphibians in the LAA is possible, but a measurable change in the abundance of amphibians in the RAA is unlikely. In contrast, the magnitude of the residual effect during 1:10 year flood and post-flood operations is low because no high and moderate habitat suitability in the LAA would be affected. Residual effects on northern leopard frog breeding habitat would be relatively short in duration and irregular in occurrence. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal because post-flood operations would have greater potential to affect northern leopard frog habitat during the breeding season.

Elk

Because flood operations would occur in the spring or summer season, elk winter feeding habitat would not be affected by flood water residing in the reservoir. Therefore, the effects of flood operations are not assessed on elk winter feeding habitat suitability. Post-flood operations are more likely to affect this type of habitat through mortality of vegetation after prolonged flooding and sediment left behind. Most high and moderate suitability in the LAA exists along the Elbow River and within the off-stream reservoir. During post-flood operations, residual effects are likely to be greater during the first winter season after a flood when grassland vegetation has died from prolonged flooding, and sediment left behind in the reservoir could also alter the quality of forage in tame pasture and grassland habitats. However, vegetation is likely to be renewed the following spring. Additionally, depending on the amount of work, partial removal of sediment and sensory disturbance from other maintenance activities would result in the displacement of elk from winter feeding habitat early in the season. Other areas in the RAA, such as tame pasture or hay (9,716 ha), grassland (27,916 ha), and shrubland (2,682 ha) provide winter forage and security for elk.

Overall, the magnitude of the residual effect during post-flood operations would be moderate because a measurable change in the abundance and distribution of elk, and other ungulates in the LAA is possible, but a measurable change in the abundance of elk in the RAA is unlikely.

Residual effects on elk winter feeding habitat would be relatively short in duration and irregular in occurrence.

High and moderate suitability elk summer feeding habitat exists in similar locations and amounts as for the winter feeding habitat. Based on design flood conditions, 24.3 ha in the reservoir, 12.2% in the LAA, and 69.9 ha in the reservoir, 11.8% in the LAA, of high and moderate elk summer feeding habitat would be temporarily affected relative to baseline (Table 11-6).

Overall, the magnitude of the residual effect during flooding on elk summer feeding habitat is considered high because more than 10% of high and moderate habitat suitability in the LAA would be affected. The magnitude of the residual effect during post-flood operations would be moderate because a measurable change in the abundance and distribution of elk, and other ungulates in the LAA is possible, but a measurable change in the abundance of elk in the RAA is unlikely. Residual effects on elk winter feeding habitat would be relatively short in duration and irregular in occurrence.

For both winter and summer feeding habitat, timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect elk winter and summer feeding habitat at different times of year, but also might occur during a restricted activity period (e.g., KWBZ).

Grizzly Bear

For design flood conditions, moderate suitability grizzly bear spring feeding habitat of 9.5 ha in the reservoir, 5.0% of the LAA, and high suitability habitat of 31.9 ha in the reservoir, 20.8% of the LAA, would be affected relative to baseline (Table 11-6). Most high and moderate suitability feeding habitat in the LAA exists along the Elbow River, with patches of moderate suitability habitat existing within the off-stream reservoir. During post-flood operations, sediment left behind in the reservoir could reduce forage quality, and partial removal of sediment and sensory disturbance from other maintenance activities would result in displacement of grizzly bear from feeding habitat; however, other areas within the RAA, especially west of the PDA (Collister and Kansas 1997; Jorgenson 2016), would provide suitable spring feeding habitat.

Overall, the magnitude of the residual effect during flooding on grizzly bear spring feeding habitat is considered high because more than 10% of high and moderate habitat suitability in the LAA would be affected. The magnitude of the residual effect during post-flood operations would be low because a measurable change in the abundance of grizzly bears in the LAA is unlikely, although temporary local shifts in distributions might occur. Residual effects on grizzly bear spring feeding habitat would be relatively short in duration and irregular in occurrence.

Based on design flood conditions, no high or moderate suitability grizzly bear summer feeding habitat would be affected relative to baseline (Table 11-6). No high suitability habitat exists in the LAA, but most moderate suitability habitat exists along the Elbow River. The effect would be similar for the 1:100 year and 1:10 year floods.

Overall, the magnitude of the residual effect during flood and post-flood operations on grizzly bear summer feeding habitat is considered low because no high and moderate habitat suitability in the LAA would be affected, and a measurable change in the abundance of grizzly bears in the LAA is unlikely, although temporary local shifts in distributions might occur. Residual effects on grizzly bear summer feeding habitat would be relatively short in duration and irregular in occurrence. Timing for flood operations is seasonal because a flood event is limited to the spring and summer months. Timing for post-flood operations is seasonal because post-flood operations would have greater potential to affect grizzly bear spring and summer feeding habitat at different times of the year.

11.3.3 Change in Movement

11.3.3.1 Project Pathways

The diversion of flood waters into the off-stream reservoir would retain wildlife habitat connectivity and movement corridors downstream of the diversion structure that would otherwise be temporarily flooded; however, the effects of flooding would be moved into the upland area of the off-stream reservoir during diversion. During flood and post-flood operations, the water contained in the off-stream reservoir and diversion channel has potential to create physical barriers that might temporarily hinder terrestrial wildlife movement in the LAA. Barriers to movement can fragment a species' habitat and reduce the connectivity of movement corridors and landscape linkages. This might reduce access to resource patches, affect daily or seasonal movement patterns, or change dispersal events (Sawyer et al. 2009; Ament et al. 2014; Bartzke et al. 2015; Benz et al. 2016). Flood operations are not likely to restrict the movement of birds; however, floods can temporarily attract waterbirds because they perceive the area as a waterbody that has potential to provide feeding habitat (Roshier et al. 2002; Elphick and Oring 2003; King et al. 2010). As a result, floods can affect bird movement.

Amphibians rely on aquatic habitats and, as with birds, flooded areas can appear attractive and affect local movement. Floods can also result in temporary loss of wetland habitat; however, flood water can also connect isolated patches of wetland, increasing the chances of dispersal (Ward et al. 1999; Wassens et al. 2008). Although amphibians can swim, they typically avoid swimming in deep, open waters because of increased predation risk by fish (Lannoo 2005; SRD 2003). As such, amphibians are more likely to move along the shoreline. Because amphibians have smaller dispersal ranges relative to medium and large mammals, it would take amphibians longer to go around physical barriers.

Constructed reservoirs, and their associated canals, have been documented to act as barriers to wildlife movement (Andrews 1990; Messing 1990). Movement of large mammals such as ungulates, cats and bears could be affected by temporary physical barriers created by flood operations (Berger 2004; Bartzke et al. 2015). However, smaller, less-mobile mammals (e.g., rodents and weasels) are most likely to be affected by physical barriers due to their smaller ranges. The diversion channel and off-stream reservoir would be flooded with water during a flood and serve as a physical barrier to wildlife.

The diversion channel overlaps a KWBZ that follows the Elbow River (AEP 2015). KWBZs are intended, in part, to protect locally and regionally significant wildlife movement corridors (Government of Alberta 2015). Although flood operations would create temporary physical barriers to wildlife, during post-flood operations, barriers to wildlife movement would mainly be through sensory disturbance related to post-flood maintenance of project infrastructure (e.g., cleanup and repair of the diversion channel, off-stream reservoir, and the low-level outlet channel), public roads and bridges.

11.3.3.2 Mitigation

Flood and post-flood operations have the potential to affect wildlife movement in the LAA and RAA through the creation of physical barriers and sensory disturbance. Mitigation measures to reduce potential effects on wildlife movement include operational and design features as described below:

- The side slopes and bottom of the diversion channel will be vegetated, except under the proposed bridges and at Pirmez Creek. Vegetated areas would provide a more conducive wildlife passage across the channel.
- Post-flood infrastructure maintenance will be temporary and the duration would be reduced as much as possible.
- Post-flood maintenance will be localized and occur only during daylight hours.

11.3.3.3 Project Residual Effects

Flood operations have potential to hinder movement of amphibians and medium to large mammals (e.g., ungulates and bears), including key indicators; however, flood operations are unlikely to hinder movement of birds. Water impoundment during floods would be temporary. Based on a design flood, the off-stream reservoir would take approximately 3.75 days to fill, and flood water would reside in the off-stream reservoir for 20 days. Water would then take another 38 days to drain. As the reservoir drains, effects on wildlife movement are expected to diminish. Post-flood operations have potential to create sensory disturbance during project maintenance activities, which might affect wildlife movement.

The residual effects of project-related change to wildlife movement are characterized below for each key indicator and related species. Effect pathways are the same for each flood scenario; however, the effect characterization differs depending on the magnitude of the flood.

Olive-sided Flycatcher and Sprague's Pipit

Flood operations have limited potential to affect olive-sided flycatcher and Sprague's pipit movement, as well as all other non-waterbird migratory birds that fly over the Project. Waterbird movement is more likely to change in the LAA and RAA because of their attraction to waterbodies. During the design flood and 1:100 year flood, waterbirds might perceive the flooded off-stream reservoir as a lake and use it for feeding or resting (Roshier et al. 2002; Elphick and Oring 2003; King et al. 2010). However, waterbirds are unlikely to establish nesting while the off-stream reservoir is flooded because floods are more likely to occur late in the breeding season (e.g., June [Farjad et al. 2015]) when nesting territories have already been established elsewhere in the LAA or RAA. Effects on bird movement would diminish to baseline during post-flood operations as the water in the off-stream reservoir recedes.

Because the 1:10 year flood would create a smaller waterbody, it is likely that fewer waterbirds would be attracted to the reservoir; therefore, residual effects would be reduced during this flood magnitude.

For all flood scenarios, the magnitude of the residual effect is low because a measurable change in the abundance of birds, including migratory birds, in the LAA is unlikely, although temporary local shifts in distributions might occur. The effects are also expected to be short-term and irregular in occurrence because changes in the movement of these species in the LAA would be limited to filling of the off-stream reservoir (estimated to last up to three days) and during drainage following a design flood (approximately 42 days or fewer for smaller floods). Timing is not applicable because effects from flood and post-flood operations would be similar regardless of season or other timing characteristics.

Northern Leopard Frog

The Project has potential to affect amphibian movement during flood operations, where the temporary filling of the off-stream reservoir might hinder amphibians attempting to travel in the LAA. Most amphibian breeding wetlands were observed in or near the off-stream reservoir, and flood operations might affect localized amphibian movement in this area, although no amphibian SOMC were observed. The likelihood of amphibians swimming across the length of the flooded off-stream reservoir at design flood and the 1:100 year flood would be low because of avoidance behaviour of deep waters, which are usually associated with fish (i.e., increased predation risk). Effects on amphibian movement would diminish to baseline levels during post-flood operations as the water in the off-stream reservoir drains.

The 1:10 year flood would create a smaller waterbody, which could be more feasible for amphibians to move through; therefore, residual effects would be reduced during this flood magnitude.

Residual effects on amphibian movement are low in magnitude for all three flood scenarios because a measurable change in the abundance of amphibians in the LAA is unlikely, although temporary local shifts in distributions might occur. The residual effect is likely to extend into the LAA, but both flood operations and residual effects on amphibian movement would be short-term in duration and irregular in frequency. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. For post-flood, timing is not applicable because effects from Project activities would be similar regardless of season or other timing characteristics.

Elk

Elk and other ungulates travelling through the LAA north of the Elbow River might have their movement temporarily hindered by the flooded diversion channel or off-stream reservoir. Field observations documented elk moving through the field where the diversion channel is proposed.

During a design flood, the extent of reservoir filling (730 ha) would be within 800 m of the TransCanada Highway (see Figure 11-1). The combination of obstruction in movement from the flooded off-stream reservoir and avoidance associated with highway traffic (Gagnon et al. 2007; Montgomery et al. 2013) might temporarily limit east-west ungulate movement through the LAA north of the Elbow River. Flood water impoundment would be temporary, and the effect of the flooded off-stream reservoir to elk movement in the LAA would diminish as the reservoir drains into the Elbow River following a flood. Although elk are more likely to travel around waterbodies rather than swim across, elk (as well as most other medium and large mammals potentially occurring in the RAA) are capable of swimming across small and medium sized waterbodies and watercourses. Therefore, the potential barrier created by the flooded diversion channel and off-stream reservoir might be permeable.

