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Abbreviations

ACIMS	Alberta Conservation Information Management System
FAC	A species that occurs in wetlands and non-wetlands
FACU	A species that usually occurs in non-wetlands, but may occur in wetlands
LAA	local assessment area
PDA	project development area
RAA	regional assessment area
SARA	*Species at Risk Act*
SOMC	species of management concern
UPL	A species that almost always occurs in uplands

10.0 ASSESSMENT OF POTENTIAL EFFECTS ON VEGETATION AND WETLANDS

The scope of the assessment and existing conditions for vegetation and wetlands are presented in Volume 3A, Section 10.1 and Section 10.2. This section assesses the effects of the Project on vegetation and wetlands during flood and post-flood operations.

Assessment of potential direct and indirect effects during flood and post-flood operations relies on a selection of measurable parameters that are quantifiable (e.g. area of direct vegetation loss). However, not all effects on vegetation and wetlands can be quantified (i.e., indirect effects on plant species of management concern (SOMC), introduction and establishment of regulated weeds). Therefore, some effects on vegetation and wetlands are assessed qualitatively using of scientific literature, professional judgement and past project experience. Selected measurable parameters assessed are presented in Volume 3A, Table 10-1.

10.1 PROJECT INTERACTIONS WITH VEGETATION AND WETLANDS

Table 10-1 identifies the project components and physical activities that might interact with vegetation and wetlands during flood and post-flood operations. These interactions are discussed in detail in Section 10.2 in the context of effects pathways, standard and project-specific mitigation and residual effects. A justification for no interaction is provided following Table 10-2.

Table 10-1 Project-Environment Interactions with Vegetation and Wetlands during Flood and Post-Flood Operations

Project Components and Physical Activities	Environmental Effects			
	Change in Landscape Diversity	Change in Plant Community Diversity	Change in Species Diversity	Change in Wetland Functions
Flood and Post-Flood Operations				
Reservoir filling	–	✓	✓	✓
Reservoir draining	–	✓	✓	✓
Reservoir sediment partial cleanup	–	✓	✓	✓
Channel maintenance	–	–	–	–
Road and bridge maintenance	–	–	–	–

NOTES:
✓ = Potential interaction
– = No interaction

Filling and draining of the reservoir, as well as reservoir sediment partial cleanup, would not fragment patches of native plant communities. The composition of native communities may be altered, but areas would likely not be lost. As a result, fragmentation is not assessed. Maintenance of the channel, road and bridge would occur within areas of permanent disturbance; therefore, these activities would unlikely affect vegetation and wetlands.

10.1.1 Mitigation

Mitigation measures that would be implemented are listed below.

- Maintenance activities will be restricted to the reservoir footprint to reduce the area of disturbance during post-flood operations.
- All equipment will arrive at the Project site clean and free of soil and vegetative debris.
- Areas of sediment deposition where wind erosion may be an issue may be hydroseeded with native plant species and a tackifier to reduce erosion. An operation and maintenance plan for the reservoir will be developed that would include sediment stabilization and debris removal.
- Where sediment cleanup is required to maintain hydrological function of the Project, graded soil material will be directed away from adjacent wetlands.

10.2 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON VEGETATION AND WETLANDS

10.2.1 Analytical Assessment Techniques

To assess changes in community and species diversity, as well as wetland functions, three flood events are assessed, 1:10 year flood, 1:100 year flood and the design flood (2013 event), as well as, post-flooding potential effects on vegetation and wetlands. Sediment deposition patterns and depth were modeled for the design flood. The 1:10 year and design floods are based on hourly hydrographs from the WSC Bragg Creek station (See Volume 3b Section 6.4.1.1). An hourly hydrograph was simulated for a 1:100 year flood using the Hydrologic Engineering Center Hydrological Modeling System. The 1:10 year and design floods provide the minimum and maximum projected effects and form the basis of the assessment of effects on vegetation and wetlands.

The 1:10 year flood is the minimum flow that the Project would actively divert and the design flood is based on the 2013 flood. These floods equal a 10% and a less than a 0.5% probability of a flood of that magnitude occurring in any given year. As a result, these two floods provide a lower and upper envelope for operation of the Project. Data for the 1:10 year flow is based on the 2008 hydrograph, which peaked at 205 m^3/s. Diversion commences at 160 m^3/s. Hourly flow data for the 2008 flood and the design flood was sourced from the Water Survey of Canada for

Bragg Creek (D. Lazowski, pers. comm. 2016). This hydrological data was used with available sediment data to dynamically model the extent of sediment deposition within the off-stream reservoir (See Volume 3B Section 6.5.1.3). Average sedimentation depth across each plant community polygon was modelled for the design flood to determine the potential effect on community and species diversity, and wetland functions.

10.2.2 Change in Plant Community Diversity

After draining of the reservoir, water may be present at or near the ground surface of the reservoir for a period of time as water evaporates or infiltrates into the soil. The amount of time needed to return the soil water content back to baseline conditions after a flooding event would be dependent on evapotranspiration (the rate of evaporation plus plant transpiration of water that occurs during photosynthesis) and soil type (see Section 9.2). Flooding may also deposit sediment that could bury or suffocate plants. Sediment deposition patterns and depths were modeled for the design flood.

Each flood has a predicted area and duration of flooding (Table 10-2).

Table 10-2 Flood Scenario Information

Flood Event	Area (ha) of Inundation in Reservoir	Reservoir Filling (days)	Residence Time in Reservoir (days)	Time to Drain Reservoir (days)	Total Duration (days)
1:10 year	21	0.38	43	30	74
1:100 year	481	1.80	43	39	84
Design	816	3.75	20	38	62
NOTE: Area of inundation is a conservative estimate because the total area identified would not be under water during the filling or draining stage. See Volume 3B, Section 6.4.1.4 for more information					

Plant communities would respond to flood duration and sedimentation in three possible ways (Van der Valk et al. 1983):

1. no change as a result of flood duration and/or sediment deposition
2. most species comprising plant community at existing conditions are retained in addition to recruitment of new species
3. most of the species at existing conditions are lost and are replaced by new species

Through review of the literature, the following flood event (Table 10-3) and sedimentation (Table 10-4) thresholds are expected.

Table 10-3 Predicted Effect flood Event Effect on Vegetation and Wetlands

Plant Community Type	Predicted Effect
Upland Plant Community	Large changes to upland plant communities existing species diversity and abundance would occur. Species that are lost would be replaced by species within the seedbank or that can seed-in from surrounding areas (Blom and Voesenek 1996).
Wetland Plant Community	Most species comprising wetland plant communities at existing conditions are retained in addition to recruitment of new species (Ewing 1996). Small changes to existing species diversity and abundance are expected.

Table 10-4 Sediment Deposition and Predicted Effect on Vegetation and Wetlands

Sediment Threshold	Predicted Effect
<3 cm	No Affect to upland and wetland plant communities, though minor effects to germination of annual may occur (Wang et al. 2013)
3-10 cm	Most species comprising upland and wetland plant communities at existing conditions are retained in addition to recruitment of new species (Van der Valk and Bliss 1971; Van der Valk et al. 1983; Limon and Peco 2016). Small changes to existing species diversity and abundance are expected.
>10 to 100 cm	Most of the species at existing conditions are lost in the herbaceous and short shrub layers and are replaced by new species that can seed-in from surrounding areas (Van der Valk et al. 1983; Luo and Zhao 2015).
> 100 cm	Loss of tall shrub layer and likely mortality of trees. Vegetation reestablishment is expected to occur by colonizing through primary succession species (Wang et al. 2013)

Change in community diversity, species diversity and wetland functions as a result of flood duration and sedimentation are assessed using these models. Post-flooding effects, which include cleanup and repair to the diversion channel, reservoir, low-level outlet channel and roads are also assessed. For each flood, timing is not applicable because effects from project activities would be similar regardless of season or other timing characteristics.

