Table of Contents

6 TERRESTRIAL 6.1
6.1 LAND USE AND LAND MANAGEMENT 6.1
Question 362 ..... 6.1
6.2 CONSERVATION AND RECLAMATION 6.3
Question 363 ..... 6.3
Question 364 ..... 6.7
Question 365 ..... 6.7
Question 366 ..... 6.9
Question 367 ..... 6.11
Question 368 ..... 6.15
Question 369 ..... 6.21
Question 370 ..... 6.22
Question 371 ..... 6.26
Question 372 ..... 6.27
Question 373 ..... 6.29
6.3 TERRAIN AND SOILS 6.31
Question 374 ..... 6.31
Question 375 ..... 6.34
Question 376 ..... 6.37
Question 377 ..... 6.39
Question 378 ..... 6.41
Question 379 ..... 6.44
Question 380 ..... 6.45
Question 381 ..... 6.45
Question 382 ..... 6.54
Question 383 ..... 6.56
Question 384 ..... 6.57
Question 385 ..... 6.62
Question 386 ..... 6.75
Question 387 ..... 6.76
Question 388 ..... 6.80
Question 389 ..... 6.83
Question 390 ..... 6.85
Question 391 ..... 6.87
Question 392 ..... 6.88
Question 393 ..... 6.92
Question 394 ..... 6.93
Question 395 ..... 6.96
Question 396 ..... 6.97
Question 397 ..... 6.98
Question 398 ..... 6.100
Question 399 ..... 6.101

Question 400 ..... 6.103
6.4 VEGETATION 6.105
Question 401 ..... 6.105
Question 402 ..... 6.105
Question 403 ..... 6.108
Question 404 ..... 6.109
Question 405 ..... 6.115
Question 406 ..... 6.116
Question 407 ..... 6.117
6.5 WILDLIFE 6.119
Question 408 ..... 6.119
Question 409 ..... 6.122
Question 410 ..... 6.123
Question 411 ..... 6.126
Question 412 ..... 6.129
Question 413 ..... 6.130
Question 414 ..... 6.132
Question 415 ..... 6.134
Question 416 ..... 6.135
Question 417 ..... 6.136
Question 418 ..... 6.136
Question 419 ..... 6.139
Question 420 ..... 6.140
Question 421 ..... 6.142
Question 422 ..... 6.144
Question 423 ..... 6.145
Question 424 ..... 6.146
Question 425 ..... 6.147
Question 426 ..... 6.147
Question 427 ..... 6.148
Question 428 ..... 6.153
Question 429 ..... 6.155
Question 430 ..... 6.156
Question 431 ..... 6.188
Question 432 ..... 6.189
Question 433 ..... 6.191
Question 434 ..... 6.192
Question 435 ..... 6.193

LIST OF TABLES

Table IR368-1 Soil Units in the Terrain and Soils LAA at Post-Construction (from Volume 3A, Section 9, Table 9-13) 6.18
Table IR368-2 Changes in Areas of Agricultural Land Capability (from Volume 3A, Section 9, Table 9-14) 6.19
Table IR371-1 Native Seed Mix for Zone 6 ..... 6.27
Table IR373-1 Potential Erosion Control Mix 6.29
Table IR373-2 Native Seed Mix for Zone 6 ..... 6.30
Table IR381-1 Erosion Control Measures – Source Control (from Table 7.3 in the Erosion and Sediment Control Manual) 6.49
Table IR388-1 Comparison of Parameters for Sampled Sediment and Soil 6.81
Table IR392-1 Comparison of Baseline Groundwater Electrical Conductivity and Sodium Adsorption Ratio to Salt Contamination and Remediation Guidelines for Soil[1] 6.90
Table IR404-1 Observed Plants Lacking Sufficient Characteristics for Positive Species Identification and Potential Rare Plant Species 6.111
Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations 6.157

LIST OF FIGURES

Figure IR363-1 Permanent and Temporary Features of the Project (from Volume 4, Appendix D, Figure 2-2) 6.4
Figure IR368-1 Areas of Topsoil and Subsoil Salvage and Replacement in the PDA 6.17
Figure IR368-2 Agricultural Land Capability Classes for the Project Development Area and Local Assessment Area at Post-construction 6.20
Figure IR370-1 Topsoil Reclamation Suitability for the Project Development Area and Local Assessment Area at Post-construction 6.24
Figure IR370-2 Subsoil Reclamation Suitability for the Project Development Area and Local Assessment Area at Post-construction 6.25
Figure IR375-1 Location of Soil To Be Used For Project Construction 6.36
Figure IR384-1 Structures in the PDA 6.60
Figure IR385-1 Soil Map Units in the Project Development Area and Local Assessment Area, Area 1 ..... 6.64
Figure IR385-2 Soil Map Units in the Project Development Area and Local Assessment Area, Area 2 ..... 6.65
Figure IR385-3 Soil Map Units in the Project Development Area and Local Assessment Area, Area 3 ..... 6.66
Figure IR385-4 Soil Map Units in the Project Development Area and Local Assessment Area, Area 4 ..... 6.67

Figure IR385-5 Soil Map Units in the Project Development Area and Local Assessment Area, Area 5 ..... 6.68
Figure IR385-6 Soil Map Units in the Project Development Area and Local Assessment Area, Area 6 ..... 6.69
Figure IR385-7 Soil Map Units in the Project Development Area and Local Assessment Area, Area 7 ..... 6.70
Figure IR385-8 Soil Map Units in the Project Development Area and Local Assessment Area, Area 8 ..... 6.71
Figure IR385-9 Soil Map Units in the Project Development Area and Local Assessment Area, Area 9 ..... 6.72
Figure IR385-10 Soil Map Units in the Project Development Area and Local Assessment Area, Area 10 ..... 6.73
Figure IR385-11 Soil Map Units in the Project Development Area and Local Assessment Area, Area 11 ..... 6.74
Figure IR404-1 Survey Locations where Plants were not Identifiable to Species Level 6.110
Figure IR408-1 Animal-Vehicle Collision Locations for Large-bodied Species 6.121
Figure IR411-1 Highway 22 Bridge over the Diversion Channel 6.127
Figure IR411-2 Unnamed Creek Culvert Crossing at Raised Intersection of Highway 22 and Springbank Road 6.128
Figure IR413-1 Proposed Location of Wildlife Friendly Fencing 6.131

LIST OF APPENDICES

Appendix IR375-1 Limited Phase I Environmental Site Assessment
Appendix IR396-1 Properties of Promatrix
Appendix IR397-1 Certificate of Analysis for Report #R2314206 Version 1 – Final 2016/12/09
Appendix IR407-1 Draft Vegetation and Wetland Mitigation, Monitoring and Revegetation Plan
Appendix IR425-1 Draft Wildlife Mitigation and Monitoring Plan

Abbreviations

ACIS	Alberta Collision Information System
AEP	Alberta Environment and Parks
AER	Alberta Energy Regulator
AGRASID	Agricultural Region of Alberta Soil Inventory Database
AVC	animal-vehicle collisions
AWW	Alberta Wildlife Watch
BMP	best management practices
BTEX	benzene, toluene, ethylbenzene and xylenes
CHV	combustible headspace vapours
COPC	contaminants of potential concern
CSA	Canadian Standards Association
DEP	diesel exhaust particulate
EC	electrical conductivity
ECCC	Environment and Climate Change Canada
ECO Plan	Environmental Construction Operations Plan
EIA	environmental impact assessment
ENFOR	Enforcement Occurrence Record database
EPEA	*Environmental Protection and Enhancement Act*
EPP	environmental protection plan
ESAR	Environmental Site Assessment Repository
FWMIS	Fisheries and Wildlife Management Information System
HVP	high vapour pressure
IR	information request
KWBZ	Key Wildlife and Biodiversity Zone
LAA	local assessment area
LCC	land capability change
LVP	low vapour pressure

LUA	land use area
MBCA	*Migratory Birds Convention Act*
MSDS	material safety data sheets
MSTB	Mesa Butte/Twin Bridges
NEB	National Energy Board
NRCB	Natural Resources Conservation Board
PDA	Project development area
PHC	petroleum hydrocarbon
PID	photoionizing detector
Project	Springbank Off-stream Reservoir
RAA	regional assessment area
RAP	restricted activity period
RCC	roller compacted concrete
RCMP	Royal Canadian Mounted Police
RECP	rolled erosion control products
SAR	sodium adsorption ratio
SDI	Slake durability index
SOMC	species of management concern
TAS	traffic accommodation strategy
TBR	Twin Bridges
TDR	technical data report
TDRA	TIMS Data Repository Application
TIMS	Alberta Transportation's Information Management System
TOC	total organic content
TSS	total suspended solids
TVM	total variability metric
UV	ultraviolet
VHV	volatile headspace vapours
WMMP	Wildlife Mitigation and Monitoring Plan
WMU	wildlife management unit

ZDL	disturbed land
ZOI	zone of influence
ZREC	reclaimed land

6 TERRESTRIAL

6.1 LAND USE AND LAND MANAGEMENT

Question 362

Volume 1, Section 1.3.2.1, Page 1.10 to 1.12
Volume 1, Section 1.4.1.1, Page 1.14
Volume 1, Section 1.4.1.2, Page 1.14
Volume 1, Section 1.4.1.2, Table 1-1, Page 1.15 and 1.16
Volume 1, Section 1.4.1.3, Table 1-2, Page 1.17

Volume 1, Section 1.3.2.1 Land Use states *Most land within or near the Project is privately owned; public land is limited to the rights-of-way for roads and road allowances, and the bed and banks of the Elbow River and its tributaries*.

Volume 1, Section 1.4.1.1 Provincial Environmental Impact Assessment Requirements states: *The Project requires an Environmental Impact Assessment (EIA) under the Alberta Environmental Protection and Enhancement Act.* In Section 1.4.1.2 Other Provincial Regulatory Approval Requirements states: *"The Project will be subject to other provincial approval or notification requirements as listed in Table 1-1.* In Section 1.4.1.3 Other Applicable Provincial Regulatory Requirements states: *Other applicable provincial environmental legislation that could directly affect Project activities is listed in Table 1-2.*

- **Table 1-1 Provincial Approvals or Notifications Required for the Project lists the *Natural Resource Conservation Board Act*, *Historical Resources Act*, *Water Act* and *Fisheries Act***
- **Table 1-2 Other Applicable Requirements for the Project lists the Soil Conservation Act, Weed Control Act and Wildlife Act**

The bed and shore of the Elbow River and its tributaries are crown owned under section 3 of the Public Lands Act. The *Public Lands Act* is not mentioned in either Section 1.4.1.2 or 1.4.1.3, or listed in either Table 1-1 or 1-2.

Authorizations will be required under the *Public Lands Act* for the following activities and occupations:

- **For instream works within the Elbow River and its tributaries**
- **For instream infrastructure permanently installed within the Elbow River and its tributaries.**

a. The bed and shore of the Elbow River and its tributaries are crown owned under Section 3 of the *Public Lands Act*. Has Alberta Transportation submitted an application under the *Public Lands Act* for instream works within the Elbow River and its tributaries and for instream infrastructure permanently installed within the Elbow River and its tributaries? If so when were these applications submitted? If there were application numbers assigned provide them. If these applications have not yet submitted when does Alberta Transportation plan to submit the applications?

Response 362

a. The omission of identification of the requirement for an application under the *Public Lands Act* is an error. The *Public Lands Act* requirement for instream works and structures should have been listed in Volume 1, Section 1.4.1.2, Table 1-1.

   Alberta Transportation and intends to submit the application prior to the NRCB hearing.

6.2 CONSERVATION AND RECLAMATION

Question 363

Volume 1, Section 3.3.1.3, Page 3.24
Volume 1, Section 3.3.4, Page 3.28
Volume 1, Section 3.2.1, Figure 3-1

Alberta Transportation states that Rock or soil materials that are unsuitable for construction will be left as spoil near the diversion structure (see Figure 3-1).

a. Describe and map the designated spoil location(s) as it was not included on Figure 3- 1 as stated in Section 3.3.1.3 (page 3.24) or Section 3.3.4 (page 3.28).

b. Describe the characteristics of rock or soil materials that would deem them unsuitable for construction.

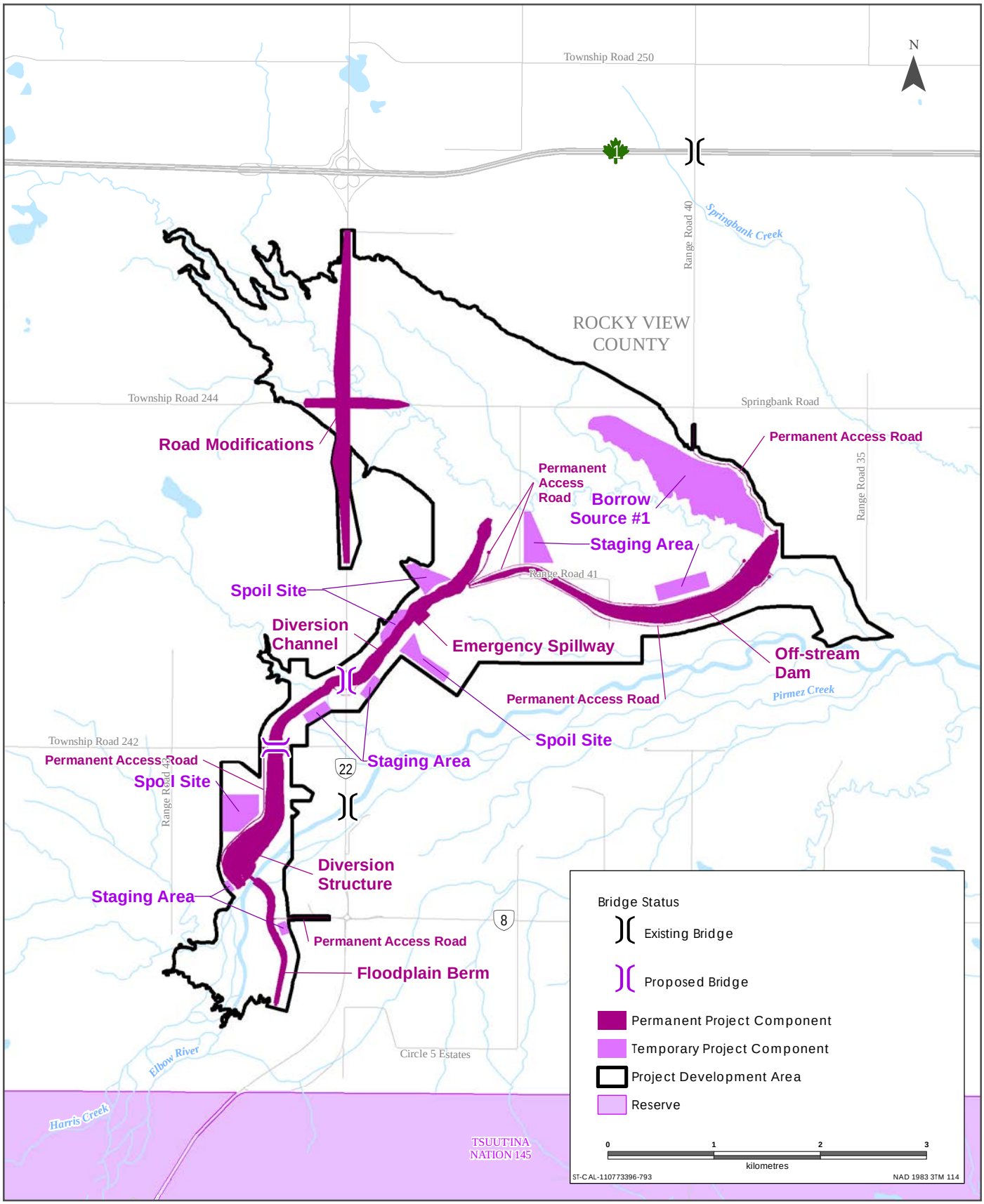
c. Describe related field screening methods and laboratory analytical testing that will be conducted to determine suitability for construction.

d. Describe the storage, transport, and disposal methods for unsuitable rock or soil material if contaminants of concern are identified.

e. Describe the soil sampling that may be conducted in spoil storage areas to ensure that contaminants of concern have not leached into the soil from the spoil piles, prior to the reclamation of the storage areas.

Response 363

a. The reference to Figure 3-1 is incorrect. The reference should have stated Volume 4, Appendix D, Section 2, Figure 2-2, which illustrates the spoil sites and is reproduced here as Figure IR363-1.



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

Permanent and Temporary Features of the Project
(from Volume 4, Appendix D, Figure 2-2)

b. Alberta Transportation (2007) defines waste material as "native soils or rock obtained from required excavations or specified borrow areas that do not meet the requirements for Random Fill Zone 2A; and/or are excess quantities of Random Fill Zone 2A". Waste Fill will only be placed in designated areas and will not be used as fill for Project components. Properties of Random Fill Zone 2A include:

   1. Selected soil embankment may include moderate to highly plastic glacio-lacustrine clay soils or glacial till clay soils placed in the embankment shell and compacted to a minimum of 95% of standard Proctor value and placed in maximum 250 mm (10 inch) lifts with an allowable moisture content ranging from minus two percent to plus two percent of optimum moisture content. Highly plastic glacio-lacustrine clay would not be used until specified Impervious Fill Zone 1A placements have been completed.

   2. Non-durable rock/soil embankment will consist of soil and weathered, non-durable bedrock (Slake durability index (SDI) <85) placed in maximum 200 mm (8 inch) lifts. Large rock fragments will be broken down into pieces less than 150 mm (6 inches) in any dimension or removed from the lift. Non-durable rock shall be broken down and watered to the satisfaction of the engineer prior to compaction. All Zone 2A (2) materials will be approved by the engineer and compacted to 95% of the standard Proctor value or as required by the engineer.

   3. Rock Fill embankment will consist of sound durable sandstone and shale rock fill within the embankment shell zones with a minimum SDI value of 85. The maximum lift thickness will be 600 mm (24 inches) with a maximum particle size of 450 mm (18 inches).

   It is anticipated that some of the weathered rock or non-durable rock may be classified as waste due to commingling of durable and non-durable rock and soil during excavation and subsequent difficulty with placement of the commingled material.

c. During construction, Alberta Transportation and the selected construction contractor will implement a testing program to confirm the suitability of soils excavated from the diversion channel and borrow source for potential use as compacted embankment materials within the off-stream dam. The testing program will consist of a material sampling protocol and a laboratory testing program to identify suitable soils for construction.

   To check for contaminants of potential concern (COPC), protocols for detecting the presence of COPC will include visual means to detect the presence of hydrocarbons and selective point sampling to detect the presence of salts, nutrients, or metals, where suspected. Soil with suspected hydrocarbons will be field screened for presence of combustible headspace vapours (CHV) and volatile headspace vapours (VHV) using a portable RKI Instrument (RKI) EAGLE 2 gas detector with photoionizing detector (PID) capability. Based on the results of the field screening completed during construction, soil samples could be submitted for laboratory analysis, including, but not limited to, benzene,

toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs) fractions 1 to 4 (F1 to F4) salinity parameters (i.e., pH, conductivity, chloride, etc.) nutrients (i.e., total organic nitrogen, available phosphorus, nitrites and nitrates) and regulated metals.

Soil nutrients would be associated with concentrated livestock facilities (wintering corrals),on-farm septic systems, and related disposal areas. Results of soil surveys (Volume 4, Section 3.2, Appendix G) also show that soils within the soils and terrain LAA are of low salinity and sodicity. Should soil salinity in the borrow source be present during excavation, it would be associated with deeper geologic formations such as shale bedrock or deeper till deposits. Salinity would also be associated with sites of concentrated livestock facilities, on-site septic systems, and disposal areas. Geologic layers associated with higher metal availability would be associated with deeper geologic layers formed under anaerobic conditions (e.g., shales and mudstones, and could be encountered during excavation). Metals may also be associated with on-site septic systems and related disposal areas.

d. Contaminated soils will be further characterized to meet landfill acceptance (e.g., Class II landfill analysis). Following the results of the landfill characterization, the analytical results will be provided to a licensed landfill facility for approval. Following landfill approval, the impacted soil will be trucked off-site to the approved landfill facility for disposal. All trucks hauling impacted soil will be manifested in order to document the amount of impacted material removed from the PDA. The manifests will be tracked and recorded.

e. Contaminated materials will not be placed within the stockpile areas. Therefore, testing of soils within the stockpile areas associated with leaching is not planned.

REFERENCES

Alberta Transportation. 2017. Section 002330, Earthwork Materials. Accessed at: https://www.transportation.alberta.ca/Content/docType125/Production/Section02330.pdf.

Question 364

Volume 1, Section 3.3.1.4, Page 3.24
Volume 4, Appendix D, Section 4.5, Page 4.14
Volume 4, Appendix D, Figure 2-2, Page 2.7

Alberta Transportation states that *A temporary laydown/stockpile area to support construction will be set up within the reservoir area, near the dam in a location accessible from the existing road network (Figure 3-1)*.

a. Describe and map the temporary laydown/stockpile area to support construction of the off-stream reservoir as it was not included on Figure 3-1 as stated in Section 3.3.1.4.

b. Provide a figure to illustrate the location of salvaged topsoil and subsoil as Figure 2- 2 does not illustrate salvage/ stockpiling sites.

Response 364

a-b. The reference to Volume 1, Section 3, Figure 3-1 is incorrect. The reference should be to Volume 4, Appendix D, Figure 2-2 and is included in the response to IR363, Figure IR363-1, which shows the temporary laydown areas (labelled as "Staging Area").

There are four locations for the storage of salvaged topsoil and subsoil. These locations are labelled as "Spoil Site" on Figure IR363-1.

Question 365

Volume 3A, Section 9.5, Page 9.43
Volume 4, Appendix D, Section 4.2, Page 4.5
Volume 3A, Section 9.7.2, Page 9.44
Volume 3A, Section 9.4.3.3, Figure 9-13, Page 9.40
Volume 3A, Section 9.4.3.3, Table 9-14, Page 9.38
Volume 3A, Section 9.1.6, Page 9.8

Alberta Transportation states in Volume 3A that *There is a reduction in the areal extent of land rated as agricultural capability class 3 (mode) by 7% of the LAA during construction and dry operations (Table 9-13). This reduction is the result of the construction of the Project components. Because post-construction, the dam and reservoir will not be under agricultural land use, the effect of the changes on soil quality and soil quantity are assessed as not significant*. However, Alberta Transportation states in the Conservation Principles in Volume 4, Appendix D that *To the degree practical, the reconstructed landscape will have land capabilities equivalent to what is*

present under existing conditions; this does not infer that identical uses will occur but the potential to support similar uses will exist.

Since land capabilities are a measure of the land's potential to support a particular land use, consideration of future land uses should not be used to conclude that a reduction in land capability is not significant.

a. Define agricultural land capability.

b. Explain why the change in land use for the Project was used to conclude that the effect of changes on soil quality and quantity are not significant.

c. Evaluate post-construction land capability independent of the target end land use.

d. Re-evaluate the significance of the effect of change in soil quality or quantity using the Significance Definition provided in Section 9.1.6.

e. Provide detailed rationale to explain how the environmental effect on soil quality and quantity was assessed for significance.

Response 365

a. Agricultural land capability is a quantitative measure of how climate, soil and landscape determine the ability of land to support cereal production. It was measured for the Project by adopting as the standard national "Land suitability rating system for agricultural crops 1. Spring-seeded small grains" (Agronomic Interpretations Working Group1995). The soil data collected in the soils and terrain LAA was compared to that standard.

b. The conclusion of "not significant" for effects on soils and terrain (for change in land use) is not correct. See the response to d. for a discussion regarding effects on soils and terrain, including a correction to the significance conclusion.

c. An evaluation of post-construction land capability independent of the target end land use is provided in Volume 3A, Section 9.4.3.3. The change in land capability class due to construction of the Project is shown in Table 9-14 as a 6.9% reduction in the area of Land Capability Class 3 within the LAA as a result of the construction of permanent project components (i.e., areas where land capability is listed as "not applicable" in the table).

d. The correction to the significance conclusion referred to in a. is the following: using the definition in Volume 3A, Section 9.1.6, construction of the Project would result in a significant effect on soil because there will be a change in soil quality or quantity resulting in a reduction in agricultural land capability that cannot be offset through mitigation or compensation measures (this occurs in the off-stream reservoir).

However, the context for this conclusion is that it is a highly conservative evaluation of potential effects on agricultural capability: there are 30,957 ha of agricultural and pasture land within the RAA (Volume 3C, Section 1.2.6, Table 1-8) and construction of the Project will result in a reduction of 342 ha of agricultural and pasture land (a reduction of 1.1%). While there will be a reduction in the agricultural capability of soils within the PDA (primarily the off-stream reservoir) as a result of Project construction, the Project is not expected to have a significant effect on agriculture in the RAA, overall.

In addition, this assessment does not account for the positive effects of the Project associated with preventing flood damage to agricultural land and agricultural capability downstream of the Project site.

e. See the response to b. and d.

REFERENCES

Agronomic Interpretations Working Group. 1995. Land Suitability Rating System for Agricultural Crops: 1. Spring-seeded small grains. Edited by W.W. Pettapiece. Tech. Bull. 1995-6E. Centre for Land and Biological Resources Research, Agriculture and Agri-Food Canada, Ottawa. 90 pages, 2 maps

---

Question 366

Volume 4, Appendix D, Table 4-3, Page 4.11-4.12
Volume 4, Appendix D, Section 4.4.2, Page 4.11
Volume 4, Appendix G, Technical Data Report, Table 3-22, Page 3.38
Volume 4, Appendix G, Technical Data Report, Figure 3-7, Page 3.40
Volume 4, Appendix G, Technical Data Report, Figure 3-8, Page 3.41

Alberta Transportation indicates in Volume 4, Appendix D that 0.25 m of topsoil and 0.25 m of subsoil will be salvaged and that *Most of the soil map units have similar reclamation suitability ratings so that minor amounts of over-stripping into the upper subsoil should have no adverse effects on topsoil quality*. Alberta Transportation also shows the range of average topsoil and subsoil depths within the LAA (Volume 4, Appendix G Table 3-22), and many areas have more than 0.25 m of topsoil and 0.25 m of subsoil, and map units within the Regosol soil order have less than 0.25 m of topsoil and 0.25 m of subsoil.

a. Explain how the conservation (salvage) depths for topsoil and subsoil were selected.

b. Explain why unique conservation (salvage) depths for topsoil and subsoil were not selected for the dominant soil orders within each Project feature area as an effort to reduce over-stripping and admixing.

c. Explain the measures that will be implemented in areas where the colour transition between the topsoil and subsoil is not visually apparent.

d. Discuss the potential residual impacts on the environment for PDA areas that are not represented by the selected salvage depths of topsoil and subsoil.

Response 366

a. Data was collected from 360 soil inspection points and contributed to the calculation of topsoil and subsoil thicknesses for each soil map unit. Topsoil and subsoil values from soil survey locations were used to spatially interpolate raster surfaces representing topsoil and upper subsoil depths. Statistics were then run on the rasters and the average raster value within each polygon was retained as an approximate value of topsoil and subsoil depth (Volume 4, Appendix D, Section 3, Figure 3-7 and Figure 3-8). Average topsoil and upper subsoil depths are not uniform across the PDA, nor is the average uniform across a particular soil map unit, as shown in Volume 4, Appendix G, Section 3, Table 3-22. For example, Gleysolic soils have larger ranges of topsoil values whereas Chernozem soils have more consistent topsoil values (Volume 4, Appendix D, Section 3.2.6.3). Volume 4, Appendix D, Figure 3-7 illustrates the averages across the soils and terrain LAA. Salvage depths for topsoil were based on the overall average topsoil depth across the LAA using averages in Volume 4, Appendix G, Attachment C, Tables C.1-C.14. The overall average is 25 cm (range of 9 cm to 70 cm).

   The overall average for upper subsoil is approximately 23 cm (range of 0 cm to 51 cm). A salvage depth of 25 cm was prescribed as the approximate depth that is practical for excavation machinery and a depth that reclamation suitability of the upper suitability would not be degraded by admixing with the lower subsoil. The large machinery operator may salvage approximately 25 cm. To specifically state that the operator would salvage exactly 23 cm would be inaccurate as large machinery is not precise enough. See Volume 4, Appendix G, Section C.1 for dominant soil map unit averages and Volume 4, Appendix D, Table 3-3 for reclamation suitability for topsoil and subsoil.

b. Unique conservation (salvage) depths for topsoil and upper subsoil were not selected for the dominant soil orders within each Project feature area; instead, they were averaged over the total area. Averages were given as guidance and not as an absolute salvage depth. Rather, the colour transition between the topsoil and subsoil will specifically guide the on-site environmental inspector and equipment operators (Volume 4, Appendix D, Section 4.4.2). The environmental inspector will be the on-site authority and will determine more accurate topsoil and upper subsoil stripping during construction. The inspector's judgements will specifically reduce over-stripping and admixing.

c. Where colour transition between the topsoil and subsoil is not visually apparent, the on-site environmental inspector (a professional agrologist or suitable equivalent) will determine the appropriate salvage depth and communicate it to the operators (Volume D, Section 4.2).

d. There are no expected potential residual impacts on the environment for PDA areas that are not represented by the selected salvage depths of topsoil and subsoil. Due to the natural variability in topsoil and upper subsoil depths, the recommended depths are guidance only. The on-site environmental inspector will specifically guide salvage depths during construction. Reclamation suitability and agricultural land class will be unaffected by soil salvage at the recommended depths.

Question 367

Volume 4, Appendix D, Section 4.4.2, Table 4-3, Page 4.12
Volume 4, Appendix D, Section 5.2.2, Table 5-1, Page 5.5

Alberta Transportation states in Note 3 on both tables in Volume 4, Appendix D that Borrow Source #1 *will be developed and reclaimed in compliance with the requirements of Alberta Transportation 2013b and GoA 2004*.

a. Summarize the relevant portions of these references and explain how they relate to soil handling and reclamation of borrow sources for this Project.

b. Summarize how the processes in these references will help to mitigate potential effects from borrow source development.

Response 367

a. Part 5 of GoA (2004) provides conservation and reclamation requirements. It specifies that all topsoil and subsoil must be salvaged prior to borrow source extraction and stipulates that salvaged topsoil must not be used for any other purpose than the reclamation of the pit from which the topsoil was salvaged. Soil is conserved for reclamation by stockpiling topsoil on topsoil and subsoil on subsoil. Overburden, aggregate reject, or other material must be stockpiled on an area in which all topsoil and subsoil has been previously salvaged (or these soils must be stockpiled greater than 3 m from other stockpiles) and stockpiles must be 5 m away from all pit faces.

   Reclamation requirements to conserve soil include no burying waste or woody debris and, unless authorized, reclamation materials (topsoil, subsoil, overburden, or reject) must have been previously salvaged. Replaced topsoil must not have rocks, stones, woody debris or other debris that interferes with reclamation and reclaimed slopes above water must be no steeper than 3:1. Lastly, topsoil and subsoil must be replaced in accordance with the most recent activities plan authorized in writing by the Director (that is, no activity may commence at a pit unless a registration has been obtained for the activity (Section 3.1.1)).

Alberta Transportation (2013a) includes relevant information as follows.

- reclamation planning

  This is step one and requires a pre-disturbance assessment and report for soil handling. The report is the starting point for the excavation and reclamation plan and includes topsoil and subsoil stripping depths, volumes of materials to be salvaged, stored and conserved for reclamation.

- topsoil salvage, handling and storage

  This builds on the pre-disturbance assessment report. It provides guidance to operators on how to identify topsoil, particularly topsoil that has poor colour contrast from the subsoil. It provides additional information on topsoil salvage such as identifying topsoil depths, measures to minimize erosion, ensuring the borrow source has space for stockpiles (with 1 m separation between topsoil and subsoil), ensuring all construction personnel have the excavation and reclamation plan, and the importance of not admixing topsoil and subsoil. Furthermore, this segment provides information on how to choose the appropriate salvage equipment for accurate soil stripping and conditions for suspending operations to conserve soil.

- subsoil salvage, handling and storage

  This describes how to identify subsoil from the C horizon and steps to follow for subsoil conservation. This includes identifying the depth of subsoil to be salvaged (consulting the pre-disturbance assessment report), flagging poor quality subsoil, salvage practices for thin subsoil and thick subsoil and the separation of topsoil and subsoil stockpiles.

- rebuilding the landscape

  Rebuilding the landscape includes information on reclaiming the landscape after the borrow source material has been removed. It consists of activities that affect final site reclamation. This section includes information on grading and contouring, soil replacement, creating an adequate seedbed and information on how to prevent soil compaction during reclamation.

- revegetation

  This provides reclamation guidance on seeding methods (drill seeding, broadcast seeding and hydroseeding), choosing seed mixes, timing requirements, soil amendments (fertilizer, organic matter amendments, lime, gypsum, mulches and tackifiers, and weed control).

- problem soils

  Problem soils are saline, solonetzic, and coarse textured soils. These soils require special care when salvaging, handling, storing and replacing. Topsoil and subsoil salvage depths, topsoil stripping, erosion protection, and selection of the appropriate revegetation mix must be done with accuracy and precision.

b. By following the processes outlined in GoA (2004; Part 5) and Alberta Transportation (2013a), potential effects from borrow source development will be mitigated and soil will be conserved. Specific potential effects and how these processes mitigate these effects follow.

- potential decrease in soil fertility due to admixing

  By following the guidelines for careful reclamation planning and topsoil and subsoil salvage handling and storage, the likelihood for admixing will decrease. Information gathered during the field surveys will provide more information for topsoil and subsoil salvage depths, suitable stockpile locations and plans for specific soil handling. The pre-disturbance assessment report will be used for specific conservation and reclamation strategies to maintain soil fertility.

- potential loss of soil due to erosion

  When salvaging topsoil, wind erosion may become a serious risk. The guidelines state that stripping or other soil handling operations must be discontinued if excessive topsoil is being lost through wind erosion. Additional guidance is provided for protecting topsoil stockpiles from water erosion including minimizing channeling of runoff, directing runoff away from topsoil storage areas and using physical barriers such as silt fences. During construction, operators should avoid soil compaction as reduced soil porosity can increase the potential for soil erosion. During reclamation, direction is given to reconstructing slopes to limit soil erosion, reducing over discing or harrowing that would pulverize the soil and increase erosion and using appropriate erosion control measures until vegetation can be established.

- pre-disturbance assessment (Alberta Transportation 2013b)

  As identified in Volume 4, Appendix D, Section 1.0, with respect to pre-construction inspection protocols for Borrow Source 1, Alberta Transportation will be following the protocols on the number of inspection points, the kinds of soil and vegetation data to collect at each inspection point, and criteria for evaluating the quality of topsoil and subsoil for reclamation. These data are intended to guide soil salvage and reclamation practices at the borrow source.

  - The number of pre-disturbance inspection points is based on the area of the borrow source and length of haul road and is described in Alberta Transportation (2013b; Table 2), with additional consideration as to the complexity of soil pattern or

topography. The number of inspection points per unit area decreases as the borrow source footprint increases. Inspection point intensity decreases from 5 inspection sites per ha for borrow areas of 3 ha or less, to 3 inspection sites per ha for borrow source areas greater than 3 ha. Footprints of proposed haul roads are assessed at a rate of 1 inspection site per 100 m length. These inspection intensities are the minimum; in complex topography or soils, additional soil inspections are to be completed at the judgement of the soil surveyor.

- Terrain features are described, including land use, drainage, surface stoniness, presence and intensity of surface erosion, presence of debris, evidence of instability, and topographic slope class, as defined in Table 1 (Alberta Transportation, 2013b).
- Soil profiles at each inspection point are characterized for topsoil depth, topsoil texture, proportion of gravel or stones, and restrictive subsoil layers.
- Vegetation is characterized for type, productivity, health and presence of weeds (Alberta Transportation 2013b; Table 3). Vegetation productivity is measured in terms of height, percent cover, length of seed heads, density of stems or post-harvest stubble (Alberta Transportation 2013b; Table 5).
- If restrictive soil layers are present, they are described in terms of soil structure attributes and rated for their effect on root growth, vegetation productivity and permeability to water movement (Alberta Transportation 2013b; Table 4)).

- post-disturbance assessment (Alberta Transportation 2013c)

  Post-reclamation data are collected from the borrow source and haul road area and from adjacent reference sites that serve as points of comparison. Sites completed as part of the pre-disturbance assessment can also be used as reference sites.

  Data collected for terrain include surface contour, re-establishment of drainage, the abundance of stones or gravel, and the presence of debris. Vegetation data include species present, productivity and plant health. Soil quality indicators include topsoil depth, texture, structure, consistence, coarse fragment content, and nature of rooting restrictions.

  Pass/fail criteria are detailed for topsoil depth (Alberta Transportation 2013c; Table 5), topsoil texture (Alberta Transportation 2013c; Table 7), topsoil tilth (Alberta Transportation (2013c; Table 9), and restrictive layers (Alberta Transportation 2013c; Table 11).

REFERENCES

Alberta Transportation. 2013a. Alberta Transportation Guide to Reclaiming Borrow Excavations, Dec. 2013 edition. Available at: https://open.alberta.ca/dataset/2f0dfad8-1d66-402e-a6df-8d0c919a62e6/resource/1ba3bdf3-9800-4b29-958e-1a7dfee3197c/download/borrowguide.pdf

Alberta Transportation. 2013b. Alberta Transportation Pre-Disturbance Assessment Guide for Borrow Excavations, Dec. 2013 edition. Available at: https://open.alberta.ca/publications/alberta-transportation-pre-disturbance-assessment-guide-for-borrow-excavations

Alberta Transportation. 2013c. Alberta Transportation Post-Disturbance Assessment Guide for Borrow Excavations, Dec. 2013 edition. Available at, https://open.alberta.ca/publications/alberta-transportation-post-disturbance-assessment-guide-for-borrow-excavations

GoA (Government of Alberta). 2004. Code of Practice for Pits, as amended. Available at, http://www.qp.alberta.ca/documents/codes/PITS.PDF

Question 368

Volume 4, Appendix D, Section 5.2, Page 5.3
Volume 3A, Section 9.4.3.3, Table 9-14, Page 9.38
Volume 3A, Section 9.4.3.3, Figure 9-13, Page 9.40
Volume 3A, Section 9.1.3, Table 9-1, Page 9.3
Volume 3A, Section 9.4.3.2, Page 9.36
Volume 1, Section 3.3.14, Page 3.24
Volume 4, Appendix D, Figure 4-1, Page 4.13

Alberta Transportation states in Volume 4, Appendix D that *Undisturbed soil profiles consist of topsoil that overlies subsoil and unaltered parent materials; however, this is not the case with soil that has been salvaged and is replaced in the landscape. The replaced materials might be technically the same if what is removed is replaced in two lifts, but they will be functionally different*. However, the project construction areas within the off-stream reservoir basin where soil will be stripped, salvaged, and replaced appear to have not been accounted for in the Changes in Extent of Agricultural Land Capability in Table 9-14 and Figure 9-13 (Volume 3A).

a. Clarify the areas within the off-stream reservoir basin that will be stripped, salvaged, and reclaimed with subsoil and topsoil. Provide figures to illustrate these areas.

b. Explain why areas within the reservoir that will be stripped and reclaimed are not included in the post-construction and reclamation changes in the extent of agricultural land capability (Table 9-14 and Fig 9-13).

c. Revise Table 9-14 to include changes in agricultural land capability after construction for areas that will be stripped and reclaimed.

d. Revise Figure 9-13 to illustrate changes in agricultural land capability after construction for areas that will be stripped and reclaimed.

Response 368

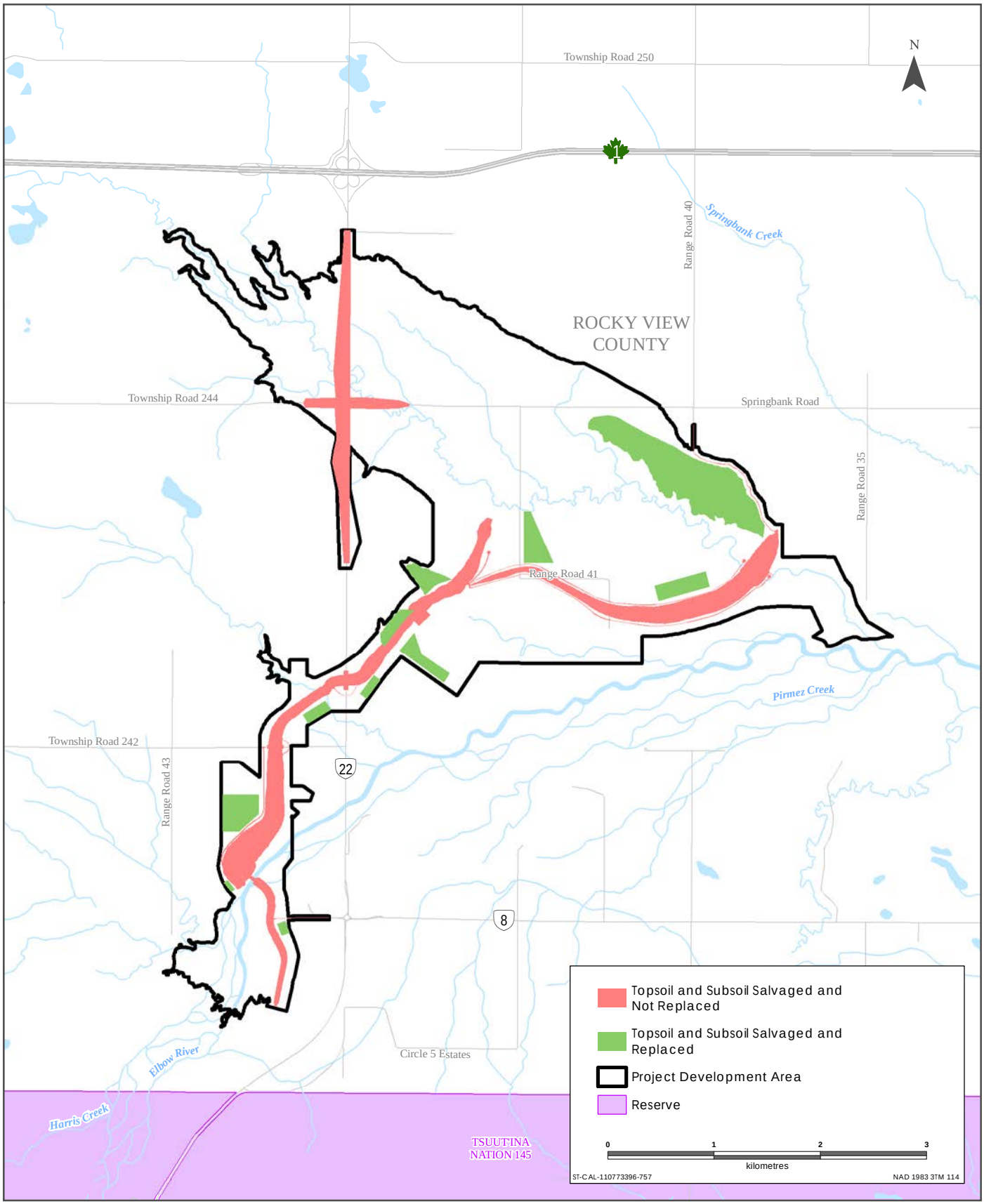
a. The following areas in the PDA will be stripped, salvaged and reclaimed with subsoil and topsoil (see Figure IR368-1):

- permanent Project structures (e.g., permanent access roads, diversion channel, road modifications) where topsoil and subsoil will be salvaged but the features will not be reclaimed. While the off-stream dam is a permanent structure, the intent is to replace subsoil and topsoil on the surface of the dam and revegetate it, once constructed.
- temporary disturbance (e.g., borrow source area, spoil sites, staging areas) where topsoil and subsoil will be salvaged prior to disturbance and the areas will be reclaimed following construction.

b-d. Areas within the PDA that are subject to salvage and reclamation are included in estimates of change for land capability and reclamation suitability, as follows.

Five reclamation coversoils are presented in Volume 3A, Section 9.4.3.3, Table 9-13 (reproduced here as Table IR368-1) (ZREC2A, ZREC2B, ZREC2C, ZREC3A and ZREC3B). Calculations of agricultural capability and reclamation suitability of these coversoils are based on estimated physical and chemical characteristics of the salvaged topsoil and subsoil, weighted by the salvage volumes contributed by individual soil series, and set to the expected drainage regime.

Changes in agricultural capability are included in the distribution presented in Volume 3A, Section 9.4.3.3, Table 9-14 (reproduced here as Table IR368-2). Figure IR368-2 shows the spatial distribution of land capability at post-construction for all soil units, including the five reclamation coversoils. Agricultural land capability was not calculated for areas occupied by permanent project structures, post-construction, which is reflected by the increase in area rated as “not applicable” in Table IR368-2.