Wildlife movement in the PDA might be hindered during flood operations upstream of the diversion structure; however, the diversion of flood water into the off-stream reservoir would likely maintain ungulate movement potential along the Elbow River floodplain downstream of the diversion structure at baseline levels.

Sensory disturbance associated with post-flood operations might affect elk movement through the LAA. Repairing and revegetating major components of the Project (e.g., off-stream dam, floodplain berm, diversion channel) might require the use of heavy equipment. However, maintenance activities would be localized and temporary after flood water has been drained from the off-stream reservoir. While post-flood operations are performed, sensory disturbance

would be intermittent with periods of low or no activity (e.g., at night), which might reduce the effect of sensory barriers to wildlife movement through the LAA.

Overall, the residual effects of flood and post-flood operations to ungulate movement are moderate in magnitude during a design flood because a measurable change in the abundance and distribution of ungulates in the LAA is possible, but a measurable change in the abundance of ungulates in the RAA is unlikely. The residual effect would be short-term in duration and irregular in frequency. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. For post-flood, timing is not applicable because effects from Project activities would be similar regardless of season or other timing characteristics.

The extent of reservoir filling during a 1:100 year flood would be smaller than a design flood, reaching just north of Springbank Road (500 ha; see Figure 11-1). The off-stream reservoir would take less than 42 days to drain. While the off-stream reservoir itself is predicted to hinder elk movement, the deflection required by individuals travelling east-west to circumvent the off-stream reservoir is considerably less than in a design flood and would have a reduced effect on movement in the LAA and RAA. Post-flood maintenance activities would be expected to have similar residual effects as design flood. Overall, the residual effects of flood and post-flood operations to ungulate movement are low in magnitude for a 1:100 year flood because a measurable change in the abundance of ungulates in the LAA is unlikely, although temporary local shifts in distributions might occur. The residual effect would be short-term in duration and irregular in frequency.

During a 1:10 year flood, effects of flood operations on wildlife movement through the LAA would be much smaller than a design flood and 1:100 year flood because of a reduction in the extent of the flooded area (60 ha; see Figure 11-1). Post-flood maintenance activities would be expected to have limited residual effects compared with design flood and the 1:100 year flood. Residual effects of flood and post-flood operations to ungulate movement are low in magnitude for a 1:10 year flood because a measurable change in the abundance of ungulates in the LAA is unlikely, although temporary local shifts in distributions might occur. The residual effect would be short-term in duration and irregular in frequency. Similar to the design flood, timing for flood operations is seasonal because a flood event is limited to the spring and summer months. For post-flood, timing is not applicable because effects from Project activities would be similar regardless of season or other timing characteristics.

Grizzly Bear

Based on existing information and field data, the diversion structure and floodplain berm proposed along the Elbow River are more likely to affect grizzly bear movement than the diversion channel and off-stream dam since grizzly bears are likely to travel along the Elbow River (see Volume 3A, Section 11.4.3.3). Therefore, floods are less likely to hinder grizzly bear

movement in the upland portions of the LAA. However, grizzly bears might still travel where the off-stream reservoir is proposed and in this case, floods could change daily movement. During a design flood, the extent of reservoir filling (730 ha) would approach the TransCanada Highway (within 800 m; see Figure 11-1). As with elk, the combination of obstruction in movement from the flooded off-stream reservoir and avoidance associated with highway traffic (Gibeau et al. 2002; Northrup et al. 2012) might temporarily limit east-west grizzly bear movement through the LAA north of the Elbow River.

The diversion of flood water into the off-stream reservoir would likely maintain grizzly bear movement potential along the Elbow River floodplain downstream of the diversion structure at baseline levels.

Depending on the timing of a design flood, sensory disturbance associated with post-flood operations might affect grizzly bear movement through the LAA in the spring, based on the presence of preferred habitat in the off-stream reservoir. Maintenance activities at the diversion structure and floodplain berm are more likely to result in potential sensory disturbance because grizzly bears are more likely to be travelling along the Elbow River. Maintenance activities would be temporary after flood water contained behind the floodplain berm draws down. Sensory disturbance would be intermittent with periods of low or no activity (e.g., at night), which might reduce the effect of sensory barriers to grizzly bear movement along the Elbow River floodplain.

Overall, the residual effects of floods on grizzly bear movement are low in magnitude during a design flood because a measurable change in the abundance of grizzly bears in the LAA is unlikely, although temporary local shifts in distributions might occur. The residual effect would be short-term in duration and irregular in frequency. YTiming for flood operations is seasonal because a flood event is limited to the spring and summer months. For post-flood, timing is not applicable because effects from Project activities would be similar regardless of season or other timing characteristics.

The extent of reservoir filling during 1:100 year and 1:10 year floods is smaller than a design flood (see Figure 11-1). For the 1;100 year and 1:10 year floods, the off-stream reservoir would take less than 42 days to drain. Post-flood maintenance activities would be expected to have limited residual effects compared with design flood since it is expected that little to no maintenance activities would be required at the floodplain berm near the Elbow River (i.e., where grizzly bears are more likely to travel).Residual effects on grizzly bear movement during flood and post-flood operations for 1:100 year and 1:10 year floods are low in magnitude because a measurable change in the abundance of grizzly bears in the LAA is unlikely, although temporary local shifts in distributions might occur. The residual effect would be short-term in duration and irregular in frequency. Similar to the design flood, timing for flood operations is seasonal because a flood is limited to the spring and summer months. For post-flood, timing is not applicable as effects from Project activities would be similar regardless of season or other timing characteristics.

11.3.4 Change in Mortality Risk

11.3.4.1 Project Pathways

Flood and post-flood operations have the potential to result in increased mortality risk for wildlife in the PDA. Direct wildlife mortalities could result from destruction or abandonment of wildlife residences (e.g., nests), drowning in diverted flood water, and animal-vehicle collisions. Mortality risk would vary depending on the magnitude of the flood and water depths.

Through the Project-specific Indigenous Engagement program, Tsuut'ina Nation expressed concerns that use of the dam would likely result in the loss of migratory bird nests. Reservoir filling during flood operations is likely to increase nest failure of migratory and non-migratory birds in the flooded area through nest destruction or abandonment (Sidle et al. 1992; Ellis et al. 2009; Anteau et al. 2012). Reservoir filling has been shown to confine birds to smaller, less suitable nesting territories, which reduces nesting success (Fleshman and Kaufman 1984). Migratory bird species that nest on or near the ground (e.g., savannah sparrow [*Passerculus sandwichensis*] and western meadowlark [*Sturnella neglecta*]) would be most vulnerable.

Amphibians potentially occurring in the LAA, including northern leopard frog, normally breed in warm, shallow waterbodies without predatory fish (Merrell and Rodell 1968; Egan and Paton 2004; COSEWIC 2009). Inundation of amphibian breeding ponds with cold water from the Elbow River might increase development time and reduce survivorship of egg masses and larvae (Marian and Pandian 1985; Germaine and Hays 2007; Wheeler et al. 2015). Flood water diverted into the off-stream reservoir would likely also contain predatory fish species, which might result in direct mortality of amphibian eggs and larvae (Vredenburg 2004; Smith and Keinath 2007). Although flood waters can create some amphibian habitat along the shoreline, it can act as an ecological trap, in which filling the off-stream reservoir would be temporary, and as the water drains, might expose amphibians to desiccation and predation, thereby increasing mortality risk (Gyug 1999; Wassens et al. 2008).

Filling the diversion channel and reservoir could lead to mortality of mammal species. Wuczyński and Jakubiec (2013) found that mortality of mammals following a flood disproportionately affected small and young mammals, presumably because they are less able to escape flood waters. Of the species they studied, red deer (*Cervus elaphus*; closely related to elk) suffered the lowest mortality relative to estimated abundance. Drownings of ungulates, including elk, and of grizzly bear have been documented in diversion and irrigation canals (e.g., Rautenstrauch and Krausman 1989; BC Hydro 2013; USGS 2017). However, in these cases, all canals were concrete-lined structures, which trapped animals within them. In contrast, the diversion channel would have gradually sloped, vegetated sides, which would facilitate escape.

Although diversion of flood waters might increase mortality risk for wildlife within the off-stream reservoir, it might decrease mortality risk for wildlife in the Elbow River floodplain downstream of the diversion structure where flood levels would be reduced.

Post-flood operations might require equipment to travel over potential migratory songbird nesting habitat (e.g., vegetated off-stream dam and floodplain berm) during the Primary Nesting Period (PNP) (ECCC 2016), or through amphibian habitat created during a flood (e.g., pools of water left behind in the off-stream reservoir after draining) where there might be amphibians residing or stranded in these areas. These activities might increase mortality risk for nesting birds and amphibians in the PDA. Road closures (e.g., Springbank Road) due to floods would divert traffic to other areas of the RAA, altering traffic patterns, but increased vehicle use during post-flood maintenance (e.g., maintenance crews bringing in heavy equipment) would increase the risk of animal-vehicle collisions (Dodd et al. 2006; Ament et al. 2008; Garrah et al. 2015). Dead fish or other animals deposited in the previously flooded area of the off-stream reservoir might attract scavenger species and create potential for human-wildlife conflicts during post-flood maintenance. These conditions could result in the destruction of nuisance animals, particularly bears and other carnivores.

11.3.4.2 Mitigation

Flood and post-flood operations have the potential to increase mortality risk for wildlife in the PDA. Although some Project-related mortality risks cannot be mitigated (e.g., nest and burrow destruction due to reservoir filling), others might be reduced through appropriate mitigation; for example:

- The diversion channel will be built with 3H:1V side slopes, which is within the range that most large mammals (e.g., elk,) are known to traverse (McCorquodale 2003; Frair et al. 2005; Mao et al. 2005; The Bow Corridor Ecosystem Advisory Group 2012).
- The side slopes and bottom of the diversion channel will be vegetated, which would provide a more conducive material to help facilitate wildlife escape from rising flood waters or when swimming across the channel.
- Restrict all post-flood maintenance activities to the approved project footprint and reduce the area of disturbance during operations. All maintenance traffic will adhere to safety and road closure regulations.
- If post-flood maintenance in the off-stream reservoir occurs more than seven days following reservoir draining, and during the RAP for nesting migratory birds and raptors, nest searches will be conducted by qualified wildlife biologists to reduce potential mortality risk to birds attempting to nest in the area.

- If an active nest or den is found, it will be subject to a provincial or federal disturbance setback buffer and site-specific mitigation (see Volume 3A, Table 11-10 and Table 11-11).
- Do not harass or feed wildlife. Store waste in wildlife-proof containers and provide wildlife awareness training to all staff on site.
- Report sightings of project-specific species of interest to the Environmental Inspector(s) or designate. Protection measures might be implemented and the sighting will be recorded.
- If previously unidentified listed or sensitive wildlife species or their site-specific habitat (e.g., dens, nests) are identified during maintenance operations, report to the Environmental Inspector(s) or designate.
- Unanticipated wildlife issues encountered during flood and post-flood operations will be discussed and resolved by the Environmental Inspector(s) or designate, Wildlife Resource Specialist(s), and the responsible regulatory agencies, if necessary.

11.3.4.3 Project Residual Effect

During flood and post-flood operations (i.e., draining the off-stream reservoir), direct mortality risk to wildlife (including key indicators) would be greater than during post-flood maintenance activities. This is largely because of increased drowning hazards. Direct mortality risk to wildlife during maintenance activities would be minimal because human interaction with wildlife species would be limited to permanent access roads and major components of the Project, and mitigation such as nest searches and setback distances would be implemented within the off-stream reservoir.