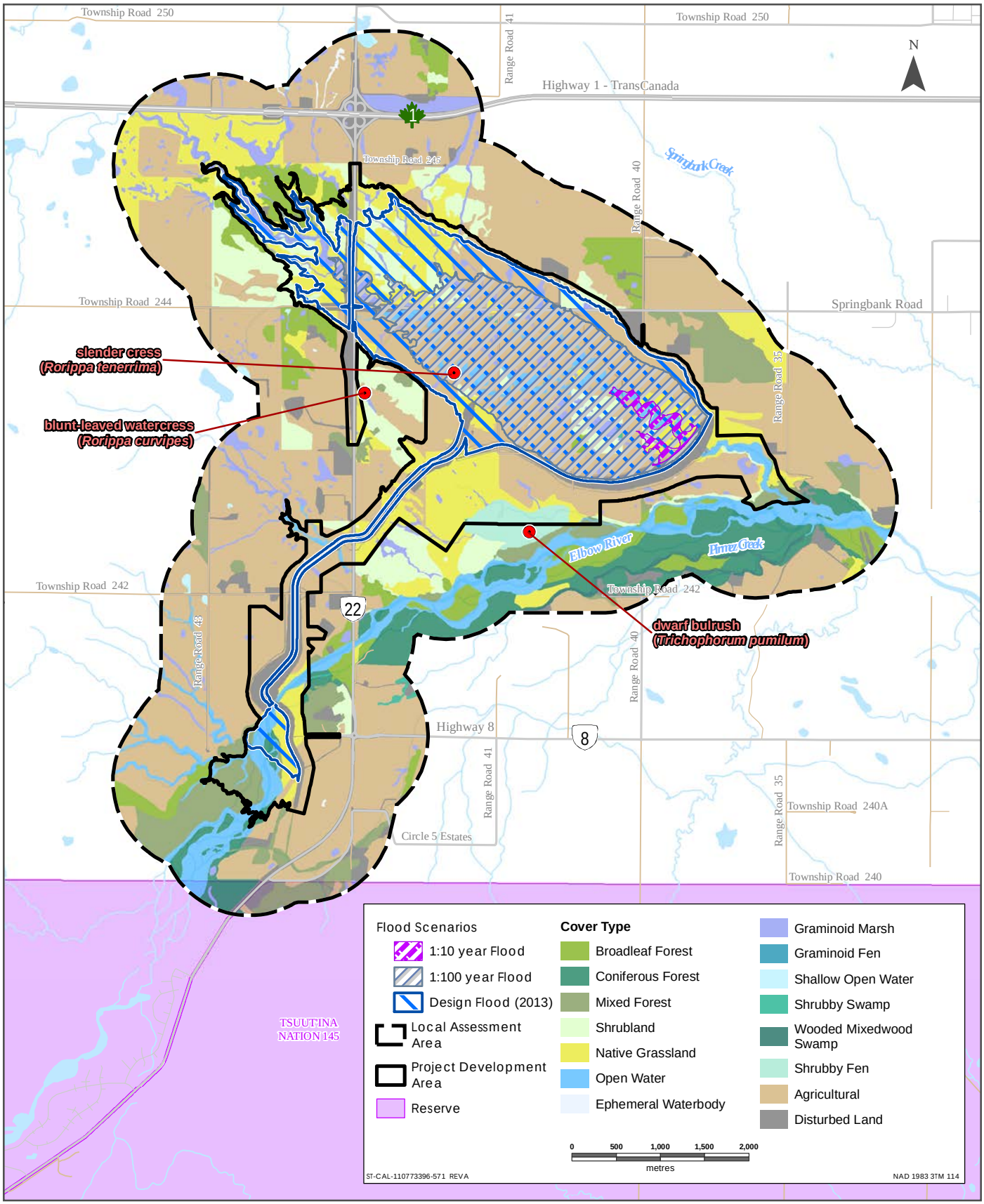
10.2.2.1 1:10 Year Flood

A 1:10 year flood is predicted to cover 21.4 ha (in the reservoir); see Figure 10-1. Open water (9.4 ha) would be the most temporarily inundated cover type followed by native grasslands (5.8 ha) and shrublands (1.5 ha) (Table 10-5). Each plant species has varying tolerance levels to flooding and soil saturation. For example, young plants are more susceptible to prolonged flooding than

established plants of the same species (Yoshiyasu et al. 2008). Reservoir filling, holding and draining together would have a duration of 74 days (Table 10-2).

Many plant species have intrinsic adaptations to short periods of flooding (Bayley and Guimond 2008), including many of the dominant species of the affected communities. Mesic/rich e3 shrubland was observed to be dominated by rose (*Rosa* sp.) and buckbrush (*Symphoricarpos occidentalis*) with Kentucky bluegrass (*Poa pratensis*) in the herb layer. Rose prefers moist to wet soil conditions, and buckbrush and Kentucky bluegrass prefer dry to moist soil conditions and all have been shown to tolerate temporary flooding (Hardy BBT Limited 1989 and Hauser 2007). Subhygric/rich f3 shrubland is dominated by beaked willow (*Salix bebbiana*) and rose, with Kentucky bluegrass in the herb layer. Beaked willow prefers moist to wet soil conditions and is also tolerant of flooding (Hardy BBT Limited 1989). Submesic/medium b5 grassland is generally dominated by mountain rough fescue (*Festuca campestris*), which can tolerate subhydric soil moisture conditions (Klinkenberg 2017) and would likely be tolerant of temporary flooding. Some b5 ecosites that were surveyed are dominated by slender wheat grass (*Elmus trachycaulus*), which grows in dry to moist soil conditions and would be less tolerant to temporary flooding due to it having a low anaerobic tolerance (United Stated Department of Agriculture 2017). Mesic/medium e0 grassland in the PDA are dominated by bluejoint (*Calamagrostis canadensis*) or Kentucky bluegrass (ESRD 2012a). Bluejoint prefers moist to wet soils conditions and is tolerant of flooding (Hardy BBT Limited 1989). Subhygric/rich f4 grassland is dominated by Kentucky bluegrass and wire rush (*Juncus balticus*). Wire rush prefers moist to wet soil conditions and is generally found in areas that are seasonally flooded (United States Department of Agriculture 2013).

Soil oxygen, which is required for healthy root metabolism, would likely become depleted during the 1:10 year flood duration of 73 days (soil anoxia) and this could alter plant growth, reproduction, competitive ability and potentially, species composition. Soil anoxia impairs root metabolism and growth, and increases accumulation of toxins and root decay (Drinkard et al. 2011 and Kozlowski 1997). Some plants can grow better in these conditions than others and plants that are better suited to low oxygen soils may increase in abundance while other plants not well suited may decrease in abundance. Although the dominant plants of inundated communities can tolerate short flood durations, the total inundation time of 74 days that is predicted for the 1:10 year flood would likely affect community diversity. Therefore, it is predicted that the shrub layers in mesic/rich e3 shrubland and subhygric/rich f3 shrubland would change to modified grassland e (mesic/rich) and modified grassland f (subhygric/rich), respectively.