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

Areas of Topsoil and Subsoil Salvage and Replacement in the PDA

Stantec

Table IR368-1 Soil Units in the Terrain and Soils LAA at Post-Construction (from Volume 3A, Section 9, Table 9-13)

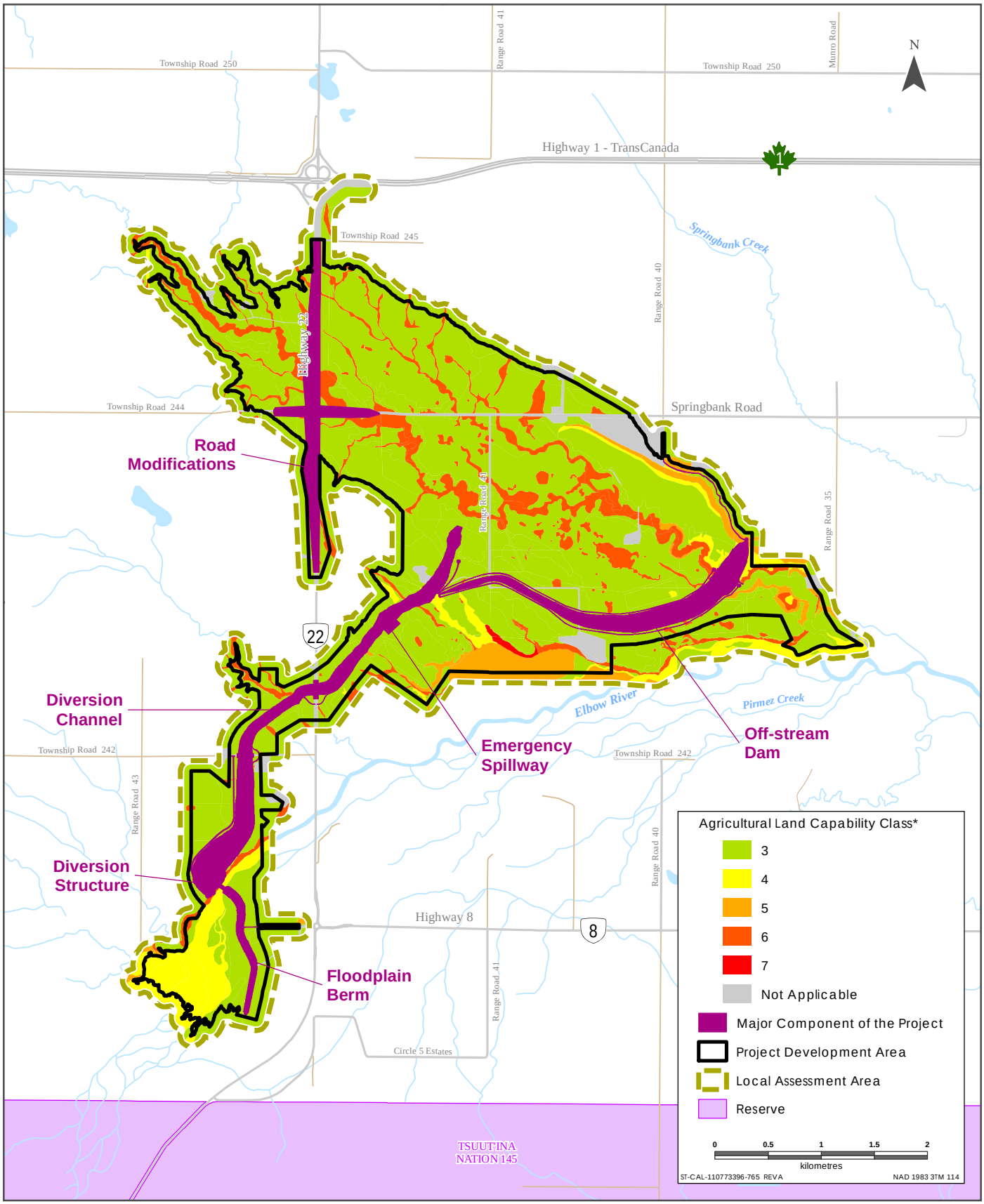
Soil Unit	Area at Existing Conditions (ha)	Area at Post-Construction (ha)	Change (ha)	% Change of soils and terrain LAA
Units with fine to very fine-textured till and glaciolacustrine parent materials				
DVFS1	55.2	48.4	-6.8	-0.4
DVFS2	304.3	251.6	-52.7	-2.8
DVG1	281.5	190.3	-91.2	-4.8
FSH1	276.6	255.1	-21.5	-1.1
FSH2	437.2	382.6	-54.6	-2.9
POT1	30.0	23.9	-6.1	-0.3
POT2	20.5	16.5	-4.0	-0.2
POT6	43.1	43.2	0.1	0.0
Units with medium-textured fluvial parent materials				
SRC1	35.8	32.0	-3.8	-0.2
SRC4	2.3	2.3	0.0	0.0
Units with moderately coarse to very coarse-textured fluvial and glaciofluvial parent materials				
TBR1	6.4	6.4	0.0	0.0
TBR2	50.7	44.8	-5.9	-0.3
TBR4	11.4	11.4	0.0	0.0
TBRgr1	61.9	61.6	-0.3	0.0
TBRgr2	6.8	6.8	0.0	0.0
ZGC1	35.0	34.6	-0.4	0.0
Undifferentiated, transitional areas				
POT7	81.7	78.0	-3.7	-0.2
TBR6	15.1	12.1	-3.0	-0.2
TBSR1	30.0	30.0	0.0	0.0
MSTB1	2.8	2.8	0.0	0.0
Disturbed Land and Reclaimed Units				
ZDL	97.1	242.9	145.8	7.7
ZREC	1.1	1.1	0.0	0.0
ZREC2A	0.0	99.0	99.0	5.2
ZREC2B	0.0	5.6	5.6	0.3
ZREC2C	0.0	2.4	2.4	0.1
ZREC3A	0.0	1.0	1.0	0.1

Table IR368-1 Soil Units in the Terrain and Soils LAA at Post-Construction (from Volume 3A, Section 9, Table 9-13)

Soil Unit	Area at Existing Conditions (ha)	Area at Post-Construction (ha)	Change (ha)	% Change of soils and terrain LAA
ZREC3B	0.0	0.2	0.2	0.0
Total	1,886.5	1,886.5		
NOTE: Areas and proportions will not sum exactly to totals because of rounding				

Table IR368-2 Changes in Areas of Agricultural Land Capability (from Volume 3A, Section 9, Table 9-14)

Agricultural Capability Class	Existing Conditions (ha)	After Construction and Reclamation (ha)	Change (ha) from existing conditions	Change % of soils and terrain LAA
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	1,425.2	1,295.6	-129.6	-6.9
4	134.6	123.1	-11.5	-0.6
5	85.9	91.9	6.0	0.3
6	142.2	131.5	-10.7	-0.6
7	1.4	1.4	0.0	0.0
Not Applicable	97.1	242.9	145.8	7.7
Total	1,886.5	1,886.5		
NOTE: Areas and proportions will not sum exactly to totals because of rounding				



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
**Refer to Tables D7-15 and D7-16 for Agricultural Land Capability Class descriptions.*

Agricultural Land Capability Classes for the Project Development Area and Local Assessment Area at Post-construction

Stantec

Question 369

Volume 4, Appendix D, Section 5.2.2, Page 5.3
Volume 4, Appendix D, Section 4.5, Page 4.14
Volume 4, Appendix D, Section 4.2, Page 4.5

Alberta Transportation states that *After rough grading of permanent features has been completed, areas where soil replacement and revegetation occur would be de-compacted, as directed by the environmental inspector*.

a. Clarify the agency, department, or company who would employ the environmental inspector.

b. Clarify the role and qualifications of the environmental inspector to the environmental supervisor identified in Section 4.2.

Response 369

a. Alberta Transportation will select and retain a contractor to construct the Project, including all environmental works. As part of the *Environmental Construction and Operations Plan (ECO Plan) Framework* (see Volume 4, Supporting Documentation, Document 10), Section 5.1, "The Contractor must identify an on-site individual to be their On-Site Representative; this individual is responsible for maintaining the environmental controls and addressing any environmental issues or questions that arise." The contractor's on-site representative would be the environmental inspector.

b. For clarification, the environmental supervisor and the environmental inspector are the same role. Alberta Transportation (2017) provides the following guidance:

   "Engage qualified personnel, professional engineers, and independent Canadian Standards Association (CSA) certified materials engineering and testing companies to carry out designs and to perform tests when required by the Specifications."

   It is expected the contractor will use qualified professionals to monitor environmental components. Professional organizations include professional biologists (wildlife, vegetation), professional agrologists (soil), qualified aquatic environmental specialist (fish) and professional engineers (construction).

REFERENCES

Alberta Transportation. 2017. Quality Control and Quality Assurance, Section 01452. Accessed at: https://www.transportation.alberta.ca/Content/docType125/Production/Section01452.pdf

Question 370

Volume 4, Appendix G, Technical Data Report, Section 3.2.6.10, Page 3.70
Volume 4, Appendix G, Technical Data Report, Section 3.3.1, Page 3.76
Volume 4, Appendix G, Technical Data Report, Section 3.2.6.10, Tables 3-38, 3-39, 3-40, and 3-41
Volume 3A, Section 9.2.4, Tables 9-7 and 9-8, Pages 9.22 and 9.23
Volume 3A, Section 9.2.4, Figures 9-5, Page 9.25
Volume 3A, Section 9.2.4, Figures 9-7 and 9-8, Pages 9.27-9.28
Volume 3A, Section 9.4.3.3, Table 9-15, Page 9.41

Alberta Transportation states in Volume 4, Appendix G that *For the second lift, most of the LAA—except for the portions not rated (5%) for reclaimed and disturbed soil units, and the medium to coarse-textured glaciofluvial units (SRCca, TBR and ZGC)—is rated as poor (81%) to unsuitable (4%)*. Alberta Transportation concludes that *LAA soils typically had fair reclamation suitability for the first lift and poor reclamation suitability for the second lift.*

a. Evaluate and discuss potential Project effects related to poor and unsuitable reclamation suitability ratings for construction and reclamation.

b. Explain why areas of reclaimed and disturbed land (identified in Volume 3A, Figure 9-5) are deemed *Not Applicable* in Volume 3A, Tables 9-7, 9-8 and Figures 9-7 and 9-8 for Reclamation Suitability.

c. Provide a figure to illustrate the Changes in Extent of Reclamation Suitability Class that are listed in Table 9-15 in Volume 3A.

d. Describe the mitigation measures to account for the poor and unsuitable reclamation suitability ratings for the second lift in the LAA.

e. Describe the potential residual impacts of poor and unsuitable reclamation suitability ratings for the second lift, following implementation of the mitigation measures.

Response 370

a. Reclamation suitability refers to the soil's capability to support vegetation and ecosystems. If the reclamation suitability of topsoil is poor, the post-reclamation soil will also be poor: a soil low in organic matter and nutrients would not be reclaimed to a soil high in organic matter and nutrients. There are some situations, such as long-term stockpiling, where a soil high in organic matter and nutrients may degrade due to changes in biological activity; however, because construction is expected to take approximately three years, degradation is unlikely to occur. On the site, reclamation suitability is unlikely to change: topsoil will still be poor for supporting vegetation and ecosystems.

If a topsoil that has a poor reclamation suitability is overstripped into an "unsuitable" reclamation suitability subsoil, the topsoil would be degraded. Reclamation of the soil to its previous ecosystem may be challenging.

For Project effects related to poor and unsuitable reclamation suitability ratings for construction and reclamation, potential effects would be limited to the PDA and not the entire soils and terrain LAA. Within the LAA, there are two soil map units with unsuitable subsoil: TBR (Twin Bridges) and MSTB (Mesa Butte/Twin Bridges). These soil map units are not within the PDA and will not be disturbed. Accordingly, there will be no Project effect there.

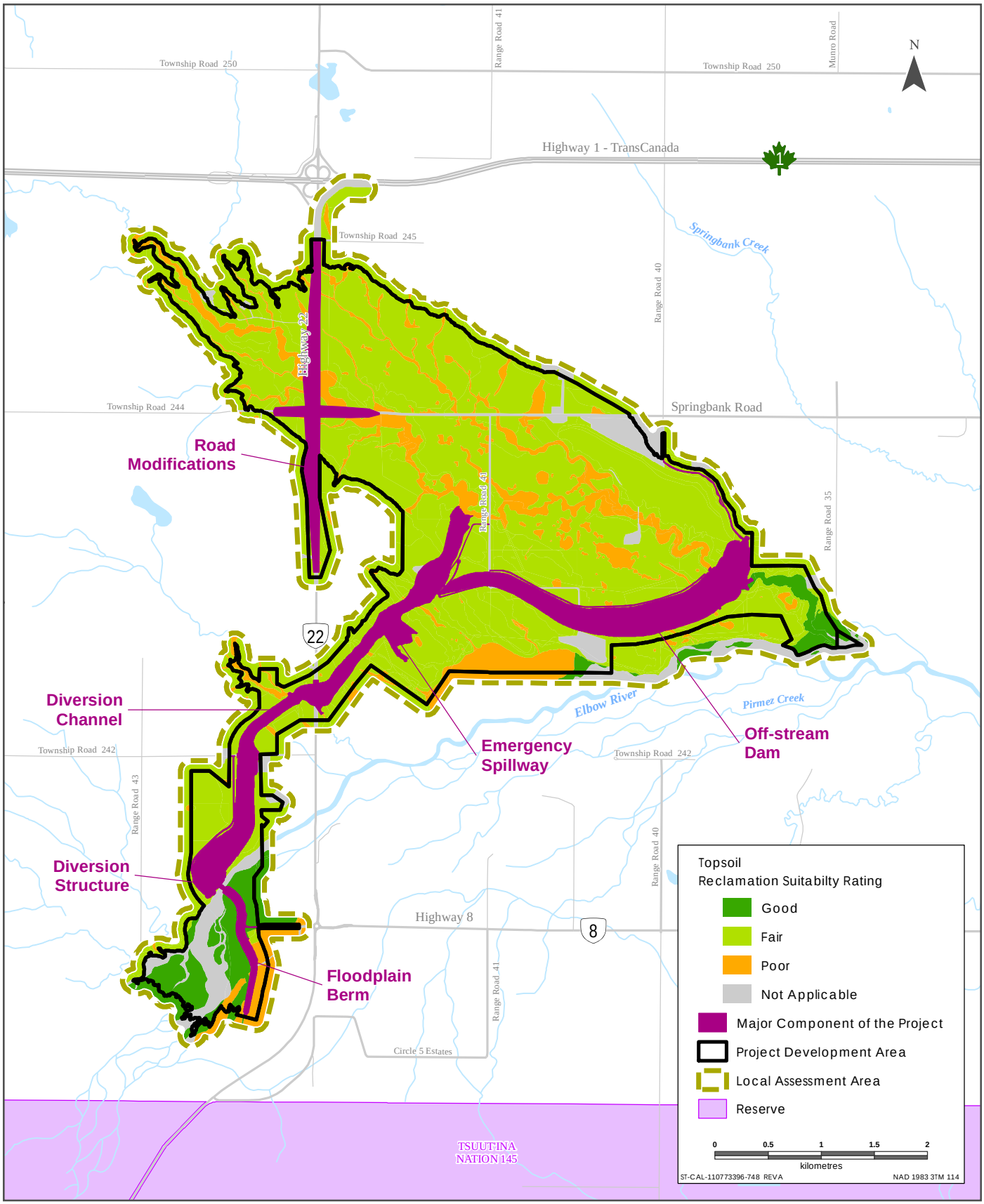
b. Soil mapped as reclaimed land (ZREC) occupies 1.1 ha in the LAA. Areas identified as ZREC in Volume 3A, Figure 9-5, were rated for both first and second lift reclamation suitability. The first and second lift reclamation suitability ratings are shown in Volume 4, Appendix G, Table 3-38 (first lift) and Table 3-39 (second lift). Reclamation suitability ratings for the ZREC unit were fair (first lift) and poor (second lift). Areas of ZREC presented in Volume 3A, Figures 9-7 and 9-8 correctly show the reclamation suitability of these areas.

   Soil mapped as disturbed land (ZDL) occupies 97.1 ha in the terrain and soils LAA. The first and second lift reclamation suitability ratings for the ZDL unit are not applicable, as shown in Volume 4, Appendix G, Table 3-38 (first lift) and Table 3-39 (second lift), and presented in Volume 3A, Figures 9-7 and 9-8. Areas of ZDL were rated as not applicable because Alberta Transportation has not collected soil data within these areas to characterize first and second lift soil properties. The soil profiles are expected to have been previously disturbed and these areas are not considered for salvage.

c. See Figure IR370-1 and Figure IR370-2 for the changes in areas of reclamation suitability class that are listed in Volume 3A, Section 9, Table 9-15.

d. Soils with an unsuitable reclamation suitability rating are identified as permanent features and will not be reclaimed. These subsoils are along and in the Elbow River channel and will not be saved for reclamation as they will be a part of the diversion structure. When second lift soil with a poor reclamation suitability rating is salvaged, mitigation measures outlined in Volume 4, Appendix D, Section 4.2 must be followed to prevent degradation in soil quality. Reclamation of these soils will meet the desired end land uses.

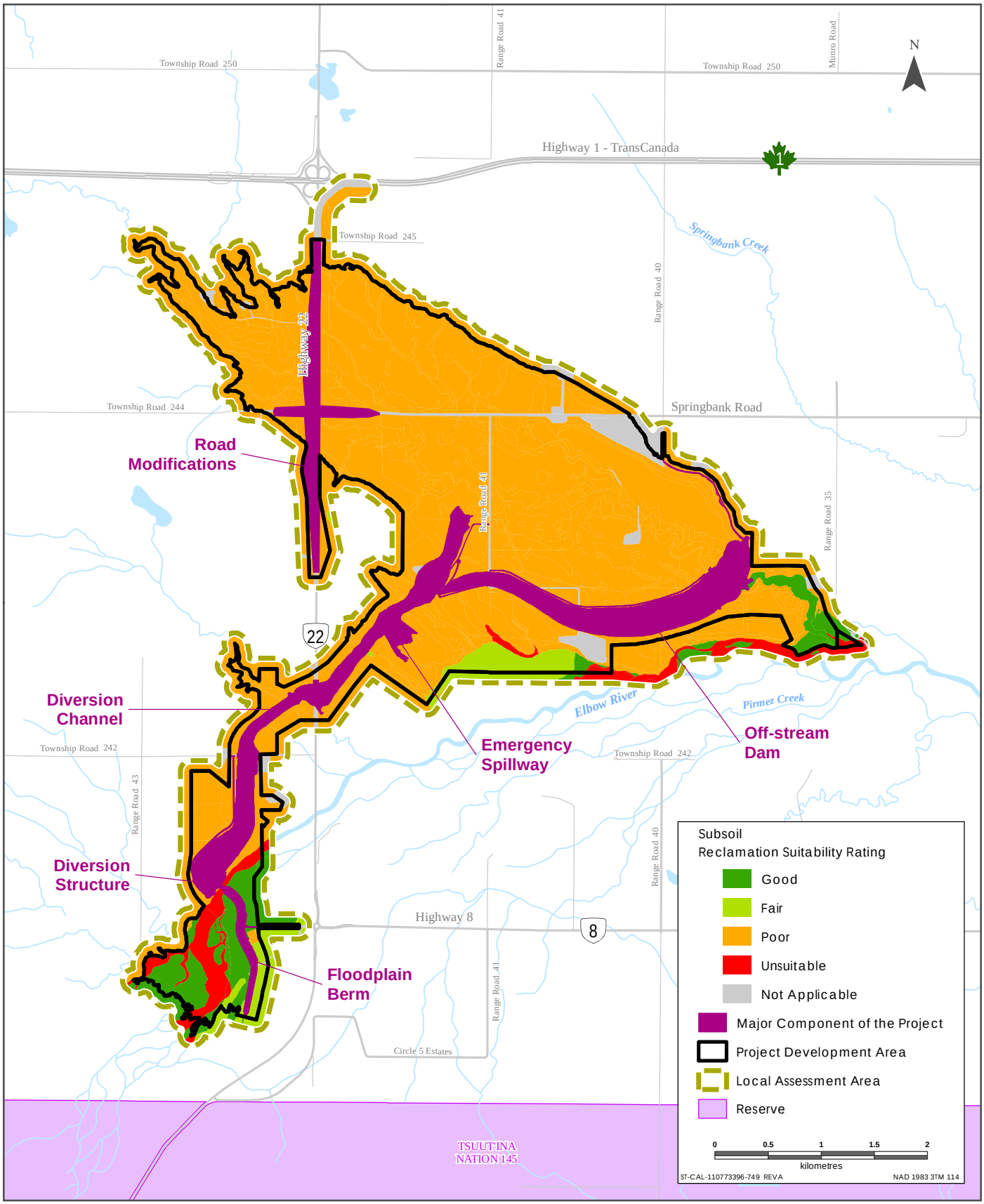
e. Salvaged second lift soil rated as unsuitable will not be used for reclamation because it is underneath permanent features. If poor rated soil is admixed during topsoil stripping, potential residual effects may include a lack of vegetation growth or less vegetation cover because poor nutrients (such as salts) from the second lift will degrade the more fertile topsoil. This may cause a decrease to topsoil fertility that may impact vegetation growth.



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

Topsoil Reclamation Suitability for the Project Development Area and Local Assessment Area at Post-construction

Stantec



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

Subsoil Reclamation Suitability for the Project Development Area and Local Assessment Area at Post-construction

Stantec

Question 371

Volume 3A, Section 10.3.1, Table 10-11, Page 10.38, Page 10.39
Volume 3A, Section 10.4.1, Page 10.40
Volume 4, Appendix D, Section 4.1.1, Page 4.4
Volume 4, Appendix D, Section 5.3, Table 5-2, Page 5.6

Alberta Transportation states *native upland and wetland vegetation that is disturbed would be reclaimed with Alberta Transportation custom native seed mix….This basic native species reclamation mix can serve as a starting point from which to develop suitable variations*….Examination of the native seed mixture indicates some species proposed although native to Alberta are not necessarily common within the Project Development Area.

a. **Has consideration been given to what alternative species may be placed in the seed mixture and which species may be removed? If so, what considerations were made? Why were these considerations not adopted? If no consideration has been given to what alternative species may be placed in the seed mixture and which species may be removed explain why this choice was made.**

b. **Has the proposed seed mixture been applied in other situations within the Regional Assessment Area? Have follow-up assessments been conducted on these sites to determine the resultant species composition? If so, list the areas and explain which species are the most abundant in each area. Are there any species from the seed mixture which have lower population numbers when compared to other species? For species in the seed mix with limited establishment success has a reason been determined for their poor results?**

c. **For wetland areas has a seed mixture been formulated yet and if so what mixture is proposed? If a seed mixture has not been formulated yet when will one be formulated and when and how will this information be communicated to AEP.**

Response 371

a-b. Alterations will be made to the Alberta Transportation custom native seed mix in consideration of site-specific conditions of vegetation communities and input from Indigenous groups as to species that are culturally important to them. Reclamation details will be discussed in planned meetings with Indigenous groups and the resultant seed mixes will be communicated with AEP.

It is likely that the native seed mix for Zone 6 identified in AIT (2005) will form the basis of native seed mixes (Table IR371-1).

Table IR371-1 Native Seed Mix for Zone 6

Species Common Name	Species Scientific Name	Seed Mix Percentage by Weight
slender wheat grass	*Agropyron trachycaulum*	30
smooth wildrye	*Elymus glaucus*	20
northern wheat grass	*Agropyron dasystachyum*	10
tickle grass	*Agrostis scabra*	10
fringed brome	*Bromus ciliatus*	10
tufted hairgrass	*Deschampsia cespitosa*	10
Foothills rough fescue	*Festuca campestris*	10

Native seed mixes will likely be targeted to high value native communities in areas of temporary disturbance lacking abundant weeds or aggressive non-native plant species. Suitable variations for revegetation of Project temporary disturbances of native areas will be developed following discussions with Indigenous groups and stakeholders. Variations will support diversification of vegetation communities, traditional use, and wildlife habitat.

c. A seed mix is not proposed for temporarily affected wetland areas because most weeds in Alberta, including species observed during field surveys, are not tolerant of periodic flooding and anoxic soils, and are not likely to increase to unacceptable percentages in wetter wetlands. The seed mix in Table IR371-1 may be applied to wetland edges to provide initial coverage and reduce weed establishment in temporarily wetted areas. Native plants of more seasonally to semi-permanently wetted areas will be left to naturally establish.

REFERENCES

AIT (Alberta Infrastructure and Transportation). 2005. Grass Seed Mixtures Used on Highway and Bridge Projects, Design Bulletin No. 25. https://open.alberta.ca/dataset/cc7e748a-4aa0-4a80-ab1e-19e1f87a0f7b/resource/a7abb720-c5ad-40ed-9590-29a87703cda3/download/designbulletin25.pdf

Question 372

Volume 3A, Section 10.4.1, Page 10.40
Volume 4, Appendix D, Section 4.1.1, Page 4.4
Volume 4, Supporting Documentation. BMP 22, Page viii (page 605 of 884)

Alberta Transportation states *agricultural cover types that are disturbed by the Project would be reclaimed using Alberta Transportation agronomic seed mix and are predicted to become tame pasture*. Examination of the agronomic seed mixture indicates two of the perennial species (Dahurian wild rye and pubescent wheatgrass) proposed in the mixture tend to be short lived

under Alberta's environmental conditions and the third perennial species (Sheep fescue) is known to invade native fescue grasslands.

a. Is the final composition of the agronomic seed mixture finalized or is it open to modification to utilize species with reasonable longevity and low invasive potential? If the mixture is finalized justify and explain why Dahurian wild rye and pubescent wheatgrass were selected when they tend to have a short persistence in Alberta and when it is documented sheep fescue will invade native rough fescue grasslands. If the composition is open to modification how is one to provide input? How will Alberta Transportation communicate what input was accepted or rejected into the final composition and the reasoning behind each acceptance or rejection.

Response 372

a. Alberta Transportation is open to discussion regarding appropriate seed mixes based on revegetation objectives and site conditions. Alterations will be made in consideration of site-specific conditions of vegetation communities and input from Indigenous groups as to species that are culturally important to them.

   Shorter-lived species may have beneficial effects such as acting as a cover crop to suppress weed establishment until other natural colonizing species can re-establish. Sheep fescue is an excellent weed control species because it has an extensive and dense bunch-type root system. Once a good stand is established, it excludes the invasion of most weeds (Ogle et al. 2010).

   Seed mixes will be adjusted while balancing need for vegetative cover, suppressing weed establishment and managing surrounding undisturbed areas. Species used will also be based on availability of required quantities.

   Further communication regarding seed mix recommendations can be referred to Mark Svensen at Alberta Transportation by email at Mark.Svenson@gov.ab.ca. Final seed mix details will be provided in the monitoring and revegetation plan, including the reasoning for the inclusion or rejection of recommended species.

REFERENCES

Ogle, D., M. Stannard, P. Scheinost, and L. St John. 2010. Plant guide for sheep fescue (*Festuca ovina* L.). USDA-Natural Resources Conservation Service, Idaho and Washington Plant Materials Program. https://plants.usda.gov/plantguide/pdf/pg_feov.pdf

Question 373

Volume 3A, Section 8.4.3.7, Page 8.54
Volume 3A, Section 9.4.2.2, Page 9.33
Volume 3B, Section 9.2.2.2, Page 9.5

Regarding reclamation Alberta Transportation states *streambanks and approach slopes will be revegetated using an appropriate native seed mix or erosion control mix.* Similar comments are made regarding channel banks and channel bank stability.

a. What species are under consideration in the event an erosion control mix is used and how does the composition of such a mixture differ from a native seed mix? Explain how species under consideration in the erosion control mix were determined. Provide the justification behind why the erosion control mix and the native species mix will be different if at all.

Response 373

a. The erosion control and native seed mixes have not yet been finalized. Indigenous groups and stakeholder engagement is ongoing and will guide seed mix selection and use. Guidelines in AEP (2003) will used. The erosion control mix will likely be similar to the agronomic seed mix listed in AIT (2005) (reproduced here as Table IR373-1). This mix is intended for disturbances in agricultural areas, hayland, tame pasture, and stream banks and approach slopes with abundant weeds. These species were selected due to their ability to establish rapidly on a wide range of soil types, root structure or leaf abundance, competitive ability, and varying life expectancy. Dahurian wildrye (*Elymus dahuricus*), for example, establishes quickly, providing ground cover and root growth which reduce opportunities for weed establishment and helps limit soil erosion (Tilley and St. John 2014). Dahurian wildrye, though is short lived (1-3 years) and longer-lived species, such as pubescent wheat grass (*Agropyron trichophorum*) (4 years to 10 years) (North Star Seed n.d.) are included.

Table IR373-1 Potential Erosion Control Mix

Species Common Name	Species Scientific Name	Seed Mix Percentage by Weight
pubescent wheat grass	*Agropyron trichophorum*	40
Dahurian wildrye	*Elymus dahuricus*	22
sheep fescue	*Festuca ovina*	30
perennial ryegrass	*Lolium perenne*	8

It is likely that the native seed mix for Zone 6 identified in AIT (2005) will form the basis of native seed mixes (Table IR373-2).

Table IR373-2 Native Seed Mix for Zone 6

Species Common Name	Species Scientific Name	Seed Mix Percentage by Weight
slender wheat grass	*Agropyron trachycaulum*	30
smooth wildrye	*Elymus glaucus*	20
northern wheat grass	*Agropyron dasystachyum*	10
tickle grass	*Agrostis scabra*	10
fringed brome	*Bromus ciliatus*	10
tufted hairgrass	*Deschampsia cespitosa*	10
Foothills rough fescue	*Festuca campestris*	10

Native seed mixes will likely be targeted to high value native communities in areas of temporary disturbance lacking abundant weeds or aggressive non-native plant species. Mitigation involving planting or re-seeding will be based on post-construction land use objectives, which will be identified within the final land use plan that is currently under discussion with First Nations and other stakeholders.

REFERENCES

AEP (Alberta Environment and Parks). 2003. Revegetation using Native plant Materials Guidelines for industrial development sites. September 2003, R&R\03-3. http://aep.alberta.ca/land/programs-and-services/reclamation-and-remediation/legislation-and-general-information/guidelines.aspx

AIT (Alberta Infrastructure and Transportation). 2005. Grass Seed Mixtures Used on Highway and Bridge Projects, Design Bulletin No. 25. https://open.alberta.ca/dataset/cc7e748a-4aa0-4a80-ab1e-19e1f87a0f7b/resource/a7abb720-c5ad-40ed-9590-29a87703cda3/download/designbulletin25.pdf

North Star Seed. No Date. Native and Reclamation Seed Guide. 24 pp.

Tilley, D. and L. St. John. 2014. Plant Guide for Dahurian wildrye (*Elymus dahuricus*). USDA-Natural Resources. 3 pp.

6.3 TERRAIN AND SOILS

Question 374

Volume 1, Section 3.2, Figure 3-1, Page 3.3
Volume 1, Section 3.2.4, Page 3.12
Volume 1, Section 3.3.1.4, Page 3.24
Volume 4, Appendix D, Table 2-2, Page 2.5
Volume 4, Appendix D, Figure 2-2, Page 2.7
Volume 4, Appendix D, Section 4.4.2, Table 4-3, Page 4.11
Volume 4, Appendix D, Section 5.2.2, Table 5-1, Page 5.5

Alberta Transportation illustrates two borrow source areas on Figure 3-1 in Volume 1. However, only one borrow source is mentioned elsewhere in Volume 1 and Volume 4, Appendix D. For example, Alberta Transportation states in Volume 1 that *Should the amount of soil material generated by excavation of the diversion channel be insufficient to meet all the construction requirements for fill, the shortfall will be made up with material excavated from the borrow area in the reservoir* and *The borrow area construction sequence will be: pre-construction inspection…*

a. Clarify and harmonize the number of borrow source areas to be utilized.

b. Describe the *pre-construction inspection* protocols for the borrow area construction sequence (Volume 1, Page 3.24).

c. Describe the analytical sampling methods and laboratory testing that will be conducted on soil samples from the source area(s) to ensure the borrow material does not contain any potential contaminants of concern, including but not limited to salinity, anions and cations, nutrient parameters, petroleum hydrocarbons, and metals.

d. Describe the mitigation measures that will be taken should the borrow material contain contaminants of concern.

e. Describe the storage, transport, and disposal methods that will be undertaken should the borrow material contain contaminants of concern.

Response 374

a. Alberta Transportation initially identified two potential locations for borrow sources (as identified in Figure 3-1 of Volume 1, Section 3.2). Upon further review, Alberta Transportation expects to use only one of these borrow sources (Borrow Source 1), should excavation of the diversion channel yield insufficient or unsuitable material for constructing Project components. Borrow Source 1 includes portions of sections 19-24-3-W5 and 24-24-4-W5.

b. As identified in Volume 4, Appendix D, Section 1.0, with respect to pre-construction inspection protocols for Borrow Source 1, Alberta Transportation will be following the guidance contained in Alberta Transportation (2013). These protocols include guidance on the number of soil inspection points, the kinds of soil and vegetation data to collect at each inspection point, and criteria for evaluating the quality of topsoil and subsoil for reclamation. These data are intended to guide soil salvage and reclamation practices at the borrow source.

- The number of pre-disturbance inspection points is based on the area of the borrow source and length of haul road and is described in Alberta Transportation (2013; Table 2) , with additional consideration as to the complexity of soil pattern or topography. The number of inspection points per unit area decreases as the borrow source footprint increases. Inspection point intensity decreases from 5 inspection sites per ha for borrow source areas of 3 ha or less, to 3 inspection sites per ha for borrow source areas greater than 3 ha. Footprints of proposed haul roads are assessed at a rate of 1 inspection per 100 m length. These inspection intensities are the minimum; in complex topography or soils, additional soil inspections are to be completed at the judgement of the soil surveyor.
- Terrain features are described, including land use, drainage, surface stoniness, presence and intensity of surface erosion, presence of debris, evidence of instability, and topographic slope class, as defined in Alberta Transportation (2013; Table 1).
- Soil profiles at each inspection point are characterized for topsoil depth, topsoil texture, proportion of gravel or stones, and restrictive subsoil layers.
- Vegetation is characterized for type, productivity, health and presence of weeds (Alberta Transportation 2013; Table 3). Vegetation productivity is measured in terms of height, percent cover, length of seed heads, density of stems or post-harvest stubble (Alberta Transportation 2013: Table 5).
- If restrictive soil layers are present, they are described in terms of soil structure attributes and rated for their effect on root growth, vegetation productivity and permeability to water movement (Alberta Transportation 2013; Table 4).

c. Results of a Limited Phase 1 Environmental Site Assessment (provided in the response to IR375 as Appendix IR375-1) for the PDA showed there are no historical land uses within the area of Borrow Source 1 that would suggest the presence of contaminants of potential concern (COPC). The protocols for detecting the presence of COPC will include visual means to detect the presence of hydrocarbons and selective point sampling to detect the presence of salts, nutrients, or metals, where suspected. Soil with suspected hydrocarbons will be field screened for presence of combustible headspace vapours (CHV) and volatile headspace vapours (VHV) using a portable RKI Instrument (RKI) EAGLE 2 gas detector with photoionizing detector (PID) capability. Based on the results of the field screening completed during construction, soil samples could be submitted for laboratory analysis, including, but not limited to, benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs) fractions 1 to 4 (F1 to F4) salinity parameters (i.e., pH, conductivity, chloride, etc.) nutrients (i.e., total organic nitrogen, available phosphorus, nitrites and nitrates) and regulated metals.

   Soil nutrients would be associated with concentrated livestock facilities (wintering corrals), on-farm septic systems, and related disposal areas. Results of soil surveys (Volume 4, Section 3.2, Appendix G) also show that soils within the terrain and soils LAA are of low salinity and sodicity. Should soil salinity in Borrow Source 1 be present during excavation, it would be associated with deeper geologic formations such as shale bedrock or deeper till deposits. Salinity would also be associated with sites of concentrated livestock facilities, on-site septic systems, and disposal areas. Geologic layers associated with higher metal availability would be associated with deeper geologic layers formed under anaerobic conditions e.g., shales and mudstones, and could be encountered during excavation. Metals may also be associated with on-site septic systems and related disposal areas.

d. The soil analytical results of the screened soil discussed in c. will be compared to the applicable guidelines. If the soil samples meet the applicable guidelines, the soil may be used in construction. If the analytical results confirm that COPC are above threshold levels as outlined in the applicable guidelines, a risk analysis will be completed to determine subsequent actions and mitigations. The spectrum of remediation options includes avoidance of the material, encapsulation of the material, or removal of the material. If required, the soil will be disposed of off-site at an approved facility, dependent on the identified COPC, or may be isolated on-site depending on the risk-assessment outcomes.

e. Should impacted soils, if identified, need to be disposed of off-site, the soil will be further characterized to meet landfill acceptance (i.e., Class II landfill analysis). Following the results of the landfill characterization, the analytical results will be provided to a licensed landfill facility for approval. Following landfill approval, the impacted soil will be trucked off-site to the approved landfill facility for disposal. All trucks hauling impacted soil will be manifested in order to document the amount of impacted material leaving the PDA. The manifests will be tracked and recorded.

REFERENCES

Alberta Transportation. 2013. Alberta Transportation Pre-Disturbance Assessment Guide for Borrow Excavations, Dec. 2013 edition. Available at, http://www.transportation.alberta.ca/content/doctype245/production/borrowproc.pdf

Question 375

Volume 1, Section 3.2.1.2, Page 3.7

Alberta Transportation states that the service spillway will include a *concrete stilling basin backfilled with native substrate*.

a. Describe and map the source of the native substrate to demonstrate that the source soil is located away from areas that may have been previously contaminated by anthropogenic activities, and thus is suitable as construction material.

b. Describe the field screening methods and laboratory analytical testing that will be conducted to ensure that the native substrate does not contain any potential contaminants of concern, including but not limited to salinity, anions and cations, nutrient parameters, petroleum hydrocarbons, and metals.

c. Describe mitigation measures that will be undertaken if native substrate is found to contain potential contaminants of concern.

Response 375

BACKGROUND INFORMATION

IRs 375, 376, 377, and 378 request Alberta Transportation to address how it proposes to detect and manage potential contaminants of concern (COPC) that might be present in native materials used for construction of Project components. These components and associated IRs are:

- IR375, the service spillway and concrete stilling basin
- IR376, an earthen embankment for the floodplain berm
- IR377, a roller compacted concrete gravity structure used for the auxiliary spillway
- IR378, two earthen embankments that make up the dam

To address these IRs, Alberta Transportation has completed a Limited Phase 1 Environmental Site Assessment (provided in Appendix IR375-1) for the PDA. That report identifies locations in the PDA that, based on a literature review, are associated with historical land uses that indicate a higher likelihood of possessing the presence of COPC. The information in the Phase 1 Assessment was

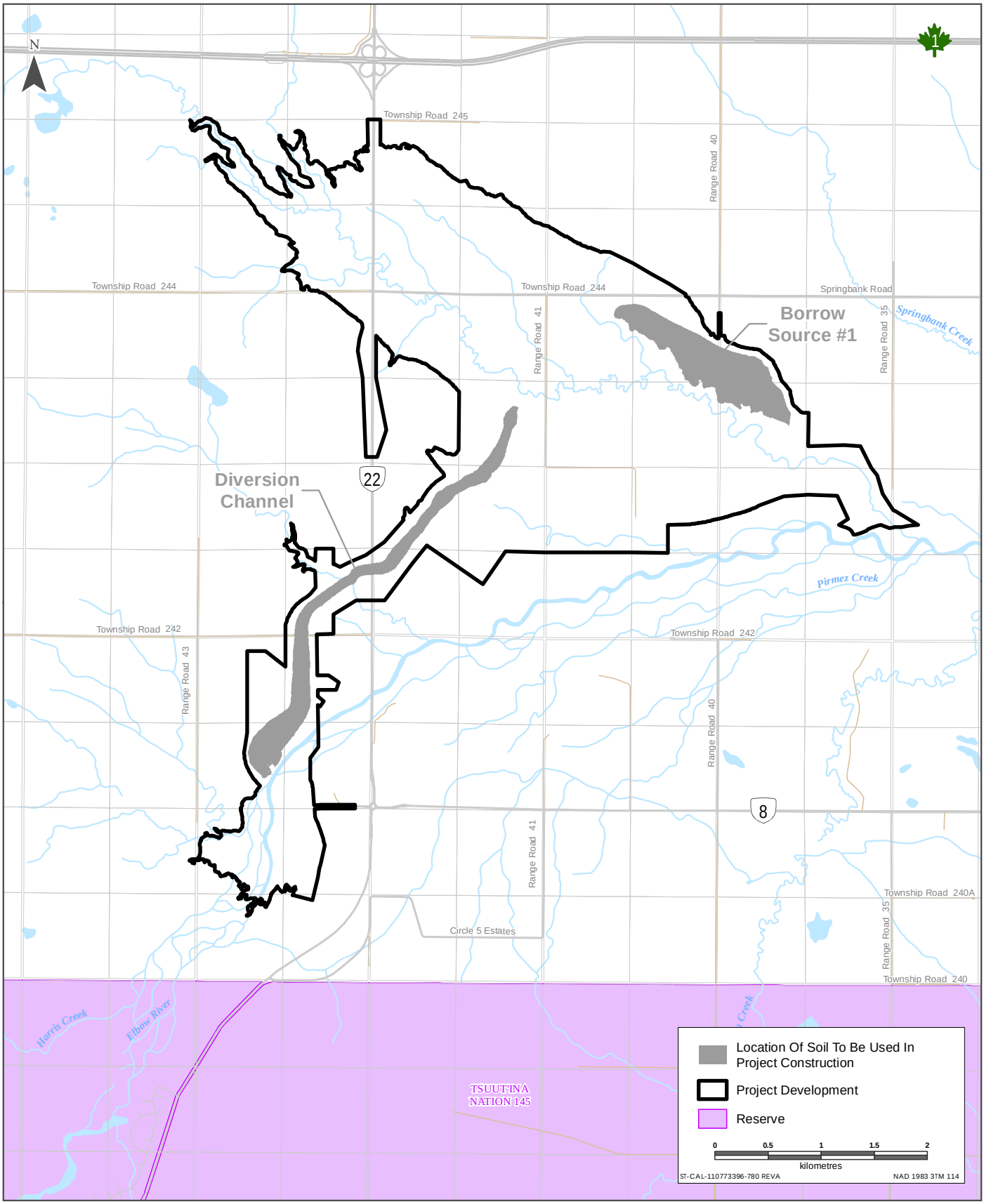
used to provide clarity on the processes Alberta Transportation will use to manage potential COPC. The risk analysis protocols, field screening methods, analytical testing, and range of options to be used for mitigation are the same for each of these Project components.

a. The source of native substrate is expected to come from the material excavated from the service spillway location within the PDA (see Figure IR375-1). The earth fill material will comply with Alberta Transportation (2017) and will consist of native soils obtained from required excavations or the specified borrow source area on site, free from organic matter, deleterious materials and frozen materials (Clauses 2.1.1, to 2.1.4). Results of the Limited Phase 1 Environmental Site Assessment (Appendix IR375-1) show there are no historical land uses that would suggest the presence of COPC associated with the area within the proposed service spillway. Results of the baseline soil survey (Volume 4, Appendix G, Section 3.2) also show that soils within the soils and terrain LAA are of low salinity and sodicity.

   Results from the Limited Phase 1 Environmental Site Assessment indicate that there were historical land uses that would suggest the presence of COPC at several quarter sections where the stilling basin is to be located. With the exception of the existing pipelines, all of the locations are outside the PDA but less than 100 m from the PDA boundary. The following are the sites of COPC:

   - Volker Stevin highway maintenance yard within NE 10-24-4-W5, where above ground storage tanks are located
   - a decommissioned pit in the same quarter section (NE 10-24-4-W5) approximately 50 m southwest of the PDA. The status date of the decommissioned pit was February 23, 1995. No additional information was provided.
   - multiple pipelines within the PDA, including in section 10-24-4-W5 where the service spillway is to be located. The contents of the pipelines included high vapour pressure products, low vapour pressure products, natural gas and condensate.

   These sites contain potentially mobile hydrocarbon contaminants either close to the PDA or, in the case of pipelines, within the PDA. Responsibility for both existing and future hydrocarbon contamination from pipelines would be with the pipeline owners.



Sources: Base Data - Government of Canada. Thematic Data - Government of Alberta

Location of Soil To Be Used For Project Construction

Stantec

b. The protocols for detecting the presence of COPC will include visual means to detect the presence of hydrocarbons and selective point sampling to detect the presence of salts, nutrients, or metals, where suspected. If hydrocarbons are detected, point samples will be collected and field screened for presence of combustible headspace vapours (CHV) and volatile headspace vapours (VHV) using a portable RKI Instrument (RKI) EAGLE 2 gas detector with photoionizing detector (PID) capability. The service spillway and concrete stilling basin soil will be analyzed prior to use in order to determine suitability. Based on the results of the field screening completed during construction, soil samples could be submitted for laboratory analysis, including, but not limited to, benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs) fractions 1 to 4 (F1 to F4), salinity parameters (i.e., pH, conductivity, chloride, etc.) nutrients (i.e., total organic nitrogen, available phosphorus, nitrites and nitrates) and regulated metals.

c. The soil analytical results of the screened soil discussed in b. will be compared to the applicable guidelines. If the soil samples meet the applicable guidelines, the soil may be used in construction. If the analytical results confirm that COPC are above threshold levels, a risk analysis will be completed to determine subsequent actions and mitigation measures. The spectrum of remediation options include avoidance of the material, encapsulation of the material, or removal of the material. If required, the soil will be disposed offsite at an approved facility dependent on the identified COPC or may be isolated onsite, depending on the risk-assessment outcomes.

REFERENCES

Alberta Transportation. 2017. Section 002330, Earthwork Materials. Accessed at: https://www.transportation.alberta.ca/Content/docType125/Production/Section02330.pdf

Question 376

Volume 1, Section 3.2.1.4, Page 3.9
Volume 1, Section 3.2.1.4, Figure 3-5, Page 3.9
Volume 1, Section 3.3.1.2, Page 3.23

Alberta Transportation states that the floodplain berm is *an earth embankment*, and Figure 3-5 shows that *Random Fill* will be used in Zone 2A.

a. Describe and map the source of the earth and random fill to demonstrate that the source soil is located away from areas that may have been previously contaminated by anthropogenic activities and thus is suitable as clean construction material.

b. Describe the field screening methods and laboratory analytical testing that will be conducted to ensure that the earth and random fill does not contain any potential contaminants of concern, including but not limited to salinity, anions and cations, nutrient parameters, petroleum hydrocarbons, and metals.

c. Describe mitigation measures that will be undertaken if earth or random fill is found to contain potential contaminants of concern.

Response 376

a. The source of native substrate is expected to come from the material excavated from the diversion channel (see Figure IR375-1). The earth fill material will comply with Alberta Transportation (2017) and will consist of native soils obtained from required excavations, free from organic matter, deleterious materials and frozen materials (Clauses 2.1.1, to 2.1.4).

   Results of the baseline soil survey (Volume 4, Appendix G, Section 3.2) show that soils within the local soils and terrain LAA are of low salinity and sodicity. Soil sampling conducted as part of the surface water quality baseline found that most topsoil samples had hydrocarbons below detection limit throughout the PDA (Volume 4, Appendix K, Attachment A, Table A-4).

   The nature of material to be excavated from the diversion channel is also described in the Hydrogeology TDR Update see the response to IR42; Appendix 42-1, Section 3, Figure 3-14 to Figure 3-18). These figures show that till material of about 10 m in thickness commonly blankets the underlying bedrock at the interface of the Elbow River valley and adjacent upland areas. Clay-rich till material will, therefore, make up a large part of the material excavated from the diversion channel.

b. The protocols for detecting the presence of contaminants of potential concern (COPC) will include visual means to detect the presence of hydrocarbons and selective point sampling to detect the presence of salts, nutrients, or metals, where suspected. The focus will be two locations within section 10-24-4-W5 that were historically associated with fuel storage tanks as indicated in the Limited Phase 1 Environmental Site Assessment (see the response to IR375, Appendix IR375-1). If hydrocarbons are detected, point samples will be collected and field screened for presence of combustible headspace vapours (CHV) and volatile headspace vapours (VHV) using a portable RKI Instrument (RKI) EAGLE 2 gas detector with photoionizing detector (PID) capability. The floodplain berm soil will be analyzed prior to use in order to determine its suitability for construction purposes. Based on the results of the field screening completed during construction, soil samples could be submitted for laboratory analysis, including, but not limited to, benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs) fractions 1 to 4 (F1 to F4), salinity parameters (i.e., pH, conductivity, chloride, etc.) nutrients (i.e., total organic nitrogen, available phosphorus, nitrites and nitrates) and regulated metals.

c. The soil analytical results of the screened soil discussed in b. will be compared to the applicable guidelines. If the soil samples meet the applicable guidelines, the soil may be used in construction. If the analytical results confirm that COPC are above threshold levels, a risk analysis will be completed to determine subsequent actions and mitigation measures. The spectrum of remediation options includes avoidance of the material, encapsulation of the material, or removal of the material. If required, the soil will be disposed offsite at an approved facility dependent on the identified COPC or may be isolated onsite, depending on the risk-assessment outcomes.