The residual effects of Project-related change to wildlife mortality risk are characterized below for each key indicator and related species. Effect pathways are the same for each flood scenario; however, the effect characterization differs depending on the magnitude of the flood.

Olive-sided Flycatcher

Olive-sided flycatchers generally nest in the branches of conifer trees. Because very little suitable olive-sided flycatcher nesting habitat exists within the off-stream reservoir, the risk of direct mortality due to nest flooding during a design flood is low. Some flooding might occur on the upstream side of the floodplain berm where coniferous trees exist (see Section 11.3.2; Figure 11-1). Olive-sided flycatchers can nest between 1.5 m to 34 m above ground (Altman and Sallabanks 2012), with 52% of nests observed between 6 m and 12 m in British Columbia (Campbell et al. 1997). Nests located high enough above flood waters are unlikely to be destroyed during flood operations at design flood. No flooding is expected to occur on the upstream side of the floodplain berm during a 1:100 year flood or 1:10 year flood.

Depending on the timing of nesting and floods, sensory disturbance during post-flood operation maintenance can lead to nest abandonment. However, disturbance would be limited for olive-sided flycatchers because the only structures that might require maintenance and are near high and moderate suitability habitat are the diversion structure and floodplain berm, if affected during a design flood. With mitigation, changes in mortality risk would be reduced. Changes to olive-sided flycatcher mortality risk in the LAA during post-flood operations for the 1:100 year and 1:10 year floods include the same pathways as during design flood. However, the effect would be reduced in each flood because lower volumes of diverted flood water would require less post-flood maintenance.

For the design flood, the change in mortality risk to olive-sided flycatcher is low in magnitude because a measurable change in the abundance of olive-sided flycatcher and other forest migratory birds in the LAA is unlikely, although temporary local shifts in distributions might occur (Table 11-7). Residual effects are expected to be short term and irregular in frequency, and limited to the PDA. For the 1:100 year and 1:10 year floods, the change in mortality risk would be negligible in magnitude because no measurable change in olive-sided flycatcher and forest migratory bird abundance and distribution would be observed because no suitable breeding habitat would be affected. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. The criteria of timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect mortality risk during the breeding season, but also might occur during a restricted activity period.

Sprague's Pipit

Low suitability Sprague's pipit breeding habitat exists within the off-stream reservoir at baseline conditions, and there were no observations of Sprague's pipit during field surveys. As such, it is unlikely that reservoir filling during a design flood would increase mortality risk for Sprague's pipit, although reservoir filling would temporarily increase mortality risk for other ground-nesting migratory birds in the LAA (e.g., savannah sparrow, western meadowlark, and Le Conte's sparrow [*Ammodramus leconteii*]). Most migratory and non-migratory birds were observed in mixed forest, which mainly occurs along the Elbow River in the LAA. Diversion of flood waters would reduce mortality risk to migratory birds in riparian habitats along the Elbow River floodplain downstream of the diversion structure. Although fewer birds (i.e., lower density) were observed in grassland habitat compared to forested habitat, grasslands would be one of the most affected habitats during floods. Mortality risk would decrease with the 1:100 year and 1:10 year floods, given their smaller extents of filling.

During post-flood operation maintenance after a design flood, there is potential for increased mortality risk for ground nesting migratory birds because of maintenance activities (e.g., some sediment and debris cleanup) within the off-stream reservoir, which might require the use of heavy equipment. Although the filling of the off-stream reservoir would destroy nests, birds are likely to re-establish nesting after reservoir draining depending on the condition of the

vegetation and timing of the flood (i.e., early or late in the breeding season). With mitigation, changes in mortality risk would be reduced. Changes to Sprague's pipit and other grassland or ground nesting bird mortality risk in the LAA during post-flood operations for the 1:100 year and 1:10 year floods include the same pathways as during a design flood. However, the effect would be reduced in each scenario as lower volumes of diverted flood water would require less post-flood maintenance.

For the design flood and 1:100 year flood, the change in mortality risk to Sprague's pipit is low in magnitude, but moderate for other grassland-dependent birds and limited to the PDA. Residual effects are expected to be short term and irregular in frequency. For the 1:10 year flood, the change in mortality risk would be negligible for Sprague's pipit, but low for other grassland birds because only 1.1% of grassland habitat in the LAA would be temporarily inundated (see Table 11-5). Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect mortality risk during the breeding season, but also might occur during a restricted activity period.

Northern Leopard Frog

During 2016 field surveys in the LAA, most amphibian breeding wetlands were observed within the off-stream reservoir (see Volume 4, Wildlife and Biodiversity Technical Data Report). High and moderate suitability northern leopard frog breeding habitat is present within the off-stream reservoir. Flood operations are most likely to occur before larvae have undergone metamorphosis and can use terrestrial habitats. Inundation of potential breeding wetlands with floodwater might increase the mortality risk of larval northern leopard frogs and other amphibians. The risk of mortality would be greatest for the design flood given the spatial extent of flooding, but would reduce with decreasing flood magnitude (e.g., 1:100 year and 1:10 year floods). Mortality risk for amphibians in the Elbow River floodplain downstream of the diversion structure would remain near baseline levels because flooding would be less-severe, thereby lowering the potential to sweep away eggs or tadpoles.

There is potential for increased mortality risk for amphibians during post-flood operations (i.e., while draining the off-stream reservoir) because there is potential to ecologically trap amphibians, and because predatory fish are likely to be present. Maintenance activities within the off-stream reservoir might require the use of heavy equipment. Amphibians left in the off-stream reservoir would be exposed to the risk of being run over by heavy equipment, desiccation, or predation by terrestrial predators. Changes to amphibian mortality risk in the LAA during post-flood operations for the 1:100 year and 1:10 year floods include the same pathways as during the design flood; however, the effect would be reduced in each flood because lower volumes of diverted flood water would require less post-flood maintenance. For the design and 1:100 year floods, the change in mortality risk to amphibians is moderate since a measurable change in the abundance and distribution of amphibians in the LAA is possible, but a

measurable change in the abundance of amphibians in the RAA is unlikely. Residual effects would be limited to the PDA, and expected to be short term, and irregular in frequency. For the 1:10 year flood, the change in mortality risk to amphibians would be low. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal because post-flood operations would have greater potential to affect mortality risk during the breeding season.

Elk

Mortality risk is reduced for larger, more mobile animals like elk, that can move away from flooding during flood operations. However, if elk are using the areas where flooding would occur as parturition sites (e.g., dense shrubby habitats), neonatal calves might be more vulnerable because they are less mobile during this period and typically hide in concealment cover to reduce predation risk (Barbknecht et al. 2011). Elk typically give birth to calves from mid-April to the end of June (ACD 2002). It is not known where elk are calving in the LAA, but incidental field observations have shown elk calves to be present within the off-stream reservoir, and remote cameras have shown young-of-the-year white-tailed deer as well. There would be potential for reservoir filling to coincide with the early stages of calves born in the off-stream reservoir. Mortality risk for these individuals might increase if water levels rise very rapidly (e.g., design flood or the 1:100 year flood) and they become entrapped by rising waters. Mortality risk would decrease with the 1:10 year flood because of the reduced extent of the flooded area in the off-stream reservoir.

During post-flood operations when the reservoir is draining, the risk of drowning would still be present if ungulates decide to swim across the diversion channel or off-stream reservoir. However, the likelihood of being entrapped in the diversion channel is low because of the vegetated side slopes. Depending on the magnitude of the flood, post-flood operations would potentially result in a small increase in risk of animal-vehicle collisions for elk and other ungulates, because of the additional road use by maintenance crews and transportation of heavy equipment in the LAA and RAA to and from the PDA. After maintenance is completed, traffic volumes would return to baseline.

For the design and 1:100 year floods, residual effects on mortality risk for elk and other ungulates during flood and post-flood operations are low in magnitude because a measurable change in the abundance of ungulates in the LAA is unlikely, although temporary local shifts in distributions might occur. Residual effects would be limited mostly to the PDA during flood operations, but would extend into the RAA during post-flood maintenance. Residual effects would be short term and irregular in frequency. Residual effects on elk and other ungulates, for the 1:10 year flood, would be negligible. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect mortality risk during the winter season, but also might occur during a restricted activity period (e.g., KWBZ).

Grizzly Bear

Changes to grizzly bear mortality risk in the LAA during floods would include the same pathways as elk where young-of-the-year might have difficulty avoiding rising water levels (e.g., grizzly bear and black bear cubs were observed via remote cameras on the banks of the Elbow River). For these bears, there would be a risk of drowning while attempting to swim. During post-flood operations, maintenance activities might potentially result in a small increase in mortality risk due to a rise in traffic volume in the LAA and RAA for maintenance crews to travel to and from the Project area, thereby increasing the risk of animal-vehicle collisions. However, mortality risk for grizzly bears during flood and post-flood operations would be relatively lower compared with elk due to the smaller likelihood of grizzly bears travelling through the LAA north of the Elbow River compared to moving along the river.

The effect would be reduced for lesser-magnitude flood scenarios as lower volumes of diverted flood water would reduce the extent of off-stream reservoir filling and require less post-flood maintenance.

Residual effects on mortality risk for grizzly bears during flood and post-flood operations for the design and 1:100 year floods would be low in magnitude because a measurable change in the abundance of grizzly bears in the LAA would be unlikely, although temporary local shifts in distributions might occur. Residual effects would be limited mostly to the PDA during flood operations, but would extend into the RAA during post-flood maintenance. Residual effects would be short term, and irregular in frequency. Residual effects for the 1:10 year flood would be negligible. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal because post-flood operations would have greater potential to affect mortality risk during the non-hibernating activity period.

11.3.5 Change in Biodiversity

11.3.5.1 Project Pathways

Floods have the potential to change species and community, diversity through soil saturation and sediment deposition, which can affect vegetation composition and distribution (i.e., wildlife habitat), and plant and wildlife species diversity. Intermediate levels and frequencies of disturbance events, such as floods, typically result in higher levels of biodiversity (Ward et al. 1999; Biswas and Mallik 2010). For example, higher levels of biodiversity in floodplain river ecosystems result from a diverse mosaic of riparian habitat with different age structures (Naiman et al. 1993; Ward et al. 1999; Beechie et al. 2006). However, flooding for the Project would occur infrequently and in upland habitat, with vegetation that is typically not adapted to flooding. Vegetation productivity would likely be constrained for inundated upland vegetation (Kozlowski 1997; Mollard et al. 2008; Azizi et al. 2016), and recovery times would potentially be slower

compared to flood-tolerant vegetation (Barrat-Segretain et al. 1999). These changes could potentially affect species and community diversity.

Indirect effects of the Project on biodiversity in the Elbow River floodplain downstream of the diversion structure would reduce the extent of flooding from extreme events, such as the design flood and 1:100 year flood, that would likely to be destructive and would temporarily reduce biodiversity along the Elbow River (Beechie et al. 2006). Diversion of these flood waters into the off-stream reservoir would be beneficial for biodiversity downstream. However, the 1:10 year flood is a more common event that could be relied upon for biotic diversity to persist (Bayley 1995).

11.3.5.2 Mitigation

Project-specific mitigation measures recommended for change in habitat (Sections 10.2 and 11.3.2), change in movement (Section 11.3.3) and change in mortality risk (Section 11.3.4) will work together to reduce effects on biodiversity. As such, there are no additional mitigation measures recommended to reduce potential Project effects on biodiversity during floods.

11.3.5.3 Project Residual Effects

Flooding of the off-stream reservoir is not expected to fragment the landscape because floods are temporary. Flooding and post-flood sediment, however, is predicted to modify certain upland and wetland communities to modified grassland ecosites with similar soil moisture and nutrient regimes. See Sections 10.2.2 and 10.2.3 for details on changes to vegetation community and plant species diversity, respectively.