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

Flood Event Extent

Stantec

Table 10-5 Vegetation and Wetland Cover Types Inundated in a 1:10 Year Flood

Cover Type	Land Unit [a, b]	Land Unit Area Inundated in the Reservoir (ha)	Percent of Land Unit in PDA%	Total Land Unit Area in the PDA (ha)
Broadleaf Forest	d1 Pine grass Aw	0.0	0.0	0.1
	e1 Snowberry-silverberry Aw-Pb	0.0	0.0	0.3
	f2 Red osier dogwood Pb-Aw	0.0	0.0	21.5
Coniferous Forest	g1 Horsetail Sw	0.0	0.0	6.3
Mixed Forest	b3 Hairy wild rye Aw-Sw-Pl	0.0	0.0	5.2
	e2 Snowberry-silverberry Sw	0.0	0.0	21.6
	e4 Snowberry-silverberry Sw-Aw	0.0	0.0	2.5
	f1 Red osier dogwood Sw	0.0	0.0	2.9
Shrubland	e3 Shrubland - mesic/rich	0.9	4.2	20.8
	f3 Shrubland - subhygric/rich	0.6	0.5	136.2
Native Grassland	b5 Grassland - submesic/medium	1.6	4.9	32.3
	c1 Rough fescue	0.0	0.0	191.0
	d0 Grassland - mesic/medium [c]	0.0	0.0	0.0
	e0 Grassland - mesic/medium [c]	2.1	6.7	30.6
	f4 Grassland - subhygric/rich	2.2	2.5	86.0
	g0 Grassland - hygric/rich [c]	0.0	0.0	8.7
Upland Subtotal		***7.3***	***1.3***	***566.0***
Open Water	Open Water	9.4	5.8	161.0
Open Water Subtotal		***9.4***	***5.8***	***161.0***
Ephemeral Waterbody	Ephemeral Waterbody	0.0	0.0	1.0

Table 10-5 Vegetation and Wetland Cover Types Inundated in a 1:10 Year Flood

Cover Type	Land Unit [a, b]	Land Unit Area Inundated in the Reservoir (ha)	Percent of Land Unit in PDA%	Total Land Unit Area in the PDA (ha)
Graminoid Marsh	Temporary graminoid marsh	1.1	2.7	39.8
	Seasonal graminoid marsh	0.0	0.0	60.2
	Semi-permanent graminoid marsh	0.0	0.0	25.9
Shallow Open Water	Shallow open water with submersed and/or floating aquatic vegetation	0.0	0.0	0.2
Shrubby Swamp	Seasonal shrubby swamp	0.0	0.0	2.2
Shrubby Fen	Moderate-rich shrubby fen	0.0	0.0	22.3
Graminoid Fen	Moderate-rich graminoid fen	0.0	0.0	0.1
Wetland Subtotal		***1.1***	***0.7***	***151.7***
Agricultural	Dugout	0.0	0.0	0.8
	Tame pasture	2.7	0.3	855.0
Disturbed Land	Disturbed land[d]	1.0	0.5	207.4
Anthropogenic Subtotal		**3.7**	***0.3***	***1063.2***
Grand Total		**21.4**	**1.1**	**1942**

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 2012a)

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

[c] A zero ecosite phase indicates that the overstorey vegetation has been cleared or there has been high mortality in the overstorey, but ecosite moisture and nutrient regime remain unchanged

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

10.2.2.2 1:100 Year Flood

A 1:100 year flood is predicted to cover 480.5 ha in the reservoir (Figure 10-1). Open water (52.8 ha) would be the most affected cover type should a 1:100 year flood occur, followed by shrubland (42.6 ha) and native grasslands (39.2 ha) (Table 10-6). Should a 1:100 year flood occur, 42.2 ha of wetland, mostly graminoid marsh would be inundated for 84 days. Since total inundation for a 1:100 year flood is predicted to be ten days longer than that of a 1:10 year flood, effects to plant communities are expected to be the similar. Land units with shrub and tree strata that are inundated for prolonged periods are expected to become modified grassland ecosites with similar soil moisture and nutrient regimes (Table 10-7).

Table 10-6 Vegetation and Wetland Cover Types Inundated in a 1:100 Year Flood

Cover Type	Land Unit [a, b]	Land Unit Area Inundated in the Reservoir (ha)	Percent of Land Unit in PDA	Total Land Unit Area in the PDA (ha)
Broadleaf Forest	d1 Pine grass Aw	0.0	0.0	0.1
	e1 Snowberry-silverberry Aw-Pb	0.0	0.0	0.3
	f2 Red osier dogwood Pb-Aw	3.5	16.5	21.5
Coniferous Forest	g1 Horsetail Sw	0.0	0.0	6.3
Mixed Forest	b3 Hairy wild rye Aw-Sw-Pl	0.0	0.0	5.2
	e2 Snowberry-silverberry Sw	0.0	0.0	21.6
	e4 Snowberry-silverberry Sw-Aw	0.0	0.0	2.5
	f1 Red osier dogwood Sw	0.0	0.0	2.9
Shrubland	e3 Shrubland - mesic/rich	3.5	17.0	20.8
	f3 Shrubland - subhygric/rich	39.0	28.7	136.2
Native Grassland	b5 Grassland - submesic/medium	5.4	16.8	32.3
	c1 Rough fescue	12.2	6.4	191.0
	d0 Grassland - mesic/medium [c]	0.0	0.0	0.0
	e0 Grassland - mesic/medium [c]	6.7	21.9	30.6
	f4 Grassland - subhygric/rich	14.9	17.3	86.0
	g0 Grassland - hygric/rich [c]	0.0	0.0	8.7
Upland Subtotal		***85.3***	***15.1***	***566.0***
Open Water	Open Water	52.8	32.8	161.0
Open Water Subtotal		***52.8***	***32.8***	***161.0***

Table 10-6 Vegetation and Wetland Cover Types Inundated in a 1:100 Year Flood

Cover Type	Land Unit [a, b]	Land Unit Area Inundated in the Reservoir (ha)	Percent of Land Unit in PDA	Total Land Unit Area in the PDA (ha)
Ephemeral Waterbody	Ephemeral Waterbody	0.3	33.4	1.0
Graminoid Marsh	Temporary graminoid marsh	11.3	28.4	39.8
	Seasonal graminoid marsh	17.2	28.7	60.2
	Semi-permanent graminoid marsh	12.2	47.0	25.9
Shallow Open Water	Shallow open water with submersed and/or floating aquatic vegetation	0.0	0.0	0.2
Shrubby Swamp	Seasonal shrubby swamp	1.1	50.0	2.2
Shrubby Fen	Moderate-rich shrubby fen	0.0	0.0	22.3
Graminoid Fen	Moderate-rich graminoid fen	0.0	0.0	0.1
Wetland Subtotal		***42.2***	***27.8***	***151.7***
Agricultural	Dugout	0.4	50.0	0.8
	Tame pasture	277.9	32.5	855.0
Disturbed Land	Disturbed land[d]	21.8	10.5	207.4
Anthropogenic Subtotal		***300.1***	***28.2***	***1063.2***
Grand Total		**480.5**	**24.7**	**1942**

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 2012a)

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

[c] A zero ecosite phase indicates that the overstorey vegetation has been cleared or there has been high mortality in the overstorey, but ecosite moisture and nutrient regime remain unchanged

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

Table 10-7 Predicted Change in Land Unit due to the 1:100 Year Flood

Baseline Condition	Predicted Ecosite Post-Design Flood
f2 Red osier dogwood Pb Aw	Modified grassland f (subhygric/rich)
e3 Shrubland - mesic/rich, e4 Snowberry-silverberry Sw Aw	Modified grassland e (mesic/rich)
Seasonal shrubby swamp	Graminoid dominated marsh
NOTES: Aw – aspen (*Populus tremuloides*) Pb – balsam poplar (*Populus balsamifera*) Sw – white spruce (*Picea glauca*)	

10.2.2.3 Design Flood

It is estimated that water would be diverted to the reservoir for about 3.75 days during the design flood, would be in the reservoir for 20 days, and 38 days would be needed to drain the reservoir. The reservoir would be flooded for 62 days, covering 816.0 ha (Table 10-2 and Figure 10-1). Most of the affected native communities being upland (234.2 ha, 41% of the PDA), including 7.1 ha (33% of the PDA) of broadleaf forest, 3.1 ha (50% of the PDA) of coniferous forest, 2.5 ha (8% of the PDA) of mixed forest, 86.6 ha (55% of the PDA) of shrubland, 134.9 ha (39% of the PDA) of native grassland (Table 10-8).