REFERENCES

Alberta Transportation. 2017. Section 002330, Earthwork Materials. Accessed at: https://www.transportation.alberta.ca/Content/docType125/Production/Section02330.pdf

Question 377

Volume 1, Section 3.2.1.5, Page 3.10
Volume 1, Section 3.2.1.5, Figure 3-6, Page 3.10

Alberta Transportation states that the auxiliary spillway is *a roller compacted concrete (RCC) gravity structure founded on bedrock and covered with earth*, and Figure 3-6 states that *Fill Anticipated to Erode for Major Storm Events* will cover the concrete.

a. Describe and map the source of the earth fill/ backfill to demonstrate that the source soil is located away from areas that may have been previously contaminated by anthropogenic activities, and thus is suitable as construction material.

b. Describe the field screening methods and laboratory analytical testing that will be conducted to ensure that the earth fill/ backfill does not contain any potential contaminants of concern, including but not limited to salinity, anions and cations, nutrient parameters, petroleum hydrocarbons, and metals.

c. Describe mitigation measures that will be undertaken if earth fill/ backfill is found to contain potential contaminants of concern.

d. Describe potential residual impacts if earth fill/ backfill containing potential contaminants of concern is eroded during major storm events.

Response 377

a. The source of native substrate is expected to come from the material excavated from the diversion channel within the PDA (see the response to IR 375, Figure IR375-1). The earth fill material will comply with Alberta Transportation (2017) and will consist of native soils obtained from required excavations, free from organic matter, deleterious materials and frozen materials (Clauses 2.1.1, to 2.1.4).

   Results of a Limited Phase 1 Environmental Site Assessment (Appendix IR375-1) showed there are no historical land uses within the proposed auxiliary spillway nor in the area where the diversion channel will be excavated that would suggest the presence of contaminants of potential concern (COPC). However, there are several locations within 100 m of the PDA where COPC may be present in the form of hydrocarbon spills from fuel storage areas associated with borrow source development or highway maintenance. Results of the baseline soil survey (Volume 4, Appendix G, Section 3.2) also show that soils within the terrain and soils LAA are of low salinity and sodicity. Soil sampling conducted as part of the surface water quality baseline found that most topsoil samples had hydrocarbons below detection limit throughout the PDA (Volume 4, Appendix K, Attachment A, Table A-4).

   The nature of material to be excavated from the diversion channel is also described in the Hydrogeology TDR Update see the response to IR42; Appendix 42-1, Section 3, Figure 3-14 to Figure 3-18). These figures show in both plan view and cross section view that till material of about 10 m in thickness commonly blankets the underlying bedrock at the interface of the Elbow River valley and adjacent upland areas. Clay-rich till material will, therefore, make up a large part of the material excavated from the diversion channel.

b. The protocols for detecting the presence of COPC will include visual means to detect the presence of hydrocarbons and selective point sampling to detect the presence of salts, nutrients, or metals, where suspected. If hydrocarbons are detected, point samples will be collected and field screened for presence of combustible headspace vapours (CHV) and volatile headspace vapours (VHV) using a portable RKI Instrument (RKI) EAGLE 2 gas detector with photoionizing detector (PID) capability. The auxiliary spillway soil will be analyzed prior to use in order to determine its suitability for construction purposes. Based on the results of the field screening completed during construction, soil samples could be submitted for laboratory analysis, including, but not limited to, benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs) fractions 1 to 4 (F1 to F4), salinity parameters (i.e., pH, conductivity, chloride, etc.) nutrients (i.e., total organic nitrogen, available phosphorus, nitrites and nitrates) and regulated metals.

c. The soil analytical results of the screened soil discussed in b. will be compared to the applicable guidelines. If the soil samples meet the applicable guidelines, the soil may be used in construction. If the analytical results confirm that are above threshold levels as outlined in the applicable guidelines, a risk analysis will be completed to determine

subsequent actions and mitigations. The spectrum of remediation options includes avoidance of the material, encapsulation of the material, or removal of the material. If required, the soil will be disposed of off-site at an approved facility, dependent on the identified COPC, or may be isolated on-site depending on the risk-assessment outcomes.

d. As stated in the response to a., the source material for the auxiliary spillway is unlikely to contain COPC so the potential for residual effects resulting from erosion during storm events is low. If contaminants are found, Alberta Transportation will treat them as described in the response to c. In addition, construction of the Project will follow Alberta Transportation (2011) and a site-specific Erosion and Sediment Control Plan (to be developed by the contractor) will be created as part of the Environmental Construction Operation Plan (ECO Plan), which will contain erosion control measures and monitoring to limit the potential for erosion from storm events.

REFERENCES

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

Alberta Transportation. 2017. Section 002330, Earthwork Materials. Accessed at: https://www.transportation.alberta.ca/Content/docType125/Production/Section02330.pdf

---

Question 378

Volume 1, Section 3.2.5, Pages 3.14-3.15
Volume 1, Section 3.2.5, Figure 3-8, Page 3.14
Volume 1, Section 3.2.5, Figure 3-9, Page 3.15

Alberta Transportation states that *the dam includes two zoned earthen embankments*…and Figure 3-8 shows *Embankment Core* and Figure 3-9 shows *Impervious Zone 1A* and *Random Fill Zone 2A.*

a. Describe and map the relationship between the two zoned embankments, the Primary Embankment (Figure 3-8) and Secondary Embankment (Figure 3-9), of the off- stream dam and their components. For example, explain the relationship between the Embankment Core and the Impervious Zone 1A.

b. Describe and map the source of the earth fill to demonstrate that the source soil is located away from areas that may have been previously contaminated by anthropogenic activities, and thus is suitable as construction material.

c. Describe the field screening methods and laboratory analytical testing that will be conducted to ensure that the source soil does not contain any potential contaminants of concern, including but not limited to salinity, anions and cations, nutrient parameters, petroleum hydrocarbons, and metals.

d. Describe mitigation measures that will be undertaken if source soil is found to contain potential contaminants of concern.

Response 378

a. Volume 1, Section 3.2.5.1 states that the primary embankment is 3,300 m in length. The secondary embankment is an additional 400 m at the western extent of the embankment (shown in Volume 1, Figure 3-1, Figure 3-8 and Figure 3-9). There are three kinds of fill material to be used in the construction of the off-stream dam. First, the impervious zone 1A consists of materials that resist seepage, and these materials form the core of both the primary and secondary embankments. Second, the random fill 2A consists of materials that have a wider range of properties and are used to provide additional stability to the dam in the embankment shell of both the primary and secondary embankments. Third, there is a one metre thick fine filter material (Zone 3A), that is placed strategically along portions of the embankment core and is designed to provide additional internal drainage. Additional geotechnical data will be used to refine the sources of material used in these embankment components.

b. The source of native substrate The source of native substrate is expected to come from the material excavated from the diversion channel within the PDA is expected to come from the material excavated from the diversion channel within the PDA; however, it could also be obtained from other sources, such as Borrow Source 1, depending on the availability of different materials during construction (Figure IR375-1). The earth fill material will comply with Alberta Transportation (2017) and will consist of native soils obtained from required excavations or the specified borrow source area on site, free from organic matter, deleterious materials and frozen materials (Clause 2.1.1 to 2.1.4). The fine filter sand will be imported.

   Results of a Limited Phase 1 Environmental Site Assessment (Appendix IR375-1) showed there are no historical land uses with the area within the proposed dam nor in the area where the diversion channel will be excavated, or the area within Borrow Source 1 that would suggest the presence of contaminants of potential concern (COPC). However, there are several locations up to 100 m outside the PDA where COPC may be present in the form of hydrocarbon spills from fuel storage areas associated with borrow source development or highway maintenance in section 10-24-4-W5.

Results of the baseline soil survey (Volume 4, Appendix G, Section 3.2) show that soils within the terrain and soils LAA are of low salinity and sodicity. Soil sampling conducted as part of the surface water quality baseline found that most topsoil samples had hydrocarbons below detection limit throughout the PDA (Volume 4, Appendix K, Attachment A, Table A-4).

The nature of material to be excavated from the diversion channel is also described in the Hydrogeology TDR Update see the response to IR42; Appendix 42-1, Section 3, Figure 3-14 to Figure 3-18). These figures show that till material of about 10 m in thickness commonly blankets the underlying bedrock at the interface of the Elbow River valley and adjacent upland areas. Clay-rich till material will, therefore, make up a large part of the material excavated from the diversion channel.

c. The protocols for detecting the presence of COPC will include visual means to detect the presence of hydrocarbons and selective point sampling to detect the presence of salts, nutrients, or metals, where suspected. If hydrocarbons are detected, point samples will be collected and field screened for presence of combustible headspace vapours (CHV) and volatile headspace vapours (VHV) using a portable RKI Instrument (RKI) EAGLE 2 gas detector with photoionizing detector (PID) capability. The off-stream dam soil will be analyzed prior to use in order to determine its suitability for construction purposes. Based on the results of the field screening completed during construction, soil samples could be submitted for laboratory analysis, including, but not limited to, benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs) fractions 1 to 4 (F1 to F4), salinity parameters (i.e., pH, conductivity, chloride, etc.) nutrients (i.e., total organic nitrogen, available phosphorus, nitrites and nitrates) and regulated metals.

d. The soil analytical results of the screened soil discussed in c. will be compared to the applicable guidelines. If the soil samples meet the applicable guidelines, the soil may be used in construction. If the analytical results confirm that COPC are above threshold levels, a risk analysis will be completed to determine subsequent actions and mitigation. The spectrum of remediation options includes avoidance of the material, encapsulation of the material, or removal of the material. If required, the soil will be disposed offsite at an approved facility, dependent on the identified COPC, or may be isolated on-site depending on the risk-assessment outcomes.

REFERENCES

Alberta Transportation. 2017. Section 002330, Earthwork Materials. Accessed at: https://www.transportation.alberta.ca/Content/docType125/Production/Section02330.pdf

Question 379

Volume 1, Section 3.2.8.1, Pages 3.20 and 3.21
Volume 1, Section 3.2.8.1, Figure 3-12, Page 3.21

Alberta Transportation states that *Oil and gas pipelines operated by four companies…are in the PDA*. Alberta Transportation also states that the pipelines will be re-located or retrofitted.

a. Describe field screening methods and laboratory analytical testing that will be conducted to ensure that the soil remaining in the footprint of the retrofitted and/or re-located pipelines does not contain any potential contaminants of concern, including but not limited to salinity, anions and cations, nutrient parameters, petroleum hydrocarbons, and metals.

b. Describe mitigation measures that will be undertaken if soil remaining in the footprint of the retrofitted and/or re-located pipelines is found to contain potential contaminants of concern.

Response 379

a. The relocation or retrofitting of the pipelines within the PDA is the responsibility of the pipeline operators. The operator will be responsible for obtaining all regulatory approvals and following regulatory requirements in relation to any soil testing or remediation post-relocation/retrofitting. Federally regulated pipelines would apply for applications to the National Energy Board (NEB) under the *National Energy Board Act* and provincially regulated pipelines would apply for applications to the Alberta Energy Regulator (AER) under the *Pipeline Act*. TransCanada Pipelines Ltd. currently operates two federally regulated pipelines in the PDA, Plains Midstream Canada operates three provincially regulated pipelines (including one abandoned pipeline) in the PDA, and both Caledonian Midstream Corporation and Pembina each operate a provincially regulated pipeline in the PDA. Additional information on pipelines in the PDA is provided in the response to SIR 533.

b. Mitigation of identified contaminants within the PDA of the retrofitted and/or re-located pipelines is the responsibility of the pipeline operators and is part of the pipeline's environmental protection plan (EPP). The EPP follows guidelines set by the regulatory agency of the pipeline (the NEB for federally regulated pipelines and the AER for provincially regulated pipelines) and is specific to the material carried within the line (e.g., low vapour pressure vs. high vapour pressure products). Any contamination identified associated with NEB-regulated pipelines will be reported to the NEB and remediated in accordance with the NEB (2019) and GoA (2019) will be followed for AER-regulated pipelines. Contaminants could be mitigated either through removal of contaminated soil or insitu treatment, but the specific methods would depend on a number of factors, including the nature of the contaminants found, areas of the contamination found during testing, and the decision of the operator. Any contaminated material that is disposed of will be disposed according Provincial waste-management directives, such as Directive 058: Oilfield Waste Management Requirements for the Upstream Petroleum Industry.

REFERENCES

GoA (Government of Alberta). 2019. Accessed at: https://www.alberta.ca/part-one-soil-and-groundwater-remediation.aspx?utm_source=redirector. Alberta Tier 1 Soil and Groundwater Remediation Guidelines

NEB (National Energy Board). 2019. Remediation Process Guide. Accessed at: https://www.neb-one.gc.ca/sftnvrnmnt/nvrnmnt/rmdtnprcssgd/rmdtnprcssgddrft-eng.pdf

Question 380

Volume 1, Section 3.2.8.2, Page 3.22

Alberta Transportation states that *AltaLink operates a transmission line that crosses the diversion channel (Figure 3-12). Power pole locations will be adjusted to permit a clear span over the channel.*

a. Describe field screening methods and laboratory analytical testing that will be conducted to ensure that the soil remaining in the footprint of the relocated power poles does not contain any potential contaminants of concern.

b. Describe mitigation measures that will be undertaken if soil remaining in the footprint of the relocated power poles is found to contain potential contaminants of concern.

Response 380

a-b. The reallocation of power poles within the PDA is the responsibility of the powerline operator, AltaLink. The operator will be responsible, under the *Hydro and Electrical Energy Act*, for obtaining all regulatory approvals and following regulatory requirements in relation to any soil testing or remediation, post-relocation.

Question 381

Volume 1, Section 3.3, Page 3.22 and 3.23

Alberta Transportation states that *Other Alberta Transportation guidance documents that apply to the project deal specifically with erosion and sediment control (Alberta Transportation 2011) and borrow excavations (Alberta Transportation 2013a, 2013b, 2013c)*.

a. Summarize the relevant portions of these references in terms of environmental protection during construction related to erosion, sediment control, and borrow excavations.

b. Summarize how the processes in these references will help to mitigate potential effects from construction of the Project.

Response 381

a. Alberta Transportation (2011) provides a large volume of relevant information on regulatory requirements, erosion and sediment control management strategies, the erosion and sediment process, instructions for a site assessment, including erosion potential and evaluation, erosion and sediment control methods, best management practices, permanent and temporary erosion and sediment control plans, guidelines for estimating runoff, and sediment containment. This will be followed throughout construction for soil movement and stockpiling. Alberta Transportation (2011) is intended for use in the design, construction and maintenance of erosion and sediment control measures for terrestrial highway infrastructure and would be applicable to work in the PDA except for instream work.

   Thirty-nine erosion and sediment control best management practices are presented in Tables C-1, C-2 and C-3 of Appendix C, pages C-1 to C-12 of the Manuel (also in Volume 4, Supporting Documentation, Document 6). Thirteen best management practices for non-structural methods that can reduce erosion and sediment transport are in Table C-5 in Appendix C, pages C-13 to C-14 of the Manuel. The appendix describes the various erosion control measures along slopes, ditches, flat surfaces, borrow source area, stockpile areas, and the advantages and limitations to the erosion control measure.

   For a borrow source, Alberta Transportation (2013a, b and c) has guidelines for pre-disturbance assessments, post-disturbance assessments, and reclamation of a borrow source area. Alberta Transportation (2013a) does recommend actions to avoid wind and water erosion, including reducing excessive soil compaction, controlling drainage so as to not cause erosion through water runoff, reconstruction of site slopes to limit the susceptibility of erosion (long straight slopes versus shorter, more complex slopes), maintenance of soil structure to avoid wind erosion, and use of appropriate erosion control measures until vegetation can be established (mulches, tackifiers, hydroseeding, erosion control berms).

   Alberta Transportation (2013b for pre-disturbance assessment does not indicate specific mitigation for erosion and sediment control. Instead, the pre-disturbance assessment are surveys carried out prior to borrow source excavation. The pre-disturbance assessment collects baseline soil and vegetation information to provide guidance for a reclamation plan and for a comparison for post reclamation. It does not provide information specific to erosion and sedimentation; however, soil information gathered will be able to identify soils that may be sensitive to erosion.

   Alberta Transportation (2013c) for post-disturbance assessment requires that there should be no erosion in excess of that noted in the pre-disturbance assessment, or equivalent to erosion noted adjacent to the site. It identifies that crop cover or native forage should be sufficient to prevent erosion, but sparse enough to assist in natural encroachment of native species. For the Project, the specific seed mix will be informed by input from Indigenous groups as to species that are culturally important to them.

In addition to the Alberta Transportation (2011), a site-specific Erosion and Sediment Control Plan will be created as part of the *Environmental Construction Operations Plan (ECO Plan) Framework* (see Volume 4, Supporting Documentation, Document 10). This Plan will be developed by the selected construction contractor using Alberta Transportation's ECO Plan framework for use during construction.

b. Within the site-specific ECO Plan, erosion and sediment control measures will be incorporated to mitigate potential effects to vegetation, hydrology, surface water quality, and aquatics from construction. Such mitigation measures include:

- A cover crop seed mixture should be used to assist in weed and erosion control on exposed soils where warranted.
- Bank and riparian areas disturbed during construction will be reclaimed and re-vegetated. Silt fences, turbidity barriers and riprap materials will be used to prevent bank erosion.
- Instream work areas will be isolated from the main river flow by using cofferdams, silt fences and turbidity barriers. Total suspended solids (TSS) will be monitored and measured for conformance with Volume 4, Supporting Documentation, Document 9.
- Suspended sediment concentrations will be monitored upstream and downstream of instream construction activities. Should an unacceptable increase in suspended sediment concentrations occur, it would be mitigated immediately, or the work halted until mitigation is in place.

Additionally, the following Alberta Transportation specifications will be incorporated into the ECO Plan:

- *Turbidity Barriers and Monitoring Section 02242 of the Civil Works Master Specifications for Construction of Provincial Water Management Projects* (Volume 4, Supporting Documentation, Document 9)
- *Care of Water Section 02240 of the Civil Works Master Specifications for Construction of Provincial Water Management Projects* (Volume 4, Supporting Documentation, Document 12)
- *Soil Erosion Protection Section 02930 of the Civil Works Master Specifications for Construction of Provincial Water Management Projects* (Volume 4, Supporting Documentation, Document 14)

Alberta Transportation (2011) and Alberta Transportation (2013a) provide mitigation to reduce the potential effects of accelerated rates of erosion and sedimentation from construction activities. If left uncontrolled, erosion and sedimentation may result in an adverse impact to the environment.

Alberta Transportation (2011; Table 7.3) provides information on how the best management practices mitigate for erosion and sedimentation processes. For example, the process of placing mulch protects soil erosion from rain splash erosion, preserves soil moisture and protects germinating seed from temperature extremes. Table 7.3 has been reproduced here for convenience, as Table IR381-1, which provides explanations of how the mitigation will prevent soil erosion and sedimentation.

REFERENCES

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

Alberta Transportation. 2013a. Guide to Reclaiming Borrow Excavations. Alberta Transportation, Edmonton, Alberta.

Alberta Transportation. 2013b. Pre-disturbance Assessment Guide for Borrow Excavations. Alberta Transportation, Edmonton, Alberta.

Alberta Transportation. 2013c. Post-Disturbance Assessment Guide for Borrow Excavations. Alberta Transportation, Edmonton, Alberta.

Table IR381-1 Erosion Control Measures – Source Control (from Table 7.3 in the Erosion and Sediment Control Manual)

Best Management Practice (BMP) #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
25	Topsoiling	✓	✓	✓	✓	Placing topsoil provides excellent medium for vegetation root structure development, organic content promotes plant growth, reuse organics (topsoil or peat) stripped from the site at start of grading; absorbs raindrop energy to minimize erosion potential	Cannot be effective without seeding and allowing time for plant growth; not appropriate for slopes steeper than 2H:1V (steep slopes will require soil covering over topsoil and specialized design); dry topsoil susceptible to wind erosion, susceptible to erosion prior to establishment of vegetation
22	Seeding	✓	✓	✓	✓	Inexpensive and relatively effective erosion control measure, effectiveness increases with time as vegetation develops, aesthetically pleasing, enhances terrestrial and aquatic habitat	Must be applied over prepared surface (topsoiled), grasses may require periodic maintenance (mowing), uncut dry grass may be a fire hazard, seeding for steep slopes may be difficult, seasonal limitations on seeding effectiveness may not coincide with construction schedule, freshly seeded areas are susceptible to runoff erosion until vegetation is established, reseeding may be required for areas of low growth

Table IR381-1 Erosion Control Measures – Source Control (from Table 7.3 in the Erosion and Sediment Control Manual)

Best Management Practice (BMP) #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
23	Mulching	✓	✓	✓	✓	Used alone to protect exposed areas for short periods, protects soil from rain splash erosion, preserves soil moisture and protects germinating seed from temperature extremes, relatively inexpensive measure of promoting plant growth and slope protection	Application of mulch on steep slopes may be difficult, may require additional specialized equipment. May deplete available nitrogen. Nitrogen rich fertilizer may need to be added
24a 24b	Hydroseeding / Hydromulching	✓	✓	✓	✓	Economical and effective on large areas, mulch tackifier may be used to provide immediate protection until seed germination and vegetation is established, allows revegetation of steep slopes where conventional seeding/mulching techniques are very difficult, relatively efficient operation, also provides wind erosion control	Site must be accessible to hydroseeding and hydromulching equipment (usually mounted on trucks with a maximum hose range of approximately 150 m), may require subsequent application in areas of low growth as part of maintenance program
26	Sodding	✓	✓	✓	✓	Provides immediate vegetation and protection, instant buffer strip and/or soft channel lining, can be used on steep slopes, relatively easy to install, may be repaired if damaged, aesthetically pleasing	Expensive, labour intensive to install, sod may not be readily available in all areas of the province, relatively short 'shelf-life' (sod can't be stored on-site for excessive periods of time)

Table IR381-1 Erosion Control Measures – Source Control (from Table 7.3 in the Erosion and Sediment Control Manual)

Best Management Practice (BMP) #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
14	Riprap Armouring	✓	✓			Most applicable as channel lining with geotextile underlay, used for soils where vegetation not easily established, effective for high velocities or concentrations, permits infiltration, dissipates energy of flow from culvert inlets/outlets, easy to install and repair, very durable and virtually maintenance free	Expensive, may require heavy equipment to transport and place rock, may not be feasible in areas of the province where rock is not readily available, may be labour intensive to install; generally thickness of riprap is higher when compared to gabion mattress
13	Rolled Erosion Control Products (RECP)	✓	✓			Provides a protective covering to bare soil or topsoiled surface where need of erosion protection is high, can be more uniform and longer lasting than mulch, wide range of commercially available products	RECP use is labour intensive to install, temporary blankets may require removal prior to restarting construction activities, RECP not suitable for rocky slopes, proper site preparation is required to seat RECP onto soil correctly; high performance is tied to successful vegetation growth
15	Cellular Confinement System	✓	✓			Lightweight cellular system and easily installed, uses locally available soils for fill to reduce costs	Not commonly used in Alberta highway construction, expensive, installation is labour intensive (hand installation), not suitable for slopes steeper than 1H:1V

Table IR381-1 Erosion Control Measures – Source Control (from Table 7.3 in the Erosion and Sediment Control Manual)

Best Management Practice (BMP) #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
27a	Live Staking	✓		✓		Establishes vegetative cover and root mat, reduces flow velocities on vegetative surface, traps sediment laden runoff, aesthetically pleasing once established, grows stronger with time as root structure develops, usually has deeper root structure than grass	Expensive, may be labour intensive to install, not commonly used in Alberta highway construction projects, revegetated areas are subject to erosion until plants are established, plants may be damaged by wildlife, watering is usually required until plants are established
30	Riparian Zone Preservation	✓	✓	✓	✓	Preserve a native vegetation buffer to filter and slow runoff before entering sensitive (high risk) areas, most effective natural sediment control measure, slows runoff velocity, filters sediment from runoff, reduces volume of runoff on slopes	Freshly planted vegetation for newly created riparian zones requires substantial periods of time before they are as effective as established vegetation at controlling sediment
32	Scheduling	✓	✓	✓	✓	Identifies protection issues and plans for efficient, orderly construction of BMPs; minimizes bare soil exposure and erosion hazard; allows early installation of perimeter control for sediment entrapment; and early installation of runoff control measures	
34	Slope Texturing	✓			✓	Roughens slope surface to reduce erosion potential and sediment yield; suitable for clayey soils	Additional cost; not suitable for silty and sandy soils; not practical for slope length <8 m for dozer operation up/down slope

Table IR381-1 Erosion Control Measures – Source Control (from Table 7.3 in the Erosion and Sediment Control Manual)

Best Management Practice (BMP) #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
36	Polyacrylamide (PAM)	✓	✓		✓	Increase cohesion of soil particles, thus enhancing terrestrial and aquatic habitat and improving water quality	Not for application to surface waters. Not commonly used in highway construction projects and may be expensive. Treatment area must be accessible to spray equipment. Temporary measure only. Performance decreases due to exposure to ultraviolet (UV) light and time
35	Straw Mulching & Crimping (Straw Anchoring)	✓			✓	Economical method of promoting plant growth and slope protection	Availability of straw. “Punching” of straw does not work on sandy soils. Application of straw by hand is labour intensive. If using straw blowers, treatment area must be accessible to trucks
37	Compost Blanket	✓		✓	✓	Economical. Appropriate on slopes 2H:1V to level surface	Application on steep slopes may be difficult. Treatment area should be accessible to blower trucks

Question 382

Volume 1, Section 3.6.1, Table 3-10, Page 3.37
Volume 1, Section 3.6.5, Page 3.38
Volume 1, Section 4.5, Table 4-1, Page 4.2
Volume 3B, Section 9.1, Page 9.2
Volume 3B, Section 9.2.3.2, Page 9.8
Volume 4, Appendix D, Section 6.2, Page 6.2

Alberta Transportation uses different terms to describe fates of post-flood sediments in different Volumes and Sections. For example, Volume 1 states *removal* and *partial removal of sediment… to the extent necessary to maintain functionality* of the Project components. Volume 3B Section 9.1 states *reservoir sediment cleanup is expected to be minimal*. Volume 4, Appendix D indicates that *The reservoir has been designed so that it can function as required with up to 10% of its capacity lost (i.e. filled with sediment). It is, therefore, not necessary to remove post-flood deposits that do not reach this level….*

a. **Clarify discrepancies in sediment fate terminology throughout the applicable Volumes. For example, correct or explain partial removal, removal, versus minimal cleanup.**

b. **Clarify the fate (i.e. disposal, retention, removal, cleanup) of post-flood sediment as it relates to different component and stages of the Project.**

c. **Clarify the conditions where sediment removal or cleanup would be necessary.**

d. **Describe the sediment removal or cleanup procedures including any sampling and analysis for potential contaminants of concern.**

e. **Describe the pre-determined depth of sediment that would require removal in order to maintain functionality of the Project components.**

f. **Explain why sediment removal is not anticipated for areas that may accumulate sediment depths ranging between 1.0 m and greater than 4.0 m as described in Volume 3B Section 9.2.3.2.**

Response 382

a-c. Post-flood sediment in the off-stream reservoir will be retained, although it may be moved within the reservoir if it interferes with drainage to the low-level outlet or functioning of the reservoir or associated components. Sediment will be moved away from other Project components:

- diversion channel to the extent necessary to maintain the flow of water into the reservoir during diversion and maintain channel capacity
- dam embankment at the inner toe of the dam to the degree required to maintain functionality of the access road and the dam drainage ditch
- low-level outlet works to the degree required to maintain optimal functionality

Removal of sediment from the reservoir to another off-site location is not planned.

d. Sediment grading within the reservoir will be conducted with the use of earth-moving equipment to move the sediment away from areas where it affects the functionality of the Project components or blocks drainage. Testing would not be necessary because sediment will remain onsite.

e. There is no pre-determined depth of sediment that would require moving or regrading of sediment to maintain functionality of Project components in order for water to continue to flow. Therefore, depth of removal would depend on the location of sediment deposition. The need to regrade sediment within the reservoir to maintain functionality will be determined after the reservoir is drained during post-flood operations.

f. Sediment depths ranging between 1.0 m and greater that 4.0 m are not planned to be moved or regraded unless drainage into the reservoir or out of the reservoir through the low-level outlet is interfered with. The reservoir has been designed to include capacity of a 10% volume increase above that needed to handle the equivalent of the 2013 flood. This excess capacity will be able to accommodate potential sediment and debris accumulation.

Question 383

Volume 1, Section 3.6.5, Page 3.38
Volume 1, Section 3.6.1, Table 3-10, Page 3.37
Volume 1, Section 4.5, Table 4-1, Page 4.2

a. Alberta Transportation states that Wastes generated during post-flood operations would consist primarily of sediment and debris removed from Project Components and that sediment will be landfill tested and either integrated into the landscape or hauled to an appropriate facility.

b. Describe sampling methods, field screening methods and laboratory analytical testing that will be conducted to assess whether post-flood sediment contains any potential contaminants of concern, including but not limited to salinity, anions and cations, nutrient parameters, petroleum hydrocarbons, and metals.

c. Describe conditions where flood sediment may be integrated into the landscape.

d. Describe how flood sediment may be integrated into the landscape.

e. Provide a figure to illustrate the landscape where flood sediment may be integrated.

f. Describe evaluation criteria that will be used to assess whether post-flood sediment will be suitable for integration into the landscape or require disposal at an appropriate facility.

g. Define appropriate facility as stated in Table 4-1.

Response 383

a-d. See the response to IR382 for a description of sediment movement in the PDA to maintain water flow functionality of Project components.

Removal of sediment from the reservoir to another off-site location is not planned.

e. A figure cannot be produced at this time. In post-flood operations, AEP Operations will evaluate the effects of sediment within the PDA and determine if corrective actions to maintain positive drainage to the low-level outlet and functionality of Project components.

f-g. When sediment is deposited in the off-stream reservoir following a flood, the intent is that it will mostly be left in place where deposited (movement and regrading within the PDA will only occur to maintain positive drainage to the low-level outlet and functionality of Project components). Testing would not be necessary because sediments will remain onsite.

Question 384

Volume 3A, Section 9.2.3, Page 9.16
Volume 4, Appendix G, Technical Data Report, Section 1.2, Page 1.3
Volume 4, Appendix G, Technical Data Report, Section 3.1.1.1, Page 3.1

Alberta Transportation described the physical setting of the Local Assessment Area (LAA) using data *obtained from published sources including AGRASID (Alberta Soil Information Centre 2003) and from the soil survey for the Calgary Urban perimeter (MacMillan 1987)*.

The methods do not include a Phase 1 Environmental Site Assessment to review existing background information on potential soil contamination from previous or current anthropogenic activities.

a. **Provide figures and summarize the results of database reviews for potential existing soil contamination within the LAA and PDA, including, but not limited to a search of the Environmental Site Assessment Repository (ESAR).**

b. **Identify all potential historic and current anthropogenic activities within the LAA and PDA that may be a source of existing soil contamination, including but not limited to:**

   i. **Oil and gas activities, including two sites with historic Surface Land Reclamation Certificates**

   ii. **Agricultural farm sites**

   iii. **Highway maintenance yards**

   iv. **Underground and aboveground storage tanks**

   v. **Septic fields and underground septic systems**

   vi. **Garbage pits or unregistered landfills**

c. **For each anthropogenic activity identified, describe how potential soil contamination will be investigated. Describe the field screening methods and laboratory analytical testing that will be conducted to ensure that the soil in these areas does not contain any potential contaminants of concern.**

d. **For each anthropogenic activity identified, describe how impacts from potential soil contamination will be mitigated.**

e. For each anthropogenic activity identified, describe how residual impacts from potential soil contamination that cannot be mitigated may affect the Project components and the environment.

Response 384

a. Alberta Transportation has completed a Limited Phase I Environmental Site Assessment (provided in the response to IR375 as Appendix IR375-1) by reference to databases that identify activities with the potential for soil contamination. Of particular relevance in the Phase 1 Environmental Site Assessment is Appendix A (Figures) and Appendix C. Databases reviewed were:

- Ecolog ERIS
- Abacus Abadata
- AENV Active and Inactive Landfill Disposal Sites and Industrial Landfill Sites
- Alberta Environment and Parks (AEP) Environmental Site Assessment Repository (ESAR)
- AEP Regulatory Approvals Centre
- AEP Freedom of Information and Protection of Privacy Office
- AEP Water Wells
- Environmental Law Centre
- Government of Alberta Spin II Database
- Historical air photos review
- Search for previous environmental reports

b. Alberta Transportation has identified historic and current anthropogenic activities that offer a higher risk of soil contamination within the PDA.

i. The details of pipeline ownership are presented in Appendix IR375-1, Table 3 and are also presented in Volume 3A, Section 12, Figure 12-6. Historical reclamation certificates were obtained for a site in SW 13-24-4-W5 subject to a spill and another site in SE 10 24-4-W5 that involved reclamation of a decommissioned valve site. Volume 3A, Section 12.2.2.1 states that there are no oil and gas wellsites within the PDA in the land use and management LAA.

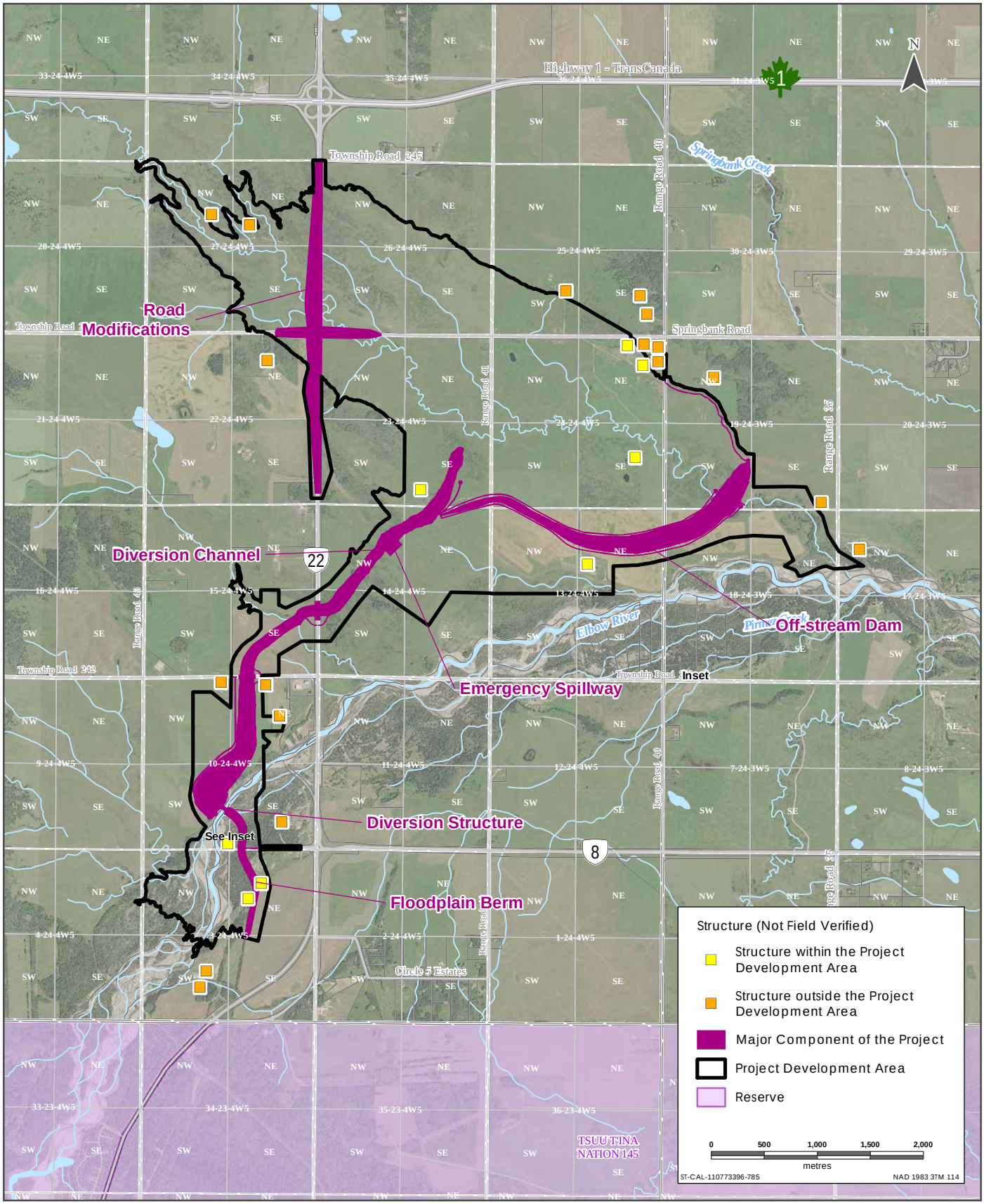
ii. Both residences and businesses are present in the LAA, as identified in Volume 3A, Section 12, Figure 12-3 and Volume 4, Appendix N, Attachment A, Table 12A-4. There are eight residences and one private event centre that are located outside but within 100 m of the PDA (Figure 12-3). There are eight structures/residences located within the PDA (Figure IR384-1). The eight structures located within the PDA will require additional analysis for contaminants of potential concern to determine if these could affect the Project.

iii. A highway maintenance yard is located in NE 10-24-4-W5 within the LAA but about 50 m outside the PDA boundary. This yard has two above ground storage tanks. While this area is not affected during the construction phase or flood phase of the Project, it is recognized as an area of potential environmental concern.

iv. A decommissioned pit, located in NE 10-24-4-W5, is about 50 m outside the PDA boundary and may have been the location of fuel storage tanks. The other pit was proposed in 1995 for a location in SW 10-24-4-W5, within the PDA. Historically, pits (e.g., gravel pits) had fuel storage associated with them, as described in Appendix IR375-1, Section 4.1.

v. Septic fields and underground septic systems are likely associated with each farmyard or rural residential site. Livestock wastes including manure are also associated with some of the farmyards as well as with grazing and pasture lands in the PDA. The Phase 1 Environmental Site Assessment did not address these components.

vi. There are no registered landfills identified in the PDA; the locations of unregistered garbage pits or landfills will receive further investigation after land ownership is transferred to Alberta Transportation.



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
Land ownership boundaries were acquired from Alberta Environment and Sustainable Resource Development (ESRD).
The Land ownership boundaries are subject to all easements, covenants and restrictions, recorded and/or unrecorded.
Stantec Consulting Ltd. make no guarantee with respect to the existence of such restrictions.

Structures in the PDA

Stantec

c. Upon Project approval, sites identified in the Phase I Environmental Site Assessment with a risk of soil contamination will be investigated (with a targeted Phase II site assessment) as follows:

i. The plan for pipeline relocation was presented in Volume 1, Section 3, Figure 3-16. Existing utility lines and planned relocations are also presented in Volume 3A, Section 12, Figure 12-6. This plan includes the rerouting of portions of some pipelines, the abandonment and reclamation of portions of some, and the continued operation of portions of some pipelines. Two locations were the subject of higher soil contamination risk and both have received reclamation certificates. Reclamation certificate #1527 was obtained for a spill location in SW 13-24-4-W5 (1967). Reclamation certificate #11013 was obtained for a location of a decommissioned valve in SE 10-24-4-W5 (1992) (Appendix IR375-1).

ii. If residence or business locations are deemed to be of concern based on their location, and screening of these sites for additional sampling will be carried out after land ownership is transferred to Alberta Transportation. If required, these facilities will be decommissioned.

iii. If decommissioning is required of the highway maintenance site at the Elbow River bridge on Highway 22, established protocols will be followed to find and remove potentially contaminated soils. The soil at the highway maintenance yard will be analyzed prior to use in order to determine its suitability. Point samples will be collected and field screened for presence of combustible headspace vapours (CHV) and volatile headspace vapours (VHV) using a portable RKI Instrument (RKI) EAGLE 2 gas detector with photoionizing detector (PID) capability. Based on the results of the field screening, soil samples could be submitted for laboratory analysis, including, but not limited to, benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs) fractions 1 to 4 (F1 to F4), salinity parameters (i.e., pH, conductivity, chloride, etc.) nutrients (i.e., nitrites and nitrates) and regulated metals. Additionally, background soil samples will be collected and analyzed for the same parameters at the maintenance yard.

iv. The locations of two pits where storage tanks may have been present will be investigated further after land acquisition using protocols identified in c, iii. If contamination is encountered, protocols identified in iii will be used to mitigate and restore soil quality.

v. Yard and farm sites will be investigated for presence of septic field infrastructure after land acquisition. Septic field locations will be identified during removal and decommissioning of buildings and infrastructure. Sampling of soils for nutrients, metals, pathogens will be completed at this time, using protocols outlined in c, iii.

vi. The PDA will be investigated for potential unregistered landfills and garbage pits after land acquisition, using protocols outlined in c, iii.

d. The soil analytical results of the screened soil will be compared to the applicable guidelines. If the soil samples meet applicable guidelines, the soil may be used in construction. If the analytical results exceed applicable guidelines and have concentrations above the background levels, a risk analysis will be completed to determine subsequent actions and mitigation. The spectrum of remediation options includes avoidance of the material, encapsulation of the material, or removal of the material. If required, the soil will be disposed offsite at an approved facility, dependent on the identified material, or may be isolated onsite depending on the risk-assessment outcomes.

e. Non-Project related residual effects of soil contamination after mitigation are considered negligible. Detection of contamination will be followed by mitigation up to and including removal, transport and safe disposal offsite.

Question 385

Volume 3A, Section 9.2.4, Page 9.16

Alberta Transportation states that *Reclaimed and disturbed land makes up approximately 5.2% of the LAA*.

a. Describe and map each occurrence of reclaimed or disturbed land, at a 1:5000 scale or finer resolution.

b. Identify measures that will be taken to ensure the physical and chemical suitability of the soil from reclaimed and disturbed land for inclusion in the components of the reservoir Project.

c. Describe the field screening methods and laboratory analytical testing that will be conducted to ensure that the soil in these areas does not contain any potential contaminants of concern that could be mobilized into flood water, groundwater, or surrounding soil as a result of the use of the reservoir during and after flood operations. The contaminants of potential concern include but are not limited to salinity, anions and cations, nutrient parameters, petroleum hydrocarbons, and metals.

d. Describe mitigation measures for impacts from potential contaminants of concern in soil.

Response 385

a. The technical data report for terrain and soil reported two miscellaneous map units for mapping reclaimed land (ZREC) and disturbed land (ZDL), (Volume 4, Appendix G, Section 3.2.2, Table 3-17). Given that ZDL consisted of a wide range of attributes—ranging from highways with extreme soil disturbance to portions of residences where soils have minimal disturbance—areas identified as ZDL are mapped at a scale ranging from 1:1,000 to 1:3,000 and three subunits are present:

- Subunit ZDL1 consists of roads, highways, and their associated ditches. Its area is 45 ha.
- Subunit ZDL2 consists of the developed areas of residences. These include features such as houses, barns, sheds, lanes, parking areas, and areas of soil excavation. Its area is 7.5 ha.
- Subunit ZDL3 consists of portions of residences or farming infrastructure that have received little direct soil disturbance. These include features such as hay storage yards, confined livestock pens, planted hedges and other areas of residences where disturbance is minimal. Its area is 47.2 ha.

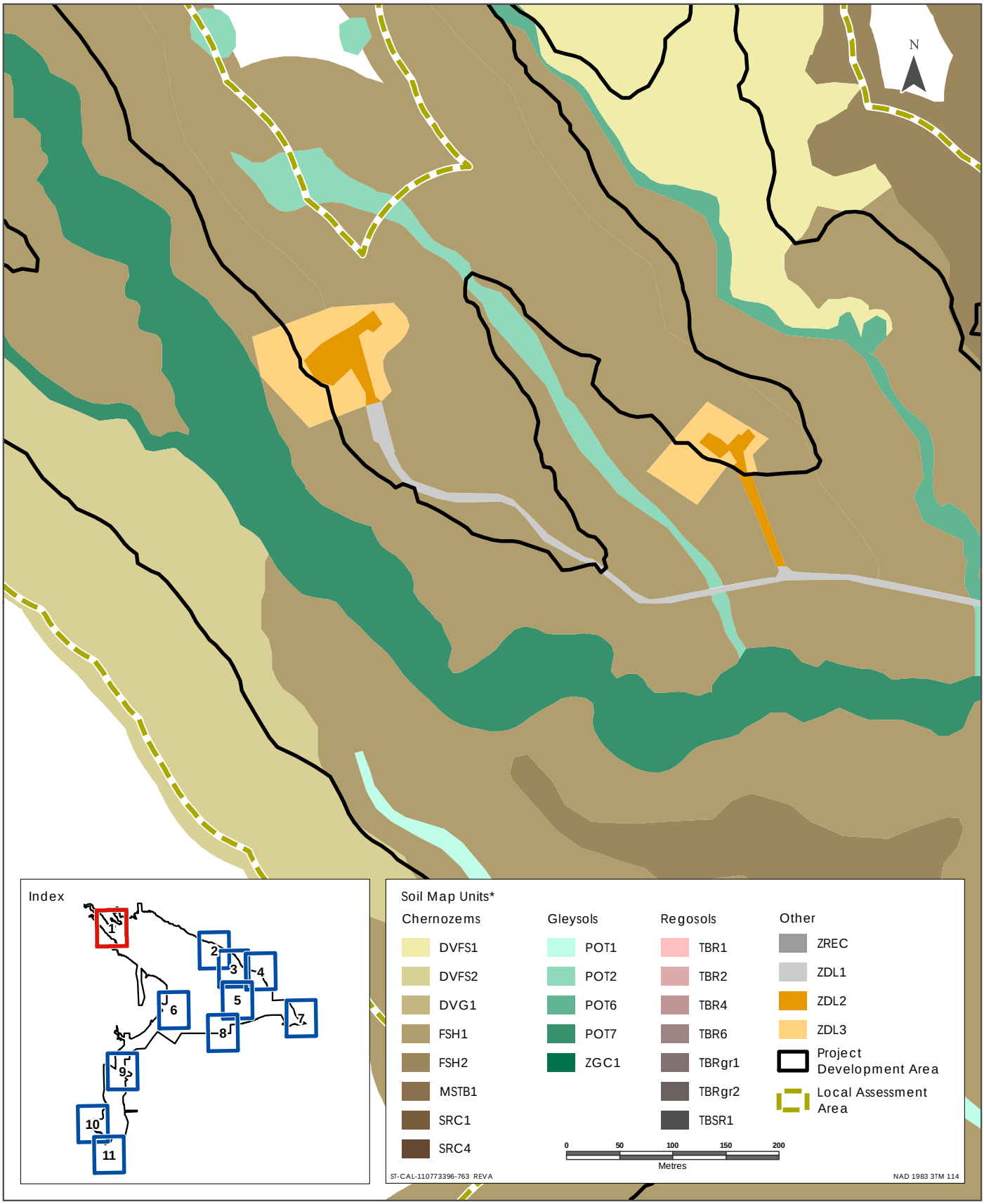
The expected intensity of soil disturbance is least for ZDL3, intermediate for ZDL2, and greatest for ZDL1. Figure IR385-1 to Figure IR385-11 identify the areas where ZDL2 and ZDL3 subunits can be found within the terrain and soils LAA. Because the ZDL1 subunit (roadway) is an additional 29 figures, the higher resolution mapping was not undertaken, given that it does not add to understanding the Project.