Some mortality of birds and amphibians residing in the reservoir during floods is certain and likely to temporarily reduce relative abundance in the LAA; however, species richness would likely be unaffected. Land unit types most affected by floods (flood water and sediment left behind) during the design flood include native grasslands, shrublands, tame pasture, and wetlands (see Section 11.3.2.3). Shrubland and native grassland habitats in the LAA have lower bird species richness and relative abundance compared to treed habitat types (Volume 4, Appendix H, Wildlife and Biodiversity Technical Data Report). Tame pasture can be used by wildlife, but bird species richness and relative abundance is even lower compared to shrubland and native grassland (Volume 4, Appendix H, Wildlife and Biodiversity Technical Data Report). Based on area, most flooding and sedimentation during the design flood would be on tame pasture, habitat that supports fewer bird species and individuals. For amphibians, it is anticipated that up to 3.9% (11.7 ha) of wetlands in the LAA would be lost to sedimentation (see Section 11.3.2.3). Within the context of the RAA, floods would affect less than 3% of available habitats that would be flooded in the reservoir.

Overall, residual effects on biodiversity are negligible for all three flood scenarios because measurable changes in plant (upland and wetland) communities are not expected to affect the sustainability of community and species diversity in the LAA or RAA, and because there would be no effects on rare ecological communities (Table 11-7). Except for some loss of wetlands, most residual effects on biodiversity would be short-term and irregular. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing is not applicable for post-flood operations because effects from Project activities would be similar regardless of season or other timing characteristics.

11.3.6 Change in Wildlife Health

11.3.6.1 Project Pathways

Floods have the potential to result in changes to wildlife health. Methylmercury occurs naturally in aquatic environments where microbes convert (methylate) mercury into this organic substance. This process occurs, for example, in natural wetlands (Holmes and Lean 2006; Hall et al. 2008). Although methylmercury occurs naturally, high levels can be toxic to wildlife.

Filling the off-stream reservoir with water would initiate the process of mercury methylation; however, accumulation of methylmercury in aquatic environments to levels that are hazardous can take many years and depends on several factors (e.g., net methylation rates, sources of mercury, and sources of organic matter for microbial activity) (Hecky et al. 1991; Ullrich et al. 2001). Large, permanent reservoirs and dams are known for having elevated concentrations of methylmercury because of increased conversion rates (Hecky et al. 1991; Mailman et al. 2006). Elevated levels of methylmercury combined with bioaccumulation can lead to higher health hazards for wildlife (Scheuhammer et al. 2007; Edmonds et al. 2012; Hall et al. 2014), especially piscivorous (fish-eating) species (Scheuhammer et al. 2007; Hall et al. 2014). For more detailed information regarding methylmercury production in reservoirs, see Section 7.

Floods can transport pathogens and contaminants from one area to another (Hilscherova et al. 2007; Harmon and Wyatt 2008). Therefore, flood operations can potentially deposit contaminated sediments into the off-stream reservoir, and draining of the reservoir would leave the deposited sediment behind. The risk of sediment becoming airborne through wind erosion could be present.

11.3.6.2 Mitigation

Flood operations have the potential to affect wildlife health through methylmercury production and transport of pathogens and contaminants. Mitigation to reduce these effects are described below:

- The off-stream reservoir will be seeded only if there are dust issues.
- If revegetation is not successful, a tackifier or sprayable erosion control product will be applied within the off-stream reservoir to reduce wind erosion (Section 9).

11.3.6.3 Project Residual Effects

Based on the surface water quality assessment (Section 7), the overall rate of methylmercury production (net methylation) during floods is expected to be low given the short water retention time (between 62 and 85 days) and characteristics of water from the Elbow River (cold, well oxygenated, neutral pH [pH = 7]). These conditions are not optimal for anaerobic microbial activity for methylation. Because methylmercury concentrations are not expected to exceed guidelines, no toxicological effects on aquatic and terrestrial wildlife are anticipated.

During post-flood operations, deposited sediment in the reservoir would reflect natural background chemistry in the watershed; therefore, the quality of the sediment would not be toxic (see Section 7). Results of the hydrology assessment (Section 6) indicate that most sediment deposited in the reservoir would be coarse material (i.e., silt/very fine sand and medium sand sized material), not fine particulate matter (i.e., clay and fine silt) that is more susceptible to wind erosion. To further mitigate soil erosion due to wind, areas of sediment deposition where wind erosion might be an issue would be hydroseeded with native plant species. AEP would develop an operation and maintenance plan for the reservoir that would include sediment stabilization and debris removal. However, revegetation success is not certain, given the initial high moisture contents of the soil (see Section 9) and reduced energy inputs for plants in the fall. If revegetation is not successful, newly added sediment would be sprayed with a biodegradable tackifier.

Overall, residual effects on wildlife health are negligible in magnitude; therefore, all other characterizations are not assessed. Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing is not applicable for post-flood operations because effects from Project activities would be similar regardless of season or other timing characteristics.

11.3.7 Summary of Project Residual Effects

The residual effects characterized in Table 11-7 are based on criteria described in Volume 3A, Table 11-5. All changes are relative to baseline levels. Changes in magnitude for habitat, movement, and mortality risk, and changes in geographic extent for mortality risk vary with key indicators.

Table 11-7 Project Residual Effects on Wildlife and Biodiversity during Flood and Post-Flood Operations

Residual Effect	Residual Effects Characterization								
	Project Phase	Timing	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in habitat	F	S	A	N-H	LAA	ST	IR	R	D
	PF	S/R	A	N-M	LAA	ST	IR	R	D
Change in movement	F	S	A	N-M	LAA	ST	IR	R	D
	PF	N/A	A	L-M	LAA	ST	IR	R	D
Change in mortality risk	F	S	A	N-M	PDA	ST	IR	R	D
	PF	S/R	A	N-M	RAA	ST	IR	R	D
Change in biodiversity	F	S	A	N	N/A	N/A	N/A	N/A	N/A
	PF	N/A	A	N	N/A	N/A	N/A	N/A	N/A
Change in wildlife health	F	S	A	N	N/A	N/A	N/A	N/A	N/A
	PF	N/A	A	N	N/A	N/A	N/A	N/A	N/A

KEY

See Table 11-5 in Volume 3A for detailed definitions

Project Phase
F: Flood Operation
PF: Post-flood Operation

Timing Consideration
T: Time of day
S: Seasonality
R: Regulatory

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
LT: Long-term

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological and Socio-Economic Context:
D: Disturbed
U: Undisturbed

N/A: Not applicable

11.3.8 Additional Assessments

11.3.8.1 Sora

Change in Habitat

Flood operations would temporarily render wetland habitat inaccessible in the flooded area (up to 45 days [Table 11-1]) for sora, thus reducing habitat suitability. During post-flood operations, potential direct effects on sora habitat include left over sediment covering wetlands and reducing habitat suitability. Sensory disturbance caused by maintenance equipment might contribute to temporary indirect effects on sora (i.e., habitat avoidance or displacement).

The additional time for vegetation, and thus habitat, to return to baseline conditions (i.e., dry operations) following a flood would depend on the magnitude of the flood. The flood tolerance of plants varies with species and age, frequency and duration of floods, water quality, and site characteristics (Kozlowski 1997; Casanova and Brock 2000). Wetlands in the off-stream reservoir are likely to tolerate floods (Casanova and Brock 2000, and see Volume 3B, Section 10.2.3) compared to upland vegetation that is not adapted to prolonged flooding (van Eck et al. 2004).

If sediment partial cleanup and debris removal in the off-stream reservoir occurs more than seven days following reservoir draining, and during the RAP for nesting migratory birds, as mitigation, nest searches would be conducted by qualified wildlife biologists. If an active nest is found, it would be subject to a provincial or federal disturbance setback buffer and site-specific mitigation (see Volume 3A, Table 11-10 and Table 11-11). If an active sora nest is found, it would be subject to a provincial disturbance setback buffer of 100 m (SRD 2011).

The reservoir created during a design flood would result in a temporary reduction of 28.5 ha (28.3%) of high suitability sora breeding habitat and 40.2 ha (85.9%) of moderate suitability habitat (Table 11-8). During a 1:100 year flood, the extent of reservoir filling would be less, which would decrease the amount of high and moderate suitability habitat affected to 18% and 76% respectively (Table 11-8). No high suitability habitat would be affected during a 1:10 year flood; however, a very small amount (0.1ha) of moderate habitat would be temporarily affected (Table 11-8).

Although wetland vegetation is more tolerant to flooding, wetlands with sediment greater than 10 cm in depth left behind in the reservoir after draining would be altered. During a design flood, 3.9% (11.7 ha) of wetlands in the LAA (Section 10, Table 10-11), or 1.2% of wetlands in the RAA (973 ha available at baseline), would be altered during post-flood operations.

Table 11-8 Change in Habitat for Sora in the LAA

Key Indicators	Habitat Suitability Rating	Baseline	Design Flood	1:100 Year Flood	1:10 Year Flood	Change from Baseline					
						Design Flood		1:100 Year Flood		1:10 Year Flood	
		ha	ha	ha	ha	ha	%	ha	%	ha	%
Sora	High	100.8	72.3	82.6	100.8	-28.5	-28.3	-18.2	-18.1	0.0	0.0
	Moderate	46.8	6.6	11.3	46.7	-40.2	-85.9	-35.5	-75.9	-0.1	-0.3
	Low	337.0	973.8	739.0	343.7	636.7	188.9	402.0	119.3	6.7	2.0
	Very Low to Nil	4375.2	3807.2	4027.0	4368.7	-568.0	-13.0	-348.2	-8.0	-6.5	-0.1

Overall, the magnitude of the residual effect on sora breeding habitat is high for the design flood and 1:100 year flood because more than 10% of high and moderate habitat suitability in the LAA would be affected (Table 11-8). Residual effects during post-flood operations would be moderate because a measurable change in the abundance and distribution of sora in the LAA is possible, but a measurable change in the abundance of sora in the RAA is unlikely. In contrast, the magnitude of the residual effect during 1:10 year flood and post-flood operations is low because no high and very little moderate habitat suitability in the LAA would be affected.

Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect sora habitat during the breeding season, but also might occur during a restricted activity period.

Change in Movement

Flood operations are not likely to restrict the movement of birds, but might temporarily attract waterbirds because they might perceive the area as a waterbody that has potential to provide feeding habitat (Roshier et al. 2002; Elphick and Oring 2003; King et al. 2010). Due to deeper waters and openness of the habitat (i.e., no established emergent vegetation), the flooded reservoir during a design or 1:100 year flood is more likely to attract waterfowl and wading birds, whereas marsh birds like sora prefer shallow water and are less likely to be attracted to the flooded reservoir. Effects on bird movement would diminish to baseline as the water in the off-stream reservoir recedes. The 1:10 year flood would create a smaller waterbody; therefore, it is likely that fewer waterbirds would be attracted to the reservoir and reduce any potential changes in movement for those species during this flood magnitude. The residual effects on sora movement would also be reduced during a smaller flood event.

For all modelled floods, the magnitude of the residual effect for marsh birds is low because a measurable change in the abundance of marsh birds in the LAA is unlikely, although temporary local shifts in distributions might occur. The effects are also expected to be short-term and irregular in occurrence because changes in the movement of these species in the LAA would be limited to filling of the off-stream reservoir (estimated to last up to three days) and during drainage following a design flood (approximately 42 days or fewer for smaller floods).

Timing is not applicable for flood and post-flood operations because effects from Project activities would be similar regardless of season or other timing characteristics.

Change in Mortality Risk

Through the Project-specific Indigenous Engagement program, Tsuut'ina Nation expressed concerns that use of the dam would likely result in the loss of migratory bird nests. Reservoir filling during flood operations is likely to increase nest failure of migratory birds in the flooded area through nest destruction or abandonment (Sidle et al. 1992; Ellis et al. 2009; Anteau et al. 2012;

Robertson 2012). Reservoir filling has been shown to confine birds to smaller, less suitable nesting territories, which reduces nesting success (Fleshman and Kaufman 1984). The eggs and young of migratory bird species that nest on or near the ground such as sora, would be most vulnerable to drowning. Mortality risk would vary depending on the magnitude of the flood (i.e., how much area is covered by water). Due to the temporal timeframe of flood events (i.e., infrequent with a short duration), there are no potential pathways for flood and post-flood operations to change predator/prey relationships that may affect sora or other marsh bird populations.