Plant species that were commonly found to dominate upland plant communities in the reservoir all have low to no tolerance of anaerobic conditions (United States Department of Agriculture 2017; U.S. Army Corps of Engineers 2016):

- aspen (*Populus tremuloides,* FAC [occurs in wetlands and non-wetlands]
- white spruce (*Picea glauca*, FACU [usually occur in non-wetlands, but may occur in wetlands])
- Canada buffaloberry (*Shepherdia canadensis*, FACU)
- prickly rose *(Rosa acicularis*, FACU)
- silverberry (*Elaeagnus commutate*, UPL [almost always occurs in uplands])

Thus, it is unlikely that these species would survive prolonged flooding such as that predicted to occur for the design flood. Therefore, it is anticipated that there would be high mortality of species in every stratum (tree, shrub, etc.) comprising upland plant communities. Species that are lost would be replaced, in time, by species within the seedbank, surviving propagules or that can seed-in from surrounding areas.

Plant adaptations such as prolific production of seed—as occurs in goosefoot species (*Chenopodium* spp.), or elongation of shoots in response to flood such as that observed in water smartweed (*Persicaria amphibia*) and dock species (*Rumex* spp) (Blom and Voesenek 1996)—increases these plants ability to survive and/or recolonize after a flood. These species were commonly observed in the reservoir; therefore, they may increase in abundance during post-flood.

Approximately 234.2 ha (41% of the PDA) of upland in the reservoir would be inundated by a design flood, and Table 10-9 lists expected changes in upland forest and shrubland cover types as a result. During post-design flood, these areas are expected to become modified grassland ecosites with similar soil moisture and nutrient regimes as indicated in Table 10-9. After flood waters recede and soil moisture levels return to baseline conditions (See Volume 3B, Section 9.2.3.3 for predicted timeline), surviving plant propagules (e.g., stem and root segments, seeds, rhizomes), in addition to seeds blown-in from surrounding area, would likely begin to grow and recolonize the area.

A design flood would inundate, in the reservoir, approximately 450.4 ha (55% of the PDA) agricultural and disturbed land and 70.3 ha (9% of the PDA) is wetland; little effect is expected in these areas due to the dominance of non-native plants species and flood tolerant species. Plants species that comprise wetland plant communities have inherent adaptation to seasonal or periodic flooding (Cronk and Fennessy 2001). Thus, wetland plant communities would be more tolerant to prolonged flooding. There may be some exceptions, and mortality could occur in the tree or shrub strata; therefore, it is predicted that seasonal shrubby swamp may recover as graminoid dominated marsh following flooding. Additionally, 0.2 ha of ephemeral and 4.1 ha of temporary marshes, may be altered by the duration of flooding to conditions more comparable to seasonally or semi-permanently flooded wetlands for at least one growing season. Alternatively, they might be dominated by areas of open water similar to an open water phase of seasonally or semi-permanently flooded wetlands at a hydroperiod maximum.

Table 10-8 Vegetation and Wetland Cover Types Inundated during the Design Flood

Cover Type	Land Unit [a, b]	Land Unit Area Inundated in the Reservoir (ha)	Percent of Land Unit in PDA%	Total Land Unit Area in the PDA (ha)
Broadleaf Forest	d1 Pine grass Aw	0.0	0.0	0.1
	e1 Snowberry-silverberry Aw-Pb	0.0	0.0	0.3
	f2 Red osier dogwood Pb-Aw	7.1	33.0	21.5
Coniferous Forest	g1 Horsetail Sw	3.1	49.7	6.3
Mixed Forest	b3 Hairy wild rye Aw-Sw-Pl	0.0	0.0	5.2
	e2 Snowberry-silverberry Sw	0.0	0.0	21.6
	e4 Snowberry-silverberry Sw-Aw	1.6	63.1	2.5
	f1 Red osier dogwood Sw	0.9	32.1	2.9
Shrubland	e3 Shrubland - mesic/rich	6.9	33.2	20.8
	f3 Shrubland - subhygric/rich	79.7	58.5	136.2
Native Grassland	b5 Grassland - submesic/medium	6.3	19.6	32.3
	c1 Rough fescue	78.0	40.8	191.0
	d0 Grassland - mesic/medium [c]	0.0	0.0	0.0
	e0 Grassland - mesic/medium [c]	12.0	39.3	30.6
	f4 Grassland - subhygric/rich	35.2	40.9	86.0
	g0 Grassland - hygric/rich [c]	3.3	37.7	8.7
Upland Subtotal		***234.2***	***41.4***	***566.0***
Open Water	Open Water	61.2	38.0	161.0
Open Water Subtotal		***61.2***	***38.0***	***161.0***
Ephemeral Waterbody	Ephemeral Waterbody	0.4	39.8	1.0

Table 10-8 Vegetation and Wetland Cover Types Inundated during the Design Flood

Cover Type	Land Unit [a, b]	Land Unit Area Inundated in the Reservoir (ha)	Percent of Land Unit in PDA%	Total Land Unit Area in the PDA (ha)
Graminoid Marsh	Temporary graminoid marsh	23.7	59.6	39.8
	Seasonal graminoid marsh	31.7	52.7	60.2
	Semi-permanent graminoid marsh	13.3	51.2	25.9
Shallow Open Water	Shallow open water with submersed and/or floating aquatic vegetation	0.2	100.0	0.2
Shrubby Swamp	Seasonal shrubby swamp	1.1	50.0	2.2
Shrubby Fen	Moderate-rich shrubby fen	0.0	0.0	22.3
Graminoid Fen	Moderate-rich graminoid fen	0.0	0.0	0.1
Wetland Subtotal		***70.3***	***46.4***	***151.7***
Agricultural	Dugout	0.4	50.0	0.8
	Tame pasture	373.1	43.6	855.0
Disturbed Land	Disturbed land[d]	76.8	37.0	207.4
Anthropogenic Subtotal		***450.4***	***42.4***	***1,063.2***
Grand Total		**816**	**42**	**1,942**

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 2012a)

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

[c] A zero ecosite phase indicates that the overstorey vegetation has been cleared or there has been high mortality in the overstorey, but ecosite moisture and nutrient regime remain unchanged

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

Table 10-9 Predicted Change in Land Unit due to the Design Flood

Baseline Condition	Predicted Ecosite Post-Design Flood
f1 Red osier dogwood Sw, f2 Red osier dogwood Pb Aw, f3 Shrubland - subhygric/rich	Modified grassland f (subhygric/rich)
g1 Horsetail Sw	Modified grassland g (hygric/rich)
e3 Shrubland - mesic/rich, e4 Snowberry-silverberry Sw Aw	Modified grassland e (mesic/rich)
Seasonal shrubby swamp	Graminoid dominated marsh
NOTES: Aw – aspen (*Populus tremuloides*) Sw – white spruce (*Picea glauca*)	

Table 10-10 shows the change in area of communities following the 1:10, 1:100 and the design flood.