The ZREC unit was used to characterize areas of pipeline right of way that have been reclaimed by the operator and cover an area of 1.1 ha. Due to the small area of the ZREC unit, higher resolution mapping was not undertaken.

b. After Project approval, additional investigation, sampling and analysis will be undertaken for areas mapped as ZDL2, and ZDL3 to confirm that contaminants of potential concern (COPC) are not present above applicable guidelines, as applicable.

Areas mapped as unit ZREC are expected to have been sampled for reclamation certification and are of low risk for COPC.

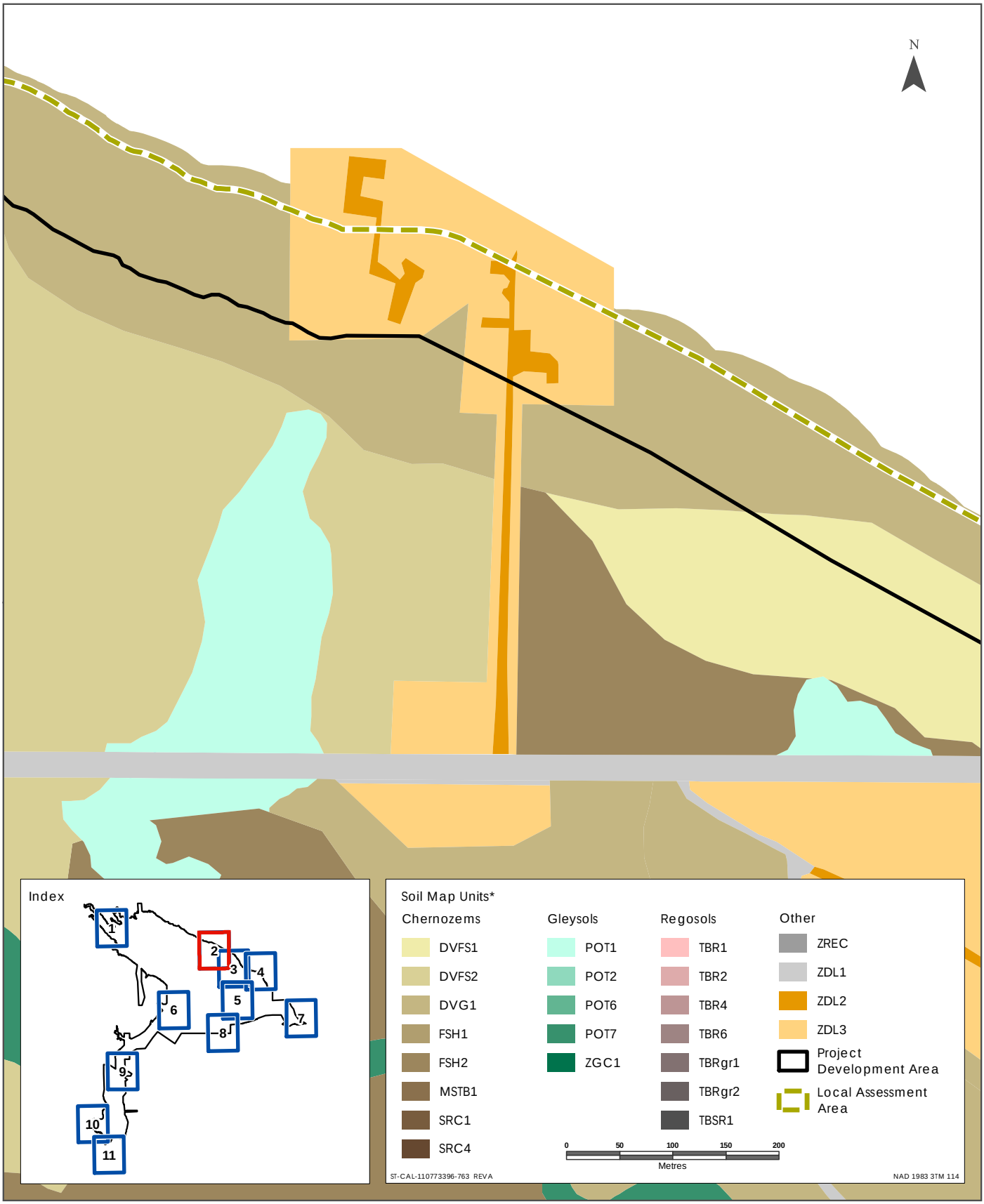
Parameters of interest will likely include salinity and sodicity, extractable anions and cations, nutrient parameters (e.g., nitrogen, phosphorus, potassium, sulfur), petroleum hydrocarbons and metals. Proposed sampling methods are described in the responses to IR374c.



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 1

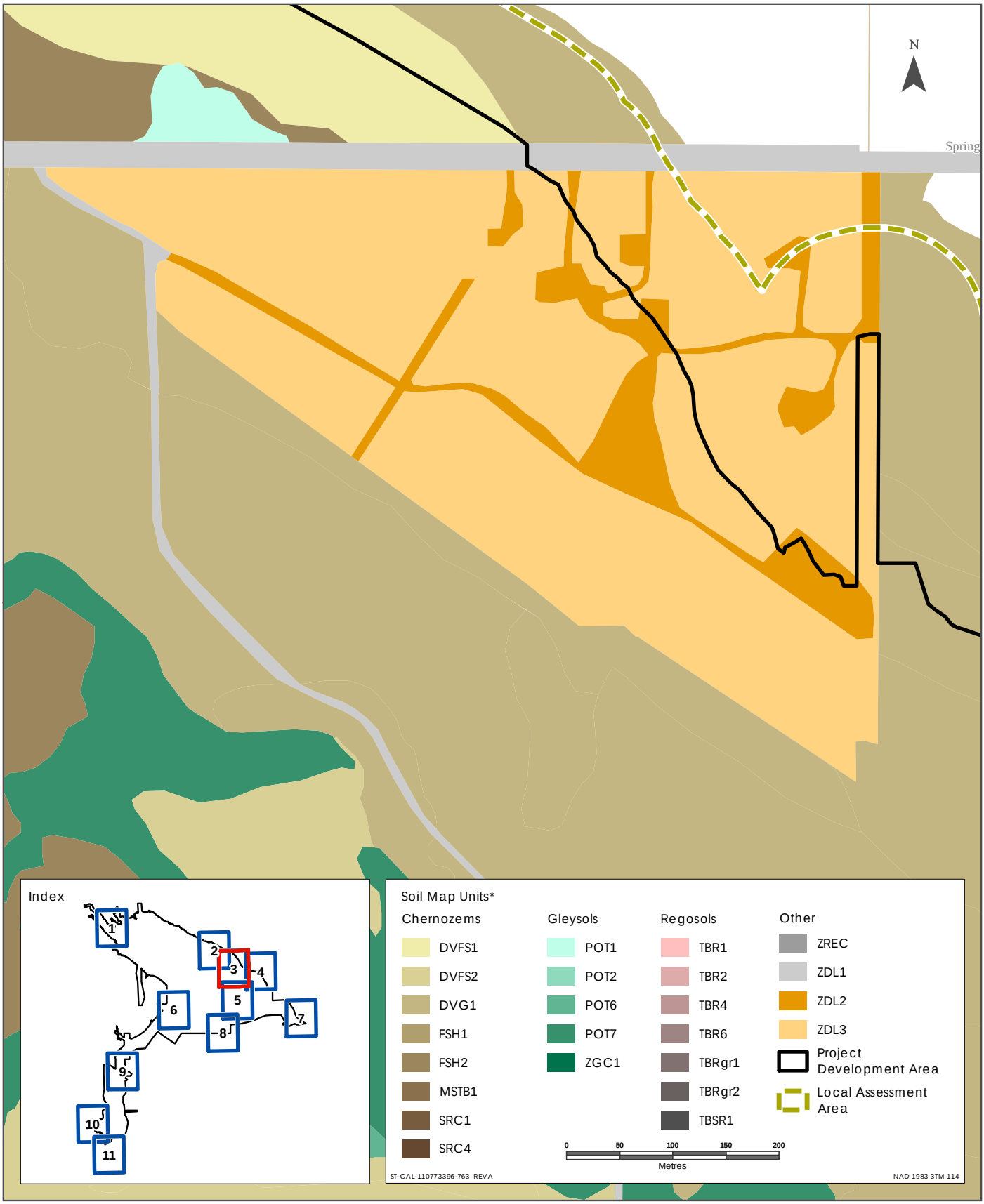
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 2

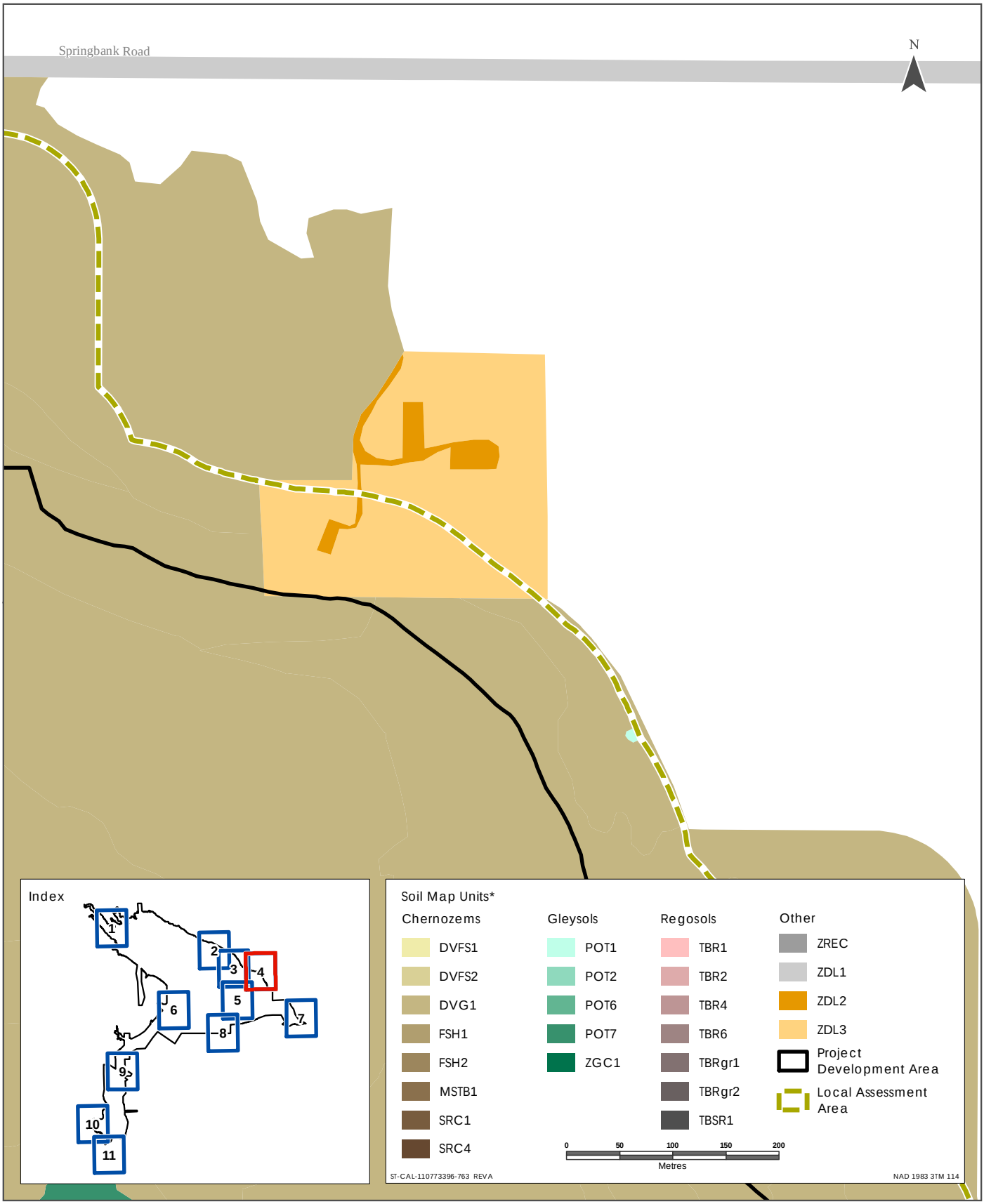
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 3

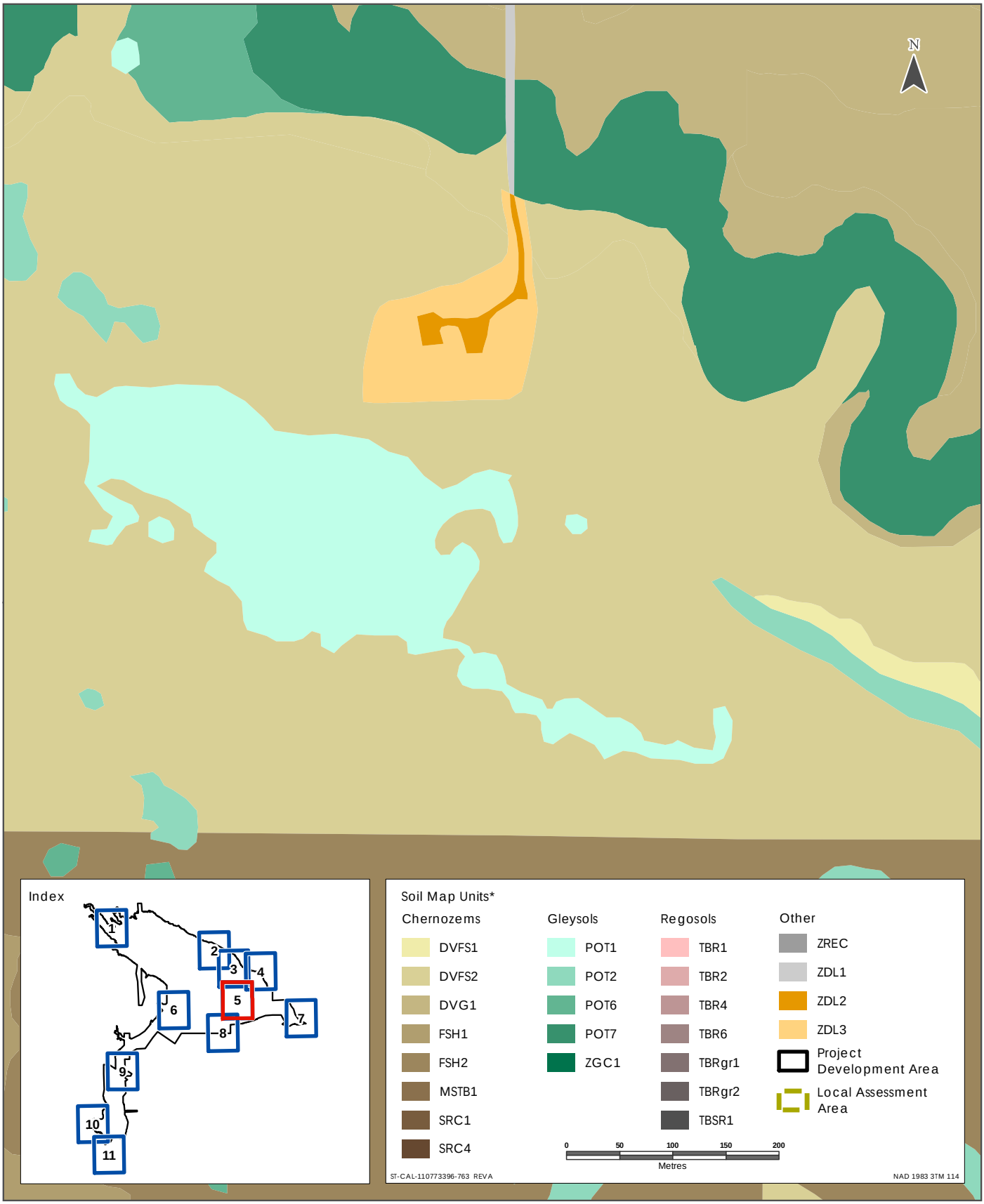
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 4

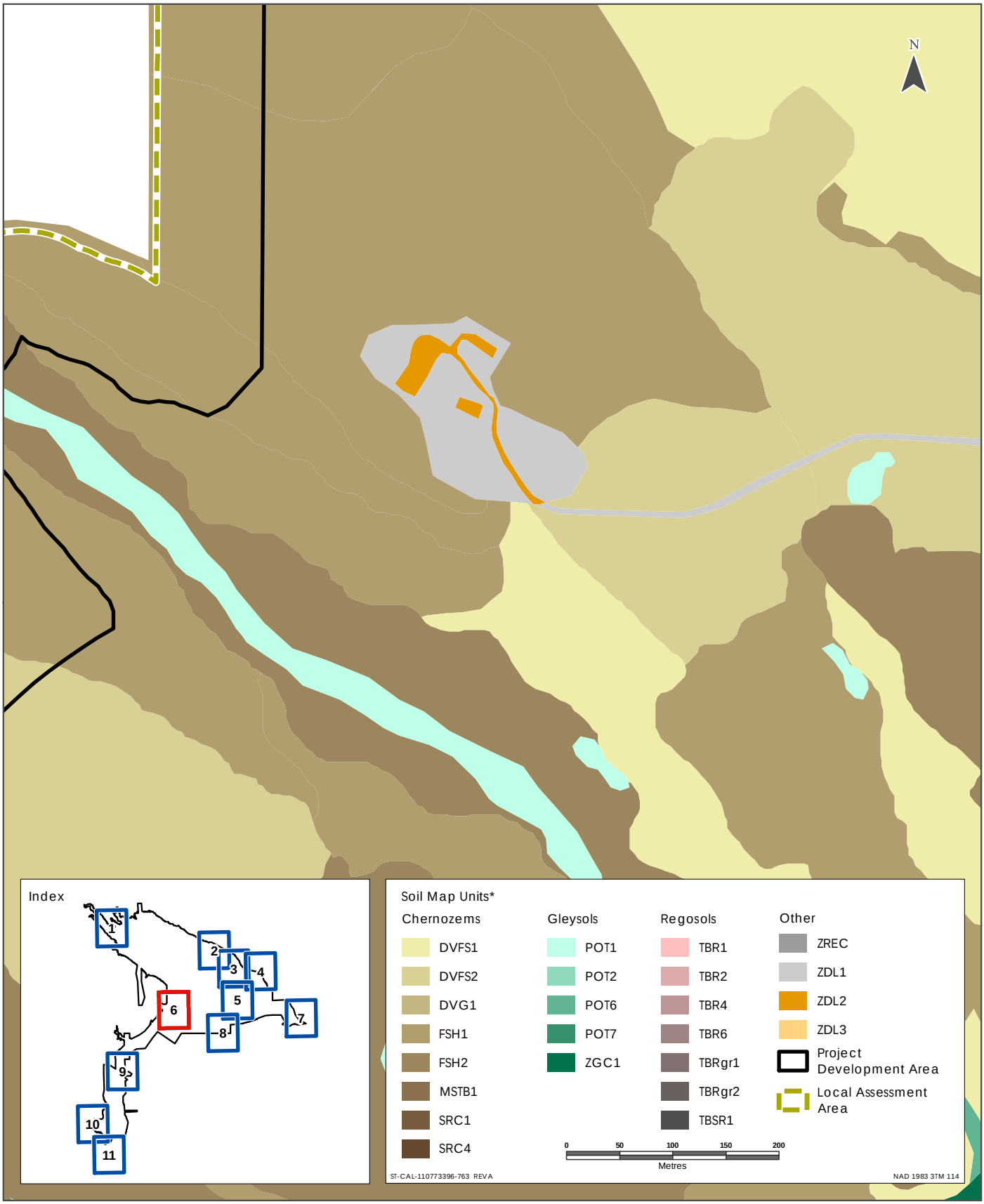
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 5

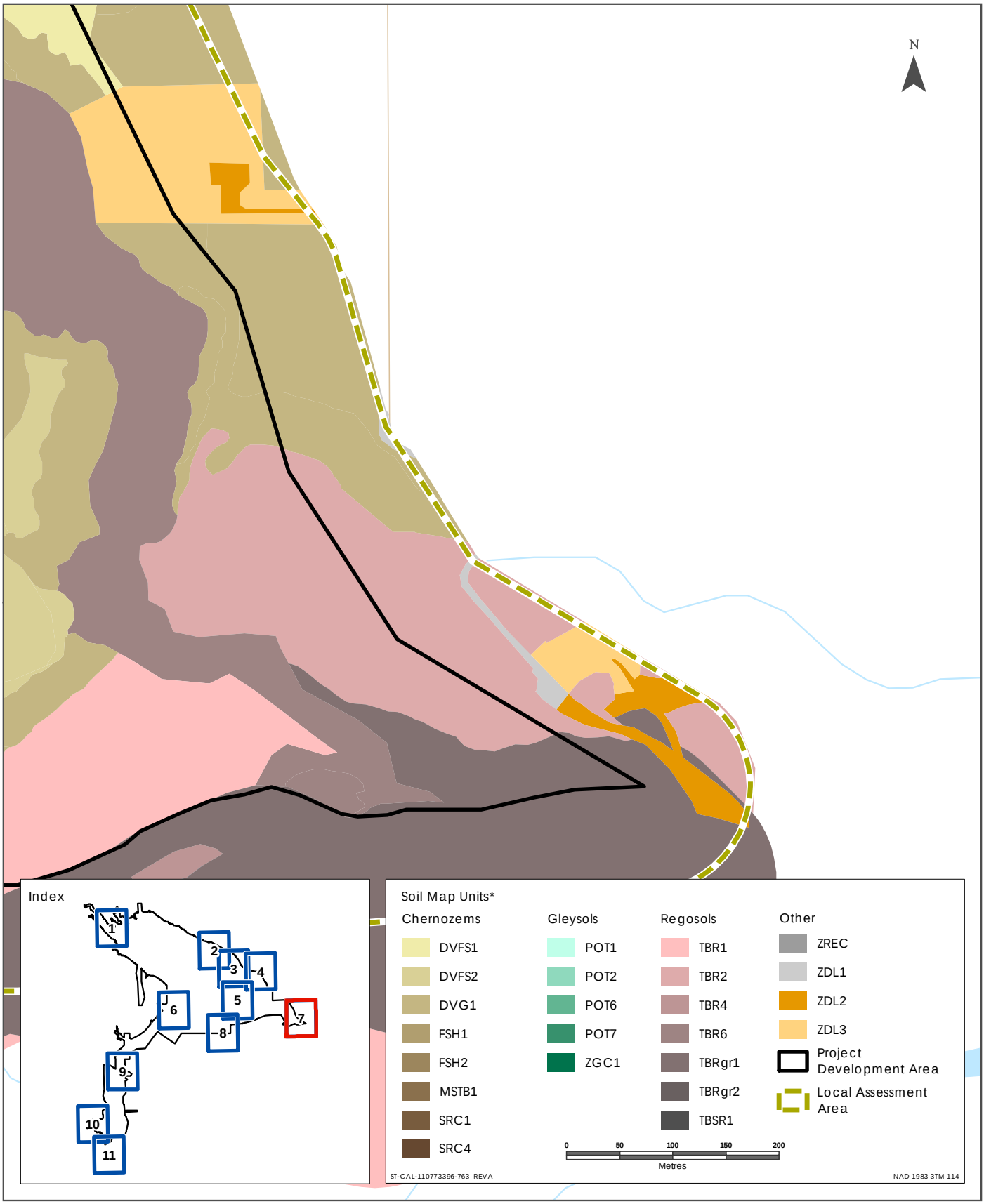
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 6

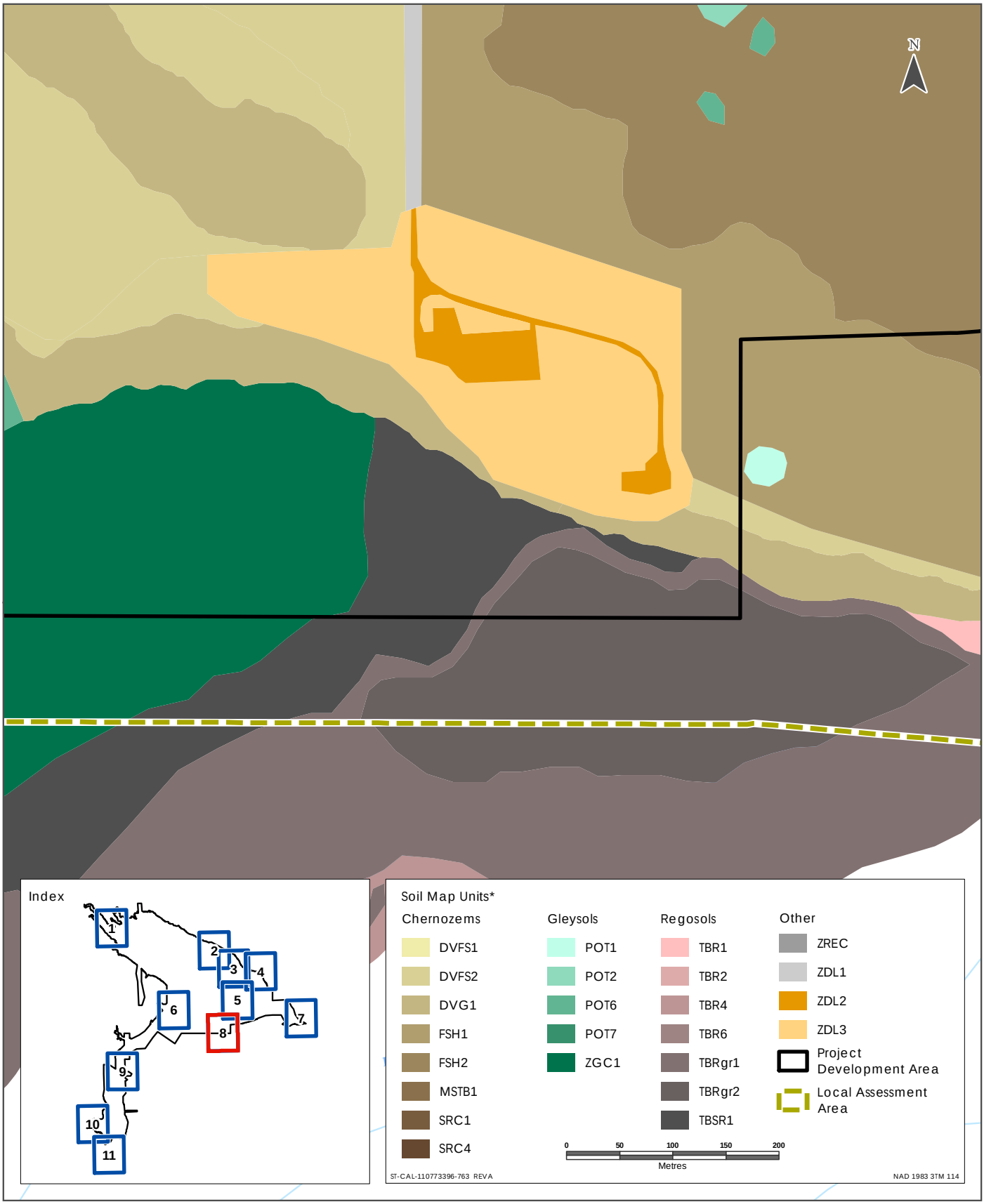
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 7

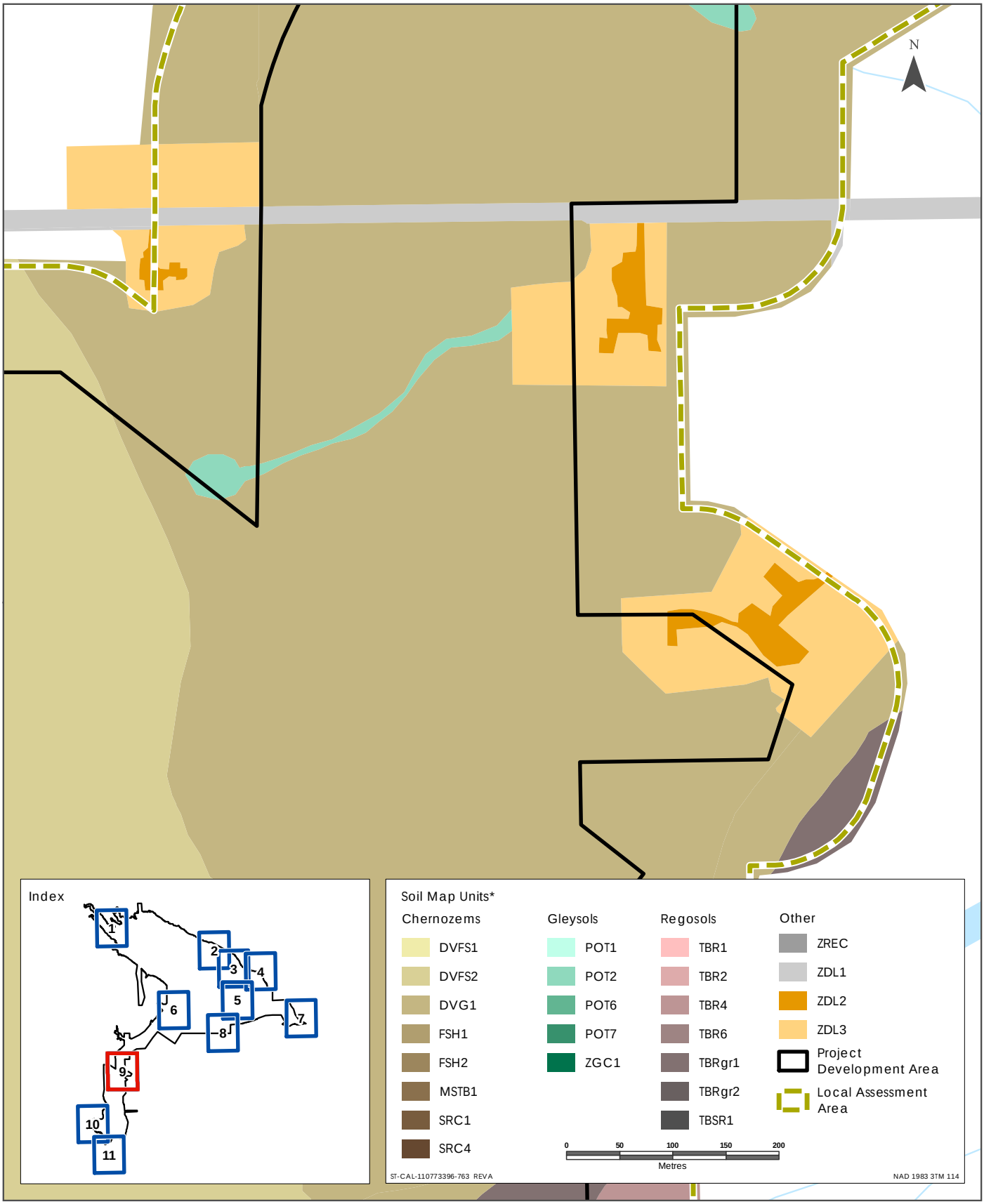
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 8

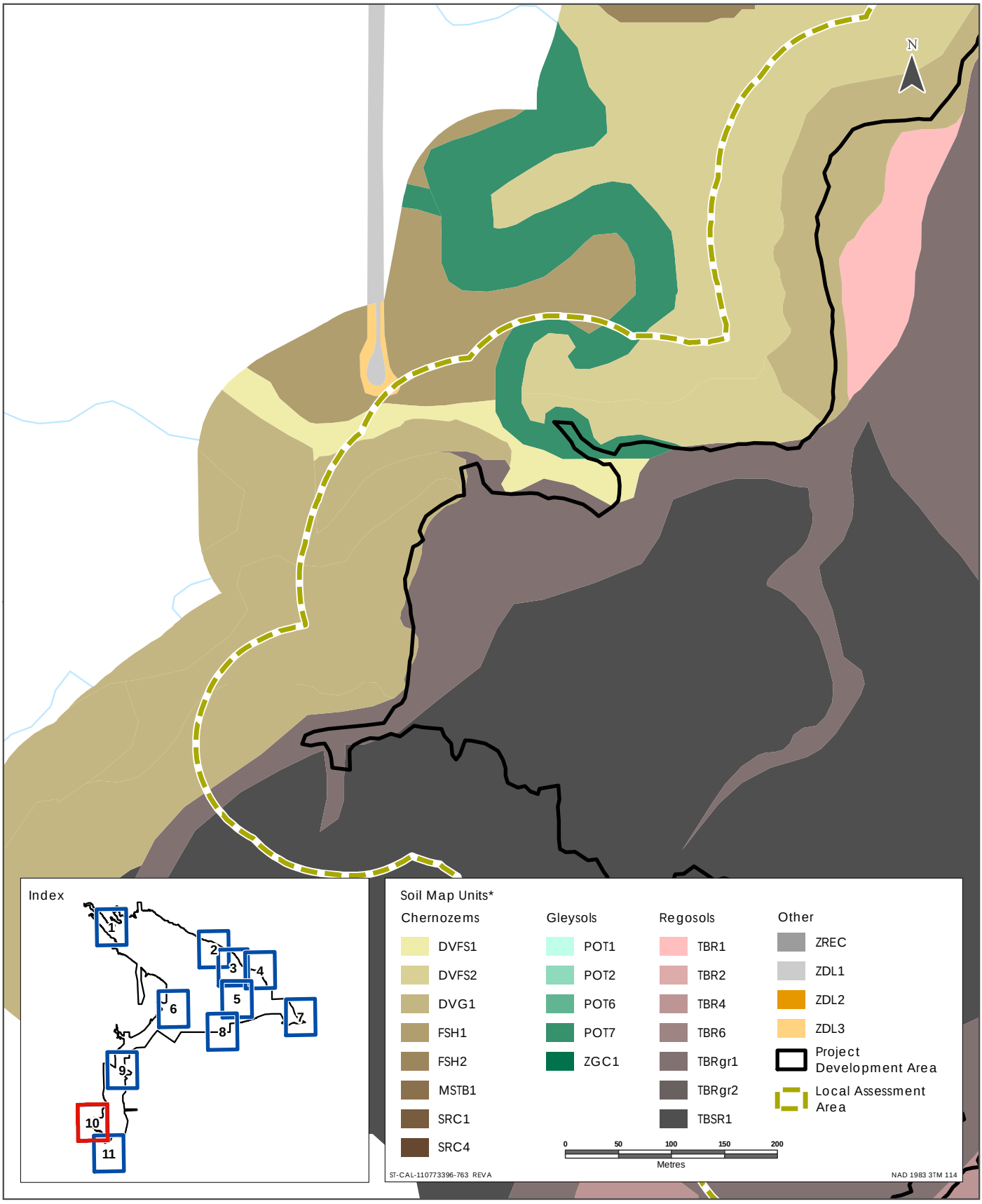
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 9

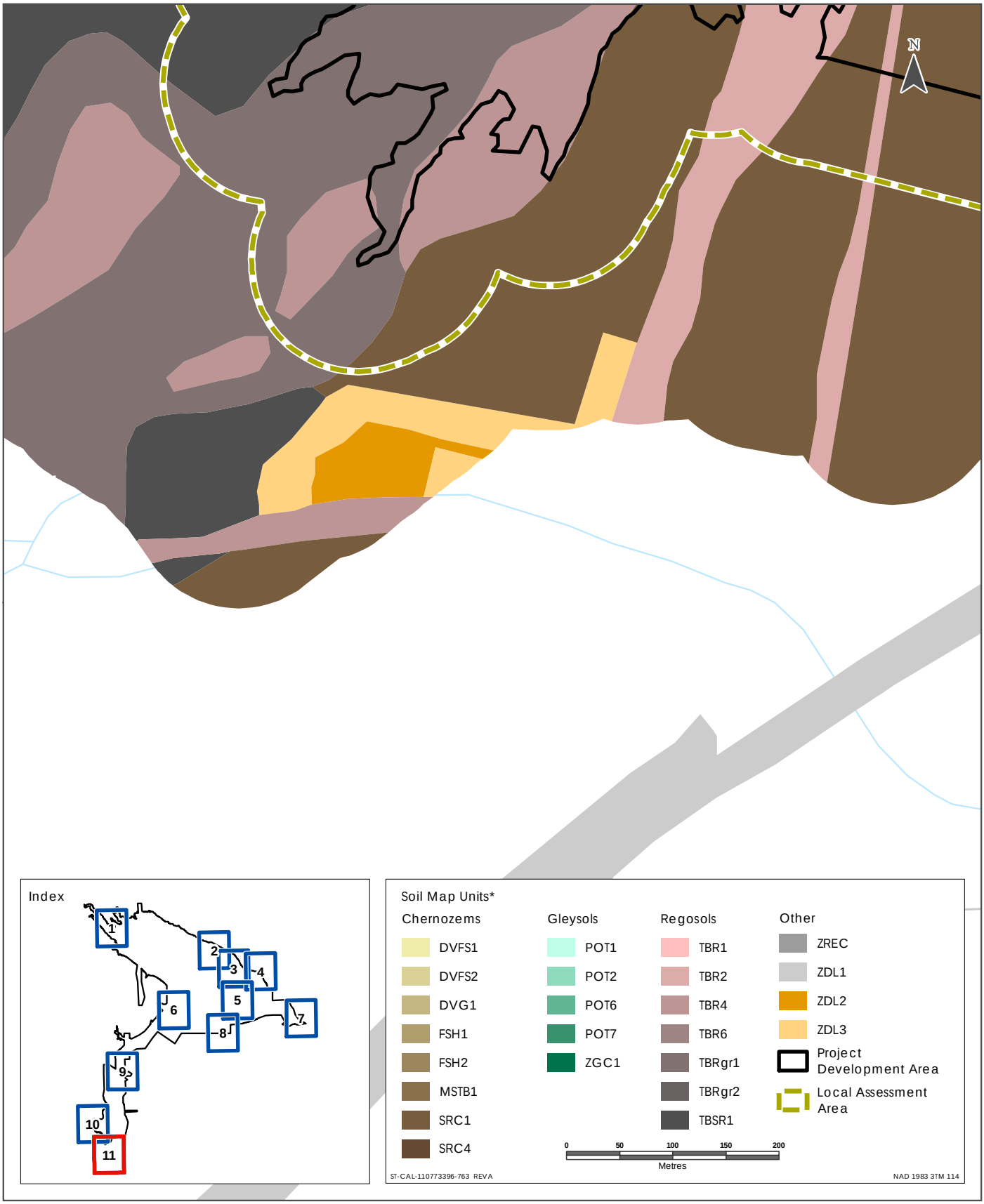
Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 10

Stantec



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to Table 9-5 for Soil Map Unit descriptions.*

Soil Map Units in the Project Development Area and Local Assessment Area, Area 11

Stantec

c. The soil on lands classified as ZDL2 and ZDL2 (e.g., farmyards) will be investigated prior to use in order to determine its suitability. The protocols for detecting the presence of COPC will include visual means to detect the presence of hydrocarbons and selective point sampling to detect the presence of salts, nutrients, or metals, where suspected. Soil with suspected hydrocarbons will be field screened for presence of combustible headspace vapours (CHV) and volatile headspace vapours (VHV) using a portable RKI Instrument (RKI) EAGLE 2 gas detector with photoionizing detector (PID) capability. Based on the results of the field screening, soil samples could be submitted for laboratory analysis, including, but not limited to, benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs) fractions 1 to 4 (F1 to F4), salinity parameters (i.e., pH, conductivity, chloride, etc.) nutrients (i.e., total nitrogen, available phosphorus, nitrites and nitrates) and regulated metals.

d. The soil analytical results of the screened soil will be compared to applicable guidelines. If the soil samples meet the applicable guidelines, the soil may be used in construction. If the analytical results confirm that COPC are above threshold levels as outlined in applicable guidelines, a risk analysis will be completed to determine subsequent actions and mitigations. The spectrum of remediation options includes avoidance of the material, encapsulation of the material, or removal of the material. If required, the soil will be disposed of off-site at an approved facility, dependent on the identified COPC, or may be isolated on-site depending on the risk-assessment outcomes.

Question 386

Volume 3A, Section 9.6, Page 9.44

Alberta Transportation states that *If borrow pit development becomes more certain, additional standards of Alberta Transportation (2013) could be applied to better characterize topsoil and subsoil properties in the specific borrow sites*.

a. Describe and explain how these standards differ from the approaches to characterize topsoil and subsoil in all other areas of the Project Development Area.

Response 386

a. Soil classification and mapping in the terrain and soils LAA (including the PDA) followed the guidelines in GoA (2013), which, in turn, are linked to soil classification protocols (Expert Committee on Soil Survey 1983).

Alberta Transportation(2013) describes the intensity of field inspections and the types of soil data to be collected solely in support of a borrow source excavation, and it is focused on soil salvage and conservation requirements rather than soil classification needs, whereas soil classification guidelines that are used in the assessment emphasize characterization of the entire 1 m soil profile and classification to the soil series. Alberta Transportation (2013; Table 2)

defines the number of inspection points per unit area of a borrow source or per unit length of haul road. The number of inspection points increases as a project footprint decreases. For instance, for a borrow source area greater than 3 ha, the target inspection density is 3 sites/ha and for a borrow source area less than 3 ha, the number of inspections is 5 sites/ha.

The survey intensity level for the Project is reported in Volume 4, Appendix G, Terrain and Soils Technical Data Report, Table 3-3. The density of soil inspection points in the LAA was 1 site/5.25 ha (SIL 2) and the number of delineations with at least one inspection point was 40.5% (SIL 4).

Soil inspection intensities based on Alberta Transportation (2013) would result in more soil inspection points per unit area within the proposed borrow source than are presented in the Terrain and Soils Technical Data Report. However, this guide is not intended to be used outside of a borrow source area.

In contrast to other areas of the PDA, borrow source soil data are focused on physical properties of topsoil and upper subsoil, including topsoil and subsoil thicknesses, textures, consistence, and structure. Additional parameters include the intensity of rooting restrictions presented by subsoil.

REFERENCES

GoA (Government of Alberta). 2013. Guide to Preparing Environmental Impact Assessment Reports in Alberta. Updated March 2013.

Alberta Transportation. 2013. Alberta Transportation Pre-Disturbance Assessment Guide for Borrow Excavations. Dec 2013 Edition.

Expert Committee on Soil Survey. 1983. The Canada Soil Information System (CANSIS). Research Branch. Agriculture Canada. Ottawa, ON.

Question 387

Volume 3B, Section 9.2.3, Page 9.6

Alberta Transportation states that *Submergence and saturation would lead to soil anoxia in all soils subject to flooding. Related effects include increased solubility of anions such as phosphorus, reduction of manganese and iron, denitrification, and conversion of organic carbon to methane…However, because of the relatively short period of potential anoxia, soil oxygen levels in topsoil horizons would be maintained in the aerobic range soon after reservoir drainage, typically within one or two months of reservoir drainage. Soil anoxia is not discussed further.*

a. Given that the soil would be saturated over intervals ranging between 5 and 67 days, provide further rationale why soil anoxia is not a potential effect during flood or post-flood operations.

b. Describe the typical length of time of submergence and saturation that would result in soil anoxia.

c. Discuss the potential effects of soil anoxia on deeper soil profiles following each flood intensity.

d. Describe the likelihood and duration of soil anoxia occurring with each flood intensity.

e. Discuss potential soil contamination as an effect of soil anoxia.

f. Describe mitigation measures for soil anoxia with each flood intensity.

g. Describe the potential residual impacts of the Project following implementation of mitigation measures for soil anoxia in the reservoir.

Response 387

a. Soil anoxia is an effect of the Project during the flood and post-flood operations. Soil anoxia is a reversible condition; removal of water in the soil profile to a level that allows about 10% air content by volume (water content 90% of pore volume) is generally associated with the return of aerobic soil conditions. Some soils in the terrain and soils LAA (e.g., Pothole Creek soil series), regularly experience saturation and anoxia; in the reservoir, the Project will extend the duration of anoxia in these soils above background levels. Vegetation in these areas will tolerate anoxic soil. Areas of Chernozemic soil (in the reservoir), however, have not regularly been subjected to the anoxic conditions, which will be introduced by the Project. These areas will likely be more strongly affected by flood operations. In particular, vegetation associated with Chernozemic soils will not tolerate anoxia. However, aeration is expected to be restored in topsoil and upper subsoil of the reservoir within one to two months after reservoir drainage and the effects of soil anoxia will then cease.

b. Anaerobic soil conditions are likely to arise within one to two days of soil saturation, while the reservoir is filling. Lower available organic carbon in lower horizons may reduce the speed at which anoxia develops at greater depths relative to topsoil horizons that have higher organic carbon and microorganism populations. Anaerobic conditions will persist until water content returns to approximately 90% of pore volume, one to two months after reservoir drainage. The lengths of time associated with anaerobic soil conditions in different soil units are noted in Volume 4, Appendix G, Attachment 9A, Section 9A.2.5, Table 9A-3.

c. The effects of anaerobic soil conditions for deeper horizons will be similar to the effects of anaerobic conditions on upper horizons discussed in Volume 3B, Section 9.2.3.1. However, lower organic carbon contents of deeper soil horizons will reduce the relative degree of changes introduced by soil anoxia, since organic carbon is a major driver of these biologically-mediated processes. Lower concentrations of available nitrogen, sulfur and phosphorus in deeper soil horizons mean anaerobic conditions will not be as important as anoxia effects on these nutrients in upper horizons (Alexander 1977).

   Effects of anoxia on deeper soil horizons will be similar for each flood because the time it takes to restore aerated conditions will be the same regardless of the size of a flood (within one to four years after reservoir drainage). However, the area of the effects of anoxia will differ between floods, i.e., larger floods will cover a larger area of the reservoir. Anaerobic soil conditions change the solubility of many ionic species, including some metals (Brady and Weil 2010; Bohn et al. 1985). Manganese and iron change from low solubility forms to higher solubility forms, becoming more mobile. Indraratne and Kumaragamage (2018) studied the effect of soil anoxia on solubility of potentially toxic elements present in uncontaminated upland agricultural soil. Anaerobic conditions produced by artificial flooding promoted solubility of iron, manganese, phosphorus, arsenic, nickel, aluminum and selenium into soil pore water. While anaerobic conditions are likely to increase the solubility of some ionic species, the high pH (approximately pH of 8) of the soil solution will limit the solubility of many metals regardless of redox potential. Transport of ionic species to surface water will also be interrupted by increases in oxygen content and reduced solubility when soil solution transitions (seeps) into surface water, where those waters are oxygenated. Seepage of water from soil to surface water after reservoir drainage is unlikely to contribute higher concentrations of nutrients or metals to surface waters.

d. Soil anoxia will occur with each flood in areas subject to inundation and soil saturation. Estimated duration of anoxic conditions was provided in Volume 4, Appendix G, Attachment 9A, Section 9A.2.5, Table 9A-3, which lists the estimated time for the soil profile to achieve either 10% air capacity (aeration) or dewatering to background soil moisture content. These are conservative estimates, including the assumption of no vertical or lateral drainage and evapotranspiration rates equal to lake evaporation rates.