Post-flood operations might require equipment to travel over potential nesting habitat during the PNP (ECCC 2016). These activities might increase mortality risk for nesting sora in the PDA. If post-flood maintenance in the off-stream reservoir occurs more than seven days following reservoir draining, and during the RAP for nesting migratory birds, mitigation as nest searches would be conducted by qualified wildlife biologists to reduce potential mortality risk to birds attempting to nest in the area. If an active nest or den is found, it would be subject to a provincial or federal disturbance setback buffer and site-specific mitigation (see Volume 3A, Table 11-10 and Table 11-11). If an active sora nest is found, it would be subject to a provincial disturbance setback buffer of 100 m (SRD 2011).

The risk of direct mortality due to nest flooding during a design flood is high for marsh birds due to near ground nest placement. Flood operations during the design flood would temporarily affect 23.7% (70.3 ha) of wetland habitat in the LAA (Table 11-5), with 28.3% (28.5 ha) of high suitability sora breeding habitat and 85.9% (40.2 ha) of moderate suitability habitat being affected (Table 11.3-3). Mortality risk would decrease with the 1:100 year and 1:10 year floods, based on smaller extents of reservoir filling.

Depending on the timing of nesting and floods, sensory disturbance during post-flood operation maintenance can lead to nest abandonment. During post-flood operation maintenance after a design flood, there is potential for increased mortality risk for marsh birds because of maintenance activities (e.g., some sediment and debris cleanup) within the off-stream reservoir, which might require the use of heavy equipment. Although the partial flooding of the off-stream reservoir would destroy nests, birds are likely to re-establish nesting after reservoir draining, depending on the condition of the vegetation and timing of the flood (i.e., early or late in the breeding season). Changes to marsh bird mortality risk in the LAA during post-flood operations for the 1:100 year and 1:10 year floods include the same pathways as during design flood. However, the effect would be less for each flood because lower volumes of diverted flood water would require less post-flood maintenance. With mitigation, changes in mortality risk would be reduced during post-flood operations (see Section 11.3.4.2, this volume).

For the design flood and 1:100 year flood, the change in mortality risk to marsh birds such as sora is moderate in magnitude and limited to the PDA. Residual effects are expected to be short term and irregular in occurrence. For the 1:10 year flood, the change in mortality risk would be low. With mitigation (see Section 11.4.3.2, this volume), the magnitude of the residual effect on

bird mortality risk during post-flood operations (i.e., maintenance and partial sediment clean-up) is low.

Timing for flood operations is seasonal because a flood is limited to the spring and summer months. Timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect mortality risk during the breeding season, but also might occur during a restricted activity period.

Change in Health

Floods have the potential to result in changes to water quality and marsh bird health. Methylmercury occurs naturally in aquatic environments where microbes convert (methylate) mercury into this organic substance. Elevated levels of methylmercury combined with bioaccumulation can lead to higher health hazards for aquatic birds, especially those that are piscivorous (Scheuhammer et al. 2007; Edmonds et al. 2012; Hall et al. 2014). Floods can also transport pathogens and contaminants from one area to another (Hilscherova et al. 2007; Harmon and Wyatt 2008). Therefore, flood operations can potentially deposit contaminated sediments into the off-stream reservoir; draining of the reservoir would leave deposited sediment behind, thus increasing the risk of exposure to contaminants.

Based on the surface water quality assessment (Section 7.4.4), the overall rate of methylmercury production (net methylation) during floods is expected to be low given the short water retention time and characteristics of water from the Elbow River (cold, well oxygenated, neutral pH [pH = 7]). These conditions are not optimal for anaerobic microbial activity for methylation. Because methylmercury concentrations are not expected to exceed guidelines, no toxicological effects on marsh birds are anticipated.

Results of the hydrology assessment (Section 6.4) indicate that most sediment deposited in the reservoir would be coarse material (i.e., silt/very fine sand and medium sand sized material), not fine particulate matter (i.e., clay and fine silt) that is more susceptible to wind erosion. To further mitigate soil erosion due to wind, areas of sediment deposition where wind erosion might be an issue would be hydroseeded with native plant species. AEP would develop an operation and maintenance plan for the reservoir that would include sediment stabilization and debris removal. However, re-vegetation success is not certain, given the initial high moisture contents of the soil (see Section 9) and reduced energy inputs in the fall for plants. If revegetation is not successful, newly added sediment would be sprayed with a biodegradable tackifier.

Overall, residual effects on migratory bird health are negligible in magnitude. Timing for flood operations is seasonal because a flood event is limited to the spring and summer months.

Timing is not applicable for post-flood operations because effects from Project activities would be similar regardless of season or other timing characteristics.

Summary or Project Residual Effects on Sora

The residual effects characterized in Table 11-9 are based on criteria described in Volume 3A, Table 11-5. All changes are relative to baseline levels for a design flood.

Table 11-9 Project Residual Effects on Sora during Flood and Post-Flood Operations

Residual Effect	Residual Effects Characterization								
	Project Phase	Timing	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in habitat	F	S	A	H	LAA	ST	IR	R	D
	PF	S/R	A	M	LAA	ST	IR	R	D
Change in movement	F	N/A	A	L	LAA	ST	IR	R	D
	PF	N/A	A	L	LAA	ST	IR	R	D
Change in mortality risk	F	S	A	M	PDA	ST	IR	R	D
	PF	S/R	A	L	PDA	ST	IR	R	D
Change in wildlife health	F	S	A	N	N/A	N/A	N/A	N/A	N/A
	PF	N/A	A	N	N/A	N/A	N/A	N/A	N/A

KEY

See Table 11-5 in Volume 3A for detailed definitions

Project Phase
F: Flood Operation
PF: Post-flood Operation

Timing Consideration
T: Time of day
S: Seasonality
R: Regulatory

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological and Socio-Economic Context:
D: Disturbed
U: Undisturbed

11.3.8.2 Migratory Birds

Although the olive-sided flycatcher and Sprague's pipit were used as key indicators to focus the assessment (see Volume 3A, Section 11.1.2 and Sections 11.3.2-11.3.6 in this volume), the information presented below provides a further assessment of migratory birds and their habitat as well as potential changes in movement, mortality risk, and health during flood and post-flood operations. Because floods typically occur in the spring or summer, the assessment focuses on the migratory bird breeding season.

Change in Habitat

Flood operations would temporarily render habitat inaccessible in the flooded area (up to 45 days [Table 11-1]) for migratory and non-migratory bird species that depend on grassland, shrubland, and forested areas (e.g., Sprague's pipit and olive-sided flycatcher), thus reducing habitat suitability. During post-flood operations, potential direct effects on migratory and non-migratory bird habitat are:

- drained reservoir would leave behind sediment covering vegetation and reducing habitat suitability for birds
- revegetation of the diversion channel, off-stream dam, and floodplain berm, which might be damaged or eroded during a flood event

Sensory disturbance caused by maintenance equipment might contribute to temporary indirect effects on migratory and non-migratory birds (i.e., habitat avoidance or displacement).

The additional time for vegetation, and thus habitat, to return to baseline conditions (i.e., dry operations) following a flood would depend on the magnitude of the flood. The flood tolerance of plants varies with species and age, frequency and duration of floods, water quality, and site characteristics (Kozlowski 1997; Casanova and Brock 2000). Wetlands in the off-stream reservoir are likely to tolerate floods (Casanova and Brock 2000, and see Volume 3B, Section 10.2.3); however, upland vegetation and tame pasture in the off-stream reservoir are not adapted to prolonged flooding compared to wetland or floodplain vegetation (van Eck et al. 2004) and are unlikely to survive prolonged flooding (see Section 10.2.3).

Other migratory and non-migratory birds might benefit from floods. For example, draining the off-stream reservoir would create pools of water and soft soil that is attractive to wading birds such as Wilson's snipe (*Gallinago delicata*), which feed on macroinvertebrates (Ausden et al. 2001). In addition, any fish left in the off-stream reservoir after draining might be scavenged by wildlife such as bald eagle (*Haliaeetus leucocephalus*).

During a flood, diversion of flood water to the off-stream reservoir might also limit potential changes in habitat on the Elbow River floodplain downstream of the diversion structure. For example, natural floods of moderate magnitude can help maintain riparian habitat (Bayley 1995; Swanson et al. 1998; Beechie et al. 2006; Biswas and Mallik 2010); however, extreme floods with higher flow rates are more likely to be destructive (Swanson et al. 1998; Beechie et al. 2006).

If sediment partial cleanup and debris removal in the off-stream reservoir occurs more than seven days following reservoir draining, and during the RAP for nesting migratory birds and raptors, as mitigation, nest searches would be conducted by qualified wildlife biologists. If an active nest or den is found, it would be subject to a provincial or federal disturbance setback buffer and site-specific mitigation (see Volume 3A, Section 11, Table 11-10 and Table 11-11).

All native cover types in the LAA provide breeding and foraging habitat for several migratory bird species. Some habitats provide relatively more structural diversity, which can result in higher abundances and/or species richness (see Volume 4, Appendix H, Wildlife and Biodiversity Technical Data Report, Table 3-1). Table 11-10 provides a summary of habitat associations for select migratory and non-migratory bird species, which were used to assess changes in migratory and non-migratory bird habitat.

Table 11-10 Examples of Migratory and Non-Migratory Birds with Potential to Occur in the LAA and their Associated Cover Type

Cover Type	Migratory Birds	Non-migratory Birds[a]
Broadleaf Forest	Baltimore oriole, warbling vireo, ovenbird	Red-tailed hawk, Cooper's hawk, broad-winged hawk
Coniferous Forest	Olive-sided flycatcher, boreal chickadee, ruby-crowned kinglet, yellow-rumped warbler	Great gray owl, northern hawk owl, northern pygmy owl, northern goshawk
Mixed Forest	Least flycatcher, western tanager, white-throated sparrow, rose-breasted grosbeak, Tennessee warbler, yellow bellied-sapsucker	Barred owl, boreal owl, northern saw-whet owl, red-tailed hawk, sharp-shinned hawk
Shrubland	Loggerhead shrike, alder flycatcher, eastern kingbird, mountain bluebird	Red-tailed hawk, Swainson's hawk, sharp-tailed grouse
Native Grassland	Sprague's pipit, Baird's sparrow, savannah sparrow, vesper sparrow	Short-eared owl, golden eagle, Swainson's hawk, northern harrier, prairie falcon, sharp-tailed grouse
Open Water	American wigeon, gadwall, mallard, northern shoveler, northern pintail, green-winged teal, blue-winged teal, cinnamon teal	Osprey, bald eagle, double-crested cormorant
Shallow Open Water		Northern harrier, rough-legged hawk
Ephemeral Waterbody		

Table 11-10 Examples of Migratory and Non-Migratory Birds with Potential to Occur in the LAA and their Associated Cover Type

Cover Type	Migratory Birds	Non-migratory Birds[a]
Graminoid Marsh	Yellow rail, sora, Nelson's sparrow, LeConte's sparrow	
Graminoid Fen		
Shrubby Swamp	Song sparrow, Lincoln's sparrow, swamp sparrow, house wren, alder flycatcher	
Shrubby Fen		
Wooded Mixedwood Swamp		

NOTE:
[a] Non-migratory birds as defined by Article I of the *Migratory Birds Convention Act, 1994*.

Flood Operations

The extent of changes to migratory and non-migratory bird habitat would depend on the flood magnitude (see Table 11-1). The design flood is predicted to cover 816 ha in the reservoir. Flood operations during the design flood would temporarily reduce 26.6% (86.6 ha) of shrubland,26.2% (134.9 ha) of grassland, and 23.7% (70.3 ha) of wetland habitat in the LAA (Table 11-5) for breeding and foraging migratory birds (Table 11-5). These losses of habitat are restricted to the off-stream reservoir.