Sediment resulting from the design flood would cover 375.4 ha of the reservoir. Most of the sediment deposition would be to 1-3 cm deep (193 ha, 51%) followed by 10-100 cm deep (105 ha, 28%); 41 ha (11%) would be covered by more than 100 cm and 37 ha (10%) would be covered by 3-10 cm (Figure 10-2 and Table 10-11). Wang et al. (2013) found that sedimentation of less than 3 cm did not significantly affect germination rates in wetland plant communities. Therefore, no effect on the 18.3 ha of wetland plant communities that would be covered by less than 3 cm of sediment is anticipated, though minor effects to germination of annuals may still occur. Information on the effect of sedimentation on the germination of upland plant species is not available in the literature; however, the effect of sediment on germination is presumed to be similar for upland and wetland plant species because it is known that changes to the microsite in which a seed settles affects the probability of seed germination, seedling emergence and survival.

Kui and Stella (2016) have shown that burial of plants by more than 10 cm of sediment results in total mortality, and species that were partially buried, where greater than 20 cm of the stem was exposed, tended to survive. Therefore, sediment deposition between 10 cm and 100 cm would likely result in mortality of species in the herb and short shrub strata, but species in the tall shrub and tree strata would likely survive. Loss of species in the short shrub and herb strata would eventually be replaced through recruitment from surrounding areas.

The design flood would cover 40.8 ha in the reservoir in greater than 100 cm of sediment, which would likely cause mortality of species in the tall shrub and tree strata. The resultant predicted effects of flood duration and sediment deposition of a design flood are included in Table 10-4.

Table 10-10 Change in Vegetation and Wetland Cover Type Abundance in the LAA

Cover Type	Land Unit [a,b]	Area of Vegetation and Wetland Cover Types in the LAA (ha)				Change from Existing Condition					
		Existing Condition	Post 1:10 Year Flood	Post 1:100 Year Flood	Post Design Flood	Post 1:10 Year Flood		Post 1:100 Year Flood		Post Design 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	65.3	61.8	58.2	0.0	0.0	-3.5	-5.4	-7.1	-10.9
	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	168.3	168.3	165.2	0.0	0.0	0.0	0.0	-3.1	-1.9
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	9.6	9.6	8.1	0.0	0.0	0.0	0.0	-1.6	-16.1
	f1 Red osier dogwood Sw	69.1	69.1	69.1	68.1	0.0	0.0	0.0	0.0	-0.9	-1.3
Shrubland	e3 Shrubland - mesic/rich	81.9	81.0	78.3	75.0	-0.9	-1.1	-3.6	-4.4	-6.9	-8.4
	f3 Shrubland - subhygric/rich	243.1	242.5	204.0	163.4	-0.6	-0.2	-39.0	-16.1	-79.7	-32.8

Table 10-10 Change in Vegetation and Wetland Cover Type Abundance in the LAA

Cover Type	Land Unit [a,b]	Area of Vegetation and Wetland Cover Types in the LAA (ha)				Change from Existing Condition					
		Existing Condition	Post 1:10 Year Flood	Post 1:100 Year Flood	Post Design Flood	Post 1:10 Year Flood		Post 1:100 Year Flood		Post Design Flood	
						ha	%	ha	%	ha	%
Native Grassland	b5 Grassland - submesic/medium	41.9	41.9	41.9	41.9	0.0	0.0	0.0	0.0	0.0	0.0
	c1 Rough fescue	372.9	372.9	372.9	372.9	0.0	0.0	0.0	0.0	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	22.7	25.4	30.3	0.9	4.1	3.6	16.5	8.5	38.8
	f4 Grassland - subhygric/rich	70.3	70.9	112.9	158.1	0.6	0.9	42.6	60.5	87.7	124.7
	g0 Grassland - hygric/rich [c]	8.7	8.7	8.7	11.8	0.0	0.0	0.0	0.0	3.1	36.1
Upland Subtotal		***1584.8***	***1584.8***	***1584.8***	***1584.8***	***0.0***	***0.0***	0.0	0.0	***0.0***	***0.0***
Open Water	Open Water	279.9	279.9	279.9	279.9	0.0	0.0	0.0	0.0	0.0	0.0
Open Water Subtotal		***279.9***	***279.9***	***279.9***	***279.9***	***0.0***	***0.0***	0.0	0.0	***0.0***	***0.0***
Ephemeral Waterbody	Ephemeral Waterbody	4.9	4.9	4.9	4.9	0.0	0.0	0.0	0.0	0.0	0.0
Graminoid Marsh	Temporary graminoid marsh	87.4	87.4	87.4	87.4	0.0	0.0	0.0	0.0	0.0	0.0
	Seasonal graminoid marsh	98.1	98.1	99.2	99.2	0.0	0.0	1.1	1.1	1.1	1.1
	Semi-permanent graminoid marsh	30.4	30.4	30.4	30.4	0.0	0.0	0.0	0.0	0.0	0.0

Table 10-10 Change in Vegetation and Wetland Cover Type Abundance in the LAA

Cover Type	Land Unit [a,b]	Area of Vegetation and Wetland Cover Types in the LAA (ha)				Change from Existing Condition					
		Existing Condition	Post 1:10 Year Flood	Post 1:100 Year Flood	Post Design Flood	Post 1:10 Year Flood		Post 1:100 Year Flood		Post Design Flood	
						ha	%	ha	%	ha	%
Shallow Open Water	Shallow open water with submersed and/or floating aquatic vegetation	7.2	7.2	7.2	7.2	0.0	0.0	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	5.0	3.9	3.9	0.0	0.0	-1.1	-21.9	-1.1	-21.9
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***	***296.3***	***296.3***	***296.3***	***0.0***	***0.0***	0.0	0.0	***0.0***	***0.0***
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	1.9	1.9	1.9	0.0	0.0	0.0	0.0	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	1488.1	1488.1	1488.1	1488.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 10-10 Change in Vegetation and Wetland Cover Type Abundance in the LAA

Cover Type	Land Unit [a,b]	Area of Vegetation and Wetland Cover Types in the LAA (ha)				Change from Existing Condition					
		Existing Condition	Post 1:10 Year Flood	Post 1:100 Year Flood	Post Design Flood	Post 1:10 Year Flood		Post 1:100 Year Flood		Post Design Flood	
						ha	%	ha	%	ha	%
Disturbed Land	Disturbed land[d]	413.7	413.7	413.7	413.7	0.0	0.0	0.0	0.0	0.0	0.0
Anthropogenic Subtotal		***2699.0***	***2699.0***	***2699.0***	***2699.0***	***0.0***	***0.0***	0.0	0.0	***0.0***	***0.0***
Grand Total		**4860**	**4860**	**4860**	**4860**						

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*)