   Under these assumptions, topsoil and upper subsoil typically require 0.3 years to 0.4 years to reach moisture contents that will allow aerobic conditions. Anoxia will persist longer in deeper horizons. Lateral drainage will allow water to move downslope, such that upper slope positions will drain first. Surface water that accumulates in depressional landscape positions from upslope profile lateral seepage will become oxygenated and ionic species will shift towards their lower solubility under aerated conditions. These ionic species will be retained in less soluble forms in the soil.

e. Anoxic soil can contribute to the redistribution of potential contaminants in soil pore water, vertically in the profile, and laterally downslope towards lower elevations. Mobilization of contaminants in the soil profile can lead to entry of contaminants into the water column during the period of inundation, or into surface drainage water during the reservoir dewatering phase. However, rapid oxygenation of the soil pore water once it seeps into surface water will change the solubility characteristics of ionic species. These will tend to precipitate and thus be retained in the soil system, rather than being transported as part of surface water. Vertical drainage could contribute dissolved phosphorus to groundwater (Ryden and Pratt 1980).

f. No mitigation measures are planned to accelerate the restoration of aerobic soil conditions.

g. Anoxic soil conditions introduced by the Project during and after reservoir flooding will increase the risk of solute transport from soil to the atmosphere, from soil to surface water, and from soil to groundwater. However, transport of dissolved metals from the soil solution to surface water is limited by natural chemical reactions that accompany oxygenation of surface water and lead to chemical precipitation and retention in soil. The restoration of aerobic conditions in upper soil horizons within one to two months after reservoir drainage means that these higher risks are present for a relatively short time period.

REFERENCES

Alexander, M. 1977. Introduction to Soil Microbiology. 2nd ed. John Wiley&Sons. New York.

Bohn, H., McNeal, B and O'Connor, G. 1985. Soil Chemistry. 2nd ed. John Wiley&Sons. New York.

Brady, N.C. and Weil R.R. 2010. Elements of the nature and properties of soils. 3rd ed. Prentice Hall. Boston.

Indraratne S.P. and Kumaragamage, D. 2018. Flooding-induced mobilization of potentially toxic trace elements from uncontaminated, calcareous agricultural soils. Can. J. Soil Sci. 98: 103–113.

Ryden, J.C. and Pratt, P.F. 1980. Phosphorus removal from wastewater applied to land. HILGARDIA. 48:1-36.

Question 388

Volume 3B, Section 9.2.3.1, Page 9.7
Volume 3B, Section 9.2.3.2, Page 9.8

Alberta Transportation states that *The sediment is expected to be primarily calcium-carbonate in mineralogy…The primary effect of calcite on soil is through its effect on soil pH*. Other potential chemical changes to soil from post-flood sediment have not been discussed.

a. Describe changes in soil quality from sediment that may contain other potential contaminants of concern, including but not limited to anthropogenic sources.

b. Describe mitigation measures to address potentially contaminated sediment that may impact soil quality through changes in soil chemistry.

c. Describe residual impacts of the Project on all chemical soil properties following implementation of mitigation measures for post-flood sediment.

Response 388

a. Additional characteristics of sediment expected to accumulate in the off-stream reservoir during floods were inferred from data provided in Volume 4, Appendix K, Surface Water Quality Technical Data Report, Attachment A, Table A-3, which lists data for sediment samples from various locations on the Elbow River. Table A-4 shows results of soils sampled in the reservoir for the same parameters. For sample locations, see Volume 4, Appendix K, Section 2, Figure 2-2.

   Methods of analysis are presented in Appendix K, Section 2, Table 2-6. Results are compared in Table IR388-1. Sediment deposition is presented only for the design flood. In summary, after a design flood, five new soil types are expected in the reservoir, as described in Volume 3B, Section 9, Table 9-5. These soils (DEP1, DEP2, DEP3, DEP4 and DEP5) are defined for the various thicknesses of flood sediment that will be deposited. These thicknesses will vary from 0.2 m to 1.0 m for the DEP1, DEP2 and DEP3 and exceed 1.0 m in thickness for the DEP4 and DEP5 units. Texture for all is expected to be coarse. Overall, soil types DEP1 to DEP5 will be most closely related to the TBR (Twin Bridges) soil series found in the Elbow River floodplain. Metal concentrations in new soil types will be similar to the concentrations observed in existing soils (refer to Table IR388-1). The new soil types will initially differ from existing soils (except for the TBR soil series) in the following ways:

   - They will have lower nutrient availability, due to high carbon/nitrogen ratio, lower organic carbon content, lower nitrogen concentration, and lower available phosphorus.

- They will have higher calcium carbonate equivalent than existing soils, except for the TBR soils.
- They can be expected to have a lower frequency of measurable hydrocarbon concentrations than existing soils.

The TBR soil series has formed from repeated sediment deposition that is associated with floods and, thus, is confined to the active floodplain. The new soils also have the potential to develop perched water tables where coarse material overlies fine textured soil.

Table IR388-1 Comparison of Parameters for Sampled Sediment and Soil

Parameter	Data from Volume 4, Appendix K, Attachment A		Comment
	Elbow River (Table A-3)	Reservoir Soils (Table A-4)	
Particle size analysis (sand/silt/clay)	Sandy loam (5 samples) to loamy sand (1 sample)	Clay, silty clay loam, silt loam, loam, sandy loam, silty clay.	Sediment samples have lower clay content than most of the soil samples. A soil sample from near the Elbow river had texture similar to sediment.
Total Kjeldahl Nitrogen (%)	0.06 to 0.1	0.088 to 1.68	Less total nitrogen in sediment than in soil
Total available nitrogen (mg/kg)	Bdl (1 sample) to 5.9	Bdl (1 sample) to 38.3	Less available nitrogen in sediment than in soil
Sulfide (mg/kg)	Bdl (1 sample) to 17.6	Bdl (11 samples) to 2.07	More sulfide in sediment than in soil
Calcium carbonate equivalent (%)	11.8 to 25.7	1.27 to 26.7	More calcium carbonate in sediment than in soil
Organic Carbon to nitrogen ratio	59 to 100.7	11.5 to 73.8	Sediment has higher C/N ratio than soil
Total organic carbon (%)	1.82 to 3.81	2.94 to 26.6	Less organic carbon in sediment than soil
Available phosphorus (mg/kg)	Bdl (6 samples)	Bdl (1 sample) to 15.8 (12 samples above detection limit but below 10 mg/kg)	Less available phosphorus in sediment than soil
Metals			
Antimony (mg/kg)	0.26 to 0.37	Bdl (5 samples) to 0.49	Similar concentrations
Arsenic (mg/kg)	5.14 to 7.27	3.14 to 6.93	Similar concentrations
Barium (mg/kg)	162 to 290	128 to 385	Similar concentrations
Beryllium (mg/kg)	0.38 to 0.52	0.15 to 1.09	Similar concentrations

Table IR388-1 Comparison of Parameters for Sampled Sediment and Soil

Parameter	Data from Volume 4, Appendix K, Attachment A		Comment
	Elbow River (Table A-3)	Reservoir Soils (Table A-4)	
Cadmium (mg/kg)	0.215 to 0.296	0.158 to 0.686	Similar concentrations
Chromium (mg/kg)	10.9 to 14.7	3.37 to 27.5	Similar concentrations
Cobalt (mg/kg)	4.51 to 7.61	1.5 to 10.7	Similar concentrations
Copper (mg/kg)	9.73 to 16.2	4.63 to 25.8	Similar concentrations
Lead (mg/kg)	5.34 to 8.14	3.2 to 14.6	Similar concentrations
Mercury (mg/kg)	0.0204 to 0.0414	0.0156 to 0.0372	Similar concentrations
Molybdenum (mg/kg)	0.64 to 0.71	Bdl (1 sample) to 1.1	Similar concentrations
Nickel (mg/kg)	14.8 to 22.7	3.93 to 28.0	Similar concentrations
Selenium (mg/kg)	0.32 to 0.47	Bdl (5 samples) to 0.71	Similar concentrations
Silver (mg/kg)	Bdl (6 samples)	Bdl (7 samples) to 0.16	Soil concentration higher than sediment
Thallium (mg/kg)	0.075 to 0.126	Bdl (6 samples) to 0.249	Similar concentrations
Tin (mg/kg)	Bdl (6 samples)	Bdl (15 samples)	Both had concentrations below detection limit
Uranium (mg/kg)	0.470 to 0.623	0.461 to 3.07	Higher concentrations in soil than sediment
Vanadium (mg/kg)	20.5 to 24.7	5.9 to 59.4	Similar concentrations
Zinc (mg/kg)	48.7 to 63.3	22.7 to 124	Similar concentrations
Hydrocarbons			
F1 (C6 to C10) (mg/kg)	Bdl (6 samples)	Bdl (15 samples)	Both had concentrations below detection limit
F1 (BTEX) (mg/kg)	Bdl (6 samples)	Bdl (15 samples)	Both had concentrations below detection limit
F2 (C10 to C16) (mg/kg)	Bdl (6 samples)	Bdl (14 samples), one sample 29	One soil sample had measurable F2 fraction whereas all other samples of both sediment and soil were below detection limit
F3 (C16 to C34) (mg/kg)	Bdl (6 samples)	Bdl (7 samples) to 319	Higher concentrations in soil than sediment
F4 (C34 to C50) (mg/kg)	Bdl (6 samples)	Bdl (10 samples) to 168	Higher concentrations in soil than sediment

Table IR388-1 Comparison of Parameters for Sampled Sediment and Soil

Parameter	Data from Volume 4, Appendix K, Attachment A		Comment
	Elbow River (Table A-3)	Reservoir Soils (Table A-4)	
F4G-SG (mg/kg)	Bdl (6 samples)	Bdl (10 samples) to 790	Higher concentrations in soil than sediment
Total HydroCarbon (C6 to C50) (mg/kg)	Bdl (6 samples)	Bdl (7 samples) to 487	Higher concentrations in soil than sediment
SOURCE: Volume 4, Appendix K, Table A-3 and Table A-4			

b. Mitigation measures expected for the areas of sediment deposition (soil units DEP1, DEP2, DEP3, DEP4, DEP5) include 1) revegetation to help withdraw soil water (evapotranspiration) gained during flood and thereby help restore aerobic conditions in the root zone; and 2) fertilization to increase available nutrient concentrations for new vegetation (nitrogen, phosphorus, potassium).

c. Table IR388-1 provides a list of the contaminants currently present in the off-stream reservoir soil and a prediction for sediment introduced to the reservoir during a flood (i.e., soil units DEP1, DEP2, DEP3, DEP4, DEP5). The areas of sediment deposition will have chemical and physical properties similar, or less than, areas of the TBR soil series. Based on the individual parameters in Table IR388-1, residual effects related to soil quality from contamination are expected to be negligible.

Question 389

Volume 3B, Section 9.2.3.2, Page 9.8

Alberta Transportation states that *There is no planned mitigation of higher calcium carbonate content in soil and higher pH. Time periods are likely too short to allow any measurable removal of free carbonates through leaching*. However, in the previous paragraph, Alberta Transportation states *This sediment is not expected to be removed*, which appears to be a contradiction.

a. Explain how time periods are too short for leaching to occur if sediment is not going to be removed.

b. If sediment removal is not conducted, describe soil chemistry residual impacts of leaving sediment in place.

Response 389

a. Flooding will result in sediment deposition in the reservoir, although at spatially-variable thicknesses. The sediment will be retained after reservoir and soil dewatering; it will not be removed, regardless of thickness. Sediment will be moved or regraded if it interferes with drainage to the low-level outlet or functioning of the reservoir or associated components (see IR382).

   The retained sediment will have a high calcium carbonate content and a pH of approximately 8. Leaching is a physical-chemical process where chemical products of acid-base neutralization interact with downward moving soil water, resulting in chemical change in the soil profile (acidification). Base cations are transported downward in the soil profile and may accumulate in deeper soil horizons. Soil acidification rates are expected to be too slow for leaching to remove appreciable amounts of base cations relative to the return periods of sediment deposition; calcium carbonate content will remain high and soil pH will tend to remain in the range of pH 8 over the long term, as explained in the response to IR391a.

b. The residual effect of flooding on soil chemistry is discussed in Volume 3B, Section 9.2.3.3, page 9-11: "Chemical Properties of Soils (Change in LCC)". The residual effects of flooding on land capability change (LCC), including changes to soil pH resulting from sediment introduction to the reservoir, is also presented in Volume 3B, Section 9.2.3.3., Table 9-5: "LCC as a Function of Flood, by Soil Unit" and in Volume 3B, Section 9.2.3.3., Figure 9-5: "Agricultural Land Capability (Soil Profile) for the Terrain and Soils Project Development Area and Local Assessment Area after the Design Flood Event, Equilibrium Effect".

   To summarize the key message of those tables and figures, the new depositional soil units that will be introduced by flooding—DEP1, DEP2, DEP3, DEP4 and DEP5 (see the response to IR388)—are defined for various thicknesses of introduced sediment. The pH of these depositional soil units is expected to be near pH 8 and the agricultural land capability of these at equilibrium is expected to range from Class 5 to Class 7. The range in agricultural land capability is due to sediment thickness, with thicker sediment resulting in lower agricultural land capability. The agricultural land capability of these depositional soil units is lower than the natural upland soil units they will replace.

   As stated in Volume 3A, Section 9.2.4, residual effects of leaving sediment in place is adverse, of high magnitude and irreversible over the long term. Retained sediment will have low water-holding capacity, low nutrient availability, and a lower agricultural land capability than pre-flood soils in the reservoir. Once aerobic conditions are established, dry-land vegetation can become established on these sites.

Question 390

Volume 3B, Section 9.2.3.2, Page 9.8
Volume 4, Appendix D, Section 6.2, Page 6.2
Volume 3B, Section 9.2.3.1, Page 9.7
Volume 3B, Section 9.2.3.3, Page 9.11
Volume 4, Appendix D

Alberta Transportation states that *Most sediment deposition thicknesses would be less than 0.5 m but there would be some areas with 1.0 m to 3.0 m thickness and a few isolated areas with up over 4 m thickness (see Section 6). This sediment is not expected to be removed*. However, Alberta Transportation states in Volume 4, Appendix D that *The reservoir has been designed so that it can function as required with up to 10% of its capacity lost…It is, therefore, not necessary to remove post-flood deposits that do not reach this level*.

a. Clarify the sediment deposition thickness that will and will not be removed.

b. Describe all potential changes to the physical properties of soil during a flood or post-flood, including but not limited to texture, structure, and bulk density.

c. Discuss mitigation measures that will be undertaken to address potential changes to all soil physical properties.

d. Provide the mitigation measures for post-flood sediment deposition to include all potential mitigation measures that may occur under different sediment depths.

e. Identify and describe all residual impacts of the Project on all physical soil properties following implementation of mitigation measures for post-flood sediment.

f. Identify and describe residual impacts for the different sediment depths that may remain in the reservoir.

Response 390

a. See the response to IR382 for details describing allowing sediment to remain in the reservoir and not removed, regardless of depth.

   While sediment may be moved or regraded within the reservoir to maintain functionality of the Project and its components, removal of sediment from the reservoir to another off-site location is not planned.

b. The physical properties of soils within the spatial limits of the design flood will change. New post-flood soil units are defined based on various combinations of sediment thickness and drainage regime (Volume 3B, 9.2.2.3, Table 9-5). Types DEP1, DEP2 and DEP3 will have sediment thicknesses between 0.2 m and 1.0 m, whereas DEP4 and DEP5 will have sediment thicknesses greater than 1.0 m (see response to IR388).

There is very limited mixing expected between existing soil horizons and sediment that would be deposited by retained waters in the reservoir, such that physical properties of existing horizons are not expected to change. Sediment will be deposited above existing profiles. The deposited sediment will have physical properties similar to the Twin Bridges soil series (TBR) and its phases. which are found on the Elbow River floodplain (Volume 4, Appendix G, Attachment C, Table C-10). Organic carbon content of the sediment will be lower than that found in TBR. Information on the chemical changes of the sediment deposited in the reservoir is presented in the response to IR388.

Physical properties expected for areas of deposition include loamy sand to sand texture, single-grained structure, and friable to very friable consistency when moist. In calculations of land capability, average dry bulk density for sediment is expected to be 1,500 kg/m^3. The sediment is expected to have a water holding capacity lower than TBR because sediment will tend to be coarser than soils on the Elbow River floodplain. However, the sediment in the off-stream reservoir will have a much lower coarse fragment content than the areas of TBR on the current floodplain in the Elbow River because gravels will not be into the reservoir.

c-d. The physical properties of the deposited sediment will lead to higher risk of wind erosion. Mitigation for wind erosion is discussed in Volume 4, Appendix G, Attachment 9A, Section 9A.3. Mitigation includes revegetation with native grasses and the use of tackifiers (sprayable erosion control product that bonds with the soil surface and creates a porous and absorbent erosion resistant blanket that can last for up to 12 months).

e-f. The residual effects of flooding on soil quality and quantity, including areas of newly deposited sediments, are presented in Volume 3B, Section 9.2.3.3 and consider the physical properties of sediment as they relate to land capability. Physical properties of sediment, including depth, texture, organic carbon content, structure, consistence, and density are integrated into measures of land capability for all new soil types (DEP1, DEP2, DEP3, DEP4, DEP5) (see Volume 3B, Section 9.2.3.3, Table 9-5 and Table 9-6). Effect on soil quality and quantity are expected to be high magnitude and irreversible because of the change in land capability associated with the introduction of new soil series with different physical properties. Specifically, there will a decrease in equilibrium land capability from existing conditions to post-flood conditions.

Question 391

Volume 3B, Section 9.2.3.3, Page 9.11
Volume 3B, Section 9.2.3.2, Page 9.8

Alberta Transportation states in Section 9.2.3.3 that *Flooding is expected to increase soil pH permanently* which contradicts Section 9.2.3.2 that states *pH can be expected to remain constant for the time periods considered*.

a. Correct or explain this contradiction.

Response 391

BACKGROUND INFORMATION

When the off-stream reservoir is operational, floods of larger magnitude will introduce sediment that is dominantly of calcite mineralogy ($CaCO_3$). $CaCO_3$ is a solid phase species that will buffer soil pH (Bohn et al. 1985), even at a small percentage of the soil volume.

The vertical pH distribution in the existing glacial-age Chernozemic-Gleysolic soils within the off-stream reservoir (Volume 1, Figure 3-7) reflects a long period of development (thousands of years). These soils are currently in the slightly acidic to slightly alkaline range. For topsoil horizons, $pH_{(CaCl2)}$ ranged from 5.68 (Volume 4, Appendix G, Attachment C, Table C3) to 7.47 (Volume 4, Appendix G, Attachment C, Table C8). For the same soils, subsoil horizons ranged in pH from 6.57 (Volume 4, Appendix G, Attachment C, Table C1) to 7.62 (Volume 4, Appendix G, Attachment C, Table C8).

The new depositional soil units that will be introduced by flooding—DEP1, DEP2, DEP3, DEP4 and DEP5 (see the response to IR388 for further detail)—are defined for various thicknesses of introduced sediment. The pH of these depositional soil units is expected to be near pH 8 and will remain that way for hundreds to thousands of years as they develop vertical pH distribution similar to soils in the existing conditions.

a. In response to the question, the cited statements are both correct and are consistent, but they are made in differing contexts.

   The context for the statement in Volume 3B, Section 9.2.3.3 is that flooding will introduce calcite into the soil system, which will result in an increase in pH, compared to existing conditions.

The context for the statement in Volume 3B, Section 9.2.3.2 is that mitigation measures for elevated pH are unnecessary because a stable pH around 8 (characteristic of the new soils) is not expected to be detrimental to vegetation establishment and function. The statement that "pH can be expected to remain constant for the time periods considered" refers to the fact that natural leaching processes would mitigate high pH, but it will take a long time.

REFERENCES

Bohn, H., McNeal, B. and O'Connor, G. 1985. Soil Chemistry. 2nd edition. John Wiley&Sons. New York. 339 pp.

Question 392

Volume 3B, Section 9.2.3.3, Page 9.12

Alberta Transportation states *An upward shift of the water table could lead to an areal expansion of soils affected by upward movement of sodium or other soluble salts. In turn, this could lead to increased sodicity and salinity in flooded soils*.

a. Describe mitigation measures to address sodicity in flooded soils.

b. Identify and describe the potential residual impacts of the Project following implementation of mitigation measures for soil sodicity and salinity in flooded soils.

Response 392

a. While the potential for increased salinity or sodicity in flooded soils was identified in Volume 3B, Section 9.2.3.3, the residual effects related to soil quality resulting from changes in salinity and sodicity are expected to be negligible over the long term (as described in b.)

Mitigation measures would only be necessary in areas where vegetation establishment is poor due to high salinity or sodicity. The primary approach to mitigating poor vegetation establishment would involve the selection of plant species most suited for the chemical conditions in the off-stream reservoir, both in the first few years post-flood and over the longer term (decades). To understand possible changes in soil chemistry (salinity, sodicity) in the off-stream reservoir resulting from flooded soils, visual (i.e., presence of salt crusts) and laboratory testing will be considered during revegetation planning.

If increased salinity reduces vegetation growth and reestablishment, it could indirectly contribute to heightened erosion risk (resulting in dust) and may require expanded use of tackifier and hydroseeding or hydromulching. During the immediate post-flood period—and where required afterward—surface tackifiers may be used to hold soil in place from wind erosion until desalinization and vegetation regrowth has occurred to a sufficient degree.

Over the long term, larger precipitation events would naturally mitigate for soluble salts, allowing salts to be leached downward into the soil profile, and no additional mitigation would be necessary for salinity.

b. Salinity changes may have positive land use effects, such as the development of additional vegetation diversity adapted to saline or sodic soils. While flood mitigation remains the primary future land use in the off-stream reservoir, knowledge of dynamic variation in salinity and sodicity response to flooding will support effective mitigation for vegetation reestablishment.

The residual effects of flooding on soil quality and quantity are presented in Volume 3B, Section 9.2.3.3 and considered the effects of changes in salinity and sodicity as they relate to land capability. Based on the parameters associated with salinity and sodicity in Table IR392-1, residual effects related to soil quality resulting from changes in salinity and sodicity are expected to be negligible, over the long term (more than a decade). Over shorter time periods, salinity levels would be more dynamic, with the result that areas subject to smaller magnitude floods (i.e., 1:10 year), would remain dynamic with respect to soil salinity and sodicity. Areas subject only to low frequency events (e.g.,1:100 year flood), would return to background with respect to salinity and so would remain near background levels most of the time. The salinity trajectory will influence the choice of vegetation establishment during post-flood mitigation.

Results of baseline soil surveys (Volume 4, Section 3.2, Appendix G) show that soils within the terrain and soils LAA are of low salinity and sodicity. To infer the possible degree of salinity and sodicity change that might accompany flooding, baseline results from groundwater were evaluated and compared to soil quality standards. Twenty-one of twenty-eight samples of groundwater obtained for determining baseline conditions (Volume 4, Appendix I, Attachment C) had sodium adsorption ratio's (SAR) levels below 4, a threshold below which subsoil may be considered of *good* quality (Alberta Environment 2001; Table 2.2). See Table IR392-1 for salt and remediation guidelines. Only one sample had a soil rating of *poor* quality due to SAR (MW16-15-34; 8.94).

Similar analysis of soluble salts showed that twenty of twenty-seven samples had electrical conductivity (EC) less than 3 dS/m, the threshold below which subsoil is considered to be of *good* quality (Alberta Environment 2001; Table 2.2). Only three samples would be rated as *poor* using these standards for salts (MW16-2-6; electrical conductivity EC=5.9; MW16-16-11 EC=5.4; and MW16-17-5; EC=6.9). Nonetheless, the effect of these groundwater conditions on possible soil salinization would depend on the amount of salt-rich groundwater that is evaporated during the post-flood soil drying process. Evaporation from the soil profile will amplify salts above initial groundwater concentrations.

Table IR392-1 Comparison of Baseline Groundwater Electrical Conductivity and Sodium Adsorption Ratio to Salt Contamination and Remediation Guidelines for Soil[1]

Groundwater Sample Identifier	Soluble EC dS/m[2]	Sodicity SAR[3]	Comparable subsoil soluble salt quality rating-conductance[4,6]	Comparable subsoil sodicity quality rating – SAR[5,6]
MW16-1-15	2.1	1.54	G	G
MW16-2-6	**5.9**	4.15	**P**	F
MW16-3-7	2.6	3.18	G	G
MW16-5-11	0.8	0.64	G	G
MW16-6-11	3.3	2.76	F	G
MW16-6-20	2.0	5.36	G	F
MW16-7-5	3.9	3.10	F	G
MW16-8-8	1.1	0.33	G	G
MW16-8-19	1.3	0.60	G	G
MW16-9-6	1.7	0.71	G	G
MW16-10-15		2.74	-	G
MW16-11-15	3.1	2.87	F	G
MW16-12-3	2.6	0.93	G	G
MW16-14-33	2.0	1.56	G	G
MW16-15-34	1.0	**8.94**	G	**P**
MW16-16-11	**5.4**	3.76	**P**	G
MW16-17-5	**6.9**	3.90	**P**	G
MW16-18-6	1.1	0.93	G	G
MW16-19-8	2.5	2.55	G	G
MW16-19-19	3.0	6.13	F	F
MW16-20-21	2.1	2.38	G	G
MW16-21-11	0.8	0.31	G	G
MW16-22-26	2.2	3.75	G	G
MW16-23-14	1.1	0.78	G	G
MW16-23-36	1.3	5.24	G	F
MW16-24-30	1.1	5.82	G	F

Table IR392-1 Comparison of Baseline Groundwater Electrical Conductivity and Sodium Adsorption Ratio to Salt Contamination and Remediation Guidelines for Soil[1]

Groundwater Sample Identifier	Soluble EC dS/m[2]	Sodicity SAR[3]	Comparable subsoil soluble salt quality rating-conductance[4,6]	Comparable subsoil sodicity quality rating – SAR[5,6]
MW16-25-9	1.1	0.43	G	G
MW16-26-18	1.3	6.13	G	F

NOTES

Bold indicates values exceed the threshold (defined in Soil Quality Guidelines for Unrestricted Land Use; Alberta Environment, 2001) for *Poor* quality rating, due to either salinity or sodicity

1 data from Volume 4, Appendix I, Attachment C

2 units of conductance in Vol 4, Appendix I, Attachment C are micro-siemens per centimeter. The conversion factor to deci-siemens per m is 10^{-3}.

3 SAR = (Na/((Ca + Mg)^0.5), all concentrations expressed in milliequivalents per litre

4 equivalent rating subsoil, Table 2.2, Salt Contamination and Remediation Guidelines, Alberta Environment, 2001.

5 equivalent rating subsoil, Table 2.2, Salt Contamination and Remediation Guidelines, Alberta Environment, 2001.

6 class symbols: G-*good*, F-*fair*, P-*poor*

Class limits for salinity, with units of dS/m: G is less than 3; F is 3 to 5; P is 5 to 10

Class limits for sodicity, unitless: G is less than 4; F is 4 to 8; P is 8 to 12.

If the soil profile in the off-stream reservoir becomes saturated with groundwater that is similar in salinity and sodicity to current groundwater, the outcome does not greatly change the chemical quality of these soils, providing that groundwater levels recede relatively quickly after reservoir drainage. However, if that recession is not as fast as predicted, rise of groundwater towards the land surface—accompanied by evaporation of that water—may result in elevated salt concentrations in surface soils.

Although there could be short-term changes in salinity for the immediate post-flood period within the area of inundation in the reservoir, the effect is expected to be reversible such that over the long-term natural precipitation rates should result in leaching of soluble salts below the rooting zone.

REFERENCES

Alberta Environment. 2001. Salt Contamination Assessment & Remediation Guidelines. 88 pages. Edmonton, AB.

Question 393

Volume 3B, Table 9-7, Page 9.22
Volume 3B, Section 9.2.4, Page 9.23
Volume 3B, Section 9.3, Page 9.23 and 9.24

Alberta Transportation states that *The predicted effects on soil quality and quantity are adverse, of high magnitude and irreversible effect with a long-term duration. Flooding would saturate the soils within the reservoir, leading to chemical change that in some cases is not reversible. Flooding would also bury baseline soil profiles beneath coarse textured sediment resulting in a loss of agricultural capability and an increase in wind erosion risk unless fully mitigated. Despite these changes to soil quality and quantity the change in land use away from agricultural means that these changes are not significant.*

Since land capabilities are a measure of the land's potential to support a particular land use, consideration of future land uses should not be used to conclude that a reduction in land capability is not significant.

a. Provide further rationale and explain why the changes to soil quality and quantity as a result of flooding are assessed as not significant.

b. Explain why the change in land use for the Project was used to conclude that the effect of changes on soil quality and quantity from flooding are not significant.

c. Evaluate post-flood land capability independent of the target end land use, with consideration of the various sediment depths that will remain in all Project components.

d. Re-evaluate the significance of the effect of change in soil quality or quantity from flooding using the Significance Definition provided in Section 9.3.

e. Provide detailed rationale to explain the determination of significance of the environmental effect of flooding on soil quality and quantity.

Response 393

a,b,e. In the assessment for soils and terrain, the conclusion of not significant (for change in land use) is not correct. See the responses below to c. and d. for a discussion on effects to soils and terrain, including a correction on significance conclusion (see d.).

c. An evaluation of post-flood land capability independent of the target end land use is provided in Volume 3B, Section 9.2.3.3, Tables 9-5 and 9-6, and Figures 9-3 and 9-5. As shown in Table 9-6, flooding and sediment deposition results in an initial reduction in the area of Land Capability Class 2 within the terrain and soils LAA of approximately 570 ha, relative to

existing conditions. Following release of water from the reservoir, soil moisture conditions will equilibrate and the initial reduction in Land Capability Class 2 will recover somewhat, resulting in a net reduction of 240 ha, compared to an initial reduction of 570 ha.

d. The correction to the significance conclusion is based on using the definition in Volume 3B, Section 9.3, whereby operation of the Project would result in a significant effect on soil because there will be a change in soil quality or quantity resulting in a reduction in agricultural land capability that cannot be offset through mitigation or compensation measures (this occurs in the off-stream reservoir).

   However, the context for this conclusion is that it is a highly conservative evaluation of potential effects to agricultural capability. There are 30,957 ha of agricultural and pasture land within the RAA (Volume 3C, Section 1.2.6, Table 1-8), and construction of the Project will result in a reduction of 342 ha of agricultural and pasture land (a reduction of 1.1%). Even with the additional reduction of 570 ha of Land Capability Class 2 soils resulting from flooding, the Project is expected to have a not significant effect on agriculture in the RAA, overall.

   In addition, this assessment does not account for the positive effects associated with the offsetting of potential flood damage to agricultural land and reduced agricultural capability downstream which are expected to be mitigated by the Project.

Question 394

Volume 4, Appendix D, Section 5.4, Page 5.7
Volume 4, Appendix D, Section 5.4.1, Page 5.8
Volume 3C, Section 2.8, Page 2.10

Alberta Transportation states in Volume 4, Appendix D that *Alberta Environment and Parks will be responsible for instituting short and long-term monitoring programs for the Project lands and lists* soil parameters that may be assessed.

a. Provide a Construction Monitoring Plan to ensure that soil used within the Project (i.e. used as base or berms) does not contain potential contaminants of concern.

b. Provide the framework for the Short-Term Soil Monitoring Plan mentioned in Volume 4, Appendix D, Section 5.4. Identify parameters and metrics that will be monitored, providing rationale for each parameter/ metric.

c. Provide a Post-Flood Sediment Monitoring Plan to assess post-flood sediments for potential contaminants of concern and to ensure appropriate handling and disposal as required.

d. Clarify the terrain and soils monitoring required in Volume 3C during the different Project phases.

Response 394

a. Soil monitoring protocols during construction to detect and manage potential contaminants of concern that might be present in native materials have been discussed in detail in the response to IR374.

b. Volume 4, Appendix D, Section 5.4 lists the various soil monitoring activities recommended for the short-term soil monitoring, which will focus on compaction, erosion and areas of poor vegetation growth and includes:

- satisfactory soil replacement depth (i.e., topsoil)
- near and subsurface compaction
- electrical conductivity
- sodium adsorption ratio
- pH
- macronutrient status (NPK)
- recording of bare areas, evidence of surface erosion, slumping or other indicators that require additional mitigation measures

Applicable criteria could include Alberta Transportation (2013) and Alberta Environment (2001) for soil quantity and quality standards used in the remaining features (construction staging areas, areas of soil and spoil stockpiles, area of floodplain berm buffer).

Proposed monitoring will be carried out by personnel with recognized expertise in both the detection and measurement of soil quality indicators. The parameters required for soil monitoring during the short-term period are:

- Visual assessments of soil erosion caused by water (rills, sheetwash, gullies) and wind (deflation hollows, dunes, reports of wind-blown dust) will be conducted in parallel to the vegetation monitoring program (see response to IR407, Appendix IR407-1).
- Visual assessments of subsidence and slope failure in areas subject to excavation (borrow source, diversion channel buffer area) will be conducted.
- Topsoil replacement depths will be measured in areas of soil reclamation not previously assessed (primarily Year 1).

- Areas of topsoil and subsoil compaction will be identified and subsequent measurements will use quantitative techniques for determining bulk density or penetration resistance (Naeth et al. 1991). This will occur primarily for Year 2 to allow one year of wet-dry and freeze-thaw to provide some attenuation.
- Areas of suspected problem chemistry will be sampled. Analyses may include indicators of salt (electrical conductivity, sodium adsorption ratio), of carbonates (pH and calcium carbonate equivalent), available and total nutrient supply (nitrogen, phosphorus, potassium), and indicators of biological health (total organic carbon). This will occur primarily for Year 2 to allow vegetation to help identify potential problem areas.

c. When sediment is deposited in the reservoir following a flood, the intent is that it will be left in place where deposited; however, it may be moved or regraded so that it does not interfere with drainage or functioning of the reservoir or associated components.

d. Volume 3C, Section 2.7 was incorrect in stating that no follow-up or soil monitoring is proposed. Soil monitoring during the post-flood phase will quantify both dynamic and static soil property changes that are predicted for the flood and post-flood phase. Monitoring will be carried out by personnel with recognized expertise in both the detection and measurement of soil quality indicators. Monitoring will address the following concerns and questions:

- the rate of soil dewatering and reestablishment of soil aeration within the area of inundation
- changes to soil salinity and sodicity introduced by soil saturation and groundwater rise within the area of inundation
- changes to topsoil pH and calcium carbonate content within the area of inundation
- the area of soil erosion caused by reservoir filling and drawdown
- the area and magnitude of sediment deposits (depth, area)
- the physical quality of sediment deposits will be assessed
- wind-erosion risk of sediment deposits and effectiveness of mitigations (tackifier, vegetation)
- incidence and areas of soil rutting

REFERENCES

Alberta Environment. 2001. Salt contamination assessment & remediation guidelines. Environmental Science Division. Edmonton, Alberta.

Alberta Transportation. 2013. Alberta Transportation Guide to Reclaiming Borrow Excavations, Dec. 2013 edition. Edmonton, Alberta.

Naeth, M.A., White, D.J., Chanasyk, D.S., Macyk, T.M., Powter, C.B. and Thacker, D.J. 1991. Soil physical properties in reclamation. Reclamation Research Technical Advisory Committee. RRTAC 91-4. 216 pp. Edmonton, Alberta.

Question 395

Volume 4, Appendix G, Attachment 9A, Section 9A.2.3, Page 9A.3
Volume 4, Appendix G, Technical Data Report, Section 1.2.5, Page 1.6
Volume 4, Appendix G, Technical Data Report, Section 1.1, Page 1.1

Alberta Transportation obtained agro-climatic monitoring data from the monitoring station at Lacombe, Alberta to *represent typical soil moisture patterns for the Project site because of similar soil and climate conditions*. Lacombe, Alberta is located within the Central Parkland Natural Subregion, whereas the PDA is located within the Foothills Parkland Natural Subregion.

a. Provide rationale and justification for the selection of the data from the Lacombe agro-climatic monitoring station rather than a monitoring station located within the same subregion as the PDA.

Response 395

a. Soil classification in the province of Alberta incorporates ecological considerations (Bock et al. 2006) and soil correlation areas are delineated to account for ecoregion qualities.

There are no soil moisture data available from agro-climatic monitoring stations located in the Foothills Parkland.

The Lacombe site was used to provide an estimate of long-term record of soil moisture content variation because the soils and climatic properties best matched those found in the terrain and soils LAA.

The closest alternative site that has a long-term record of soil moisture variation is located at Olds, Alberta. It too is located within the Central Parkland, but it is closer to the LAA. Both sites had similar period of record. Lacombe had a soil moisture content record from 2008 to 2016. The Olds site had a soil content record from 2005 to 2015. Both sites have sufficient data to serve as an indicator of long-term trends in moisture variation.

The following comparisons apply to the Lacombe site versus the Olds site with respect to the LAA and the off-stream reservoir:

- The Lacombe site soil textural property is “moderately fine” to “fine”, which is similar to 77% of the LAA (Appendix G, Terrain and Soil Technical Data Report, Table 3-16). By contrast, the Olds site has a soil textural property of “moderately fine”.

- The Lacombe site has well drained soils and the classification is "orthic black", whereas the Olds site is imperfectly drained and the classification is "gleyed black, carbonated phase". The well drained Lacombe site is, therefore, more representative of drainage conditions in the PDA, where the rank is "well" to "poor" to "imperfect."
- Imperfectly drained soils (similar to the Olds site) occupy minor areas (20% of delineation) of just 5 of the 22 soil map units in the PDA (Appendix G, Table 3-17). Moderately well to well drained soils (similar to the Lacombe site) dominate 16 of 22 soil map units in the off-stream reservoir.

Overall, the Lacombe site is more representative of the off-stream reservoir than the Olds site.

REFERENCES

Bock, M.D., J.A. Brierley, B.D. Walker, C.J. Thomas and P.E. Smith. (eds.). 2006. Alberta Soil Names File (Generation 3) User's Handbook. Land Resource Unit, Research Branch, Agriculture and Agri-Food Canada. Available at: http://www.agric.gov.ab.ca/asic. Accessed: January 2017.

Question 396

Volume 4, Appendix G, Attachment 9A, Section 9A.3, Page 9A.18
Volume 3B, Section 9.2.3.2, Page 9.9
Volume 4, Appendix D, Section 4.6, Page 4.15

Alberta Transportation states in Volume 4, Appendix G that *An alternative (it will protect soil from wind erosion over winter) is using a tackifier… It is proposed that a sprayable erosion control product be applied to the reservoir floodplain to reduce soil erodibility due to wind if vegetative controls are not effective. An example sprayable erosion control product is composed of thermally processed wood fibre, wetting agents, and other ingredients.*

a. Identify the ingredients (chemical constituents) in the tackifier or sprayable erosion control product.

b. Discuss whether the tackifier or sprayable erosion control product may release contaminants into the environment.

c. Describe mitigation measures that will be undertaken if the ingredients in the tackifier or sprayable erosion control products contain potential contaminants of concern.

d. Describe the potential residual impacts of the Project following implementation of mitigation measures for the tackifier or sprayable erosion control products.

Response 396

a. The exact product to be used as the tackifier or sprayable erosion control has not been confirmed for the Project. ProMatrix™ is one example of many comparable erosion control products that could possess the characteristics and provide the required functionality outlined in Volume 4, Appendix G, Attachment 9A, Section 9A-3. This erosion control product consists of 77% processed wood fibers, 18% wetting agents, 2.5% biodegradable fibers derived from plant sugars, and 2.5% proprietary mineral activator (see Appendix IR396-1).

b. The use of a product such as ProMatrix™ or a similar erosion control product would be safe for the environment and human health. The material safety data sheets (MSDS) for ProMatrix™ (#CON069) indicates that the toxicological properties of the wood fibre elements of the product are limited to its potential to create wood dust. The proprietary binding agent is based on guar gum. The product's MSDS notes that the US Federal *Insecticide, Fungicide and Rodenticide Act* considers guar gum to be a "minimal risk inert substance" that poses no risk to humans or to the environment.

c-d. The ingredients in the tackifier or comparable sprayable erosion control products that may be used will not contain potential contaminants of concern and no residual impacts will result from their uses.

Question 397

Volume 4, Appendix G, Technical Data Report, Section 3.1.3, Pages 3.6-3.7
Volume 4, Appendix G, Technical Data Report, Attachment C.4 and C.5

Alberta Transportation states that *Selected horizons were analyzed for one or more of the following soil properties:*

- ***pH and electrical conductivity (saturated paste)***
- ***soluble cations (calcium, magnesium, sodium and potassium) and anions (sulphate, chloride)***
- ***saturation percentage and sodium adsorption ratio (SAR)***
- ***cation exchange capacity and base saturation of upper horizons***
- ***exchangeable calcium, magnesium, sodium, potassium***
- ***calcium carbonate equivalent***
- ***total organic carbon***
- ***particle size analysis.***

All soil properties listed in this section have not been reported in Attachment C.4 and C.5. For example, cation exchange capacity, chloride and sulphate results are missing from Table C-17. Also, the Maxxam Certificate of Analysis is titled "Partial Results".

a. Explain why some of the soil properties are missing from the results and laboratory reports.

b. Explain why the Maxxam laboratory analytical package was changed from Salinity 4 to Salinity 3, as indicated on the Chain of Custody Record for Maxxam Job # B690828 D_T.

c. If all stated soil properties were not analyzed, describe how and when the missing data will be collected, or justify why the missing data is not required for assessment of the Project effects.

Response 397

a. The list of soil properties is not correct. It should be revised as follows with the indicated strikeouts:

- pH and electrical conductivity (saturated paste)
- soluble cations (calcium, magnesium, sodium and potassium) ~~and anions (sulphate, chloride)~~
- saturation percentage and sodium adsorption ratio (SAR)
- ~~cation exchange capacity and base saturation of upper horizons~~
- ~~exchangeable calcium, magnesium, sodium, potassium~~
- calcium carbonate equivalent
- total organic carbon
- particle size analysis

The Maxxam certificate provided is the correct certificate but the results are incomplete and the report # R2291185 is labelled "Version 1 – partial". The total organic content (TOC) results for the remaining 18 samples are presented in Volume 4, Appendix G, Technical Data Report, Attachment C5, Report # R4234518, Report Date 11/03/2016.

Although not identified in the IR, there is an additional mistake: one Maxxam laboratory report was not included in Volume 4, Appendix G, Technical Data Report, Attachment C5, although the data from it was included in Appendix G, Attachment C4. Appendix IR397-1 is the missing Maxxam certificate related to samples obtained from soil inspection site SRKF16140.

b. Chain of custody forms obtained from Maxxam Analytics are often pre-populated for convenience. They may also be modified by field personnel. At the time of completing the chain of custody form for the sampled soils, it was more efficient to change the column headed by "Salinity 4" to "Salinity 3" rather than to add an entirely new column headed by "Salinity 3". These types of changes are acceptable on Maxxam Analytics chain of custody forms and the modification did not result in a Chain of Custody error being issued by Maxxam Analytics.

c. Soil samples were analysed for pH, electrical conductivity, soluble cations, calcium carbonate equivalent, total organic carbon and particle size distribution. Sodium adsorption ratio (SAR) was calculated from the results for soluble cations. Analyses for exchangeable bases, cation exchange capacity and base saturation were not conducted. Exchangeable bases, exchange capacity, and base saturation data were not needed because the Project is not expected to result in changes in these soil properties. Rather, the measure of soluble cations, electrical conductivity, and SAR provided sufficient information to evaluate of Project effects on soluble salts. In the case of Maxxam certificate of analysis marked as "Partial Results", the remaining results were presented later in Volume 4, Appendix G, Technical Data Report. Attachment C5. Report No. R4234518, issued 2018/11/03, contains the TOC results of 18 samples initially included within the report labeled as "Partial Results", Report No. R2291185. To summarize, some of the chemical parameters for these 18 samples were reported in Report No. R2291185 (Partial Results) while the TOC for these 18 samples was presented in the subsequent report.

Question 398

Volume 4, Appendix G, Technical Data Report, Section 3.1.3, Page 3.7

Alberta Transportation states that *Previously published sources of chemical data were used when analytical results were not available from samples collected*.

a. Identify the previously published sources used, and identify the resulting data that was used.

b. Explain why analytical results were not available from samples collected. If analytical results are now available, provide them.

Response 398

a. Data for bulk density were obtained from the Agricultural Region of Alberta Soil Inventory Database (AGRASID; Alberta Soil Information Centre 2003) soil layer file to represent soil horizons of soil series mapped in the PDA.

b. Samples were obtained from example profiles of all mapped soil series and for all necessary parameters, except bulk density. Rather than measure bulk density, relevant data published as part of the AGRASID soils program was used. Both laboratory results from field samples and bulk density data borrowed from AGRASID are presented in Volume 4, Appendix G, Attachment C, Soil Map Unit Description Tables, Table C-1 to Table C-14. Use of AGRASID data for representative soil bulk density is an acceptable practice in environmental impact assessments. No new measurements for bulk density are necessary for the assessment.

REFERENCES

Alberta Soil Information Centre. 2003. Agricultural regions of Alberta Soil Inventory database (AGRASID). Alberta Agriculture, Food and Rural Development, Conservation and Development Branch

Question 399

Volume 4, Appendix G, Technical Data Report, Section 3.2.6.7, Page 3.54
Volume 4, Appendix G, Technical Data Report, Figures 3-13 and 3-14, Pages 3.58-3.59
Volume 4, Appendix G, Technical Data Report, Tables 3-29, 3-30, 3-31, and 3-32, Pages 3.55-3.57
Volume 4, Appendix G, Technical Data Report, Section 3.3.1, Page 3.76
Volume 3A, Section 9.1.3, Table 9-1, Page 9.3
Volume 3B, Section 9.1, Table 9-2, Page 9.3

Alberta Transportation states that *Much of the LAA is rated moderate to high for compaction risk for topsoil (1,565 ha, or 83%) and Soil series rated for subsoil compaction risk closely follow those rated for topsoil compaction risk*. However, potential effects of soil compaction have not been evaluated for the different Project phases.

a. Evaluate and discuss potential soil compaction effects during construction and dry operations.

b. Evaluate and discuss potential soil compaction effects during flood and post-flood operations, including, but not limited to, the added weight of flood water within the reservoir.

c. Describe mitigation measures at each Project phase to address the moderate to high compaction risk for topsoil and subsoil.

d. Describe the potential residual impacts of each Project phase related to moderate to high compaction risk for topsoil and subsoil, following implementation of the mitigation measures.

Response 399

a. The potential effects of soil compaction during construction is an increase in bulk density, which can result in a reduction in land capability. Construction activities have the potential to cause compaction, especially in the areas of the PDA that have finer soil textures. As mitigation, areas subject to construction activities will have both topsoil and subsoil salvaged and stockpiled prior to work taking place. Therefore, the topsoil and subsoil materials to be used for reclamation will not have been subjected to compaction. Soils below the depth of the salvaged soils will be loosened by deep ripping prior to topsoil and subsoil replacement.

   During dry operations, potential soil compaction would most likely be caused by maintenance vehicle traffic, however, vehicle traffic will be restricted to the designated access and maintenance roads within the PDA, which will limit the amount of potentially affected soil.

b. During a flood, the effect of the added weight of water could compact the soil. However, the density of water is such that, on a mass per unit area basis, the load will be much lower than loads imposed by heavy equipment. For example, a Caterpillar 140M grader typically will cause a load from each tire of about 20,000 kg/m^2. For comparison, a 10 m deep water column in the reservoir would impose a force of 10,000 kg/m^2. In addition, relative to the existing soils in the off-stream reservoir, the coarse-grained sediment deposited in the reservoir during a flood will have a low compaction risk similar to the Twin Bridges (TBR) soil series, similar to the soils currently on the Elbow River floodplain (Volume 4, Appendix G, Table 3-29 and Table 3-30).