Some of these migratory birds include loggerhead shrike and eastern kingbird (shrubland), Baird's sparrow and savannah sparrow for (grassland), and song sparrow and house wren (shrubby swamp). In addition, 25.1% (373.1 ha) of tame pasture a component of agricultural land (Table 11-5) but still used by some migratory birds with grassland habitat associations (e.g., vesper sparrow, Savannah sparrow, western meadowlark) would be temporarily unavailable during reservoir filling and draining.

For non-migratory birds, such as golden eagle, red-tailed hawk, and northern harrier, changes to terrestrial habitat (e.g., upland cover types) during construction would be similar as described for migratory birds for each habitat association. Although wetlands are not necessarily used as breeding habitat for raptors, wetlands are an important part of the landscape that can provide potential prey opportunities.

Although these habitats in the LAA would be temporarily unavailable to migratory and non-migratory birds, the RAA provides grassland, shrubland, tame pasture, and wetland habitat in other locations. Overall, the design flood would cover less than 3% of available native grassland (27,916 ha) and tame pasture (9,716 ha), and less than 1% of available wetland habitat (973 ha) in the RAA. Forest habitat in the LAA would be relatively less affected, between 1-3% (Table 11-5). The effect on migratory and non-migratory bird habitat would be less during lower-magnitude floods (Table 11-5).

Overall, the magnitude of the residual effect on migratory and non-migratory bird habitat is moderate during a design flood and 1:100 flood for grassland, shrubland and wetland dependent birds because a measurable change in the abundance and distribution of migratory and non-migratory birds in the LAA is possible, but a measurable change in the abundance of migratory and non-migratory birds in the RAA is unlikely. The magnitude of the residual effect during a design and 1:100 year flood for forest dependent migratory and non-migratory birds would be low to negligible. The magnitude of the residual effect during a 1:10 year flood would be low. Flood operations would be relatively short in duration and irregular in terms of occurrence.

Timing for flood operations is seasonal because a flood is limited to the spring and summer months.

Post-flood Operations

During a design flood, sediment modeling (see Volume 3B, Section 6.4) predicts that 3.7% (192.6 ha in the reservoir) of the LAA would be covered by sediment that is less than 3 cm deep, and 0.8% (37.4 ha) would be covered by sediment between 3 cm and 10 cm deep. The quality of vegetation and wetlands post-flood would differ from baseline conditions; however, changes to overall migratory and non-migratory bird habitat abundance and suitability would be minor under these conditions. Sediment less than 3 cm deep would have little to no effect on vegetation and wetlands, whereas sediment 3-10 cm deep could result in small shifts in plant species composition within upland and wetland ecosites, but complete changes to different communities would not be expected (see Section 10.2).

Sediment deposition of more than 10 cm is predicted for a design flood at 3.0% (145.4 ha in the reservoir) of the LAA. It is anticipated that a design flood would cover 0.8% (40.8 ha in the reservoir) of the LAA in sediment greater than 1 m deep. Although the areal extent of sediment deposition at 1 m deep is lower than for sediment less than 10 cm deep, higher sediment depths would have greater effects on the suitability of migratory and non-migratory bird habitat. Changes to habitat suitability would occur through the loss of vegetation in the herb, shrub, and/or tree strata, depending on sediment depth. For example, altered wetland habitats would affect the availability of breeding habitat for migratory birds such as waterfowl, sora, Lincoln's sparrow, and song sparrow, and foraging habitat for non-migratory birds such as northern harrier

and rough-legged hawk. However, areas affected by sediment would eventually be recolonized by vegetation from the surrounding area (see Section 10.2.2.2). Using the 10 cm to 100 cm sediment category, the most affected migratory and non-migratory bird habitats during post-flood operations would be tame pasture (3.1% in the LAA, or 45.8 ha in the reservoir), native grassland (4.1% in the LAA, or 21.2 ha in the reservoir) and wetlands (3.6% in the LAA, or 10.7 ha in the reservoir) (see Section 10.2.2.2). Residual effects of sediment deposition for lower magnitude floods would likely be less.

The magnitude of the residual effect on migratory and non-migratory bird habitat during post-flood operations at design and 1:100 year flood is moderate for grassland dependent birds, but low for forest and wetland dependent migratory and non-migratory birds. Post-flood operations would be relatively short in duration and irregular in occurrence; however, the long-term effect of deeper sediment (i.e., greater than 1 m) on vegetation left behind after draining would increase the recovery time for habitat to become suitable again for birds.

Timing for flood operations is seasonal because a flood event is limited to the spring and summer months. Timing is seasonal and regulatory because post-flood operations would have greater potential to affect some migratory birds at different times than others, but also might occur during a restricted activity period.

Change in Movement

Flood operations are not likely to restrict the movement of migratory birds; however, floods can temporarily attract waterbirds because they might perceive the area as a waterbody that has potential to provide feeding habitat (Roshier et al. 2002; Elphick and Oring 2003; King et al. 2010). Flood operations have limited potential to affect non-waterbird migratory birds that fly over the Project. Waterbird local movement is more likely to change in the LAA and RAA because of their attraction to larger waterbodies. During the design flood and 1:100 year flood, waterbirds might perceive the flooded off-stream reservoir as a lake and use it for feeding or resting (Roshier et al. 2002; Elphick and Oring 2003; King et al. 2010). However, waterbirds are unlikely to establish nesting while the off-stream reservoir is flooded because floods are more likely to occur late in the breeding season (e.g., June [Farjad et al. 2015]) when nesting territories have already been established elsewhere in the LAA or RAA. Effects on bird movement would diminish to baseline as the water in the off-stream reservoir recedes.

Because the 1:10 year flood would create a smaller waterbody, it is likely that fewer waterbirds would be attracted to the reservoir; therefore, residual effects would be less during this flood magnitude.

For all modelled floods, the magnitude of the residual effect is low for non-aquatic birds because a measurable change in the abundance of non-aquatic migratory birds in the LAA is unlikely, although temporary local shifts in distributions might occur. The magnitude of the

residual effect for waterbirds is moderate because a measurable change in the abundance and distribution of waterbirds in the LAA is possible, but a measurable change in the abundance of waterbirds in the RAA is unlikely. The effects are also expected to be short-term and irregular in occurrence because changes in the movement of these species in the LAA would be limited to filling of the off-stream reservoir (estimated to last up to three days) and during drainage following a design flood (approximately 42 days or fewer for smaller floods).

Timing is not applicable because effects from flood and post-flood operations would be similar regardless of season or other timing characteristics.

Change in Mortality Risk

Through the Project-specific indigenous engagement program, Tsuut'ina Nation expressed concerns that use of the dam would likely result in the loss of migratory bird nests. Diversion of flood waters would reduce mortality risk to migratory birds in riparian habitats along the Elbow River floodplain downstream of the diversion structure, but would increase mortality risk for migratory birds nesting in the off-stream reservoir. Reservoir filling during flood operations is likely to increase nest failure of migratory birds in the flooded area through nest destruction or abandonment (Sidle et al. 1992; Ellis et al. 2009; Anteau et al. 2012). Reservoir filling has been shown to confine birds to smaller, less suitable nesting territories, which reduces nesting success (Fleshman and Kaufman 1984). The eggs and young of migratory bird species that nest on or near the ground (e.g., savannah sparrow [*Passerculus sandwichensis*] and western meadowlark [*Sturnella neglecta*]) would be most vulnerable to drowning. Mortality risk would vary depending on the magnitude of the flood (i.e., how much area is covered by water). There are no potential pathways for flood and post-flood operations to change predator/prey relationships that may affect bird populations.

Post-flood operations might require equipment to travel over potential migratory songbird nesting habitat (e.g., vegetated off-stream dam and floodplain berm) (ECCC 2016). These activities might increase mortality risk for nesting birds in the PDA. If post-flood maintenance in the off-stream reservoir occurs more than seven days following reservoir draining, and during the RAP for nesting migratory birds and raptors, mitigation as nest searches would be conducted by qualified wildlife biologists to reduce potential mortality risk to birds attempting to nest in the area. If an active nest or den is found, it would be subject to a provincial or federal disturbance setback buffer and site-specific mitigation (see Volume 3A, Table 11-10 and Table 11-11).

The risk of direct mortality due to nest flooding during a design flood for tree nesting migratory birds is low due to higher nest heights from the ground. Compared with tree nesting birds, ground nesting migratory birds have a higher risk of mortality during flood events. Grasslands would be one of the most affected habitats during floods (see Table 11-5), although fewer birds (i.e., lower density) were observed in grassland habitat compared to forested habitat (see see Volume 4, Appendix H, Wildlife and Biodiversity Technical Data Report, Table 3-1). Most

migratory birds were observed in mixed forest habitat, which occurs mostly along the Elbow River in the LAA. Mortality risk would decrease with the 1:100 year and 1:10 year floods, based on smaller extents of filling.

Depending on the timing of nesting and floods, sensory disturbance during post-flood operation maintenance can lead to nest abandonment. During post-flood operation maintenance after a design flood, there is potential for increased mortality risk for ground nesting migratory birds because of maintenance activities (e.g., some sediment and debris cleanup) within the off-stream reservoir, which might require the use of heavy equipment. Although the partial flooding of the off-stream reservoir would destroy nests, birds are likely to re-establish nesting after reservoir draining, depending on the condition of the vegetation and timing of the flood (i.e., early or late in the breeding season). Changes to migratory bird mortality risk in the LAA during post-flood operations for the 1:100 year and 1:10 year floods include the same pathways as during design flood. However, the effect would be less for each flood because lower volumes of diverted flood water would require less post-flood maintenance. With mitigation, changes in mortality risk would be reduced during post-flood operations (see Section 11.3.4.2., this volume).

For the design flood, the change in mortality risk to tree nesting migratory birds is low in magnitude because a measurable change in the abundance of tree nesting migratory birds in the LAA is unlikely, although temporary local shifts in distributions might occur. Residual effects are expected to be short term and irregular in frequency, and limited to the PDA. For the 1:100 year and 1:10 year flood, the change in mortality risk would be negligible in magnitude because no measurable change in tree nesting migratory bird abundance and distribution would be observed and forest habitat would not be affected.

Timing for flood operations is seasonal because a flood is limited to the spring and summer months.

For the design flood and 1:100 year flood, the change in mortality risk to ground nesting migratory birds is moderate in magnitude and limited to the PDA. Residual effects are expected to be short term and irregular in occurrence. For the 1:10 year flood, the change in mortality risk would be low for ground nesting migratory birds because only 1.1% (5.9 ha) of grassland habitat in the LAA would be temporarily inundated (see Table 11-5).

Timing for flood operations is seasonal because a flood is limited to the spring and summer months.

With mitigation, the magnitude of the residual effect on migratory bird mortality risk during post-flood operations (i.e., maintenance and partial sediment clean-up) is low.

Timing for post-flood operations is seasonal and regulatory because post-flood operations would have greater potential to affect mortality risk during the breeding season, but also might occur during a restricted activity period.

Change in Health

Floods have the potential to result in changes to water quality and migratory bird health. Methylmercury occurs naturally in aquatic environments where microbes convert (methylate) mercury into this organic substance. Elevated levels of methylmercury combined with bioaccumulation can lead to higher health hazards for piscivorous waterbirds (Scheuhammer et al. 2007; Edmonds et al. 2012; Hall et al. 2014). Floods can also transport pathogens and contaminants from one area to another (Hilscherova et al. 2007; Harmon and Wyatt 2008). Therefore, flood operations can potentially deposit contaminated sediments into the off-stream reservoir draining of the reservoir would leave deposited sediment behind, thus increasing the risk of exposure to contaminants.

Based on the surface water quality assessment (Section 7.4.4), the overall rate of methylmercury production (net methylation) during floods is expected to be low given the short water retention time and characteristics of water from the Elbow River (cold, well oxygenated, neutral pH [pH = 7]). These conditions are not optimal for anaerobic microbial activity for methylation. Because methylmercury concentrations are not expected to exceed guidelines, no toxicological effects on migratory waterbirds are anticipated.