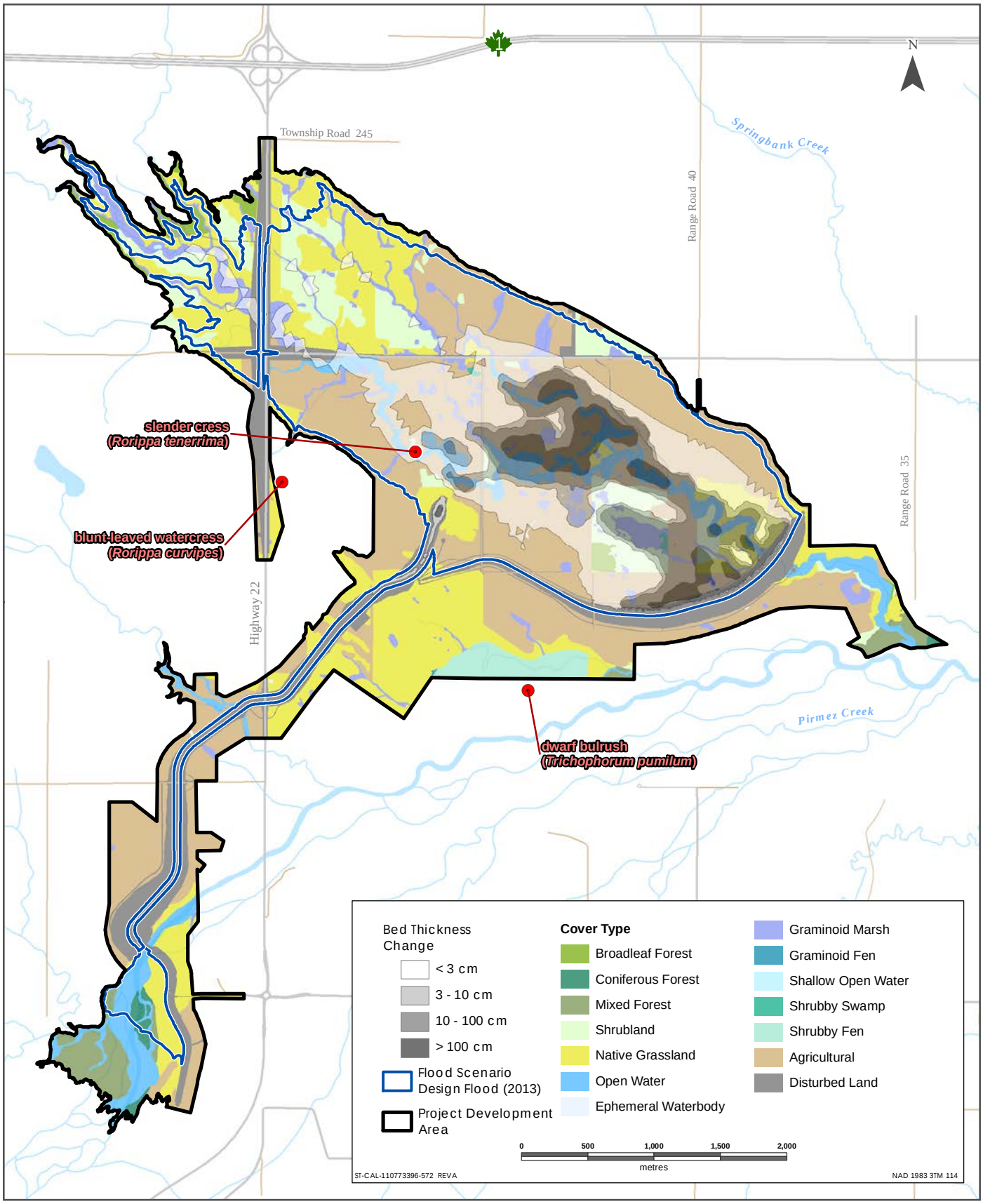
Sw – white spruce (*Picea glauca*)

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

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

[c] A zero ecosite phase indicates that the overstorey vegetation has been cleared or there has been high mortality in the overstorey, but ecosite moisture and nutrient regime remain unchanged

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



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

Sediment Deposition Pattern in the PDA Post Design Flood

Stantec

Table 10-11 Area of Vegetation and Wetland Land Units within Predicted Post-Design Flood Sediment Depth Levels

Cover Type	Land Unit [a,b]	Baseline Condition	Area and Proportion of Vegetation and Wetland Covered by each Sediment Threshold							
			< 3 cm		3 - 10 cm		10 - 100 cm		> 100 cm	
			ha	%	ha	%	ha	%	ha	%
Broadleaf forest	d1 Pine grass Aw	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	e1 Snowberry-silverberry Aw-Pb	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	f2 Red osier dogwood Pb-Aw	10.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coniferous forest	g1 Horsetail Sw	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed forest	b3 Hairy wild rye Aw-Sw-Pl	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	e2 Snowberry-silverberry Sw	21.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	e4 Snowberry-silverberry Sw-Aw	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	f1 Red osier dogwood Sw	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shrubland	e3 Shrubland - mesic/rich	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	f3 Shrubland - subhygric/rich	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland	b5 Grassland – submesic/medium	25.3	0.8	3.0	2.1	8.2	2.4	9.7	0.0	0.0
	c1 Rough fescue	178.8	3.9	2.2	0.0	0.0	0.0	0.0	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
	e0 Grassland - mesic/medium [c]	30.3	1.0	3.1	1.0	3.4	7.5	24.7	0.8	2.5
	f4 Grassland - subhygric/rich	156.7	26.5	16.9	7.1	4.6	11.3	7.2	2.7	1.7
	g0 Grassland - hygric/rich [c]	11.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Upland Subtotal		***473.3***	***32.1***	***6.8***	***10.3***	***2.2***	***21.3***	***4.5***	***3.4***	***0.7***

Table 10-11 Area of Vegetation and Wetland Land Units within Predicted Post-Design Flood Sediment Depth Levels

Cover Type	Land Unit [a,b]	Baseline Condition	Area and Proportion of Vegetation and Wetland Covered by each Sediment Threshold							
			< 3 cm		3 - 10 cm		10 - 100 cm		> 100 cm	
			ha	%	ha	%	ha	%	ha	%
Open Water	Open Water	98.8	12.8	12.9	4.9	5.0	21.6	21.9	12.2	12.3
	Open Water Subtotal	***98.8***	***12.8***	***12.9***	***4.9***	***5.0***	***21.6***	***21.9***	***12.2***	***12.3***
Ephemeral waterbody	Ephemeral waterbody	0.7	0.2	28.6	0.0	5.7	0.0	0.0	0.0	0.0
Graminoid marsh	Seasonal graminoid marsh	44.0	10.9	24.8	3.5	8.0	2.7	6.2	0.4	0.9
	Semi-permanent graminoid marsh	13.7	3.2	23.0	0.0	0.3	6.5	47.3	0.2	1.7
	Temporary graminoid marsh	27.2	4.1	14.9	0.2	0.9	1.5	5.4	0.4	1.4
Shallow Open Water	Shallow open water with submersed and/or floating aquatic vegetation	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Graminoid fen	Moderate-rich graminoid fen	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shrubby fen	Moderate-rich shrubby fen	22.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland Subtotal	***108.2***	***18.3***	***16.9***	***3.8***	***3.5***	***10.7***	***9.9***	***1.0***	***0.9***
Agricultural	Dugout	0.4	0.0	0.0	0.1	31.7	0.3	68.3	0.0	0.0
	Tame Pasture	572.3	118.4	20.7	17.0	3.0	45.8	8.0	23.7	4.1
Disturbed Land	Disturbed Land	184.5	10.9	5.9	1.2	0.6	5.0	2.7	0.5	0.3
	Anthropogenic Subtotal	***757.2***	***129.3***	***17.1***	***18.4***	***2.4***	***51.0***	***6.7***	***24.2***	***3.2***
	Grand Total	**1437.6**	**192.6**	**13.4**	**37.4**	**2.6**	**104.6**	**7.3**	**40.8**	**2.8**

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

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

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

[c] A zero ecosite phase indicates that the overstorey vegetation has been cleared or there has been high mortality in the overstorey, but ecosite moisture and nutrient regime remain unchanged

A total of 37.4 ha of the reservoir would be covered with between 3 cm and 10 cm of sediment (Table 10-11). Sediment of this depth has been shown to negatively affect vegetation productivity; however, high rates of mortality have not been observed (Van der Valk and Bliss 1971; Van der Valk et al. 1983; Limon and Peco 2016). Changes in productivity may result in small shifts in plant community composition. It is anticipated that there may be a loss of abundance or distribution of some species of a plant community, though most plant species comprising upland and wetland plant communities at existing conditions are retained, in addition to recruitment of new species, as has been observed in previous studies by Van der Valk and Bliss (1971), Van der Valk et al. (1983), and Limon and Peco (2016). Therefore, small shifts in plant community composition may occur, but a complete shift to a new plant community is not anticipated.