   During post-flood operations, the use of maintenance equipment to remove sediment or move sediment within the reservoir will occur if the sediment depositions impact the functionality of the reservoir operations or present a risk to dam integrity. Maintenance equipment will use designated access and maintenance roads.

c. Mitigation for soil compaction during construction and dry operations is as explained in the response to a. Should compaction be evident as a result of construction activities, mitigation will include ripping to loosen the subsurface to an approximate depth of 500 mm prior to placement of the topsoil and subsoil.

   Mitigation for post-flood operations may include the use of low ground-pressure equipment and avoiding traffic during wet soil conditions, as long as safely possible, when soils are at higher risk of compaction.

d. No residual impacts will occur as a result compaction mitigation for any Project phase.

Question 400

Volume 4, Appendix G, Technical Data Report, Tables 3-33, 3-34, 3-35, Pages 3.61- 3.62
Volume 4, Appendix G, Technical Data Report, Figures 3-15 and 3-16, Pages 3.63-3.64
Volume 4, Appendix G, Technical Data Report, Section 3.2.6.8, Page 3.60
Volume 4, Appendix G, Technical Data Report, Section 3.3.1, Page 3.76
Volume 3A, Section 9.1.3, Table 9-1, Page 9.3
Volume 3B, Section 9.1, Table 9-2, Page 9.3

Alberta Transportation indicates in Tables 3-33, 3-34, and 3-35 that 49% of the LAA is rated as moderate to high soil rutting risk. However, potential effects of soil rutting have not been evaluated for the different Project phases.

a. Evaluate and discuss potential soil rutting effects during construction and dry operations.

b. Evaluate and discuss potential soil rutting effects during flood and post-flood operations.

c. Describe mitigation measures at each Project phase to address the moderate to high soil rutting risk for topsoil and subsoil.

d. Describe the potential residual impacts of each Project phase related to moderate to high soil rutting risk for topsoil and subsoil, following implementation of the mitigation measures.

Response 400

a. Soil rutting has the potential to result in admixing of topsoil and subsoil, which can cause localized reduction in land capability. Soil rutting during construction can occur if soils are wet or saturated. Soil salvage of both topsoil and subsoil will occur prior to construction activities and these materials will be stored in stockpiles for use in reclamation. Therefore, the topsoil and subsoil materials available to be used for reclamation will not have been subject to rutting.

   During dry operations, potential soil rutting would most likely be caused by maintenance vehicle traffic; however, vehicle traffic will be restricted to designated access and maintenance roads, which will limit the amount of potential effected soil.

b. During flood and post-flood operations, potential soil rutting would most likely be caused by maintenance vehicle traffic; however, vehicle traffic will be restricted to designated access and maintenance roads, which will limit the amount of potential effected soil. Given that rutting may result from critical maintenance activities, mitigation for rutting will be in place. These include waiting for drying conditions as long as safely possible; the use of swamp mats; the use of low ground-pressure equipment (e.g. wide pads, balloon tires). After the work is completed and soils have dried sufficiently, ruts will be graded to facilitate drainage and disturbed areas will be reseeded.

c. Mitigation for soil rutting during construction and dry operations, flood and post-flood operations is explained in the response to a. and b.

d. No residual impacts will occur as a result of rutting mitigation for any Project phase.

6.4 VEGETATION

Question 401

Volume 1, Section 1.3.2.1, Figure 1-8, Pages 1.12 and 1.13

Alberta Transportation states *there is limited or no public access* planned for Area B as it is the reservoir. Given that flooding of the reservoir is anticipated to occur infrequently has Alberta Transportation considered grazing or haying of all or part of Area B in years once the peak flood risk has passed without incident to:

a. Mitigate against the potential fire hazard created by unutilized vegetative biomass production?

b. Mitigate against the potential creation of favourable microsites for noxious weed colonization commonly associated with unutilized vegetative biomass production over extended periods?

Response 401

a-b. Since filing the EIA, Alberta Transportation has created a draft post-construction land use document for the Project. This document was drafted using feedback from First Nations gathered through the engagement process for the Project (see the response to IR2, Appendix IR2-1). This document provides the draft principles of future land use for the PDA that apply to the land use area (LUA) outlined in yellow in Figure 1 of Appendix IR2-1. The primary use of all lands within the PDA, including the LUA, is for flood mitigation. In light of the primary use, the safety of anyone with access or land users will be an overriding factor. Secondary uses such as vegetation management will take place within the LUA and will further be refined as the land use document is finalized. Further details can be found in Appendix IR2-1.

Question 402

Volume 1, Section 3.4.1, Page 3.33
Volume 3A, Section 6.2.2.4, Figure 6-12, Page 6.31
Volume 3A, Section 10.1.3. Table 10-1, Page 10.7
Volume 3A, Section 10.2.2.2, Figure 10-3, Pages 10.19 and 10.20
Volume 3A, Section 10.4.3, Table 10-12, Pages 10.46 to 10.49

Alberta Transportation states potential *changes in wetland function include indirect alteration of surface and groundwater flow patterns*.

a. Given the diversion channel will intersect several small tributaries to the Elbow River and the flow from the tributaries upstream of the diversion channel will be re-directed into the diversion channel to the low level outlet will the reduced flow of water through the small tributaries downstream of the diversion channel cause indirect detrimental effects on the shrublands and shrubby fen lying south of the diversion channel and off-stream dam? Justify and explain how a conclusion was reached.

b. Is the size of the remaining watershed lying south of the diversion channel sufficient to sustain the water table at levels capable of maintaining the shrublands, shrubby fen, and the rare plant species, dwarf bulrush (Trichophorum pumilum) in the area south of the diversion channel and dam? Justify and explain how a conclusion was reached.

c. Have any indirect impacts to the shrublands and shrubby fen south of the diversion channel been accounted for within Table 10-12 on pages 10.46, 10.47, 10.48, and 10.49? Justify and explain how a conclusion was reached.

Response 402

a. From Volume 3A, Section 6.5.2, "Permanent diversion of five small tributaries intersected by the diversion channel and the dam would affect the input of flow from these tributaries into the Elbow River." However, the flow estimates from the five intersected tributaries are extremely low (0.36 L/s to 5.99 L/s), likely intermittent, and are already affected by roads, cultivation, and dugouts (See Volume 3A, Section 6.5.2, Table 6-11). While the measured flow from the five intersected tributaries is considered low, the intercepted flows from these tributaries will likely reduce surface water flow into the identified shrublands and shrubby fen (Volume 3A, Section 10, Figure 10-3).

   It is unclear how groundwater connectivity with the Elbow River and upslope groundwater sources influence water table levels in these habitats. The water table in shrubby fens is typically within 10 cm of the ground surface (ESRD 2015). Water table modelling indicates the water table in the area of the shrublands and shrubby fen is below the bottom elevation of the diversion channel and the diversion channel would not be able to completely intercept groundwater flows. Reduced surface water inputs into these vegetation communities may alter species composition but are unlikely to result in loss of these communities because groundwater inputs will be maintained.

b. The remaining contributing drainage basin of the shrublands and shrubby fen lying south of the diversion channel and off-stream dam is expected to be sufficient to maintain the current vegetation communities and the rare plant dwarf bulrush (*Trichophorum pumilum*). As stated in a., although a portion of surface flow north of the diversion channel and off-stream dam will be re-directed, groundwater in these areas is not expected to be completely intercepted. There is uncertainty regarding groundwater connectivity with the

Elbow River in this area, but given the low topographic position of the shrublands and shrubby fen area, groundwater inputs from the river are likely.

It can be assumed, however, that lower water inputs could potentially drive changes in species composition. Dwarf bulrush has commonly been found in saline or calcareous fens and seepage areas (Kershaw et al. 2001; Dite et al. 2013; NatureServe 2018; Flora of North America n.d.). This species is expected to persist in the shrubby fen area following construction because groundwater flow will be maintained, which is an important component for calcareous fens (ESRD 2015).

c. Indirect effects to shrublands and the shrubby fen are not addressed in Table 10-12, which only lists direct effects through disturbance and reclamation during construction and dry operations.

Indirect effects could occur due to re-direction of surface water in the five tributaries intersected by the diversion channel. The contribution of these tributaries to the shrubland and shrubby fen area water balance is uncertain, but groundwater is suspected to be an important component given the low topographic position of the shrublands and shrubby fen area and low flow estimates of the five, likely intermittent, tributaries. Species composition may be altered, but the shrublands and shrubby fen are expected to persist following construction because groundwater flow will be maintained. Inclusion of potential indirect effects to shrublands and the shrubby fen potentially affected by interception of the five tributaries would not affect the conclusion found for residual effects, as stated in Volume 3A, Section 10.9.

REFERENCES

Dite, D. M. Hajek, P. Hajkova and P. Elias Jr. 2013. The occurrence of the relict plant, *Trichophorum pumilum*, in the Western Carpathians in the context of its distribution and ecology in Eurasia. Preslia. 85:333-348.

ESRD (Alberta Environment and Sustainable Resource Development). 2015. Alberta Wetland Classification System. Water Policy Branch, Policy and Planning Division, Edmonton, AB.

Flora of North America. Date Unknown. Tricophorum pumilum. Available at: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242101207. Accessed: October 2018.

Kershaw, L., J. Gould, D. Johnson and J. Lancaster. 2001. Rare Vascular Plants of Alberta. The University of Alberta Press. 484 pgs.

NatureServe. 2018. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. Accessed: October 2018.

Question 403

Volume 3B, Section 6.4.3.2, Figure 6-12, Pages 6.29 and 6.31
Volume 3B, Section 6.4.3.3, Figure 6-17, Pages 6.39 and 6.40
Volume 3B, Section 10.2.4, Table 10-12, Pages 10.25 and 10.26

Alberta Transportation states up to 3.8 *m* depths of sediment deposition are possible in portions of the reservoir following a design flood with comparable amounts of sediment possible in the event of a 1:100 flood.

a. In a 1:100 flood or design flood could enough sediment be deposited to alter the topography of the reservoir to the point where some lowland areas near the low level outlet no longer function as wetlands and shift to upland habitat? If so, are the areas referenced in Table 10-12 of 1.4 ha of high value wetland, 3.4 ha of moderate value wetland, and 0.04 ha of low value wetland the total expected permanent loss of wetland following a design flood due to sediment deposition or is the total lost wetland area potentially greater? If the area is potentially greater provide the supporting documentation and the updated areas of wetlands to be affected. If this is not expected to occur provide the justification behind how this conclusion was reached.

Response 403

a. As stated in Volume 3B, Section 10.2.4, 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 the total permanent loss of up to 12.0 ha of wetland following a design flood.

   It is possible that some areas of wetlands will no longer function as wetlands and will shift to upland habitat. It is also possible that some upland habitat could shift to wetland habitat due to altered topography and drainage patterns, or wetland basins could have altered shape and depth as a result of sediment deposition. After a flood, the hydrodynamics of the area will find a new equilibrium based on new topography and drainage patterns. If sediment deposition alters current drainage patterns, vegetation communities, including wetlands, will respond to the new dynamic.

   Based on sediment modelling, a conservative estimate of total permanent wetland loss following a design flood is calculated using currently understood wetland conditions. These are identified in Volume 3B, Section 10.2.4, Tables 10-11 and 10-12. Table 10-11 provides results of wetland loss based on Project wetland mapping. Table 10-12 provides wetland values and estimated reduction in wetland areas due to sedimentation. Wetland values were determined using the Alberta Wetland Rapid Evaluation Tool - Estimator (GoA 2015). Changes to wetland shape and depth, resulting in an increase in wetland area, are possible

post-flood; however, the potential addition of wetlands can not be estimated with any certainty and, therefore, are not included when characterizing residual environmental effects.

REFERENCES

GoA (Government of Alberta). 2015. Alberta Wetland Rapid Evaluation Tool – Estimate of Relative Wetland Value by Section. Alberta Environment and Parks. Edmonton, Alberta.

Question 404

Volume 3A, Section 10.2.1.2, Page 10.15

Alberta Transportation states *specimens requiring further examination or species confirmation were collected with the exception of plants where seed heads or flowers required for identification to species level were unavailable or where plant populations were small… Photographs were taken of the specimen and notes made on the development stage and health.*

a. Were any potentially rare plant species noted where insufficient vegetative material existed to positively identify small patches or single plant occurrences to species level?

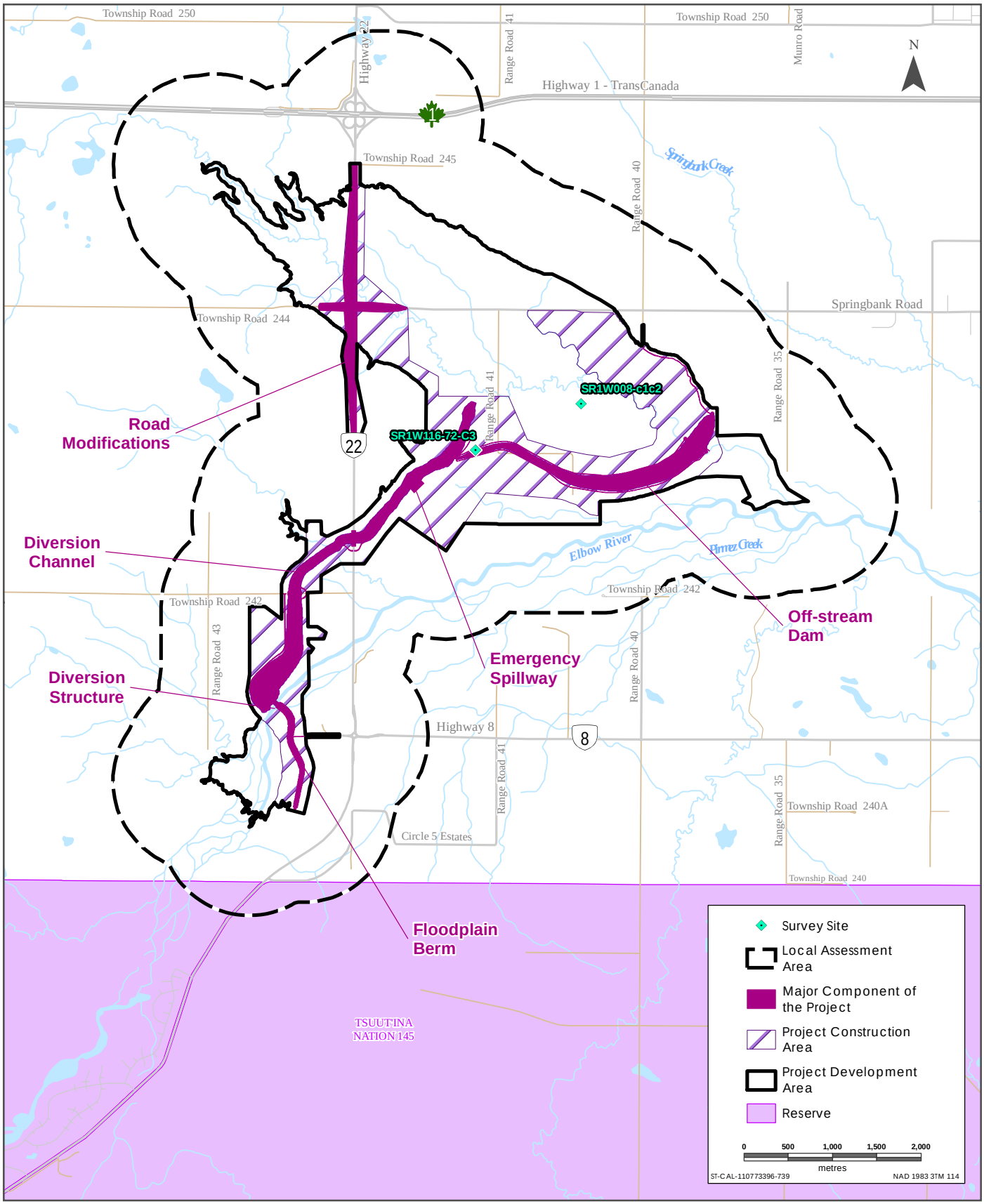
b. If so, how many sites/species were identified in the plant surveys? Provide a map outlining where these species were located.

Response 404

a. Three plants observed in the PDA could be identified only to genus level because of insufficient diagnostic characteristics or small populations: *Arnica* sp., *Potamogeton* sp. and *Utricularia* sp. (see Figure IR404-1).

One provincially rare *Potamogeton* species, *Potamogeton nodosus,* and three provincially rare *Arnica* species have been documented in natural subregions intersected by the vegetation RAA, i.e., Foothills Parkland and Montane Natural Subregions (see Volume 3A, Section 10, Figure 10-1). Table IR404-1 lists the three genus for which there was insufficient data to fully identify them to species and the potential rare species they have the potential to be.

The rare *Potamogeton* species, P. *nodosus*, is not suspected at the location SR1W116-72-c3 identified in Figure IR404-1 where a positive identification of the *Potamogeton* specimen was not possible. The site where this specimen was observed is a dugout and surrounding habitat and is unsuitable due to a lack of standing water.



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

Survey Locations where Plants were not Identifiable to Species Level

Table IR404-1 Observed Plants Lacking Sufficient Characteristics for Positive Species Identification and Potential Rare Plant Species

Observed Plants	Potential Rare Plant Species Scientific Name	Potential Rare Plant Species Common Name	ACIMS Ranks [a]			SARA Status [b]	Natural Subregions with Documented Rare Plant Occurrences	Suitable Habitat [c, d, e, f]
			Provincial	National	Tracked			
Arnica sp.	*Arnica longifolia*	long-leaved arnica	S2	N2N3	Yes	Not Listed	Foothills Parkland, Montane, Subalpine, Alpine	Open rocky alpine slopes, well-drained soil or rock near springs/seeps along cliffs and riverbanks at moderate to high elevation
	Arnica louiseana	Lake Louise arnica	S2	N3	Yes	Not Listed	Upper Foothills, Montane, Subalpine, Alpine	Alpine mesic to dry meadows and rocky slopes, tundra slopes and calcareous slides
	Arnica parryi	nodding arnica	S2	N5	Yes	Not Listed	Montane, Subalpine, Alpine	Lower elevation open mountain woods, grassy hillsides and scree slopes of foothills and mountains
Potamogeton sp.	*Potamogeton amplifolius*	large-leaved pondweed	S2	N5	Yes	Not Listed	Athabasca Plain, Central Mixedwood	Neutral pH lakes and ponds from 0 to 2900 m above sea level
	Potamogeton diversifolius	water-thread pondweed	SU	NNA	Yes	Not Listed	Dry Mixedgrass	Neutral pH ponds, lakes, streams and rivers from 5 to 2500 m above sea level
	Potamogeton epihydrus	ribbon-leaved pondweed	SU	N5	Yes	Not Listed	Upper/Lower Boreal Highlands	Still and flowing neutral pH water of ponds, lakes, streams and rivers from 10 to 1900 m above sea level

Table IR404-1 Observed Plants Lacking Sufficient Characteristics for Positive Species Identification and Potential Rare Plant Species

Observed Plants	Potential Rare Plant Species Scientific Name	Potential Rare Plant Species Common Name	ACIMS Ranks [a]			SARA Status [b]	Natural Subregions with Documented Rare Plant Occurrences	Suitable Habitat [c, d, e, f]
			Provincial	National	Tracked			
Potamogeton sp. (cont'd)	*Potamogeton nodosus*	longleaf pondweed	S1	N5	Yes	Not Listed	Foothills Parkland	Clear to turbid water of lakes, streams, rivers and sloughs from 0 to 3300 m above sea level
	Potamogeton robbinsii	Robbins' pondweed	S1	N5	Yes	Not Listed	Central/Dry Mixedwood, Kazan Uplands,	Neutral pH, shallow to deep, still to slow moving water in lakes, ponds and rivers, usually growing in organic material or muck from 0 to 3000 m above sea level
Utricularia sp.	*Utricularia cornuta*	horned bladderwort	S1	N5	Yes	Not Listed	Peace Athabasca, Lower Boreal Highlands, Athabasca Plain	Poor fens, muddy shores, calcareous wetlands
	Utricularia ochroleuca	northern bladderwort	S1	N4N5	Yes	Not Listed	Central Mixedwood	Shallow water of low nutrient lakes

Table IR404-1 Observed Plants Lacking Sufficient Characteristics for Positive Species Identification and Potential Rare Plant Species

NOTES: ACIMS (2018).

[b] Government of Canada. 2011.

[c] Kershaw et al. 2001.

[d] Klinkenberg. 2017.

[e] Flora of North America. n.d.

[f] USDA. n.d.

S1/N1 - Known from five or fewer occurrences or especially vulnerable to extirpation because of other factor(s)

S2/N2 - Known from twenty or fewer occurrences, or vulnerable to extirpation because of other factors

S3/N3 - Known from 100 or fewer occurrences, or somewhat vulnerable due to other factors

S4/N4 - Apparently secure – taxon is uncommon but not rare

SU/NU - Taxon is currently unrankable due to lack of information or due to substantially conflicting information (e.g., native vs. non-native status not resolved)

S#?/N#? - Rank is most likely appropriate, but conflicting information exists (e.g., S2? believed to be 6 - 20 occurrences)

S#S#/N#N# - A numeric range rank (e.g., S2S3 or S1S3) is used to indicate any range of uncertainty about the status of the taxon

SOURCE: ACIMS (2017b).

The unidentified *Arnica* observed at site SR1W008-c1c2 (Figure IR404-1) could potentially be the rare *A. longifolia* and/or *A. parryi* because these species are known to grow in open woods, grassy hillsides, and well drained soils near seepages and springs (Kershaw et al. 2001; Flora of North America n.d.). The survey site where the *Arnica* was observed is in a Class III (seasonal) marsh. The closest documented occurrence of the rare *Arnica* species is about 55 km southwest of the PDA (ACIMS 2017a).

Rare *Utricularia* species have not been documented in natural subregions intersected by the PDA or the vegetation RAA (Table IR404-1), therefore the *Utricularia* observed at the SR1W116-72-c3 (Figure IR404-1) is not suspected to be a rare species.

All three rare plant species identified during rare plants surveys of the PDA (Volume 3A, Section 10, Table 10-6) were observed with sufficient vegetative material and characteristics to be identified positively.

b. The plants lacking sufficient characteristics for positive identification to the species level were recorded at two locations in the PDA (Figure IR404-1). The *Potamogeton* and *Utricularia* species were observed at site SR1W116-72-c3. This site is intersected by the proposed dam. *Arnica* was observed at survey site SR1W008-c1c2, north of the proposed dam within the off-stream reservoir.

REFERENCES

ACIMS (Alberta Conservation Information Management System). 2017a. Element Occurrence Database. https://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-acims/. Accessed: October 2018.

ACIMS. 2017b. Tracked Elements Listed by Natural Subregion – July 2017.

ACIMS. 2018. List of All Vascular Plant Elements Recorded for Alberta in the ACIMS Database – March 2018. https://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-acims/. Accessed: January 2019.

Flora of North America. Date Unknown. *Arnica longifolia, A. louiseana* and A. Arnica parryi. http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=102636. Accessed: October 2018.

Government of Canada. 2011. Canada Species at Risk Act. A to Z Species Index. https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm. Accessed: January 2019.

Kershaw, L., J. Gould, D. Johnson and J. Lancaster. 2001. Rare Vascular Plants of Alberta. The University of Alberta Press. 484 pgs.

Klinkenberg, B. 2017. E-Flora BC: Electronic Atlas of the Plants of British Columbia. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. eflora.bc.ca)

USDA (United States Department of Agriculture). Date Unknown. Characteristics of Potamogeton amplifolius, P. diversifolius, P. epihydrus, P. nodosus and P. robbinsii. https://plants.sc.egov.usda.gov/java/. Accessed January 2019.

Question 405

Volume 3A, Section 10.2.2.3, Table 10-5, Pages 10.22, and Pages 10.24 to 10.28
Volume 4, Appendix L, Section 10A.2, Table 10A-1, Page 10A.20

Alberta Transportation states *twelve lichens, two liverworts, fourteen mosses…species of management concern have also been previously identified within the RAA* (Regional Assessment Area) yet only one non-vascular plant species was identified within the project development area.

a. Was only one non-vascular species present within the Project Development Area or was the intent of the plant survey to focus on vascular plant species? If more non-vascular plant species were found within the PDA list these species and their abundance. Why were these excluded from the EIA? Update the tables and the section as required to reflect these species. What are the proposed mitigation measures for the non-vascular plant species in the PDA?

Response 405

a. Only one non-vascular plant species was recorded within the PDA during field surveys. Baseline vegetation surveys were conducted to evaluate vegetation and wetland mapping, and to confirm the presence of regulated weeds and non-native invasive plants, species of management concern, wetlands, ecological communities of management concern, and traditionally used plant species. Survey methods followed ANPC (2012) and focused on vascular plant species. All field observations were reported in Volume 3A, Section 10.2.2 and, as a result, no update to the tables is required. The mitigation measures listed in Volume 3B, Section 10.1.1 and Volume 3A, Section 10.3.1 will be used to limit disturbance to vegetation, including both vascular and non-vascular plant species and to help re-establish native areas.

REFERENCES

ANPC (Alberta Native Plant Council). 2012. Guidelines for Rare Vascular Plant Surveys in Alberta – 2012 Update. Alberta Native Plant Council, Edmonton, AB. Available on-line at http://www.anpc.ab.ca/content/resources.php

Question 406

Volume 3A, Section 10.2.1.1, Page 10.12
Volume 3A, Section 10.2.2.2, Figure 10-3
Volume 3A, Section 10.2.2.2, Table 10-4, Page 10.21 and 10.22

Alberta Transportation states *upland land units (ecosites) were classified using Range Plant Communities and Range Health Assessment Guidelines for the Foothills Parkland Subregion of Alberta* for the Local Assessment Area. Assessment of the level of existing disturbance within native plant communities is better determined through determination of the plant community types as opposed to the ecosite phase.

a. Did the field surveys of the native plant communities within the Project Development Area contain sufficient information to describe the actual plant communities present? If so, provide this data.

b. What was the per cent cover of non-native species noted in the native plant communities within the Project Development Area?

Response 406

a. Field surveys within the PDA contained sufficient information to describe the ecosite phases present at each survey location. The data is not sufficient to describe plant communities potentially present in the PDA because plant community types have higher resolution and all types potentially present in the PDA were not targeted for survey.

   Many vegetation community types are differentiated by the abundance of grass species and these cannot be identified and targeted for survey using remotely sensed data. Vegetation mapping, surveys and assessment of effects used ecosite phases because these can be mapped using remotely sensed data and provide sufficient detail on plant composition and ecosystem function for assessing potential effects at the scale of the PDA. Assessing effects to the plant community level would provide higher resolution information on vegetation, but uncertainty on conditions would increase and assessment conclusions would not change.

b. Within surveyed locations of native plant communities in the PDA, non-native species cover ranged from 0% to 68% ground cover. The average non-native species cover equalled 17% (median 13%). The highest cover (68%) observed was recorded in a grazed shrubland area. This site was considered native due to the diversity of native forbs (27 species) and abundant native shrub cover. The most common non-native species were:

- quackgrass (*Elymus repens*)
- smooth brome (*Bromus inermis*)
- timothy (*Phleum pratense*)
- common dandelion (*Taraxacum officinale*)

These species are not regulated weeds (GoA 2010a) but can be aggressive competitors of native species (GoA 2010b).

Regulated weed cover in native communities ranged from 0% to 25% ground cover and averaged 1% (median 0%). Six regulated weed species were recorded (Volume 3A, Section 10.2.2.3). The most common species were creeping thistle (*Cirsium arvense*) with 19 occurrences and 2% average cover, and perennial sow-thistle (*Sonchus arvensis*), with six occurrences and 4% average cover.

REFERENCES

GoA (Government of Alberta). 2010a. Alberta Weed Control Act – Weed Control Regulation. Alberta Regulation 19/2010.

GoA. 2010b. Industrial Activity in Foothills Fescue Grasslands – Guidelines for Minimizing Surface Disturbance. Alberta Sustainable Resource Development, Lands Division.

Question 407

Volume 4, Appendix D, Section 5.4, Pages 5.7 and 5.8
Volume 4, Appendix D, Section 6.2, Page 6.2

Regarding monitoring of revegetation success for both post-construction phase and post-flood phase has Alberta Transportation developed:

a. Threshold densities of plant cover below which attempts at re-seeding are triggered? If so what are these threshold densities? How were these densities determined? If no threshold densities have been developed explain why not.

b. Threshold lengths of time where insufficient revegetation will trigger further re- seeding attempts? If so what are these threshold lengths of time? How were these lengths of time determined? How often will monitoring take place after re-seeding to determine if there is insufficient vegetation or will the same length of time originally applied be used? If no threshold lengths of time are developed explain why not.

Response 407

a-b. A draft vegetation and wetland mitigation, monitoring and revegetation plan is provided in Appendix IR407-1. The final plan will be developed following Project approval and based on provincial and federal approval conditions.

6.5 WILDLIFE

Question 408

Volume 3A, Section 11.1.4, Page 11.10
Volume 3A, Section 11.1.4.1, Table 11-3, Page 11.11
Volume 3A , Section 11.4.4.1 , Page 11.61

In Section 11.1.4 Alberta Transportation stated that *some effects on wildlife lack defined, quantifiable parameters to measure such affects…For example, increased mortality risk due to increased traffic volumes and potential vehicle collisions with wildlife is assessed qualitatively*. However, Section 11.4.4.1 references a data set; *Alberta Transportation, 2017. Animal-vehicle collision data set for Highway 22*. As well, AB Transportation collects wildlife movement and monitoring data via the Alberta Wildlife watch App and RCMP collision reports and AEP records wildlife collision data in the ENFOR Occurrence system.

a. Explain why these data were not used to quantify site specific mortality due to increased traffic volumes and vehicles collisions.

b. Provide a map of these collision locations in the PDA, LAA, and RAA.

Response 408

a. The animal-vehicle collision data (2004-2014) referred to in Volume 3A, Section 11.4.4.1 used the Alberta Collision Information System (ACIS), which is based on Royal Canadian Mounted Police (RCMP) collision reports. The ACIS data were only used to support the Project pathways discussion (i.e., the mechanism of potential effect) for change in mortality risk (see Volume 3A, Section 11.4.4.1). The ACIS data were not used in the assessment because it is recognized that animal-vehicle collisions (AVC) are under-reported using these police reports due to property damage thresholds, lack of spatial accuracy (i.e., location of AVC) and limited species-specific information (GoA 2017).

   The Enforcement Occurrence Record (ENFOR) data were not used in this assessment because the majority of records do not provide spatial locations of animal–vehicle collisions and can only be extracted using broad geographic areas (e.g., wildlife management units (WMU)), which extend beyond the wildlife LAA and RAA.

   The Alberta Wildlife Watch (AWW) Program data were not available for the assessment. However, these data are being incorporated into Alberta Transportation's Information Management System (TIMS) but will not be fully accessible until a later date, after the submission of these information requests. The AWW Program's primary goals are to reduce AVCs on provincial highways, improve driver safety, and minimize the impacts of highways on wildlife populations (GoA 2017). Data collected using the AWW website tool will be

integrated with the TIMS Data Repository Application (TDRA). The TDRA is a centralized database of TIMS data, which receives information from multiple applications including the AWW website tool (GoA 2017).

The assessment does not attempt to quantify site-specific animal-vehicle collisions (due to increased traffic volumes) because it is not known which other roadways, including site-specific locations along those roadways, might receive increased animal-crossing frequencies. However, the AWW Program will provide improved AVC data during post-construction and dry operations, which will help identify AVC prone locations and potential mitigation (see Figure IR408-1for initial data).

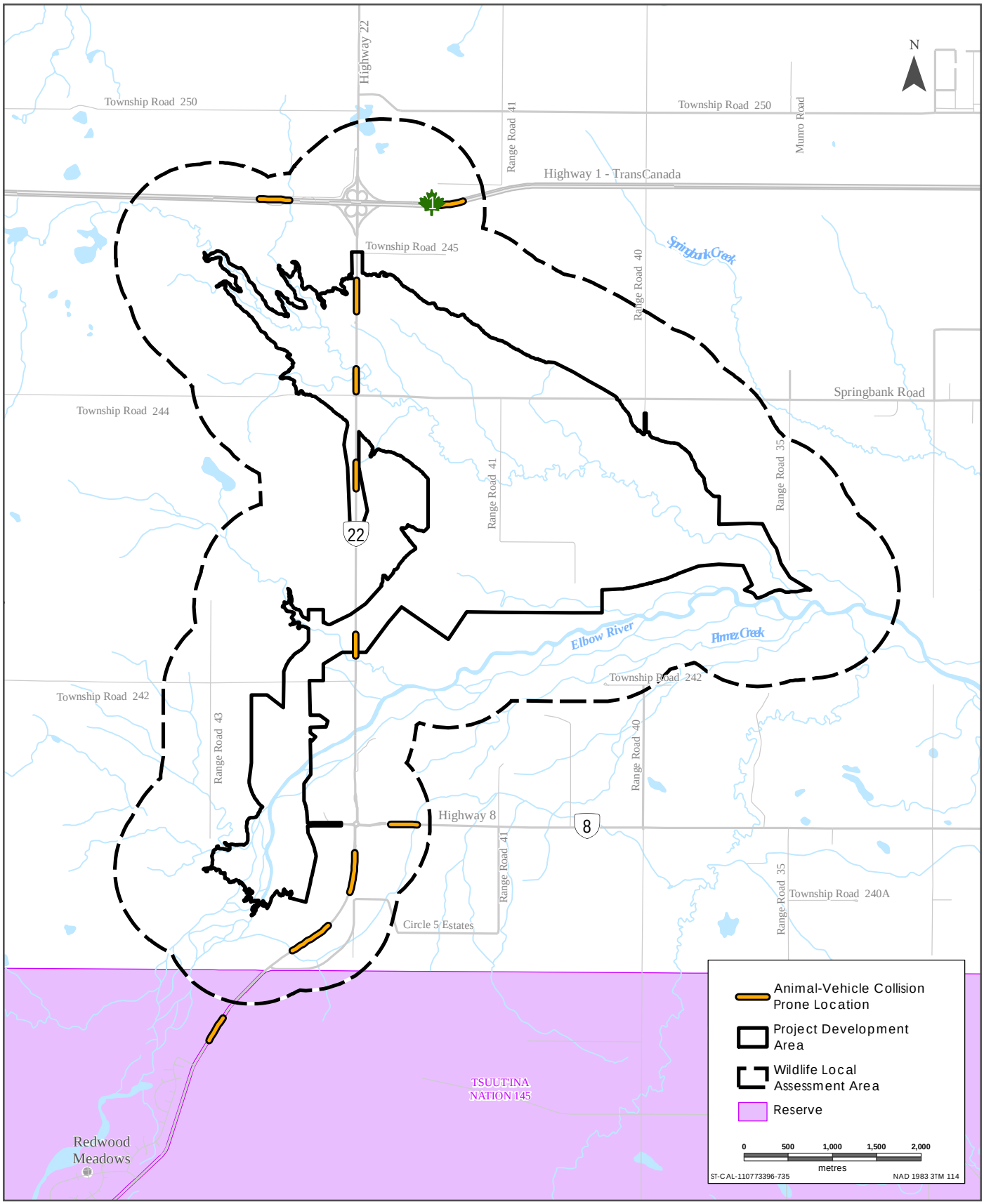
On October 11, 2018 in a consultation meeting with Alberta Transportation, Tsuut'ina Nation indicated that elk use Highway 22 as a crossing point between the east entrance of Redwood Meadows and the roundabout at the intersection of Highway 22 and Highway 8).

The potential increase in traffic volume during construction will be temporary (see Volume 3A, Section 16.4.2.1) and will be addressed as part of a traffic accommodation strategy (TAS) (see the response to IR204 and Volume 3A, Section 16.4.2.2), which will help reduce potential wildlife mortality risk.

b. These data contain legal sensitivities that must be properly managed. AVC data are managed by the Alberta Transportation in a manner that respects both the Alberta *Traffic Safety Act* and the Alberta *Freedom of Information and Protection of Privacy Act*. The release of animal carcass location and details (e.g., providing individual incident location data and maps) could readily lead to the identification of a specific person[s], incident[s] or potential human fatalities, injuries or accident report files. Due to these sensitivities at the time of finalizing this response, Alberta Transportation cannot produce individual incident location maps at this time.

REFERENCES

GoA (Government of Alberta). 2017. Alberta Wildlife Watch Program. Available at: http://www.transportation.alberta.ca/Content/docType253/Production/AlbertaWildlifeWatchProgramPlan.pdf.



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

Animal-Vehicle Collision Locations for Large-bodied Species

Stantec

Question 409

Volume 3A, Section 11.1.4, Table 11-3, Page 11.11
Volume 3B , Section 11.4.1, Table 11-2, Page 11.4
Volume 4, Appendix H, Section 3.7.1, Figure 3-5, Page 3.28
Volume 4, Appendix H, Section 3.7.3, Page 3.32

Alberta Transportation indicated that for wildlife *Effects on change in movement is assessed qualitatively* for both construction and dry operations, and for flood and post flood operations. However, winter track surveys were conducted to quantify baseline elk movements and a herd of elk was recorded in the area. AEP also has information on elk winter range distribution and movements as well as population densities in the project area.

a. Explain why these data were not used to quantify the effects of changes in wildlife movement or abundance due to the project.

Response 409

a. The AEP range distribution and population densities cannot be used as measurable parameters to assess potential Project effects on wildlife movement.

Although elk population counts are available for larger administrative areas such as wildlife management units (WMU), these counts would not represent the abundance of elk within the spatial boundaries used for the assessment nor could these counts (or densities) reliably quantify potential changes in movement due to the Project.

However, the Wildlife Technical Data Report (Volume 4, Appendix H, Attachment A, Section 11A.2.4) does provide the most recent ungulate winter survey results available for WMU 212 and WMU 312; the data are used to provide a regional overview of the estimated number of elk and winter range distribution relative to the spatial boundaries.

CLARIFICATION OF METHODS USED FOR ASSESSING MOVEMENT

The winter track surveys determined relative abundance of wildlife, including elk, in the wildlife LAA as well as potential movement routes that could be affected by Project infrastructure (see Volume 4, Appendix H, Section 2.71, page 2.9). The standardized track count results provide a quantitative estimate of wildlife species relative abundance (tracks per km-day,) but they do not provide quantitative information about movement. However, as stated in Volume 4, Appendix H, Section 3.7.3, the winter tracking surveys did identify some potential movement routes within the wildlife LAA, such as along Elbow River as well as sections of Highway 22 where elk were observed crossing.

Change in movement is assessed qualitatively primarily because quantifying elk daily or seasonal movement patterns typically requires a modelling approach that uses movement data usually generated from radio-collars. It is Alberta Transportation's understanding that these data are not available for the areas within the wildlife LAA. Without these data and a measurable parameter to assess potential effects of the Project on wildlife movement (e.g., km of known migration or movement route), a quantitative approach is not possible. A qualitative assessment is a standard approach used to assess change in wildlife movement and are in alignment with accepted environmental assessment methods in Alberta.

Question 410

Volume 1, Section 2.2.6, Pages 2.26 to 2.33
Volume 3A, Section 11.4.3, Page 11.56
Volume 3B, Section 11.3.3, Page 11.22

In Volume 1 Section 2.2.6 Alberta Transportation discussed the *Realignment and Modifications of Public Roads*. Volume 3A Section 11.4.3 and Volume 3B Section 11.3.3 Alberta Transportation discussed changes in movement in broad terms but did not specifically indicate how changes to the road system will impact ungulate movement.

a. Explain how the upgrades to Highway 22 will affect ungulate and bear movement on the Highway 22 and Springbank roads.

b. Explain how detours on Range Road 40, under the existing Highway 1 underpass, then west on Township Road 250 to Highway 22 will impact ungulate movement.

c. Explain how the EIA assessment and monitoring methods enable or prevent the ability to detect project effects via adequacy or lack of statistical power in the sampling design as it relates to wildlife movement.

d. Quantify highway and dam operations traffic volumes expected as a result of the project and indicate how this will impact wildlife.

Response 410

a. The potential effects of the proposed upgrades to Highway 22 on elk and grizzly bear movement are discussed in Volume 3A, Section 11.4.3.3 (Project Residual Effects, subsections entitled "Elk" and "Grizzly Bear"). Potential effects of the proposed upgrades to Highway 22 on elk are discussed on page 11.59, as follows:

> "The intersection of Highway 22 and Springbank Road is proposed to be raised an average of 5 m, with the highest point being 10 m at the creek north of Springbank Road. The proposed side slope of 33% gradient is within the range (17-45%) of terrain that

> elk can move in (McCorquodale 2003; Frair et al. 2005; Mao et al. 2005). These slopes will be vegetated along the sides, which will be beneficial to wildlife movement. Although deer and elk tend to use wildlife overpasses more than wildlife underpasses (Clevenger et al. 2009), the placement of a 3.67 m diameter culvert at the bottom of the raised intersection could function as a passageway for smaller ungulates and wildlife to pass under the road onto the other side".

Potential effects of the proposed upgrades to Highway 22 on grizzly bear are discussed on page 11.60, as follows:

> "Although data from government radio-collared grizzly bears have indicated there is some grizzly bear use of upland habitats that occur west of the wildlife LAA, data from field surveys suggest grizzly bear movement is more common along the Elbow River valley where bears travel between mountain and foothill habitats. Therefore, the diversion structure and floodplain berm are more likely to affect grizzly bear movement than the diversion channel and off-stream dam". Therefore, should grizzly bear be crossing Hwy 22 at the location of the upgrades during dry operations, those upgrades and associated design features are not anticipated to impede movement."

b. The portion of Range Road 40 where it intersects Highway 1 and all of Township Road 250 are outside the wildlife LAA; therefore, they are not included in the assessment for change in wildlife movement. The potential effects on ungulate movement due to these road detours would be similar to the potential effects (e.g., sensory disturbance) discussed in Volume 3A, Section 11.4.3.1 and Volume 4, Appendix H, Attachment 11A, Section 11A2.4 (see page 11A.12) as well as increased mortality risk discussed in Volume 3A, Section 11.4.4.

c. The wildlife assessment uses baseline data, scientific literature, professional judgment, and past project experience to characterize potential Project effects on wildlife movement. Potential effects on wildlife movement are assessed qualitatively (see Volume 3A, Section 11.1.4, Table 11-3) and characterized using the residual effects criteria outlined in Volume 3A, Section 11.1.6 (see Table 11-5). The qualitative methods used to assess change in movement are not conducted within a hypothesis testing framework; therefore, an analysis of statistical power is not appropriate. Prediction confidence is discussed in Volume 3A, Section 11.6, which recognizes some of the uncertainty related to potential Project effects on wildlife movement.

   The wildlife mitigation and monitoring plan (a draft is provided in the response to IR425, Appendix 425-1) will have clearly defined objectives that also address the factors related to statistical power (such as alpha levels, effect size, sample size and sample variance) in order to effectively determine changes or trends in monitoring parameters. Potential limitations of the wildlife monitoring plan related to sampling design and statistical power will be discussed in the plan once the study design and analysis methods of the monitoring plan have been determined.

d. During dry operations, there will be an estimated five full-time positions on site, including operators, supervisors, and maintenance staff, which would increase daily traffic volumes by five vehicles on the highway and within the PDA. During a design flood, traffic will be rerouted to Range Road 40 off Springbank Road, but otherwise there will be no disruption in traffic along Highway 22 and Township Road 250. During cleanup during post-flood operations, there would be temporary increase in traffic on roads (see Volume 3B, Section 16.2.2.1).

   Traffic is considered a sensory disturbance to wildlife which was assessed in Volume 3A, Section 11.4.3.3, page 11.57 and Volume 3B, Section 11.3.3.3, pages 11.25 and 11.27, for wildlife movement. Traffic was also assessed for mortality risk in Volume 3A, Section 11.4.3.4, pages 11.64 and 11.65, and Volume 3B, Section 11.3.4.3, pages 11.33 and 11.34. Overall, there will be substantially less human activity and vehicle traffic during dry operations compared to the construction phase. As indicated above potential sensory disturbance and mortality risk to wildlife associated with Project-related traffic volumes during dry operations are expected to be minimal because there will only be an estimated five additional vehicles on the highway and within the PDA.

REFERENCES

Clevenger, A.P., A.T. Ford, and M.A. Sawaya. 2009. Banff wildlife crossings project: Integrating science and education in restoring population connectivity across transportation corridors. Final report to Parks Canada Agency, Radium Hot Springs, British Columbia, Canada. 165pp.

Fiera. 2014. Environmentally Significant Areas in Alberta: 2014 Update. Available at: http://www.albertaparks.ca/media/5425575/2014-esa-final-report-april-2014.pdf

Mao, J.S., M.S. Boyce, D.W. Smith, F.J. Singer, D.J. Vales, J.M. Vore, and E.H. Merrill. 2005. Habitat selection by elk before and after wolf reintroduction in Yellowstone National Park. Journal of Wildlife Management 69: 1691-1707.

McCorquodale, S.M. 2003. Sex-specific movements and habitat use by elk in the Cascade Range of Washington. The Journal of Wildlife Management 67: 729-741.

Question 411

Volume 1, Attachment A, Section A.2.1.6, Page A.9

Alberta Transportation stated that *The road and bridge works will be constructed using standard equipment, materials and methods codified in Alberta Transportation's Standard specifications for highway construction*. Road and bridge infrastructure will affect wildlife movement.