Results of the hydrology assessment (Section 6.4) indicate that most sediment deposited in the reservoir would be coarse material (i.e., silt/very fine sand and medium sand sized material), not fine particulate matter (i.e., clay and fine silt) that is more susceptible to wind erosion. To further mitigate soil erosion due to wind, areas of sediment deposition where wind erosion might be an issue would be hydroseeded with native plant species. AEP would develop an operation and maintenance plan for the reservoir that would include sediment stabilization and debris removal. However, re-vegetation success is not certain, given the initial high moisture contents of the soil (see Section 9) and reduced energy inputs in the fall for plants. If revegetation is not successful, newly added sediment would be sprayed with a biodegradable tackifier.

Overall, residual effects on migratory bird health are negligible in magnitude. Timing is not applicable for post-flood operations because effects from Project activities would be similar regardless of season or other timing characteristics.

Summary of Project Residual Effects on Migratory Birds

The residual effects for migratory birds are characterized (Table 11-11) based on criteria described in Volume 3A, Table 11-5. All changes are relative to baseline conditions.

Table 11-11 Project Residual Effects on Migratory Birds during Flood and Post-Flood Operations

Residual Effect	Residual Effects Characterization								
	Project Phase	Timing	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in habitat	F	S	A	L-M	LAA	ST	IR	R	D
	PF	S/R	A	L-M	LAA	ST	IR	R	D
Change in movement	F	N/A	A	L-M	LAA	ST	IR	R	D
	PF	N/A	A	L-M	LAA	ST	IR	R	D
Change in mortality risk	F	S	A	L-M	PDA	ST	IR	R	D
	PF	S/R	A	L	PDA	ST	IR	R	D
Change in wildlife health	F	S	A	N	N/A	N/A	N/A	N/A	N/A
	PF	N/A	A	N	N/A	N/A	N/A	N/A	N/A

KEY

See Table 11-5 in Volume 3A for detailed definitions

Project Phase
F: Flood Operation
PF: Post-flood Operation

Timing Consideration
S: Seasonality
T: Time of day
R: Regulatory

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
LT: Long-term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological and Socio-Economic Context:
D: Disturbed
U: Undisturbed

11.3.8.3 Species at Risk

Species-specific information regarding potential Project effects on each species listed under Schedule 1 of SARA and those species listed by COSEWIC are provided in Attachment A, Table A-1. Potential direct and indirect Project effects (i.e., change in habitat, movement, and mortality risk) on each species at risk as well as proposed mitigation is summarized.

The residual effects are characterized (Attachment A, Table A-1) based on criteria described in Volume 3A, Table 11-5. All changes are relative to baseline conditions. Changes in magnitude for habitat, movement, and mortality risk, and changes in geographic extent for mortality risk varies with species.

Residual effects during flood operations for the 1:100 year flood would be lower than for the design flood, but higher than for the 1:10 year flood. Residual effects during post-flood operations were assessed for the design flood but not the 1:100 and 1:10 year floods because effects would be similar or lower (i.e., low or negligible) than what was characterized for design flood.

11.4 DETERMINATION OF SIGNIFICANCE

As defined in Volume 3A, Section 11.1.6, a significant environmental effect on wildlife and biodiversity is one that threatens the long-term persistence or viability of a wildlife species in the RAA. This includes effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans.

With the application of mitigation measures, project residual environmental effects on wildlife, including migratory birds and species at risk, and biodiversity are predicted to be not significant. Although the magnitude of some residual effects related to flood operations would be moderate or high during a design flood, the residual effects on habitat, movement, and mortality risk would be unlikely to pose a long-term threat to the persistence or viability of a wildlife species, including migratory birds and SAR, in the RAA.

11.5 PREDICTION CONFIDENCE

Prediction confidence is moderate based on the quality and quantity of available baseline data and the effectiveness of mitigation during the flood and post-flood operation phases.

11.6 CONCLUSIONS

Change in Habitat

The Project would result in temporarily unavailable wildlife habitat during flood operations and post-flood operations, with some permanent loss of wetlands from sedimentation, which would be converted into upland communities. Vegetation lost during floods would eventually be replaced by native vegetation in the surrounding area, or reestablished through hydroseeding. The amount of wildlife habitat affected for SOMC, including migratory birds and species at risk, is relatively small compared to the availability of wildlife habitat remaining in the RAA.

Change in Movement

The Project is likely to have a greater temporary effect on ungulate movement than movement of birds, amphibians, and grizzly bears during a flood. Flood water can act as a barrier to movement; however, it is somewhat permeable if animals, such as elk and grizzly bear, choose to swim across. Change in movement would depend on the magnitude of the flood because the extent of filling would affect whether animals go around or across the flooded area. Waterbirds might be attracted to the PDA during floods because the off-stream reservoir would be perceived as feeding habitat. The effects on movement would be temporary and would subside during post-flood operations. The duration would vary depending on each flood scenario because lower volumes of diverted flood water would reduce the extent of off-stream reservoir filling and require less post-flood maintenance.

Change in Mortality Risk

The Project is predicted to increase wildlife mortality risk in the PDA during a flood. Whether the risk is low or moderate depends on the species and magnitude of the flood. Most of the flooded area in the reservoir 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). For large mammals (e.g., elk and grizzly bear), mortality risk would be less because of their mobility to avoid floods. During post-flood operations, maintenance activities might potentially result in a small increase in mortality risk due to a rise in traffic volume in the LAA and RAA for maintenance crews to travel to and from the Project area, thereby increasing the risk of animal-vehicle collisions.

Mortality risk in the floodplain of the Elbow River, downstream of the diversion structure, would likely remain near baseline levels during diversion of flood waters.

Change in Biodiversity

The Project would not result in changes in biodiversity that would threaten the long-term persistence or viability of wildlife or vascular plant species of management concern in the RAA.

Change in Wildlife Health

Overall, there would be little change to wildlife health based on the expected frequency and duration of floods. Methylmercury levels would be lower than for permanent reservoirs. The sediment deposited in the off-stream reservoir is not expected to increase the hazard associated with contaminants that floods can transport. Mitigation measures used to reduce soil erosion due to wind would further reduce residual effects.

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11.8 GLOSSARY

Ecological trap	When animals are attracted to habitats that appear to be of high quality because of environmental cues or preferences, but these habitats actually provide little value for survival and reproduction. Ecological traps can result in the decline of a population.
Incidental	Any observation made outside of a specific survey with set protocols.
Key Wildlife and Biodiversity Zone (KWBZ)	Areas that provide key ungulate habitat and high habitat potential for biodiversity, as defined by Alberta Environment and Parks (AEP) and guidelines for industrial activity. These zones typically occur along major river valleys.
Restricted activity period (RAP)	The timeframe in which construction and other Project activities are limited based on federal and provincial guidelines. The RAP usually refers to the nesting season for birds or winter activities for ungulates in KWBZs.

Primary Nesting Period (PNP)	The timeframe in which migratory birds primarily start and finish nesting within a specified region.
Species of management concern (SOMC)	Any species that is listed federally as *endangered, threatened,* or *special concern* on any Schedule of the *Species at Risk Act*, designated federally as *endangered, threatened,* or *special concern* by the Committee on the Status of Endangered Wildlife in Canada, listed provincially as *endangered, threatened,* or *special concern*, including species legally protected under the Alberta *Wildlife Act*, and designated provincially as *At Risk, May be at Risk*, or *Sensitive* according to the AEP General Status of Alberta's Wild Species.
Zone of influence (ZOI)	A specified buffer surrounding a disturbance feature considered to cause indirect effects due to sensory disturbance.