Areas of deeper sediments and higher plant mortality may also be readily colonized by listed weed species and invasive plants. Six species of *noxious* weeds were observed in the reservoir and six *prohibited noxious* and 15 *noxious* weed species have been observed in Calgary (see Volume 3A, Section 10.2). These plants are prolific seed producers and tend to dominate colonized areas (Alberta Native Plant Council 2015). To help mitigate potential effects from sediment deposition and weeds, areas should be seeded with an Alberta Transportation custom native seed mix to promote reestablishment of native plant species within upland plant communities. A seed mix is not recommended for wetland areas because most weeds in Alberta, including species observed during field surveys, are not tolerant of periodic flooding and anoxic soils.

No vegetation and wetland land units are completely lost, and no lasting effects to vegetation and wetlands would be anticipated as a result of a 1:10 year, 1:100 year or design flood. Therefore, effects to plant community diversity are anticipated to be adverse, restricted to the project development area (PDA), low in magnitude and medium-term.

Effects on ecological communities of management concern are not anticipated because rare ecological communities were not identified from a review of Alberta Conservation Information Management System (ACIMS) records (ACIMS 2016a) or during field surveys of the PDA.

10.2.3 Change in Species Diversity

10.2.3.1 Species of Management Concern

1:10 Year Flood

All plant SOMC occurrences occur outside the spatial extent of the 1:10 year flood (Figure 10-1). Therefore, effects on plant SOMC as a result of a 1:10 year flood are not anticipated.

1:100 Year and Design Flood Event

One occurrence of slender cress (*Rorippa tenerrima*), an S3 tracked species (ACIMS 2016a), was observed within the extent of both the 1:100 year and the design flood (Figure 10-1). Should a design flood occur, it is predicted 1 cm to 3 cm sedimentation would cover the slender cress location (Figure 10-2). Although *slender cress* can be found in upland or wetland habitats (Kershaw et al. 2001), it is not tolerant of submerged environments (Flora of North America 2017); therefore, it is unlikely to survive the design flood (estimated flooded duration of 41.7 days). There is a lack of information in the literature on the germination and growth requirements of this species; however, it is known that this species is generally found in moist to wet soil conditions (Kershaw et al. 2001). It is unknown if seeds present in the seedbank would survive prolonged submersion as would occur during the design flood and germinate after soil moisture has returned to baseline conditions (See Volume 3B Section 9.2.3.3 for predicted timeline). The plant is assumed lost from the PDA.

Undocumented plant SOMC occurrences may be present within the PDA and could be affected by the flood. Undocumented occurrences could be present because many rare species have low numbers, are small and difficult to identify and do not always have above ground structures due to climatic conditions (see Volume 3A, Section 10.4) of Volume 3A). None of the species found during field surveys are *Species at Risk Act* (SARA) listed.

Due to the loss of one observed rare plant and assumed loss of undocumented plants, the design flood is expected to result in single occurrence, long-term, adverse, and likely irreversible residual effect. Timing is not applicable because effects from project activities would be similar regardless of season or other timing characteristics. The one documented rare plant occurrence is located in the flood and sediment zone, and the Project would result in the loss of the only known occurrence in the regional assessment area (RAA). The plant may re-establish from the seedbank, but is assumed lost in this assessment. Due to the lack of information of rare plant occurrences in the RAA a loss of a single rare plant occurrence at the local scale does not imply moderate magnitude effects at the regional scale. Slender cress habitat is present in the RAA, and therefore, it is likely that there are other occurrences of slender cress in the RAA that are currently undocumented.

10.2.3.2 Traditional Use Plant Species

Many of the plant species potentially used for traditional purposes presented in Volume 3A, Table 10-7 are upland species and likely do not have adaptions to survive prolonged flooded conditions.

It is likely, should a 1:10 year, 1:100 year or design flood occur, there would be mortality of traditional plant use species found in upland plant communities. Because these species are common (Volume 3A, Section 10.4) and widespread, it is likely that reestablishment of these species would occur by natural recruitment over time. Therefore, permanent loss of traditional plant use species is not anticipated.

Because plants potentially used for traditional purposes would likely only be temporarily affected and likely re-establish following a 1:10 year, 1:100 year or design flood, effects are expected to be adverse, but local in extent and short-term in duration. Frequency is single event but reversible. Timing is not applicable because effects from Project activities would be similar regardless of season or other timing characteristics.

10.2.4 Change in Wetland Functions

1:10 Year Flood

Seasonal or periodic flooding of wetlands is part of a natural cycle that can vary due to, for example, seasonal or annual climatic conditions (Brock 2000, Stewart and Kantrud 1971). Prolonged flooded conditions can affect the abundance and distribution of some species, and provide new habitat for others. The duration of inundations from the 1:10 year flood is 74 days. This is likely to alter wetland function (i.e., habitat, biogeochemistry and hydrology) due to the prolonged duration of flooded conditions; however, the extent of the 1:10 year flood is predicted to only affect a small area. Should a 1:10 year flood occur, 0.1 ha (1%) of high value and 0.1 ha (2%) of moderate value wetland area would be temporarily affected.

1:100 Year Flood

The duration of a 1:100 year flood is 84 days, 10 days longer, and covers approximately 22 times more area than a 1:10 year flood, and is 22 days shorter and covers just over half the area compared to a design flood. Therefore, effects to wetland functions are anticipated to be more than that predicted should a 1:10 year flood occur, but be less than that of a design flood.

Design Flood

Inundation due to a design flood would temporarily affect 3.7 ha in the reservoir (86% of the PDA) of high value, 7.1 ha (83%) of moderate value, 1.2 ha (51%) of moderately low value wetland area (Table 10-12). Wetland functions of habitat, plant and wildlife, and hydrology

would likely be reduced in these areas as plant composition may be altered and cover reduced, at least for a growing season, and lower class marsh and swamp wetlands would be flooded for a duration and depth beyond natural variation, a few days to a few weeks (Stewart and Kantrud 1971 and ESRD 2015). Biogeochemistry may also be altered, but likely positively due to increased nutrient input from river sediment and debris. Flooding has been shown to increase sediment deposition in wetlands, and flood frequency increases nutrient cycling (Wray and Bayley 2006). The inundation duration from the design flood is 62 days and deposition of sediment greater than 3 cm would likely alter wetland plant composition and abundance. It has been observed that sediment deposition of 3 cm to 4 cm is enough to affect productivity of wetland plant species in Alberta (Van der Valk and Bliss 1971). Deposition of sediment is likely to alter wetland topography, resulting in changes to surface flow and alteration of wetland basin shape and depth. Together, these changes could result in a reduction of 1.4 ha in the reservoir (33% of the PDA) of high value, 3.4 ha (40%) of moderate value and 0.04 ha (2%) of moderately low value wetland area in the LAA (Table 10-12) and result in altered surface flow patterns.

Thus, residual effects of a design flood are expected to be adverse and moderate in magnitude because of the extent of sediment deposition greater than 3 cm, medium-term and reversible due to recolonization of wetland vegetation. Timing was found to be not applicable as effects from Project activities would be similar regardless of season or other timing characteristics.