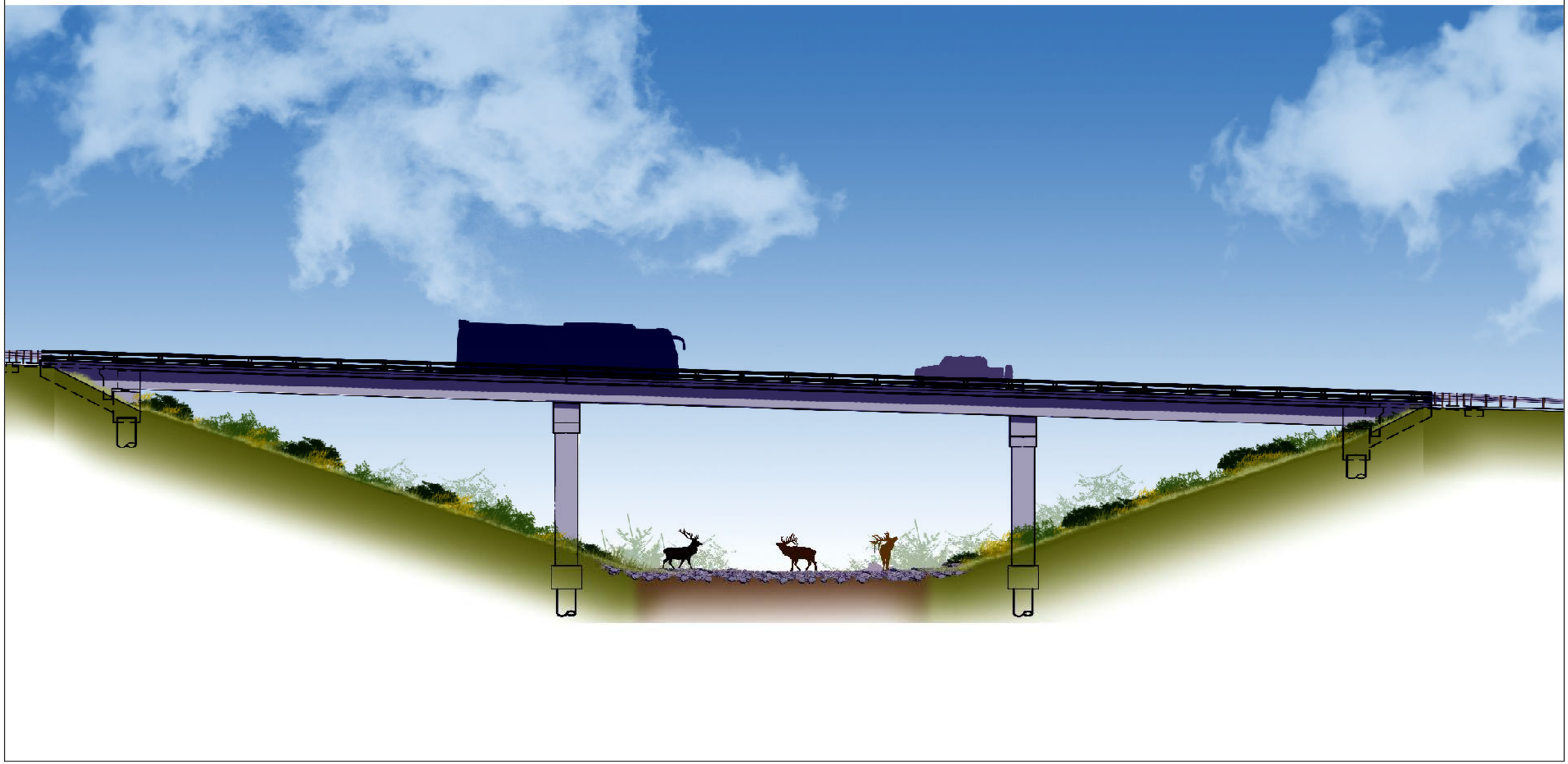
a. Explain whether designs that facilitate wildlife movement were considered and if not, provide rationale for why these designs were not considered.

Response 411

a. The road and bridge works for the Project that could facilitate wildlife movement include upgrades to Highway 22 and Township Road 242 at specific locations.

The bridge on Highway 22 replaces a section of road that will pass over the diversion channel, which may help facilitate movement of wildlife that would otherwise cross the road and increase their risk of a collision with vehicles (Figure IR411-1). The rip-rap beneath the bridge has also been designed to be filled with finer material on the bottom of the diversion channel to create a more conducive substrate for wildlife to walk on (Figure IR411-1).

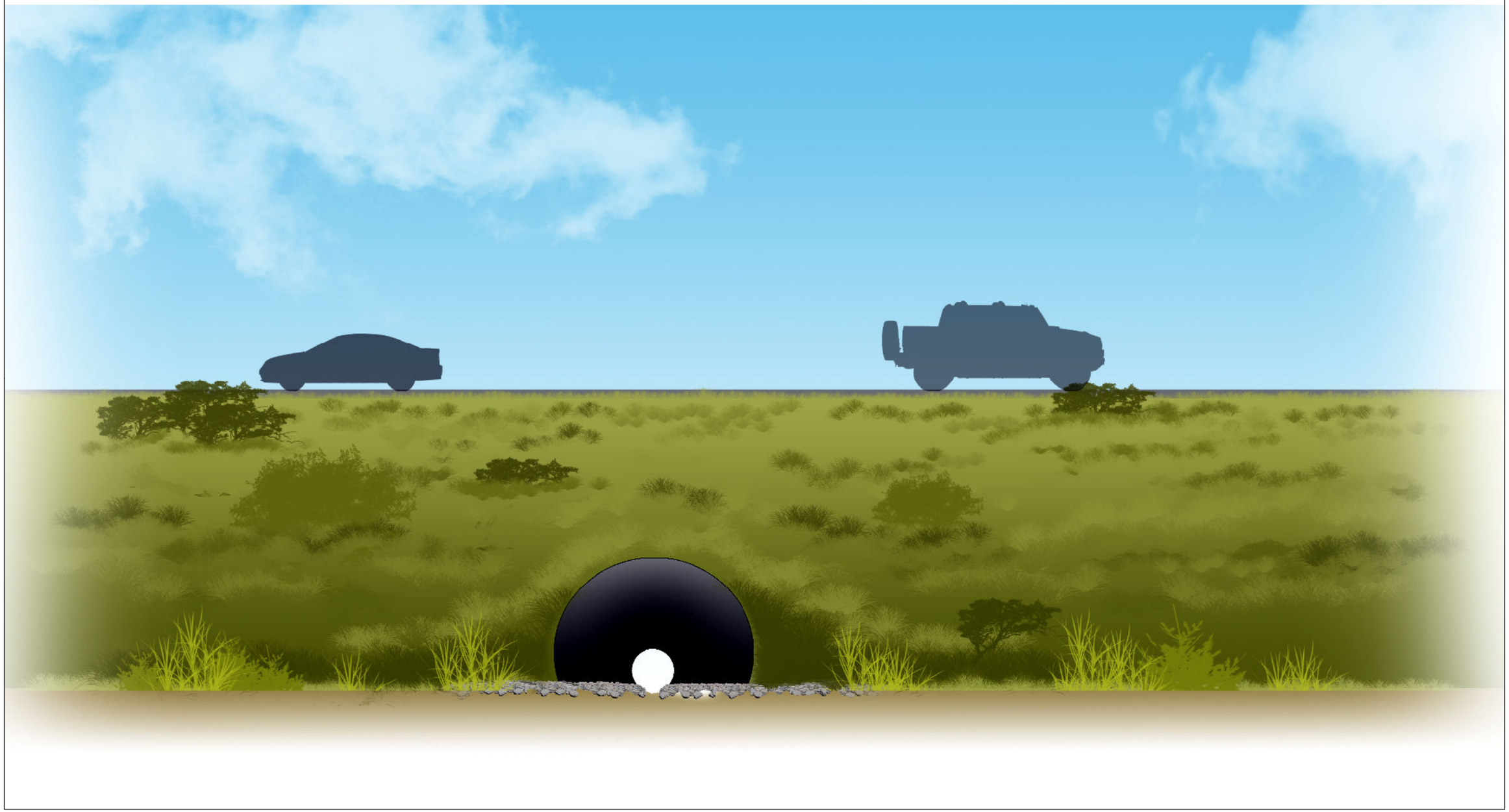
The at-grade intersection of Highway 22 and Springbank Road (Township Road 244) also be raised approximately 5 m for an approximate 500 m stretch to maintain traffic operations during a design flood along Highway 22 and up to a 1:50 year flood along Springbank Road. The proposed side slope gradient of 33% is used as a standard for highway design in Alberta and has not been found to impede wildlife movement because it is within the range (17% to 45%) of terrain that elk can move on (McCorquodale 2003; Frair et al. 2005; Mao et al. 2005), as well as other wildlife (e.g., grizzly bears [Ciarnello et al. 2005; Stevens and Gibeau 2005]). The side slopes of the raised highway will also be vegetated. A culvert with a height of 2.45 m and width of 3.67 m will be placed at the bottom of the raised intersection with an earthen-covered bottom (Figure IR411-2), which may be utilized as a passageway for smaller wildlife to pass under. There are no new adverse effects anticipated on wildlife movement from the road and bridge works due to the continued presence of Highway 22 and Township Road 242.



Sources: Stantec

Highway 22 Bridge over the Diversion Channel

Figure IR411-1



Sources: Stantec

Unnamed Creek Culvert Crossing at Raised Intersection of Highway 22 and Springbank Road

Figure IR411-2

REFERENCES

Ciarniello, L.M., M.S. Boyce, D.C. Heard, and D.R. Seip. 2005. Denning behavior and den site selection of grizzly bears along the Parsnip River, British Columbia, Canada. Ursus 16: 47-58.

Frair, J.L., E.H. Merrill, D.R. Visscher, D. Fortin, H.L. Beyer, and J.M. Morales. 2005. Scales of movement by elk (*Cervus elaphus*) in response to heterogeneity in forage resources and predation risk. Landscape Ecology 20: 273-287.

Mao, J.S., M.S. Boyce, D.W. Smith, F.J. Singer, D.J. Vales, J.M. Vore, and E.H. Merrill. 2005. Habitat selection by elk before and after wolf reintroduction in Yellowstone National Park. Journal of Wildlife Management 69: 1691-1707.

McCorquodale, S.M. 2003. Sex-specific movements and habitat use by elk in the Cascade Range of Washington. The Journal of Wildlife Management 67: 729-741.

Stevens, Saundi and Michael Gibeau. 2005. Chapter 14 Denning. Pages 223-225 in S. Herrero, editor. Biology, demography, ecology and management of grizzly bears in and around Banff National Park and Kananaskis Country: The final report of the Eastern Slopes Grizzly Bear Project. Faculty of Environmental Design, University of Calgary, Alberta, Canada.

Question 412

Volume 3A, Section 11.4.3, Page 11.56

Alberta Transportation stated that *the diversion channel, floodplain berm, off-stream-dam and associated fencing around the PDA might create hindrances to wildlife movement.*

a. Provide a more specific assessment of how these project structures may impact wildlife movement, including ungulates and grizzly bears.

Response 412

a. An assessment of how Project structures may affect wildlife movement—including ungulates (elk) and grizzly bear—is provided in Volume 3A, Section 11.4.3.3 (see pages 11.58 to 11.61). A summary of the conclusions is in Volume 3A, Section 11.7.2 (page 11.88).

Question 413

Volume 4, Appendix C, Table C-1, Page C.13

As a mitigation measure, Alberta Transportation stated that *Where fencing is proposed to restrict livestock access to project structures (e.g. diversion channels), wildlife friendly fencing will be installed to allow ungulate passage*.

a. Define what a wildlife friendly fence is, and what specifications and design features it has.

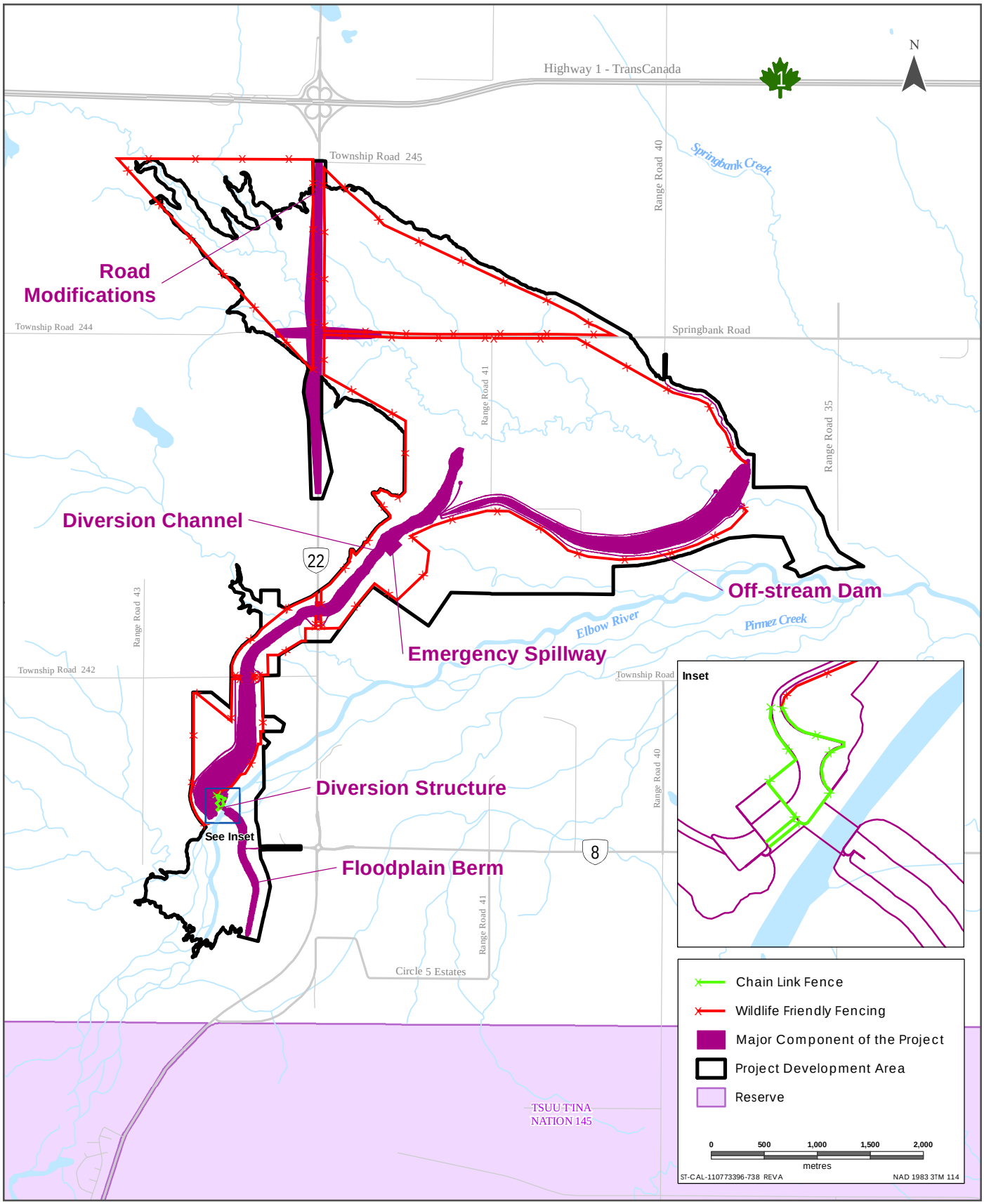
b. Detail spatially where all project fencing both wildlife friendly and non wildlife friendly will occur.

Response 413

a. A wildlife-friendly fence is typically a 4-strand wire fence designed to allow wildlife passage by having the top wire low enough for ungulates (e.g., deer, elk) to jump over (e.g., no higher than 100 cm above ground), and the bottom wire high enough for other animals (e.g., bear) to crawl under (e.g., at least 45 cm above ground) (GoA 2011; Paige 2012; Visscher et al. 2016).

   One design feature requires the top and bottom wire to be smooth and not barbed to reduce potential injury. Elk can tangle their back legs if the top wires are closer together; therefore, it is recommended that the top two wires are no less than 30 cm apart (Paige 2012). Design considerations may be modified based on sites with high or continuous livestock use (e.g., change in minimum and maximum strand heights) (Paige 2012,) if required.

b. The location of wildlife-friendly fencing is shown in Figure IR413-1. All fencing in the PDA will be wildlife friendly, except where chain-link fencing will be installed around certain Project facilities (e.g., control building) for public safety and security and to exclude large mammals.



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

Proposed Location of Wildlife Friendly Fencing

Stantec

REFERENCES

GoA(Government of Alberta). 2011. Wildlife and Fences, Interpretive Trail. Edmonton, AB. Available at: http://www.pcap-sk.org/rsu_docs/documents/wildlife-and-fences-infosheet. Pdf.

Paige, C. 2012. A Landowner's Guide to Wildlife Friendly Fences. Second Edition. Private Land Technical Assistance Program, Montana Fish, Wildlife, and Parks. Helena, MT. 56 pp.

Visscher, D.R., I. MacLeod, M. Janzen, K. Visser, and A. Lekas. 2016. The impact of wildlife friendly fences on ungulate crossing behaviour at the Wainwright Dunes Ecological Reserve. The King's University. Edmonton, AB. 52 pp.

Question 414

Volume 3A, Section 11.7, Pages 11.88 and 11.89
Volume 3B, Section 11.6, Pages 11.55 and 11.56

The assessment conclusions for both the Construction and Dry Operation Phases, and the Flood and Post Flood Recovery phases indicate that the project is *unlikely* to impact wildlife through changes in habitat, movement, mortality or biodiversity. However, given that all assessments were qualitative, there are no quantities provided to numerically indicate what the impacts might be.

a. Justify the use of these qualitative measure to adequately portray the true impact of the project on wildlife. Explain how the sampling design and EIA monitoring methods enables adequate statistical power to detect and estimate impacts with confidence.

b. Describe and assess the potential impacts of the Project due to improved access or altered access.

Response 414

a. The potential Project effects on wildlife movement and mortality risk are assessed qualitatively using baseline data, scientific literature, professional judgement and past project experience. Although qualitative, this approach is sufficient to assess wildlife movement and mortality risk, which do not have quantifiable measurable parameters applicable to this assessment. Qualitative assessments are a standard approach used to assess potential Project effects on wildlife movement and mortality risk and are in alignment with accepted environmental assessment methods in Alberta.

However, change in habitat due to the Project is assessed quantitatively by using a habitat-based approach as well as habitat suitability modelling for the following key indicator species:

- olive-sided flycatcher
- Sprague's pipit
- northern leopard frog
- elk
- grizzly bear
- sora

The amount of wildlife habitat potentially affected during construction and dry operations (in hectares) is provided in Volume 3A, Section 11, Table 11-12, Table 11-13 and Table 11-16. During flood and post-flood operations, the amount of habitat potentially affected is provided in Volume 3B, Section 11, Table 11-5, Table 11-6 and Table 11-8.

The conclusions stated in Volume 3A, Section 11.7 and Volume 3B, Section 11.6 are summary statements that incorporate the determination of significance, which considers both the quantitative (change in habitat) and qualitative (change in movement and mortality risk) for Project residual effects on wildlife. Although the change in wildlife movement is assessed qualitatively (also see the response to IR409), prediction confidence is discussed in Volume 3A, Section 11.6, which recognizes some of the uncertainty related to potential Project effects on wildlife movement. The adequacy of statistical power as it relates to monitoring is addressed in the response to IR410c.

b. Increased road access in the PDA has the potential to result in direct and indirect effects on habitat as well as increase mortality risk to wildlife including key indicators, (e.g., grizzly bear, elk). However, temporary access roads will be reclaimed, which will reduce the potential effects on wildlife and wildlife habitat (i.e., temporary disturbance) including key wildlife indicators. In addition, the proposed permanent access roads described in Volume 1, Section 3.2.7 are primarily located within or immediately adjacent to the footprint of the major Project components (see Volume 1 Section, 3.27, Figure 3-11), which the public will not have access to. In accordance AEP standard practice, any swing gate restricting access to an area is installed with a suitable locking device. Only AEP operators or those authorized by AEP staff will have the ability to open locks around the site. This will reduce potential effects associated with sensory disturbance, mortality risk and wildlife-human conflict during dry operations.

   The potential effects of the Project on mortality risk due to temporary and permanent access roads are discussed in Volume 3A, Section 11.4.4.3, which focuses on northern leopard frog due to their relatively lower mobility and increased mortality risk compared to other species assessed.

Question 415

Volume 3A, Section 11.4.3.3, Page 11.60
Volume 3A, Attachment, Table A-1, Page A.13
Volume 4, Appendix H, Wildlife and Biodiversity Technical Data Report, 3.6.1, Page 3.27
Volume 4, Appendix H, Wildlife and Biodiversity Technical Data Report, 3.6.1, Table 3-9, Pages 3.24 to 3.26

Grizzly bears are known to frequent areas to the north of the Elbow River and along highway 22 including north of the TransCanada highway, with historical sightings and occurrences recorded in the ENFOR database by AEP.

a. AEP bear use of the area is known to be greater than what this EIA monitoring reports. How will proposed public access to this acquired land affect grizzly bear conflict and conflicts with other wildlife species?

Response 415

a. The Enforcement Occurrence Record (ENFOR) data were not used in this assessment because the majority of records do not provide spatial locations of animal occurrences and can only be extracted using broad geographic areas (e.g., wildlife management units (WMU)), which extend beyond the wildlife LAA and wildlife RAA.

Current public land in the wildlife LAA is composed of rights-of-ways for roads and road allowances and the beds and shores of the Elbow River and its tributaries. Hunting may also take place on private land where access has been granted by the landowner.

Since filing of the EIA, discussions with First Nations and stakeholders have resulted in the development of a draft post-construction land use document for the Project. This document provides the draft principles of future land use for the PDA (see response to IR2, Appendix IR2-1). The principles apply to the land use area (LUA) outlined in yellow in Figure 1 of Appendix IR2-1. The primary use of all lands within the PDA, including the LUA, is for flood mitigation. In light of the primary use, the safety of anyone with access or land users will be an overriding factor. Secondary uses (e.g., activities that have a minimal impact on the land and the exercise of treaty rights such as hunting) will be allowed within the LUA.

The change in land tenure from private to Crown lands might result in increased use of the area by the public and Indigenous groups relative to existing conditions. With the potential for there to be managed access to the PDA, human-grizzly bear conflict and conflicts with other wildlife species could increase; however, the frequency of grizzly bear use is expected to be low based on the information presented in Volume 3A, Section 11.2.2.4, page 11.28, which indicates the wildlife LAA provides relatively low suitability habitat. In addition to the

mitigation commitments in Volume 3B, Section 11, Alberta Transportation (and AEP for operations) will implement beneficial management practices designed to reduce potential increase in human-wildlife conflict (e.g., signage, safety, education).

Question 416

Volume 3A, Section 11.2.2.4, Figures 11-6 & 11-7

Elk summer and winter feeding habitat suitability is mapped. It identifies areas near roadways as very low quality habitat yet some of these areas are critical to movement and mortality risk.

a. Explain why other types of habitat suitability for elk were not mapped (movement etc.)

b. How will the future presence of people and roads caused by this dams activities effect future habitat values along roadways or human access areas?

Response 416

a. Species accounts were prepared to support the habitat suitability models developed for key indicator species, including elk (see Volume 4, Appendix H, Attachment 11A, Section 11A.2.4). The species accounts describes the ecology and key habitat requirements (i.e., forage and cover) of elk as well as rating assumptions and adjustments applied to habitat ratings to account for anthropogenic disturbances such as roads.

   Mapping seasonal key habitat requirements (i.e., forage and cover) is an accepted and standard habitat suitability modelling approach used in environmental assessments. Elk movement was not mapped, primarily because the type of data typically required to identify or differentiate between daily foraging movements and seasonal travel routes in the wildlife LAA are not available (i.e., GPS collar data). Furthermore, habitats used for movement might not be directly related to foraging and cover habitats identified using available ecosite attributes mapping.

b. During dry operations, the level of future use by people along major roadways (e.g., Highway 22 and Springbank Road) is expected to be similar to existing conditions. Habitat values along these roadways are unlikely to change due to sensory disturbance, which was accounted for in the habitat suitability modelling. Access roads for the Project will be restricted to the public and active only during site access for maintenance activities; therefore, vehicle traffic will be low on these roads. There may be some indirect effect on habitat along these access roads through sensory disturbance and this effect was incorporated into habitat suitability models at dry operations by applying a zone of influence (buffer) around access roads.

Question 417

Volume 3A, Section 11.4.3, Page 11.56 Volume 3B, Section 11.3.3, Page 11.22

The Concordance Table indicates the above Sections provide required information on *how improved or altered access may affect wildlife*… however, the impact of changes to access is not cleared outlined.

a. Clearly outline how changes to access may impact wildlife.

Response 417

a. As stated in the response to IR414, increased road access in the PDA has the potential to result in direct and indirect effects on habitat as well as increase mortality risk. However, temporary access roads will be reclaimed, which will reduce the potential effects on wildlife habitat (i.e., temporary disturbance). In addition, the proposed permanent access roads described in Volume 1, Section 3.2.7 are primarily located within or immediately adjacent to the footprint of the major Project components (see Volume 1, Section, 3.27, Figure 3-11), which the public will not have access to. In accordance AEP standard practice, any swing gate restricting access to an area is installed with a suitable locking device. Only AEP operators or those authorized by AEP staff will have the ability to open locks around the site. This will reduce potential effects associated with sensory disturbance, mortality risk and wildlife-human conflict during dry operations. In addition, the proposed Highway 22 bridge over the diversion channel will provide wildlife passage under it (see the response to IR411 for further details).

Question 418

Volume 3A, Section 11, Attachment A, Table A-1, Page A.13 and A.15

Alberta Transportation sites *wildlife-human conflict (e.g. removal of nuisance animals)* as a potential project effect on both grizzly bears and elk. However, this effect is not clearly assessed in the EIA. For grizzly bears, destruction of dens is also a potential project effect.

a. Define nuisance animals and outline how they will be dealt with.

b. Quantify the potential effect on elk and grizzly bears of wildlife-human conflict.

c. Quantify the potential effect on wildlife den destruction.

d. Define nuisance animals and outline how they will be dealt with.

e. Quantify the potential effect of wildlife-human conflict on elk and grizzly bears.

f. Quantify the potential effect of wildlife-human conflict on wildlife den destruction.

g. Define nuisance animals and outline how they will be dealt with.

h. Quantify the potential effect of wildlife-human conflict on elk and grizzly bears and wildlife den destruction.

Response 418

a. A nuisance animal is broadly defined as an animal that has potential to damage property such as crops (e.g., elk) or threaten human safety (e.g., bear). During construction or dry operations, the encounter or incident would be immediately reported to the environmental inspector (designated by the contractor as the person responsible for implementing environmental mitigation measures), Alberta Transportation and AEP for further action.

b. As stated in Volume 3A, Section 11.1.4, Table 11-3, change in mortality risk, which includes risk of wildlife-human conflicts (e.g., removal of nuisance animals) is assessed qualitatively. Quantifying future human-wildlife conflicts would require a risk modelling approach using known numbers of human-wildlife conflicts and associated variables (e.g., habitat characteristics, anthropogenic features; see Northrup et al. 2012). The data necessary to develop a conflict-risk model that predicts the probability of human-wildlife conflicts at an appropriate scale is not available for the wildlife LAA. Furthermore, as indicated in response to IR408a, the ENFOR data are not used in this assessment because the majority of records do not provide spatial locations of human-wildlife encounters (e.g., animal–vehicle collisions, complaints) and can only be extracted using broad geographic areas (e.g., wildlife management units), which extend beyond the wildlife LAA and RAA.

   Mitigation measures will be implemented to reduce potential wildlife-human conflicts and mortality risk such as using wildlife-proof containers and completing wildlife awareness training (see Volume 3A, Section 11.4.4.2), which are best management practices to reduce potential human-wildlife conflicts (AEP 2011; Jorgenson 2016; AEP 2018).

c. Grizzly bears typically select den sites that are in dry, high-elevation areas with steep slopes (approximately 30% to 80%) in mature conifer stands or caves near abundant spring feeding sites. They avoid wetlands and areas with high road density and other disturbances (Vroom et al. 1980; Ciarniello et al. 2005; ESRD and ACA 2010; Libal et al. 2012; Pigeon et al. 2014; Pigeon et al. 2016). In Alberta, grizzly bears prefer to den in habitats located in the Rocky Mountains or in the boreal forest (ESRD and ACA 2010). The wildlife LAA does not provide suitable denning habitat for grizzly bears because it is in a relatively more disturbed area and lower elevation compared to the Core Grizzly Bear Zone west of the Project. In addition, there were no wildlife dens identified during the wildlife baseline field surveys; therefore, there are no potential Project effects to grizzly bear dens.

d-h. These questions are repeats of questions a. to c.

REFERENCES

AEP (Alberta Environment and Parks). 2011. Alberta BearSmart Program Manual: Enhancing the opportunities for humans and bears to co-exist in Alberta. 70 pp. Available at: https://open.alberta.ca/dataset/9b787a3c-1c59-4182-bd70-fa9e5953e857/resource/694242ba-e42f-4026-92ef-b329d8cf9f30/download/2011-albertabearsmart-programmanual-may2011.pdf

AEP. 2018. Human-Wildlife Coexistence. Recommendations for Improving Human-Wildlife Coexistence in the Bow Valley. 86 pp. Available at: http://livingwtwildlife.ca/assets/pdf/Human-Wildlife-Coexistence-Bow-Valley-Report-vf.pdf

Ciarniello, L.M., M.S. Boyce, D.C. Heard, and D.R. Seip. 2005. Denning behavior and den site selection of grizzly bears along the Parsnip River, British Columbia, Canada. Ursus 16: 47-58.

ESRD (Alberta Sustainable Resource Development) and ACA (Alberta Conservation Association). 2010. Status of the Grizzly Bear (*Ursus arctos*) in Alberta: Update 2010. Alberta Sustainable Resource Development. Wildlife Status Report No. 37 (Update 2010). Edmonton, AB. 44 pp.

Jorgenson, J.T. 2016. Bear Hazard Assessment Update for the Greater Bragg Creek Area of Southern Alberta 2016. 64 pp.

Libal, N.S., J.L. Belant, R. Maraj, B.D. Leopold, G. Wang, and S. Marshall. 2012. Microscale den-site selection of grizzly bears in southwestern Yukon. Ursus 23: 226-230.

Northrup, J.M., J. Pitt, T.B. Muhly, G.B. Stenhouse, M. Musiani and M.S. Boyce. 2012. Vehicle traffic shapes grizzly bear behaviour on a multiple-use landscape. Journal of Applied Ecology 49: 1159 – 1167.

Pigeon, K.E., S.E. Nielsen, G.B. Stenhouse, and S.D. Côté. 2014. Den selection by grizzly bears on a managed landscape. Journal of Mammalogy 95: 559-571.

Pigeon, K.E., S.D. Côté, and G.B. Stenhouse. 2016. Assessing den selection and den characteristics of grizzly bears. The Journal of Wildlife Management 80: 884-893.

Vroom, G.W., S. Herrero, and R.T. Ogilvie. 1980. The ecology of winter den sites of grizzly bears in Banff National Park, Alberta. Bears: Their Biology and Management, A Selection of Papers from the Fourth International Conference on Bear Research and Management, Kalispell, Montana, USA, February 1977 4: 321-330.

Question 419

Volume 3A, Section 11.4.2, Page 11.52

Construction activities are predicted to result in both a permanent loss of habitat due to the infrastructure footprint and a temporary loss of ungulate habitat due to construction activities and sensory disturbance. A total of approximately 117 ha of high and 377 ha of moderate winter elk feeding habitat will be affected by the Project.

a. Detail how this will affect elk movement and habitat use.

b. Why wasn't elk habitat mapped along the highway buffers in the associated maps?

c. Explain why the habitat wasn't mapped along roads and identified before being buffered in the maps?

Response 419

a. Most high suitability elk winter feeding habitat affected by the Project during construction will be at a patch of native grassland north of the Elbow River, east of Highway 22 near the emergency spillway (see Volume 3A, Section 11.2.2.4, Figure 11-6). Moderate suitability elk winter feeding habitat most affected by the Project during construction is near the unnamed creek (flow path of water from the reservoir back into Elbow River), emergency spillway, and floodplain berm (also, Figure 11-6). Project construction activities are likely to displace elk from using these areas to other high and moderate suitability elk winter feeding habitats in the wildlife LAA (e.g., north of Springbank Road or along the Elbow River). The Project construction area, of which only 168 ha will be permanent structures, will be reclaimed to modified grassland after construction; therefore, high and moderate suitability elk winter feeding habitat will be available in these areas again after reclamation.

   Construction activities associated with Project structures have the potential to create physical or sensory barriers to elk movement. Details on how Project infrastructure such as the diversion channel, floodplain berm, and off-stream dam may affect elk movement are in Volume 3A, Section 11.4.3.3, page 11.57.

b. Elk habitat was mapped along the highways that intersect the wildlife LAA (see Figure 11-6 and 11-7). Methods for mapping are discussed in Appendix H, Attachment 11A, Section 11A.1.1 and Section 11A.2.4 (page 11A.11 and page 11A.12). Disturbance such as highways, typically have a zone of influence (ZOI) (buffer), which are incorporated into habitat suitability models to account for indirect loss of habitat associated with sensory disturbance. Habitat ratings along the highways are applied and then adjusted (lowered) based on the ZOI ratings described in the methods.

c. Disturbances such as roads, typically have a ZOI, which are incorporated into habitat suitability models to account for indirect loss of habitat associated with sensory disturbance. Habitat ratings along roads were applied before the application of the ZOI rating, and then adjusted (lowered), based on the ZOI ratings described in the methods. Methods for mapping are discussed in Volume 4, Appendix H, Attachment 11A, Section 11A.1.1 and Section 11A.2.4 (page 11A.11 and page 11A.12).

Question 420

Volume 3A, Section 11.4.2.3, Page 11.52 and 11.53
Volume 3A Section 10.3.1, Page 10.39

Alberta Transportation stated that *During construction, the project would result in the direct and indirect loss and alteration of…habitat*.

a. For both elk and grizzly bear habitats:

i. Did the assessment of habitat loss include loss due to the use of the emergency and auxiliary spillways? Does this affect habitat below these spillways? Explain.

ii. Explain how the impact of sedimentation and flood debris removal on wildlife habitat was considered in the assessment. Describe what a sediment control plan will contain as per Volume 3A Section 10.3.1 Page 10.39.

iii. Explain how this habitat will be reclaimed and describe an assessment of the habitat value of the reclaimed habitat relative to the pre-disturbance habitat.

iv. Was non native habitat type on private land to be purchased assessed for the potential to offset impacts to the LAA?

Response 420

a. i. As stated in Volume 3A, Section 11.4.2.3, the Project would result in the direct and indirect loss of elk and grizzly bear feeding habitat during construction. In Volume 3B, Section 11.3.2, the assessment of habitat loss did not include loss due to the use (i.e., when in operation, flood waters will spill over below these structures) of the emergency and auxiliary spillways. Habitat below these spillways during floods will be temporarily inaccessible for elk and grizzly bear as water flows overland towards the Elbow River. Volume 1, Section 3.2.3 states, for the emergency spillway, "(it) is designed to operate during a probable maximum flood when the diversion inlet gates jam in the open position and cannot be closed, and when the capacity of the reservoir is exhausted" and in Volume 1, Section 3.2.1.5, "the spillway crest will activate when incoming flow from the Elbow River exceeds 1,720 m^3/s (approximately a 1:500 year flood). The auxiliary

spillway may also activate for smaller floods if the conveyance capacity is reduced by debris and sediment at the diversion inlet and service spillway and operations of the gates are not adjusted."

After flood waters recede, overflow on these structures will cease and habitat below these spillways will become accessible again (i.e., no habitat loss) for elk and grizzly bear. Based on the purpose of their design, the probability of use of these structures is low and only used for floods.

ii. The potential Project effects on wildlife habitat due to moving of sediment and flood debris within the PDA are assessed in Volume 3B, Section 11.3.2.2, Page 11.9 and Section 11.3.2.3, Page 11.17, by considering effects on vegetation and wildlife sensory disturbance during post-flood maintenance activities. Details on cleanup (i.e., post-flood operations) could affect elk and grizzly bear habitat are in Volume 3B, Section 11.3.2.3, page 11.20 to page 11.22. Sediment will be moved within the reservoir if it interferes with water flow into the reservoir, or drainage to the low-level outlet, or functioning of the reservoir or associated components.

Because of the variability in the geometries and composition of deposits, a site-specific erosion and control plan will need to be prepared following drawdown as part of post-flood operation. Alberta Transportation (2011) is intended for use in the design, construction and maintenance of erosion and sediment control measures for terrestrial highway infrastructure and would be applicable to work in the PDA, except for instream work. Further details are provided in response to IR381, including erosion and sediment control best management practices. Mitigation measures as part of post-flood operation may include the use of tackifier or sprayable erosion control products as well as the use of a cover crop seed mixture to assist in weed and erosion control on exposed soils, where warranted. Further details regarding tackifier or sprayable erosion control products is provided in response to IR396.

iii. Areas of habitat disturbed during construction in the PDA will be reclaimed using only Certified No.1 seed, unless Certified No. 1 seed is not available for selected reclamation species (i.e., native species). Ecosites cleared of vegetation and reclaimed with native seed mix would reestablish to a modified grassland ecosite due to disturbance during construction (see Volume 3A, Section 11.4.2.3, Table 11-12). The habitat value of the modified grassland ecosite (i.e., reclaimed habitat) relative to the pre-disturbance habitat will depend on the pre-disturbance habitat type. For example, the habitat value of the modified grassland ecosite will be similar to pre-disturbed grassland habitat for elk and grizzly bear. Habitat value of the modified grassland ecosite may be lower relative to pre-disturbed forest habitat for elk and grizzly bear because of lack of cover and/or other forage foods. Modified grassland ecosites are considered in the habitat suitability models for key indicator species in Volume 3A, Section 11.4.2.3, Table 11-12.

iv. Private lands that contain non-native habitat types were not assessed for potential to directly offset impacts to the wildlife LAA as part of any future acquirement agreements.

Following construction, crop and hayland in areas of the PDA would be left fallow. These lands are not considered for reclamation to offset permanent loss of native habitat by Project components. However, crop and hayland are expected to become tame pasture over time, which provides suitable wildlife habitat for grassland-dependent species (see Volume 3A, Section 11.4.2.3, Page 11.46). As such, vegetation succession in these areas is expected to reduce the potential effects of the Project on wildlife habitat during dry operations.

REFERENCES

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

Question 421

Volume 3C, Section 2.9.1, Page 2.11

a. Clarify how you can native upland vegetation and wetland community's habitat is predicted to be altered, but there is no loss of this habitat.

b. How will plant species and community change be determined after the dam is completed and after each flood event? Provide the plant survey methodology that was used in the assessment.

Response 421

a. As indicated in Volume 3A, Section 10.4.3, and Volume 3B, Section 10.2.2, native grassland communities will be altered from construction, flooding and post-flood sedimentation, but are expected to recover with the application of native seed. The existing area of native fescue grassland is expected to be reduced by 8.9 ha following construction (Volume 3A, Section 10.4.3, Table 10-12).

This area will be native grassland following re-vegetation, and the overall area of native grassland will increase by 90.6 ha during dry operations.

Species composition and productivity may be altered in flooded grassland areas and areas of sediment deposition (in the off-stream reservoir), but no reduction in native grassland area is expected following flooding. The area of tree and shrub cover types will be reduced by 132.2 ha from construction and up to and additional 99.3 ha following flooding. Temporarily flooded areas are expected to become modified grassland. No tree and shrub loss are expected from post-flood sedimentation.

Wetland area will be reduced by 15.3 ha following construction (Volume 3A, Section 10.4.3, Table 10-12) and potentially 11.7 ha from post-flood sedimentation greater than 10 cm deep following flooding (Volume 3B, Section 10.2.4, Table 10-12). However, wetland area lost in the PDA will be compensated and no net loss will occur.

Habitat availability (i.e., quantity and quality) will change as a result of alteration and loss of vegetation. However, changes are expected to be both positive and adverse depending on species-specific habitat preferences. For example, changes that result in the creation of grassland where shrubby or treed habitats previously occurred (i.e., after reclamation) will provide more habitat for grassland dependent species while, at the same time, reduce habitat for species that are associated with shrubby or treed habitats. Examples from the vegetation and wetands assessment are:

> Volume 3B, Section 10.2.2.1 1:10 year flood, "…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."
>
> Volume 3B, Section 10.2.2.2 1:100 year flood, "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."
>
> Volume 3B, Section 10.2.2.3 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…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."
>
> "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."

b. Post-construction and post-flood monitoring programs will provide information regarding vegetation alteration in areas revegetated during post-construction (due to direct disturbance during construction) and vegetation alteration by post-flood sedimentation.

Post-construction monitoring will be designed to assess mitigation effectiveness, erosion and sediment control and weed management (Volume 3A Section 10.8). See the response to IR407, Appendix IR407-1 for a draft vegetation and wetland monitoring and revegetation plan.

Post-flood vegetation monitoring methods will be defined in later stages of Project planning and will be based on the principles outlined in the draft post-construction land use plan (see the response to IR2, Appendix 2-1)

For plant survey methods used in the assessment, see Volume 3A, Section 10.2.1.2.

Question 422

Volume 3B, Section 10.2.2, Page 10.3

Alberta Transportation states that sediment deposition may bury and suffocate plants and that depths were modelled.

a. Discuss whether spatial sedimentation patterns may effect weed establishment and reclamation of native habitat.

b. Discuss whether the effects of sedimentation and removal will effect ungulate habitat.

Response 422

a. Sedimentation patterns will affect weed establishment and reclamation of native habitat. Areas of complete burial and full existing plant loss (i.e., 10 cm and greater) will likely take the longest to revegetate and be at the greatest risk of weed establishment. This will limit revegetation from existing sources and greater assisted recovery measures (e.g., seeding) may be required. Weeds may also establish in areas with 3 cm to 10 cm of sediment; however, reviewed literature indicates most upland and wetland plant species will persist and only small changes in species diversity and abundance are expected (Volume 3B, Section 10.2.2). Post-flood monitoring, as part of the vegetation and wetland monitoring and revegetation plan (see a draft version in the response to IR407, Appendix 407-1), will identify areas of high deposition and monitor for weeds. Monitoring results will inform any mitigation actions for vegetation re-establishment, erosion and weed control.

b. Sedimentation will have both positive and adverse effects on ungulate habitat. Positive effects related to increases in nutrients would occur where sedimentation is less and water immersion of vegetation is for shorter periods. For example, flooding experience in Manitoba has noted that native hay flooded under water for up to 60 days is beneficial for a productive native hay crop (MIT 2015). As stated in Volume 3A, Section 10.2.2, adverse effects would be related to greater sedimentation depths and longer immersion periods,

which can delay re-establishment of vegetation communities for 10 years or longer. This delay may affect forage and cover availability for ungulates (Volume 3A, Section 11.3.2.3, page 11.20 and page 11.21).

Ungulate movement may also be affected in high sedimentation areas by changing topography and cover availability. This could be both beneficial or detrimental based on deposition patterns. Exposed areas could be utilized less frequently than areas with higher cover or low-lying topographical relief.

REFERENCES

MIT (Manitoba Infrastructure and Transportation). 2015, Provincial Flood Control Infrastructure: Review of Operating Guidelines. A report to the Minister of Manitoba Infrastructure and Transportation, August 2015

Question 423

Volume 1, Attachment A, Water management Plan, Figure A-3, Page A-25
Volume 1, Attachment A, Water management Plan, Figure A-4, Page A-26

a. Explain whether downstream wildlife habitat will still receive periodic floods adequate to maintain habitat function and health.

Response 423

a. Although water will be partially diverted when flows exceed 160 m^3/s, water will continue to flow in Elbow River at a maximum flow rate of 160 m^3/s. Periodic floods will continue to occur, even with partial diversion.

For greater context, the following provides additional information.

Volume 3A, Section 6, Table 6-7, Page 6.29 indicates there have been 12 floods greater than 160 m^3/s since 1934. The recurrence interval for this size of flood is between 5 and 10 years (Volume 3A, Section 6, Table 6-6, Page 6.28). Flood mitigation would modify downstream flows and associated sediment transport (Volume 3B, Section 6.4, Page 6.12). As stated in Volume 3B, Section 6.4, pages 6.12-6.13 for the effects related to these flood operations:

> Temporary Delays: "Given that the Project may have operated approximately 12 times for the period 1934 to 2016, changes to the hydrological regime are unlikely to modify the long term median flow values in a meaningful way, given that the Elbow River is a low-flow system."

> Subsequent Release: "The net effect on the hydrological regime of the Elbow River watershed is not considered measurable because overall water volumes, less evaporation, are maintained. However, the potential for a substantial increase in flow magnitude in the low-level outlet would change the sediment transport regime and as a result, channel morphology."

Retention of water in the off-stream reservoir during diverted floods will reduce peak flows but will not reduce the occurrence of floods.

This might reduce the rate and magnitude of change to downstream habitats (e.g., scour or change in stream bank morphology), but changes to the hydrological regime due to diversion are unlikely to modify the long-term median flow values in a meaningful way (Volume 3B, Section 6.7, Pages 6.76).

Long-term changes in habitat conditions, such as scouring, plant cover, woody debris, supporting habitat functions (e.g., food sources, shelter), and health in downstream habitat are therefore also not expected to change in a meaningful way.

In conclusion, wildlife habitat downstream of the Project will continue to receive periodic floods adequate to maintain habitat function and health.

Question 424

Volume 3A, Section 11.4.4.2, Page 11.62

Alberta Transportation states that *Seasonally appropriate surveys will be undertaken to identify key habitat and habitat features (e.g. wetlands, nests) of SOMC before undertaking construction*.

a. Provide examples of proposed seasonally appropriate wildlife surveys.

Response 424

a. As stated in Volume 3A, Section 11.4.2.2, pre-construction surveys will be conducted at the appropriate time of year to confirm presence of species of management concern (SOMC) at identified wildlife features (i.e., raptor stick nests, wetlands) that may require mitigation. Examples of pre-construction surveys designed to protect wildlife features are:

- bird nest searches conducted between February 15 to August 31 to identify active raptor stick or migratory bird nests, targeting raptor SOMC such as barred owl, northern goshawk, osprey, and bald eagle, and migratory bird SOMC such as olive-sided flycatcher, barn swallow, bank swallow, long-billed curlew, sora, alder flycatcher, and least flycatcher

- nocturnal or diurnal amphibian surveys conducted mid-April to mid-June and designed to confirm presence of SOMC amphibian breeding wetlands
- mammal den and mineral lick searches conducted in early spring to identify active dens and ungulate mineral licks in the wildlife LAA

Question 425

Volume 4, Appendix C, Table C-1, Page C.14

a. Detail what the wildlife mitigation and monitoring plan content will include.

Response 425

a. A draft wildlife mitigation and monitoring plan is provided in Appendix IR425-1. The final plan will be developed following Project approval and based on provincial and federal approval conditions.

Question 426

Volume 3C, Section 2.10, Page 2.12

a. Explain the rationale why monitoring is only for a limited group of species and will only occur for a few select locations of the project.

b. Why were amphibian and avian surveys not proposed post-construction as these species will not be captured via remote camera surveys?

Response 426

a. The draft wildlife mitigation and monitoring plan (WMMP)(see the response to IR 425, Appendix IR425-1)for construction and dry operations focuses on large mammals (e.g., deer, elk, grizzly bear) because they are species of management concern (SOMC) that are most likely to be affected by the Project through changes in movement and have the greatest uncertainty regarding responses to Project components. Large mammals have a greater potential to interact with Project components that might impede or alter their movement compared to other species or species groups (e.g., birds). The WMMP will focus on the same locations and type of studies (e.g., remote camera studies) during baseline surveys as well as select locations along Project components that may affect large mammal movement. The number and locations of remote cameras will be described in more detail once the WMMP is finalized.

Post-flood, the off-stream reservoir reduces or alters habitat suitability for wildlife. The WMMP will also include surveys for bird, amphibian, as well as mammal SOMC and will involve collaboration with Indigenous groups and possibly universities (e.g., University of Calgary, Mount Royal University) to assess post-flood effects on habitat suitability.

b. There were no amphibian SOMC observed at wetlands surveyed in the wildlife LAA; therefore, none of the wetlands requires post-construction monitoring. If amphibian SOMC breeding wetlands are identified during pre-construction surveys, site-specific mitigation will be developed, which might include monitoring, if appropriate (e.g., if breeding wetland for northern leopard frog is found).