Attachment A LIST OF SPECIES AT RISK POTENTIALLY AFFECTED BY THE PROJECT

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Horned grebe (*Podiceps auritus*)	SC	SC	Breed in small to moderate sized ponds and marshes with emergent vegetation. Graminoid marsh and shallow open water make up 4.6% (224.0 ha) of LAA. Overall, low to moderate suitability breeding habitat.	Four historical observations in RAA in 2006. No field observations. Low to moderate potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 68.7 ha and 1.1 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** Flood and post-flood operations could result in changes to movement patterns (daily or seasonal) because of habitat change. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures (no mitigation for change in movement). See Volume 3A, Table 11-10 and 11-11 for horned grebe timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short Term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Positive M: Low G: LAA Dur: Short Term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short Term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Positive M: Low G: LAA Dur: Short Term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Short Term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Western grebe (*Aechmophorus occidentalis*)	SC	SC	Breed on large lakes and marshes with extensive open water. No potential breeding habitat in LAA.	No historical record in RAA. No field observations. Low potential to occur in LAA.	**Change in Habitat** No potential Project effects (flood event creates loafing habitat, but not breeding habitat). **Change in Movement** Flood and post-flood operations could result in changes to movement patterns (daily or seasonal) because of habitat change. **Change in Mortality Risk** No potential Project effects; assume no nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.6.2 for mitigation measures (no mitigation for change in movement). See Volume 3A, Table 11-10 for western grebe timing and setback distance.	**Change in Movement** T: Seasonality Dir: Positive M: Low G: LAA Dur: Short Term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Movement** T: Seasonality Dir: Positive M: Low G: LAA Dur: Short Term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Short Term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Yellow rail (*Coturnicops noveboracensis*)	SC	SC	Breed in sedge marsh habitat. Graminoid marsh and graminoid fen make up 4.4% (216.0 ha) of LAA. Overall, low suitability breeding habitat.	No historical record in RAA. No field observations. Low potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 68.7 ha and 1.1 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-11 for yellow rail timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Long-billed curlew (*Numenius americanus*)	SC	SC	Breed in short-grass or mixed-prairie habitat. Native grassland and tame pasture make up 41.2% (2,003.7 ha) of LAA. Overall, moderate suitability breeding habitat.	No historical record in RAA. No field observations. Moderate potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 507.9 ha and 8.6 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-10 and 11-11 for long-billed curlew timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Red knot (*Calidris canutus [rufa]*)	EN	EN	Breed in arctic habitats. Use saline lakeshores during migration. No potential stopover habitat during migration in LAA.	No historical record in RAA. No field observations. Low potential to occur in LAA.	No potential project effect(s) because no suitable habitat is available in the LAA; low likelihood to occur.	No mitigations required because no suitable habitat is available in the LAA; low likelihood to occur.	No project residual effects because no suitable habitat is available in the LAA; low likelihood to occur.	No project residual effects because no suitable habitat is available in the LAA; low likelihood to occur.	No project residual effects because no suitable habitat is available in the LAA; low likelihood to occur.
Short-eared owl (*Asio flammeus*)	SC	SC	Breed in tall grass prairie habitat. Native grassland and tame pasture make up 41.2% (2,003.7 ha) of LAA. Overall, low suitability breeding habitat (i.e., very little tall grass habitat).	No historical record in RAA. No field observations. Low potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 507.9 ha and 8.6 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-10 and 11-11 for short-eared owl timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Common nighthawk (*Chordeiles minor*)	TH	TH	Breed in short-grass prairie with sparsely vegetated ground, and woodland clearings. Native grassland and tame pasture make up 41.2% (2,003.7 ha) of LAA. Overall, low to moderate suitability breeding habitat.	No historical record in RAA. No field observations. Low to moderate potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 507.9 ha and 8.6 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-11 for common nighthawk timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Peregrine falcon (*Falco peregrinus*)	SC	SC	Nest on cliffs, ledges, artificial nest platforms. Potential nesting habitat along Elbow River. Overall, low suitability breeding habitat.	One historical observations in RAA in 2007. No field observations. Low potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-10 and 11-11 for peregrine falcon timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Olive-sided flycatcher (*Contopus cooperi*)[f]	TH	TH	Breed in open and semi-open coniferous and mixed-coniferous forest. High and moderate suitability breeding habitat make up 2.9% (139.5 ha) of LAA.	Three historical observations in RAA in 2010. Three field observations. Moderate potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 0.3 ha and 0 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-11 for olive-sided flycatcher timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: N/A M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Mortality Risk** T: Seasonality Dir: N/A M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: N/A M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Loggerhead shrike (*Lanius ludovicianus excubitorides*)	TH	TH	Breed in open country interspersed with shrubs and trees, particularly those with spines or thorns. Shrubland, native grassland, and tame pasture make up 47.9% (2,328.7 ha) of LAA. Overall, moderate suitability breeding habitat.	Two historical observations in RAA in 2013. No field observations. Moderate potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 594.5 ha and 10.1 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-11 for loggerhead shrike timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Bank swallow (*Riparia riparia*)	TH	TH	Breed in lowland areas along riparian habitat, lakes, reservoirs, and wetlands. Nest in vertical banks, cliffs and bluffs. Potential nesting habitat along Elbow River. Overall, high suitability breeding habitat.	Historical observations in RAA in 2010 and 2012. One breeding colony field observation. High potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. There is currently no specified timing or setback distance provided by ECCC for bank swallow. If a nest is found, species specific mitigation would be developed in consultation with ECCC.	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Barn swallow (*Hirundo rustica*)	TH	TH	Breed in various habitats: open areas with structures and near water. Anthropogenic structures (e.g., bridge, culvert, barns) near water provide nesting sites in LAA. Overall, moderate suitability breeding habitat.	One historical observation in RAA in 2012. One breeding colony field observation. High potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-11 for barn swallow timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Sprague's pipit (*Anthus spragueii*)[f]	TH	TH	Breed in native mixed-prairie habitat. Habitat fragmentation and small patch size have reduced habitat suitability. No high or moderate suitability habitat exists in the LAA. Low suitability breeding habitat makes up 16.8% (817.7 ha) of LAA. Critical habitat has been partially identified at the Canadian Forces Base Suffield National Wildlife Area. No critical habitat occurs in the LAA.	No historical record in RAA. No field observations. Low potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 195.9 ha and 3.5 ha of low suitability habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-10 and 11-11 for Sprague's pipit timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Baird's sparrow (*Ammodramus bairdii*)	SC	SC	Breed in native mixed-grass and fescue habitat, scattered with low shrubs. Native grassland makes up 10.6% (515.6 ha) of LAA. Overall, moderate suitability breeding habitat.	No historical record in RAA. No field observations. Low to moderate potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 134.8 ha and 5.9 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. There is currently no specified timing or setback distance provided by ECCC for Baird's sparrow. If a nest is found, species specific mitigation would be developed in consultation with ECCC.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Bobolink (*Dolichonyx oryzivorus*)	TH	TH	Breed in open areas with grass and broad-leaved plants. Native grassland and tame pasture make up 41.2% (2,003.7 ha) of LAA. Overall, low suitability breeding habitat.	No historical record in RAA. No field observations. Low potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 507.9 ha and 8.6 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-11 for bobolink timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Rusty blackbird (*Euphagus carolinus*)	SC	SC	Breed in wet coniferous and mixed forests in the boreal. Use cultivated fields, pastures, swamps, and wooded areas during migration. Crop, hayland, tame pasture, swamps, and coniferous/mixed forest make up 57.7% (2,804.0 ha) of LAA. Overall, high suitability stopover habitat.	No historical record in RAA. No field observations. Moderate potential to occur in LAA during spring and fall migration.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 379.8 ha and 2.7 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** No potential Project effects; assume no nests. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-11 for rusty blackbird timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Little brown myotis (*Myotis lucifugus*)	EN	EN	Roost in cavities of trees, rock crevices, or anthropogenic structures. Hibernate in caves or abandoned mines. Broadleaf, coniferous, and mixed forests make up 15.3% (744.2 ha) of LAA. Overall, high suitability roosting habitat. Critical habitat has been partially identified in Wood Buffalo National Park, and Jasper National Park and surrounding area. No critical habitat occurs in the LAA.	One historical observation in RAA in 2007. No field observations. High potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 12.7 ha and 0 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** No potential Project effects. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk because of flooding of active roost or hibernaculum. **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. There is currently no specified timing or setback distance provided by ECCC for little brown myotis. If a roost is found, species specific mitigation would be developed in consultation with ECCC.	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Grizzly bear (*Ursus arctos*)[f]	--	SC	During spring, forage in open areas, grasslands, wet meadows, and riparian habitats. During summer/fall forage in areas that contain berry producing shrubs. High and moderate suitability spring feeding habitat make up 7.1% (345.0 ha) of LAA. High and moderate suitability summer feeding habitat make up 1.0% (51.0 ha) of LAA.	No historical record in RAA. Four field observations. Low to moderate potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood during spring, 41.4 ha and 0.1 ha of habitat will be inundated, respectively. At design flood and the 1:10 year flood during summer, 0 ha of habitat will be inundated. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** Flood and post-flood operations could result in changes to movement patterns (daily or seasonal) because of habitat change and sensory disturbance. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk for young (i.e., less mobile) and flooding of den, vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals). **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.3.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-10 for grizzly bear timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: High(spring)/ Low (summer) G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low(spring)/ Low (summer) G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low(spring)/ Low (summer) G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: RAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
American badger (*Taxidea taxus taxus*)		SC	Open grassland, aspen parkland, and agricultural lands. Crop, hayland, tame pasture, grassland, and broadleaf forest make up 62.7% (3,047.7 ha) of LAA. Overall, high suitability habitat.	No historical record in RAA. No field observations. High potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 515.0 ha and 8.6 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** Flood and post-flood operations could result in changes to movement patterns (daily or seasonal) because of habitat change and sensory disturbance. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk for young (i.e., less mobile) and flooding of den, vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals). **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.3.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. There is currently no specified timing or setback distance provided by ECCC for American badger. If a den is found, species specific mitigation would be developed in consultation with ECCC.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: RAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Elk (*Cervuscanadensis*) [f,g]	--	--	Forage in mosaic of open grasslands and forest cover, feeding primarily on grasses and forbs in the summer, and browse on deciduous trees and shrub in the winter. High and moderate suitability summer feeding habitat make up 16.2% (788.7 ha) of LAA (winter feeding habitat was not assessed due to the timing of floods).	No historical record in RAA. Several field observations throughout 2017/2018 field surveys. High potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood during summer, 94.2 ha and 4.0 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** Flood and post-flood operations could result in changes to movement patterns (daily or seasonal) because of habitat change and sensory disturbance. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk for young (i.e., less mobile), vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals). **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.3.2, 11.3.4.2, and 11.3.6.2 for mitigation measures (including RAP for KWBZ).	**Change in Habitat** T: Seasonality Dir: Adverse M: High (summer) G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Continuous R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low (summer) G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate (summer/winter) G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Moderate G: LAA Dur: Long term F: Continuous R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: RAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Western toad (*Anaxyrus boreas*)	SC	SC	Graminoid marsh, swamps, shallow open water with emergent vegetation. Wetlands make up 6.1% (296.3 ha) of LAA. Overall, moderate suitability breeding habitat.	No historical record in RAA. No field observations. Low potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 70.3 ha and 1.1 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** Flood and post-flood operations could result in changes to movement patterns (daily or seasonal) because of habitat change and sensory disturbance. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk for eggs and tadpoles, vehicle and equipment movement during post-flood operations can result in accidental mortality (i.e., less mobile). **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.3.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-10 and 11-11 for western toad timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Northern leopard frog (*Lithobates pipiens*) [f]	SC	SC	Graminoid marsh, swamps, shallow open water with emergent vegetation. High and moderate suitability breeding habitat make up 2.9% (143.3 ha) of LAA.	No historical record in RAA. No field observations. Low potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 15.9 ha and 0 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** Flood and post-flood operations could result in changes to movement patterns (daily or seasonal) because of habitat change and sensory disturbance. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk for eggs and tadpoles, vehicle and equipment movement during post-flood operations can result in accidental mortality (i.e., less mobile). **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.3.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. See Volume 3A, Table 11-10 and 11-11 for northern leopard frog timing and setback distance.	**Change in Habitat** T: Seasonality Dir: Adverse M: High G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

Species	SARA[a]	COSEWIC[a]	Potential Habitat Use in the LAA at Baseline Conditions[b]	Frequency of Occurrence	Potential Project Effect(s)[c]	Key Recommendations/ Mitigation Measures	Project Residual Effects[d, e]		
							Design Flood	1:10 Year Flood	Post-flood Operations (Design Flood)
Western tiger salamander (*Ambystoma mavortium*)	--	SC	Semi-permanent and permanent wetlands. Wetlands make up 6.1% (296.3 ha) of LAA. Overall, moderate suitability breeding habitat.	Sixteen historical observations in RAA in 2000. No field observations. Moderate potential to occur in LAA.	**Change in Habitat** Temporary alteration or inaccessibility of habitat during reservoir filling and draining as well as post-flood operations (i.e., presence of sediment and debris). At design flood and the 1:10 year flood, 70.3 ha and 1.1 ha of habitat will be inundated, respectively. Direct loss of residences during reservoir filling. Indirect loss or reduced habitat effectiveness from sensory disturbance during post-flood operations (i.e., sediment partial cleanup and maintenance activities). **Change in Movement** Flood and post-flood operations could result in changes to movement patterns (daily or seasonal) because of habitat change and sensory disturbance. **Change in Mortality Risk** Reservoir filling can result in increased mortality risk for eggs and larva, vehicle and equipment movement during post-flood operations can result in accidental mortality (i.e., less mobile). **Change in Health** Reservoir filling and draining could result in increased exposure to contaminants brought in by flood water and methylmercury production in the reservoir.	See Section 11.3.2.2, 11.3.3.2, 11.3.4.2, and 11.3.6.2 for mitigation measures. There is currently no specified timing or setback distance provided by ECCC for western tiger salamander. If a breeding wetland is found, species specific mitigation would be developed in consultation with ECCC.	**Change in Habitat** T: Seasonality Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: Seasonality Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality Dir: Adverse M: Low G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: Seasonality Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: PDA Dur: Short term F: Irregular event R: Reversible E: Disturbed **Change in Health** T: N/A Dir: Adverse M: Negligible G: N/A Dur: N/A F: N/A R: N/A E: N/A

Table A-1 Summary of Project Residual Effects on Species at Risk during Flood and Post-Flood Operations

NOTES:

[a] Government of Canada 2017 and COSEWIC 2017

EN (endangered), TH (threatened), SC (special concern), IR (in review – year of assessment by COSEWIC).

[a] Baseline for flood and post-flood operations is defined as the dry operations phase with major components of the Project in place and vegetation reclaimed after construction.

[c] There are no potential Project effects to change in movement for non-aquatic bird species and bat species at risk because when considering the duration and timing of flood events, they are unlikely to affect migration patterns, flyways, local movement, and seasonal habitat use. Flood events are more likely to result in temporary foraging or loafing habitat for aquatic birds that use large waterbodies.

[d] Project residual effects characterization

T: Timing, Dir: Direction, M: Magnitude, G: Geographic Extent, Dur: Duration, F: Frequency, R: Reversibility, E: Ecological and Socio-Economic Context.

[e] Residual effects during flood operations were assessed for the design and 1:10 year flood. Residual effects during flood operations for the 1:100 year flood would be lower than for the design flood, but higher than for the 1:10 year flood. Residual effects during post-flood operations were assessed for the design flood but not the 1:100 and 1:10 year floods because effects would be similar or lower (i.e., low or negligible) than what was characterized for design flood.

[f] Habitat suitability models were used to assess potential direct (i.e., habitat loss) and indirect (i.e., sensory disturbance) effects on changes in habitat abundance in the LAA for five key indicator species.

[g] Although elk is not a species at risk, it is a species of traditional importance to Aboriginal communities and was used as a key indicator.