Table 10-12 Change in Estimated Area of Wetland Value in the PDA

Wetland Value	Estimated Area of Wetland Value in the PDA (ha)				Change from Baseline Condition to					
					1:10 Year Flood Inundation		Design Flood Inundation		Design Flood Sediment	
	Baseline Condition	1:10 Year Flood Inundation	Design Flood Inundation	Design Flood Sediment	ha	% of PDA	ha	% of PDA	ha	% of PDA
High (A-Value)	4.4	4.3	0.6	2.9	-0.1	-1.3	-3.7	-85.6	-1.4	-33.1
Moderate (B-Value)	8.5	8.4	1.5	5.1	-0.1	-1.7	-7.1	-82.7	-3.4	-40.0
Moderately Low (C-Value)	2.4	2.4	1.2	2.4	0.0	0.0	-1.2	-50.5	0.0	-1.6
Low (D-Value)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**15.3**	**15.1**	**3.3**	**10.4**	**-0.2**	**-1.3**	**-12.0**	**-78.4**	**-4.9**	**-32.0**

SOURCE:
[a] Government of Alberta 2015

10.2.5 Summary of Project Residual Effects

Table 10-13 summarizes the residual environmental effects on vegetation and wetlands during flood and post-flood operations.

Table 10-13 Project Residual Effects on Vegetation and Wetlands 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 Community Diversity	F/PF	N/A	A	L	PDA	MT	S	R	D
Change in Species Diversity	F	N/A	A	M	PDA	LT	S	I	D
Change in Wetland Functions	F/PF	N/A	A	M	PDA	MT	S	R	D

KEY

See Table 10-2 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;
MT: Medium-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/Socio-Economic Context:
D: Disturbed
U: Undisturbed

10.3 DETERMINATION OF SIGNIFICANCE

A significant environmental effect on vegetation and wetlands is one that:

- threatens the long-term persistence or viability of a plant species or community in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of recovery plans, action plans and management plans or
- results in unreplaced loss or disturbances of wetlands that has not been given prior approval by Alberta Environment and Parks or
- threatens the long-term availability of traditionally use plants within the regional assessment area.

Residual project effects are predicted to be significant, at a local scale, should a design flood occur because it would result in the loss of the only known occurrence of slender cress plant SOMC from the PDA. Due to the lack of information of rare plant occurrences in the RAA, a loss of a single rare plant occurrence at the local scale does not imply a significant effect at the regional scale. Slender cress habitat is present in the RAA and, therefore, it is likely that there are other occurrences of slender cress in the RAA that are currently undocumented.

Residual project effects to community diversity, traditional plant use and wetland functions are not anticipated because plant communities are expected to recover post-flood.

10.4 PREDICTION CONFIDENCE

Prediction confidence is moderate, because there is uncertainty around the abundance and distribution of plant and ecological communities of management concern in the RAA.

10.5 CONCLUSIONS

Residual effects on vegetation and wetlands post-flood would not result in the loss of native upland and wetland plant communities, or wetland functions from the LAA. Effects on one rare plant as well as the potential for effects on unidentified plant SOMC could occur. It is likely that habitat for plant SOMC exists elsewhere in the RAA as affected vegetation and wetland land units exist elsewhere in the RAA (see Volume 3A, Section 10.4). Effects on plant communities of management concern are not anticipated, because none were identified within the RAA.

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10.7 GLOSSARY

Anoxia	Total depletion of oxygen in a medium
Ecological Communities of Management Concern	Plant communities tracked by ACIMS, generally ranked S1, S2 and sometimes S3.
Ecosite	Ecological units that develop under similar environmental influences (climate, moisture, nutrients, substrates), frequently linked to particular landforms, slope positions and vegetation associations
Grassland	An area dominated by grass species occurring on sites that are arid or at least well-drained

Forb	Primarily broad-leaved flowering plants with net-like veins. For simplifying identification, the category can be broadened to include those parallel-veined plants with brightly coloured flowers such as orchids or lilies
Hydraulic Conductivity	Is a measure of the rate of water movement through soil
Metabolism	Chemical reactions by cellular respiration and anabolism. For example, the breaking down of glucose by cells in the roots of plants.
Moisture Regime	Represents the available moisture supply for plant growth on a relative scale. It is assessed through an integration of species composition and soil and site characteristics. Moisture regime ranges from very dry to wet
Nutrient regime	The amount of essential nutrients that are available for plant growth. Determining a soil nutrient regime for any given site (on a relative scale from very poor to very rich) requires the consideration of many environmental and biotic parameters
Plant Community	A combination of plants occurring together under a set of environmental conditions reflecting substrate, moisture and nutrient regimes, solar radiation, and site characteristics such as slope, aspect and climate
Plant Species of Management Concern	Species listed as *at risk* or *may be at risk* on the *Species at Risk Act* (Government of Canada 2016), the Committee on the Status of Endangered Wildlife Species in Canada (Government of Canada 2016), the General Status of Alberta Wild Species (ESRD 2012b) or tracked by the Alberta Conservation Information Management System (ACIMS), generally ranked S1, S2, and sometimes S3 (ACIMS 2016b).
Regulated Weed	Plant species listed as *prohibited noxious* or *noxious* in the *Alberta Weed Control Regulation*. Non-native invasive species that are aggressive competitors to native species are also assessed in this report. Exotic species, those that are designated as non-native in origin by ACIMS (2016c), are not considered weeds in this assessment.

Riparian	Plant communities adjacent to a wetland, watercourse or lake that are influenced by elevated water tables and flooding. These plant communities are transitional areas between wetlands and uplands, and as a result have relatively greater species diversity (Clare and Sass 2012).
Shrub	A woody perennial plant differing from a tree by its low stature (<5 metres) and by usually producing several basal shoots instead of a single trunk
Shrubland	An area dominated by shrubs
Soil	The naturally occurring, unconsolidated mineral or organic material at least 10 cm thick that occurs at the earth's surface and is capable of supporting plant growth
S1	Known from five or fewer occurrences or especially vulnerable to extirpation because of other factor(s)
S2	Known from twenty or fewer occurrences, or vulnerable to extirpation because of other factors
S3	Known from 100 or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factors
S4	Apparently secure – taxon is uncommon but not rare; potentially some cause for long term concern due to declines or other factors
S5	Secure – taxon is common, widespread and abundant
S#S#	A numeric range rank (e.g., S2S3 or S1S3) is used to indicate any range of uncertainty about the status of the taxon. Ranges cannot skip more than two ranks (e.g., SU is used rather than S1S4)
SU	Taxon is currently unrankable due to lack of information or due to substantially conflicting information (e.g., native vs. non-native status not resolved)
SNR	Not ranked – conservation status not yet assessed

SNA	Not Applicable – a conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities (e.g., introduced species)
Traditionally used plants	Plants that are identified and documented to be used by First Nations for food, medicine or spiritual purposes.
Upland Plant Communities	Plant assemblages that exist in areas where the soil is not saturated for extended periods of time (Natural Regions Committee 2006), and were classified at different scales based on the level of information available. At the local assessment area, upland plant communities were classified to ecosite phase, and at the regional assessment area were classified to cover type. Ecosites are plant assemblages that develop under similar environmental conditions such as climate, soil moisture and nutrient regime. Plant communities can be further subdivided into ecosite phases, which are distinguished using dominant species in the highest strata. Cover types are broad categories based on dominant canopy cover.
Wetland function	Includes water filtration and storage, flood attenuation, habitat, carbon sequestration, and nutrient cycling (Government of Canada 1991). Under the Alberta Wetland Policy, wetland value has been determined by section through examination of five variables: the relative abundance of a wetland type, human uses, water filtration, hydrologic function and habitat (Government of Alberta 2013).
Wetland Plant Communities	Areas where soils are saturated with water for enough time that water altered soils are present and there is establishment and growth of water tolerant vegetation (National Wetlands Working Group 1997).