   As indicated in Volume 3A, Section 11.4.3.3, the Project has limited potential to affect bird movement because birds can fly over Project components. If nests of migratory birds or raptors including species at risk are identified during pre-construction surveys, site-specific mitigation will be developed, which might include monitoring during construction, if appropriate (e.g., if an active bald eagle nest is found).

Question 427

Volume 3A, Section 11.4.5.2, Page 11.66

a. Provide rationale why there are no additional mitigation measures recommended when there are many mitigation measures that would be effective at further reducing impacts on wildlife.

Response 427

a. The mitigation referred to in Volume 3A, Section 11.4.5.2 pertains to change in biodiversity (Section 11.4.5). As stated in Volume 3A, Section 11.4.5.2, there are no additional mitigation measures recommended for biodiversity because the mitigation measures proposed to reduce potential Project effects on wildlife (change in habitat, movement and mortality risk) would also reduce potential Project effects on biodiversity (i.e., wildlife habitats and species diversity are components of biodiversity). Mitigation measures recommended for change in habitat, movement and mortality risk are provided below.

   From Volume 3A, Section 11.4.2.2:

   "Change in Habitat

   - Where possible, temporary workspaces and access roads will be in areas that avoid wildlife features and native vegetation (e.g., shrubland, treed areas, wetlands). Existing access roads and previously disturbed areas will be used, where feasible.

- Pre-construction surveys will be conducted to identify wildlife features (e.g., nests, dens) and appropriate site-specific mitigation developed.
- Vegetation removal will be avoided during the Restricted Activity Period (RAP) for nesting migratory birds and raptors. RAPs are primarily based on Environment and Climate Change Canada (ECCC) guidance to avoid risk of incidental take of migratory birds (ECCC 2016). ECCC direction to protect bird nests in the foothills parkland and prairie ecozone of Alberta, with consideration of migratory bird species at risk, is from April 15 to August 31 (Gregoire 2014 pers. comm.). The recommended RAP to avoid destruction and disturbance to raptor nests is from February 15 to August 15 (SRD 2011, ESRD 2013, Government of Alberta 2017b). Therefore, the combined RAP dates to avoid is from February 15 to August 31.
- If vegetation removal is scheduled to occur within the RAP for migratory birds and raptors, a qualified wildlife biologist would inspect the site for active nests within seven days of the start of the proposed construction activity (e.g., vegetation removal, blasting).
- If an active nest or den is found, it will be subject to a provincial or federal disturbance setback buffer and site-specific mitigation. Table 11-10 and Table 11-11 provide setback distances for species of management concern (SOMC) with potential to occur in the PDA.
- Where possible, construction activities during the RAP for the Key Wildlife and Biodiversity Zone (KWBZ) identified along the Elbow River (December 15 to April 30) will be avoided or reduced. This would limit potential sensory disturbance to wintering ungulates (ESRD 2015a, Government of Alberta 2017b). If construction activities must occur during this time period, a wildlife mitigation and monitoring plan will be developed in consultation with regulators, which would include monitoring ungulate habitat use and response to human disturbance.
- Where possible, lights will be focused internally to the work site to reduce potential sensory disturbance to wildlife in the surrounding habitat.
- Temporary workspaces will be reclaimed using native species that are compatible with pre-construction site conditions, as outlined in the reclamation plan.
- Change in Movement, Volume 3A, Section 11.4.3.2. Construction activities will be avoided during the RAP for the KWBZ identified along the Elbow River (December 15 to April 30). This would reduce potential effects on wildlife movement and wintering ungulates (ESRD 2015a). If construction during the RAP cannot be avoided, site-specific mitigation will be developed in consultation with AEP.
- 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 material to move across the channel.

- 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).
- To maintain ungulate movement within the KWBZ, the floodplain berm will be revegetated with materials conducive for ungulate movement. The section of reinforced concrete (approximately 250 m) closest to the Elbow River will be covered with topsoil and seeded with native grasses. The central portion of the floodplain berm includes approximately 550 m of exposed riprap, where sections will be filled with substrate finer than riprap, such as sand, gravel and vegetation to allow for more walkable sections (Austin and Garland 2001; Huijser et al. 2008; Clevenger 2011). The south portion, furthest from the Elbow River, will be a 450 m earthen embankment vegetated with native grasses.
- Where fencing is proposed to restrict livestock access to project structures (e.g., diversion channel), wildlife-friendly fencing will be installed to allow ungulate passage."

From Volume 3A, Section 11.4.4.2:

"Change in Mortality Risk

- Seasonally appropriate surveys will be undertaken to identify key habitat and habitat features (e.g., wetlands, nests) of SOMC before undertaking construction.
- Identified wildlife features will be avoided during construction activities, as identified by the appropriate signage and/or fencing. The environmental inspector(s) or designate and wildlife resource specialist(s) will recommend the appropriate setback distance for identified wildlife features.
- Vegetation removal will be avoided during the RAP for nesting migratory birds and raptors. RAPs are primarily based on ECCC guidance to avoid risk of incidental take of migratory birds (ECCC 2016). ECCC direction to protect bird nests in the Foothills Parkland and Prairie ecozone of Alberta, with consideration of migratory bird species at risk, is from April 15 to August 31 (Gregoire 2014 pers. comm.). The recommended RAP to avoid destruction and disturbance to raptor nests is from February 15 to August 15 (SRD 2011, ESRD 2013, Government of Alberta 2017b). Therefore, the combined RAP dates to avoid is from February 15 to August 31.
- If vegetation removal is scheduled to occur within the RAP for migratory birds and raptors, a qualified wildlife biologist will inspect the site for active nests within seven days of the start of the proposed vegetation removal or ground disturbance and appropriate mitigation developed.

- If an active nest or den is found, it will be subject to a recommended setback buffer and site-specific mitigation measures developed in consultation with regulators (see Table 11-10 and Table 11-11 for setback buffers specific to SOMC with potential to occur in the PDA).
- All construction traffic will adhere to safety, road closure regulations, and other access measures and guidelines for the construction area and associated access roads.
- Wildlife or livestock will not be harassed or fed. Waste will be stored in wildlife-proof containers and wildlife awareness training will be provided to staff on site to reduce human-wildlife conflict (e.g., bears, see Jorgenson 2016).
- Personnel will not be permitted to have dogs at the construction site. Firearms are not permitted in Project vehicles or on the construction footprint, or at associated project facilities. Incidents with wildlife will be reported to an Alberta Transportation representative.
- Sightings of species of interest will be reported 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 construction), then the occurrence will be reported to the environmental inspector(s) or designate.
- Unanticipated wildlife issues encountered during construction will be discussed and resolved by the environmental inspector(s) or designate, wildlife resource specialist(s), and the responsible regulatory agencies, if necessary.
- Unauthorized vehicles will be prevented from access from public roads by using gates."

Given these mitigation measures, the Project will have no significant effects on wildlife habitat, movement, and mortality risk, and will not threaten the long-term persistence or viability of wildlife in the wildlife RAA. Based on this, no further mitigation for biodiversity is required.

REFERENCES

Austin, J.M. and L. Garland. 2001. Evaluation of a wildlife underpass on Vermont State Highway 289 in Essex, Vermont. In Proceedings of the 2001 International Conference on Ecology and Transportation, Eds. C.L. Irwin, P. Garrett, and K.P. McDermott. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC: pp. 616-624.

Bow Corridor Ecosystem Advisory Group. 2012. Wildlife Corridor and Habitat Patch Guidelines. Available at: http://biosphereinstitute.org/wp-content/uploads/2015/01/BCEAGFinalReport2012.pdf

Clevenger, T. 2011. Planning Considerations for Wildlife Passage in Urban Environments. Government of Alberta Transportation Best Practice Guidelines. 6 pp. Accessed January 2017 from: http://www.transportation.alberta.ca/Content/docType245/Production/BPG_Wildlife_Passage_in_Urban_Environments.pdf

ECCC (Environment and Climate Change Canada). 2016. General Nesting Periods of Migratory Birds in Canada. Accessed February 2017 from: http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4f39a78f-1

ESRD (Environment and Sustainable Resource Development). 2013. Sensitive Species Inventory Guidelines. Alberta Sustainable Resource Development, Fish and Wildlife Division, Edmonton, AB. Accessed December 2016 from: http://aep.alberta.ca/fish-wildlife/wildlife-management/documents/SensitiveSpeciesInventoryGuidelines-Apr18-2013.pdf

ESRD. 2015a. Recommended Land Use Guidelines: Key Wildlife Biodiversity Zones. Alberta Environment and Sustainable Resource Development, Fish and Wildlife Division, Edmonton, Alberta. Accessed January 2017 from: http://aep.alberta.ca/fish-wildlife/wildlife-land-use-guidelines/documents/KeyWildlifeBiodiversityZones-Apr08-2015.pdf

Fraier, J.L., E.H. Merrill, D.R. Visscher, D. Fortin, H.L. Beyer, and J.M. Morales. 2005. Scales of movement by elk (*Cervus elaphus*) in response to heterogeneity in forage resources and predation risk. Landscape Ecology 20: 273-287.

Government of Alberta. 2017b. Master Schedule of Standards and Conditions. Accessed July 2017 from: https://open.alberta.ca/publications/master-schedule-of-standards-and-conditions.

Huijser, M.P., P. McGowen, J. Fuller, A. Hardy, A. Kociolek, A.P. Clevenger, D. Smith, and R. Ament. 2008. Wildlife-Vehicle Collision Reduction Study: Report to Congress. Federal Highway Administration. McLean, VA. 254 pp.

Jorgenson, J.T. 2016. Bear Hazard Assessment Update for the Greater Bragg Creek Area of Southern Alberta 2016. 64 pp.

Mao, J.S., M.S. Boyce, D.W. Smith, F.J. Singer, D.J. Vales, J.M. Vore, and E.H. Merrill. 2005. Habitat selection by elk before and after wolf reintroduction in Yellowstone National Park. Journal of Wildlife Management 69: 1691-1707.

McCorquodale, S.M. 2003. Sex-specific movements and habitat use by elk in the Cascade Range of Washington. The Journal of Wildlife Management 67: 729-741.

SRD. 2011. Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat within Grassland and Parkland Natural Regions of Alberta. Edmonton, AB. 5 pp.

PERSONAL COMMUNICATION

Gregoire, P. 2014. Senior Environmental Assessment Officer, Canadian Wildlife Service, Environment and Climate Change Canada, Prairie and Northern Region. Personal communication, email.

Question 428

Volume 4, Appendix C, Table C-1, Page C.36

Alberta Transportation stated that *A remote camera program will be designed, in consultation with Alberta Environment and parks, to identify whether the diversion channel acts a barrier to wildlife movement…*

a. Discuss how the remote camera monitoring program proposed will adequately enable confident conclusions on residual impacts to wildlife.

Response 428

a. Remote cameras are a common tool used to determine potential effects of human development on wildlife as well as to evaluate the effectiveness of mitigation measures (McCollister and van Manen 2010; Barrueto et al. 2014; Burton et al. 2015; Andis et al. 2017; Caravaggi et al. 2017). The purpose of the remote camera monitoring program (as part of the draft wildlife mitigation and monitoring plan; see Appendix IR425-1) is to verify predictions related to residual effects of the Project on wildlife movement in the wildlife LAA, particularly for ungulates such as deer and elk.

   With mitigation, the diversion channel and other Project components would allow for wildlife, especially elk, to cross such structures or be deflected to crossable sections (see Volume 3A, Section 11.4.3.3, page 11.59). The remote camera monitoring program will provide data to estimate occupancy or relative abundance (e.g., number of detections per 100 trap-nights) for species of management concern (SOMC) such as deer, elk or grizzly bear, as well as determine the effectiveness of mitigation applied to sections of the diversion channel (e.g., vegetated areas) by providing estimates of crossing success rates by wildlife. The ability of the remote camera monitoring program to provide robust conclusions will be a function of clearly stated monitoring objective(s) and study design.

As stated in Volume 3C, Section 2.10.3, the remote camera program will be designed to identify whether Project components (e.g., diversion channel, floodplain berm) act as a barrier to wildlife movement, focusing on large mammals such as deer and elk. A conceptual design would include the installation of six remote cameras along the Elbow River in the same locations as used in pre-construction baseline surveys; this will allow comparisons of change in relative abundance or movement during the construction phase. Three of these remote cameras will be placed upstream and three downstream of the diversion structure and will monitor wildlife movement in the Key Wildlife and Biodiversity Zone (KWBZ) for a minimum of one year during the estimated 3-year construction period.

During dry operations, 14 remote cameras will be deployed in the wildlife LAA and monitor wildlife movement for at least one year post-construction. The six remote cameras along the Elbow River will remain at the same locations as during construction. Four remote cameras will be deployed soon after completion of construction and placed at the same locations as pre-construction baseline surveys near Highway 22 (near the raised portion of the highway at the north end of the wildlife LAA). An additional four remote cameras will be installed along wildlife friendly fencing at the edge of the diversion channel at crossable sections where there is vegetation. Remote cameras at the diversion channel will be spaced approximately 1 km apart.

A wildlife biologist will visit the cameras every four months during construction and the first year of dry operations of dry operations to change out memory cards and batteries and check on the overall status of equipment (e.g., positioning, weather related malfunctions, animal or human tampering of equipment).

The details of the remote camera monitoring program will be developed in consultation with regulators and Indigenous groups. A more detailed description of the remote camera monitoring program is provided in the draft wildlife mitigation and monitoring plan (see the response to IR425, Appendix IR425-1).

REFERENCES

Andis, A.Z., M.P. Huijser, and L. Broberg. 2017. Performance of arch-style road crossing structures from relative movement rates of large mammals. Frontiers in Ecology and Evolution 5: 1-13.

Barrueto, M., A.T. Ford, and A.P. Clevenger. 2014. Anthropogenic effects on activity patterns of wildlife at crossing structures. Ecosphere 5:27.

Burton, A.C., E. Neilson, D. Moreira, A. Ladle, R. Steenweg, J.T. Fisher, E. Bayne, and S. Boutin. 2015. Wildlife camera trapping: a review and recommendations for linking surveys to ecological processes. Journal of Applied Ecology 52: 675-685.

Caravaggi, A., P.B. Banks, A.C. Burton, C.M.V. Finlay, P.M. Haswell, M.W. Hayward, M.J. Rowcliffe, and M.D. Wood. 2017. A review of camera trapping for conservation behaviour research. Remote Sensing in Ecology and Conservation 3: 109-122.

McCollister, M. F., and F.T. van Manen. 2010. Effectiveness of wildlife underpasses and fencing to reduce wildlife-vehicle collisions. The Journal of Wildlife Management 74: 1722-1731.

Question 429

Volume 3A, Section11.1.1.1, Table 11.2 , Page 11.4

a. Discuss the effectiveness of bird surveys during the breeding season to identify active nests in the PDA. Will project bird surveys prevent the harm of protected species and do they align with Environment Canada's current 2018 recommendations as it relates to large scale habitat clearing? Explain why or why not?

Response 429

a. If construction activities are unable to avoid the primary nesting period (i.e., breeding season) of migratory birds in the PDA, a qualified wildlife biologist will conduct pre-construction bird nest surveys to manage the risk of harm to nesting migratory birds. Bird nest surveys are conducted to reduce the risk of harm to migratory birds, including species at risk. In open, less complex habitats, nests are more likely to be found compared to forested areas (ECCC 2018). In the PDA, nests will be relatively easy to locate because the habitat is mostly crop, tame pasture, and grassland, which will enhance the effectiveness of the surveys.

   Techniques for nest surveys include non-intrusive passive point count or transect surveys in appropriate habitat and low intensity nest searches that involve walking transects through an entire area to be cleared/disturbed. When a nest is found, the species and location is recorded, and a species-specific setback buffer is placed around the nest. Nesting can be determined through the discovery of an actual nest, or through behavioural evidence (e.g., defensive calling and displays, carrying nest material, food, or fecal sacs) and professional judgement. Monitoring of the nest is not conducted because this causes a disturbance to the nest and increases predation risk. Instead, a conservative estimate of fledging date is provided for the nest and a biologist is required to confirm that young birds have fledged, prior to removing the buffer. This survey protocol and recommended bird mitigation align with ECCC (2018) recommendations.

REFERENCES

ECCC (Environment and Climate Change Canada). 2018. Guidelines to reduce risk to migratory birds. Available at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html Accessed December 2018.

Question 430

Volume 3A, Section 11.2.2.5, Page 11.37

a. Explain why only 5 indicator species were selected and include the rationale why other species were not included.

b. Page 11.37 indicates that only 3 of the five indicator species (elk, flycatcher, and grizzly bear) were reportedly detected during monitoring. Explain how it is useful and/or the limitations of having 2 indicator species that were not detected in the monitoring?

Response 430

a. Kennedy and Ross (1992) emphasized the importance of focusing environmental assessments during the scoping phase to address the key issues. Therefore, as stated in Volume 3A, Section 11.1.2, page 11.4 “several wildlife species of management concern (SOMC) were used to focus the assessment. SOMC represent birds, mammals, and amphibians that depend on a variety of habitat types (e.g., grassland, forests, wetlands)”.

   Furthermore, it is a standard environmental assessment approach to further focus wildlife assessments by choosing indicator species. As such, six wildlife species (i.e., olive-sided flycatcher, Sprague’s pipit, sora, northern leopard frog, elk, and grizzly bear) were chosen as indicators to assess potential Project effects on wildlife.

   Wildlife key indicators included SOMC that are either legislatively protected (i.e., species at risk) or important for traditional and economic use. It is important to emphasize that although six wildlife species are chosen as indicators, other wildlife species were addressed using a habitat-based approach to assess potential Project effects on SOMC. All 19 species at risk with the potential to occur in the wildlife RAA are assessed (Volume 3A, Attachment A). In addition, 36 wildlife species of cultural importance to Indigenous groups are also discussed in Table IR430-1.

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Birds								
Harlequin duck (*Histrionicus histrionicus*)	*Special Concern*	*Sensitive*	Fast flowing streams and rivers. Potential breeding habitat along sections of Elbow River. Low to moderate suitability breeding habitat occurs.	No Fisheries and Wildlife Management Information System (FWMIS) records in the RAA. Not observed in the LAA during field surveys. Low potential to occur in the LAA.	**Change in Habitat** Potential sensory disturbance during in-stream Project activities. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing will result in increased mortality risk from potential nest destruction.	Section 11.4.2.2 Section 11.4.4.2.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short Term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed
Canada Goose (*Branta canadensis*)	-	*Secure*	Wetlands (e.g., graminoid marsh) and agricultural lands. Wetlands are 6.4% (312 ha) and agricultural lands are 48.2% (2,343.9 ha). Overall, moderate to high suitability breeding, stopover, and wintering habitat occurs.	FWMIS records in the RAA and observed during waterbird field surveys. Moderate to high potential to occur in the LAA during the breeding and winter seasons, as well as spring and fall migration.	**Change in Habitat** Direct habitat loss or alteration due to vegetation removal (29.5 ha of wetland) during construction. Temporary construction disturbances will reduce residual effects at dry operations (habitat loss of 15.3 ha from existing conditions). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short Term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Trumpeter swan (*Cygnus buccinators*)	*Special Concern*	*Sensitive*	Shallow lakes, marshes, and wooded swamps. Wetlands are 6.4% (312 ha) and open water is 5.8% (283.5 ha). Overall, low suitability breeding habitat (i.e., only small wetlands and waterbodies occur). No potential migration stopover habitat.	FWMIS records in the RAA during early and mid-1990s. Not observed in the LAA during field surveys. Low potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration due to vegetation removal (29.5 ha of wetland) during construction. Temporary construction disturbances will reduce residual effects at dry operations (habitat loss of 15.3 ha from existing conditions). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short Term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed
American coot (*Fulica americana*)	-	*Secure*	Shallow lakes, marshes and ponds with emergent vegetation. Graminoid marsh and shallow open water is 4.9% (238.4 ha) combined. Moderate suitability breeding habitat.	Three FWMIS records in the RAA during 2006. Not observed in the LAA during field surveys. Moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration due to vegetation removal (29.5 ha of wetland) during construction. Temporary construction disturbances will reduce residual effects at dry operations (habitat loss of 15.3 ha from existing conditions). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short Term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Gray partridge (*Perdix perdix*)	-	*Secure*	Agricultural lands and grassland, which is 48.2% (2,343.9 ha) and 8.8% (425 ha) respectively. Moderate to high suitability breeding and wintering habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Moderate to high potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (89.7 ha – native grassland). During dry operations, reclamation will increase habitat by 91.2 ha from existing conditions. Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short Term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed
Ring-necked pheasant (*Phasianus colchicus*)	-	*Secure*	Agricultural lands, grassland, shrubland, wetland (marsh), forest edges. Agricultural land is 48.2% (2,343.9 ha), grassland is 8.8% (425 ha), shrubland is 8.4% (408.5 ha) and wetlands are 6.4% (312 ha). Moderate to high suitability breeding and wintering habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Moderate to high potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (204.5 ha - all native habitat types combined). During dry operations, reclamation will reduce residual effects (habitat loss of 7.5 ha from existing conditions). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short Term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Ruffed grouse (*Bonasa umbellus*)	-	*Secure*	Mixed and broadleaf forest. Mixed and broadleaf forest is 6.1% (296 ha) and 5.2 % (252 ha), respectively. Overall, moderate suitability breeding habitat.	One FWMIS record in the RAA during 2010. Not observed in the LAA during field surveys. Low to moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (38 ha – mixed and broadleaf forest combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed
Spruce grouse (*Falcipennis canadensis*)	-	*Secure*	Breed in coniferous forest. Coniferous forest is 5.0% (245 ha). Overall, low to moderate suitability breeding habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Low to moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (11 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Sharp-tailed grouse (*Tympanuchus phasianellus*)	-	*Sensitive*	Breed in native grassland and tame pasture. Limited amounts of native grassland (425 ha or 8.8%). Tame pasture is 27.3% (1,325 ha). Overall, low suitability breeding habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Low potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (89.7 ha – native grassland). During dry operations, reclamation will increase habitat by 91.2 ha from existing conditions. Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2 See Volume 3A, Table 11-10 for sharp-tailed grouse timing and setback distance.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed
Osprey (*Pandion haliaetus)*	-	*Sensitive*	Breed in broadleaf forest (large trees) or man-made structures near waterbodies with fish. Broadleaf forest is 5.2% (252 ha). Overall, moderate suitability breeding habitat along Elbow River.	No FWMIS records in the RAA. One active platform nest observed in the LAA during 2016. Moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (3 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2 See Volume 3A, Table 11-10 for osprey timing and setback distance.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Bald eagle (*Haliaeetus leucocephalus*)	-	*Sensitive*	Breed in broadleaf forest (large trees) or man-made structures near waterbodies with fish. Broadleaf forest is 5.2% (252 ha). Overall, moderate suitability breeding habitat along Elbow River.	No FWMIS records in the RAA. One active stick nest observed in the LAA during 2016. Moderate to high potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (3 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2 See Volume 3A, Table 11-10 for bald eagle timing and setback distance.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed
Barred owl (*Strix varia)*	*Special Concern*	*Sensitive*	Mixed and broadleaf forest. Mixed and broadleaf is 6.1% (296 ha) and 5.2% (252 ha), respectively. Overall, low suitability breeding habitat.	One FWMIS record in the RAA during 1980. Not observed in the LAA during field surveys. Low potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (37.8 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2. See Volume 3A, Table 11-10 for barred owl timing and setback distance.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Northern pygmy owl (*Glaucidium gnoma*)	-	*Sensitive*	Coniferous and mixed forests is 5% (245 ha) and 6.1% (296 ha), respectively. Overall, low to moderate suitability breeding habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Low potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (46 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed
Great grey owl (*Strix nebulosa*)	-	*Sensitive*	Coniferous and mixed forests, treed wetlands. Coniferous forest is 5.0% (245 ha), mixed forest is 6.1% (296 ha) and treed wetland (wooded swamp) is 0.4% (20.3 ha). Overall, low suitability breeding habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Low potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration from vegetation clearing during construction (46 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** No potential Project effects. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of nest.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Mammals								
Snowshoe hare (*Lepus americana*)	-	*Secure*	Coniferous and mixed forests, which is 5% (245 ha) and 6.1% (296 ha), respectively. Moderate suitability habitat in the LAA.	No FWMIS records in the RAA. Observed in the LAA during 2015 winter tracking survey. Moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (46 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Continuous R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
White-tailed jackrabbit (*Lepus townsendii*)	-	*Secure*	Grassland, shrubland, and tame pasture, which is 8.8% (425 ha), 8.4% (408.5 ha) and 27.3% (1325.2 ha) respectively. Overall, moderate to high suitability habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Moderate to high potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (175 ha – native grassland and shrubland combined). During dry operations, reclamation will increase habitat by 7.8 ha from existing conditions. Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.4.2.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Continuous R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Coyote (*Canis latrans*)	-	*Secure*	Forests, shrubland, grassland, agricultural fields, which is 16.3 % (793.1 ha), 8.4% (408.5 ha), 8.8% (425.1 ha) and 48.2% (2,343.9 ha) respectively. Overall, high suitability habitat.	FWMIS records in the RAA. Observed during 2015 and 2017 winter tracking surveys as well as 2016 remote camera survey. High potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (224 ha – native habitats combined). **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of den, vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals).	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Grey wolf (*Canis lupus)*	-	*Secure*	Riparian, shrubland, and forest edges. Conifer forest and shrubland is 5.0% (245.2 ha) and 8.4% (408.5 ha), respectively. Overall, low suitability habitat due to relatively high human disturbance.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Low potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (96.3 ha). **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals).	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Red fox (*Vulpes vulpes*)	-	*Secure*	Forest, shrubland, grassland, agricultural lands, represent 16.3 % (793.1 ha), 8.4% (408.5 ha), 8.8% (425.1 ha) and 48.2% (2,343.9 ha) respectively. Overall, moderate suitability habitat.	One FWMIS record in the RAA. Observed in LAA during 2015 winter tracking and 2016 remote camera surveys. Moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (224 ha – all native habitats combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in physical destruction of den, vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals).	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Canada Lynx (*Lynx canadensis*)	-	*Sensitive*	Coniferous and mixed forests is 5% (245 ha) and 6.1% (296 ha), respectively. Overall, low suitability habitat.	One FWMIS record in the RAA. Not observed in the LAA during field surveys. Low potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (46 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals).	Section 11.4.2.2 Section 11.4.4.2.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Bobcat (*Lynx rufus*)	-	*Sensitive*	Forests, shrubland, grassland, which is 16.3 % (793.1 ha), 8.4% (408.5 ha), and 8.8% (425.1 ha) respectively. Overall, low to moderate suitability habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Low to moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (224 ha – all habitats combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals).	Section 11.4.2.2 Section 11.4.4.2.	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Cougar (*Puma concolor*)	-	*Secure*	Dense or open forests, shrubland, grassland, riparian areas. Forests, shrubland, grassland is 16.3 % (793.1 ha), 8.4% (408.5 ha), and 8.8% (425.1 ha) respectively. Overall, moderate suitability habitat.	Two FWMIS records in the RAA. Observed in LAA (2016 remote camera survey). Moderate potential to occur in the LAA, particularly along Elbow River.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (224 ha- all habitats combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance **Change in Mortality Risk** Potential increased mortality risk due to vehicle collisions, wildlife-human conflict (e.g., removal of nuisance animals).	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Long term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Continuous R: Reversible E: Disturbed **Change in Mortality Risk** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Irregular event R: Reversible E: Disturbed	**Change in Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Striped skunk			Open mixed forests, shrubland, agricultural lands, which is 6.1% (296 ha), 8.4% (408.5 ha) and 48.2% (2,343.9 ha) respectively. Overall, moderate suitability habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (120 ha – native habitats combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Marten (*Martes americana*)	-	*Secure*	Coniferous and mixed forests, which is 5% (245 ha) and 6.1% (296 ha), respectively. Overall, low suitability habitat	No FWMIS records in the RAA. Observed in the LAA during field survey for drilling program. Low potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (46 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Sing event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Short-tailed weasel (*Mustela erminea*)	-	*Secure*	Coniferous and broadleaf forests, and meadows. Coniferous and broadleaf forests is 5% (245 ha) and 5.2% (252 ha), respectively. Overall, low to moderate suitability habitat.	No FWMIS records in the RAA. Potentially observed during 2017 snow track survey (i.e., unidentified weasel tracks). Low to moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (14 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Long-tailed weasel (*Mustela frenata longicauda*)	-	*Maybe at Risk*	Grassland, shrubland, forests, and agricultural lands are 8.8% (425.1 ha), 8.4% (408.5 ha), 16.3 % (793.1 ha), and 48.2% (2,343.9 ha) respectively. Overall, moderate suitability habitat.	No FWMIS records in the RAA. Potentially observed during 2017 snow track survey (i.e., unidentified weasel tracks). Low to moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (224ha – all native habitats combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
American mink (*Neovison vison*)	-	*Secure*	Forests, shrublands and grassland adjacent to water (i.e., riparian areas). Forest, grassland, shrubland, and open water is 16.3 % (793.1 ha), 8.4% (408.5 ha), 8.8% (425.1 ha), and 5.8% (283.5 ha), respectively. Overall, low to moderate habitat suitability.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Low to moderate potential to occur in the LAA (Elbow River).	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction. Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Black bear (*Ursus americana*)	-	*Secure*	Coniferous, mixed and broadleaf forests, shrubland, grassland, wet meadows, wetlands and riparian areas. Coniferous, mixed and broadleaf forests is 5% (245 ha), 6.1% (296 ha), and 5.2% (252 ha) respectively. Shrublands, grasslands and wetlands are 8.4% (408.5 ha), 8.8% (425 ha) and 6.4% (312 ha) respectively. Overall, low to moderate suitability habitat.	Six FWMIS records in the RAA. Observed in the LAA during 2016 remote camera survey (three detections). Low to moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (224 ha – all habitat types combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk due to destruction of potential den sites, vehicle collisions, and increased bear-human conflicts.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Moderate G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Moose (*Alces americanus*)	-	*Secure*	Shrublands, mixed and broadleaf forests, wetlands, which are 8.4% (408.5 ha), 6.1% (296 ha) 5.2% (252 ha), and 6.4% (312 ha) respectively. Overall, moderate to high suitability habitat.	One FWMIS record in the RAA. Observed in the LAA during 2017 winter tracking survey and 2016 remote camera survey. Moderate to high potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (123 ha – all habitat types combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Potential increased mortality risk due to vehicle collisions.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long 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: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Mule deer (*Odocoileus hemionus*)	-	*Secure*	Grassland, shrubland and forests, which is 8.8% (425 ha), 8.4% (408.5 ha) and 16.3% (793.1 ha), respectively. Overall, moderate to high habitat suitability.	No FWMIS records in the RAA. Observed in the LAA during 2015 and 2017 winter tracking surveys, and 2016 remote camera survey. Moderate to high potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (194.5 ha- all habitat types combined ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Potential increased mortality risk due to vehicle collisions.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long 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: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
White-tailed deer (*Odocoileus virginianus*)	-	*Secure*	Grassland, shrubland and forests, which is 8.8% (425 ha), 8.4% (408.5 ha) and 16.3% (793.1 ha), respectively. Overall, moderate to high habitat suitability.	FWMIS records in the RAA. Observed in the LAA during 2015 and 2017 winter tracking surveys, and 2016 remote camera survey. High potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, from vegetation clearing during construction (194.5 ha – all habitat types combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Potential increased mortality risk due to vehicle collisions.	Section 11.4.2.2 Section 11.4.3.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Moderate G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long 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: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Beaver (*Castor canadensis*)	-	*Secure*	Rivers, streams, marshes, swamps, and broadleaf forest. Open water and wetlands comprise 5.8% (284 ha) and 6.4% (312 ha) respectively. Broadleaf forests comprise 5.2% (252 ha). Overall, moderate habitat suitability.	FWMIS records in the RAA. Not observed in the LAA during field surveys. Moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (60 ha – open water and wetlands combined). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Muskrat (*Ondatra zibethicus*)	-	*Secure*	Rivers, streams, marshes, and swamps. Open water and wetlands comprise 5.8% (284 ha) and 6.4% (312 ha) respectively. Overall, moderate habitat suitability.	Three FWMIS records in the RAA. Not observed in the LAA during field surveys. Moderate to high potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (60 ha – open water and wetlands combined). Temporary construction disturbances will reduce residual effects at dry operations (habitat loss of 15.3 ha from existing conditions). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Porcupine (*Erethizon dorsatum)*	-	*Secure*	Broadleaf and mixed forests and shrubland is 5.2% (252 ha), 6.1% (296 ha) and 8.4% (408.5 ha), respectively. Overall, moderate habitat suitability.	One FWMIS record in the RAA. Not observed in the LAA during field surveys. Moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (123 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Red squirrel (*Tamiascirus hudsonicus*)	-	*Secure*	Coniferous and mixed forests is 5% (245 ha) 6.1% (296 ha), respectively. Moderate suitability habitat.	No FWMIS records in the RAA. Not observed in the LAA during field surveys. Moderate potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (46 ha). Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

Table IR430-1 Summary of Project Residual Effects on Species of Cultural Importance to Indigenous Groups during Construction and Dry Operations

Species	Conservation Status		Potential Habitat Use and Percentages in the LAA at Existing Conditions	Frequency of Occurrence[c]	Potential Project Effect(s)[d]	Key Recommendations/ Mitigation Measures Volume 3A	Project Residual Effects[e]	
	AWA[a]	AEP[b]					Construction	Dry Operations
Richardson's ground squirrel			Grassland and tame pasture is 8.8% (425 ha) and 27.3% (1325 ha), respectively. Overall, moderate to high habitat suitability.	FWMIS records in the RAA. Not observed in the LAA during field surveys. Moderate to high potential to occur in the LAA.	**Change in Habitat** Direct habitat loss or alteration, including residences, from vegetation clearing during construction (89.7 ha). During dry operations, reclamation will increase habitat by 91.2 ha from existing conditions. Indirect loss or reduced habitat effectiveness from sensory disturbance during construction and dry operations. **Change in Movement** Construction and dry operations could result in alteration of movement patterns (daily or seasonal) because of Project structures and sensory disturbance. **Change in Mortality Risk** Ground disturbance and vegetation clearing can result in increased mortality risk, accidental mortality during vehicle/equipment movement.	Section 11.4.2.2 Section 11.4.4.2	**Change in Habitat** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short term F: Single event R: Reversible E: Disturbed **Change in Movement** T: Seasonality/Regulatory Dir: Adverse M: Low G: LAA Dur: Short 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 Habitat** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed **Change in Movement** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Continuous R: Irreversible E: Disturbed **Change in Mortality Risk** T: N/A Dir: Adverse M: Low G: LAA Dur: Long term F: Irregular event R: Reversible E: Disturbed

NOTES:

[a] Government of Alberta. 2016. Species Assessed by the Conservation Committee. Available at: https://open.alberta.ca/dataset/0b3421d5-c6c1-46f9-ae98-968065696054/resource/b99ef1c9-6032-41eb-be5c-c6a2e3476960/download/speciesassessedconservation-mar2016.pdf. Accessed November 2018.

[b] Alberta Environment and Parks. 2017. Alberta Wild Species General Status Listing – 2015. Available at: https://open.alberta.ca/dataset/ad0cb45c-a885-4b5e-9479-52969f220663/resource/763740c0-122e-467b-a0f5-a04724a9ecb9/download/sar-2015wildspeciesgeneralstatuslist-mar2017.pdf. Accessed November 2018.

[c] Based on input from Indigenous groups, it is recognized that all species listed in Table IR11-1 occur in the wildlife RAA; however, the Fisheries and Wildlife Management Information System (FWMIS) records were used to assess frequency of occurrence for each species of cultural importance.

[d] There are no potential Project effects to change in movement for bird species of traditional importance because no tall structures would be erected that might affect migration patterns, flyways, local movement, and seasonal habitat use.

[e] 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.

Overall, assessing all 86 wildlife SOMC (see Volume 4, Appendix H, Table 3-12) individually would result in an overly repetitive and redundant assessment because there are multiple species that share similar habitat associations. This approach would not provide a better wildlife assessment or change the conclusions of the wildlife assessment.

Olive-sided flycatcher, sora, and Sprague's pipit are chosen as key wildlife indicators because the pathways for potential Project effects on migratory birds would be similar for a broader group of species represented under the *Migratory Birds Convention Act* (MBCA) that are dependent on forest, wetland or grassland habitat types.

Similarly, elk and grizzly bear are considered representative of wildlife species used for traditional purposes because these species depend on a variety of seasonal habitat types that would include other wildlife species of traditional importance such as mule deer, white-tailed deer, coyote and weasel that also depend on similar habitat types (e.g., grassland, shrubland, forest).

Northern leopard frog is chosen because it is a wetland dependent species sensitive to changes in proximity of habitat types required for breeding, foraging and overwintering.

b. Of the six key indicator species, Sprague's pipit and northern leopard frog were not detected during baseline surveys. These two species are listed as *threatened* and *special concern* under Schedule 1 of the *Species at Risk Act*, respectively, and are expected to be relatively rare, based on the abundance of low suitability habitat identified within the wildlife LAA (see Volume 3A, Section 11.2.2.4, Table 11-8). However, non-detection of Sprague's pipit or northern leopard frog does not equate to absence of the species in the wildlife LAA. Although these species were not detected, habitat suitability models developed wildlife assessment represent suitable grassland and wetland habitat for these species, which provides a valuable and standard approach to assessing potential Project effects on wildlife. The non-detection of Sprague's' pipit or northern leopard frog does not affect the mapped distributions of high, moderate, and low suitability habitat in the LAA (i.e., the suitability maps provide a valid and reasonable assessment of potential Project effects on these species).

REFERENCES

Kennedy, A.J., and W. Ross. 1992. An approach to integrate impact scoping with environmental impact assessment. Environmental Management 16: 475-484.

Question 431

Volume 3A, Section 11.2.1.2, Page 11.20
Volume 3A, Section 11.6, Page 11.88
Volume 3A, Section 11.1, Page 11.1

Alberta Transportation indicates that *wildlife field surveys were conducted in the LAA to estimate wildlife abundance and distribution*.

a. Define the term *wildlife abundance*.

b. Discuss the confidence of these surveys in establishing the abundance of wildlife. Will it enable detection of any changes in populations post construction to inform the residual impacts?

c. Explain why quantitative methodologies was not used to estimate residual effects on wildlife abundance.

Response 431

a. Wildlife abundance refers to the representation of a wildlife species in a particular habitat type. To clarify, the wildlife field surveys conducted in the wildlife LAA provide estimates of relative abundance (i.e., an index of abundance) and not absolute abundance (see Volume 4, Appendix H).

b. The breeding bird, amphibian, rail, raptor nest and winter tracking surveys were conducted following provincial protocols (ESRD 2013), most of which require repeat visits to increase species detection. These wildlife surveys included a remote camera survey, which resulted in 3,207 camera-days of survey effort (see Volume 4, Appendix H, Section 3.6). These data are adequate to provide baseline estimates of relative abundance in the wildlife LAA. Overall, prediction confidence is moderate based, on the quality and quantity of baseline data (see Volume 3A, Section 11.6).

   Any comparison of baseline and post-construction relative abundance data will be limited to species identified in the wildlife mitigation and monitoring plan (WMMP), which will be developed in consultation with provincial and federal regulators. Any limitations of the study design to detect potential changes in relative abundance or other metric(s) will be discussed in the plan. A draft WMMP is provided in the response to IR425, Appendix IR425-1.

c. Change in habitat was assessed quantitatively by using a habitat-based approach as well as habitat suitability modelling for the following key indicator species (see response IR430 for further details on the selection of key indicator species):

- olive-sided flycatcher
- Sprague's pipit
- sora
- northern leopard frog
- elk
- grizzly bear

The amount of wildlife habitat potentially affected during construction and dry operations (in hectares) is provided in Volume 3A, Section 11, Table 11-12, Table 11-13 and Table 11-16. Criteria used to estimate the magnitude of Project residual effects on the change in habitat are described in Table 11-5 and include inferences regarding changes to wildlife abundance. See the responses to IR409a for a discussion of the adequacy of the qualitative assessment for change in movement and change in mortality risk.

REFERENCES

ESRD (Environment and Sustainable Resource Development). 2013. Sensitive Species Inventory Guidelines. Alberta Sustainable Resource Development, Fish and Wildlife Division, Edmonton, AB. Accessed December 2016 from: http://aep.alberta.ca/fish-wildlife/wildlife-management/documents/SensitiveSpeciesInventoryGuidelines-Apr18-2013.pdf

Question 432

Volume 3A, Section 11.4.5.3, Page 11.66

a. Explain how the Alberta Transportation arrived at the conclusion that the 20% of native upland and shrub habitat types would not have any measurable impacts to species that depend on these habitats while considering the fact that many of these habitats are difficult or impossible to restore.

b. Define reclamation and restoration. How do these two forms of mitigation differ and why one or the other will be chosen for disturbed areas.

Response 432

a. Volume 3A, Section 11.4.5.3 specifically addresses Project residual effects on biodiversity, which acknowledges potential Project effects on wildlife species dependent on upland communities including bird species richness. As stated in Volume 3A, Section 11.4.5.3, "Shrubland and grassland would be reduced by up to 20.8% and 21.1% in the local wildlife LAA, respectively during construction (see Table 11-12). Reclamation of disturbed native upland and shrub habitat types will be reclaimed using an Alberta Transportation native custom seed mix (see Volume 3A, Section 10.3.1, Table 3-10). Reclamation would result in an additional 91 ha of grassland habitat in the LAA during dry operations, a 21% increase from existing conditions."

   As stated in Volume 3A, Section 11.4.5.3 and Volume 4, Appendix H, Section 3.1.1, shrubland and grassland communities have relatively lower bird species richness and relative abundance compared to other habitat types in the vegetation LAA. Overall, the conclusion that species richness is unlikely to measurably change is based on 1) the abundance of native upland and shrub habitat types remaining in the vegetation LAA and RAA and 2) proposed reclamation, which will reduce the effects of habitat loss.

b. Restoration is the process of assisting the recovery of ecosystems that have been degraded, damaged or lost (Society for Ecological Restoration 2004). Restoration typically aims to recover stable and adaptable natural or semi-natural ecosystems that are the same or similar to the natural system prior to disturbance (Burton 1991; McDonald et al. 2016).

   Reclamation is the process of stabilizing sites, controlling pollution, improving visual conditions and facilitating future land use (Burton 1991). Reclamation, aims to create conditions supporting similar land uses to those of pre-disturbance (ESRD 2013).

   Conditions and functions do not need to be identical to pre-disturbance.

   Because of the potential for future disturbance from floods, reclamation is favoured over restoration over much of the PDA (in the reservoir); however, restoration will likely be targeted to high value native communities in areas of temporary disturbance lacking abundant weeds or aggressive non-native plant species. Restoration is typically the costlier approach and success is dependent on site conditions. Conditions such as abundant weeds, excess nutrients, and alterations in surrounding lands can limit success. The following areas will be topsoiled and seeded at the end of construction:

   - the south (non-river) side of the floodplain berm
   - the upper side walls of the diversion channel
   - the dam embankment
   - contractor laydown areas

- borrow source 1
- spoil areas
- side slopes and backslopes of new roads
- areas disturbed by utility construction
- temporary construction access roads that have been decommissioned
- the decommissioned portion of Highway 22
- the temporary channel used to create in-the-dry construction conditions
- all other areas disturbed by construction that are not required for operation and maintenance

REFERENCES

ESRD (Environment and Sustainable Resource Development). 2013. 2010 Reclamation Criteria for Wellsites and Associated Facilities in Native Grasslands (July 2013 Update). Edmonton, Alberta. 92 pgs.

Burton, P.J. 1991. Ecosystem Restoration versus Reclamation: The Value of Managing for Biodiversity. Proceedings of the 15th Annual British Columbia Mine Reclamation Symposium in Kamloops BC. 1991. The Technical and Research Committee on Reclamation.

McDonald, T., G.D. Gann, J. Jonson and K.W. Dixon. 2016. International Standards for the Practice of Ecological Restoration – Including Principles and Key Concepts. Society for Ecological Restoration, Washington, D.C. 48 pgs.

Society for Ecological Restoration. 2004. The SER International Primer on Ecological Restoration. Society for Ecological Restoration, Tuscon, Arizona. 14 pgs.

Question 433

Volume 3B, Section 11.3.3, Page 11.22

a. How will the in stream Elbow River dam infrastructure affect aquatic wildlife movement (for example: waterfowl, aquatic wildlife etc.)?

Response 433

a. During dry operations, the diversion inlet gates will be closed, but the crest gates in the service spillway located in the Elbow River channel adjacent to the diversion inlet will be open to allow for movement of aquatic wildlife. The service spillway bays are designed so that fish passage is maintained with minimal adjustments to the functioning of the service spillway (see the response to IR91). This also allows for movement of waterfowl or semi-aquatic mammals (e.g., muskrat, beaver, mink) to pass through the structure.

   During flood operations, the crest gates in the service spillway are positioned to build backwater at the diversion structure to help drive floodwaters into the diversion inlet. The movement of aquatic wildlife in Elbow River would be temporarily blocked until diversion of flood waters cease.

Question 434

Volume 3A, Section 11.4.3.1, Pages 11.56

a. Explain why change in mortality risk and movement did not identify areas where conflicts should be addressed via planning, design, and mitigation, as well as monitoring.

Response 434

a. The wildlife assessment explicitly addresses planning, design and mitigation before the assessment of effects from the Project and it addresses monitoring after the effects are assessed, as described below.

   In Volume 3A, Section 11.4.3.1, Page 11.56, it is stated that "the diversion channel, floodplain berm, off-stream dam, and associated fencing around the PDA might create hindrances to wildlife movement during dry operations". In addition, it is stated that riprap used in the diversion channel may cause difficulty for some wildlife species that attempt to cross the structure.

   Conflicts with wildlife movement for these areas in the PDA will be addressed through mitigation measures that incorporates planning and design (e.g., slope gradients, covering sections of the diversion channel with vegetation, wildlife friendly fencing). See Volume 3A, Section 11.4.3.2 for these discussions.

   Residual effects for wildlife and key indicators after implementation of mitigation is addressed in Volume 3A, Section 11.4.3.3. For areas where potential effects on wildlife movement should be monitored during dry operations, see Volume 3C, Section 2.10.

In Volume 3A, Section 11.4.4.1, page 11.61, it is stated that "during construction, vegetation removal and ground disturbance can result in physical destruction of wildlife habitat features (e.g., nests, dens, roosts, hibernacula) and increase mortality risk for wildlife" and "an increase in wildlife-human conflict could result from attractants (e.g., garbage) in the PDA that might cause wildlife to enter the construction area while humans are still present".

Construction activities are to occur within the entire Project construction area; therefore, mortality risk from ground disturbance and attractants cannot be identified for particular locations within this area. Mitigation will be implemented to avoid previously identified wildlife habitat features (e.g., stick nests with setback buffers) and wildlife awareness training will be implemented to reduce mortality risk. It is also stated that "road realignments and modifications at the intersection of Highway 22 and Springbank Road could alter local traffic patterns, potentially increasing traffic volumes on other roadways in the RAA", thereby increasing the potential for animal-vehicle collisions (AVC). Details on mitigation measures are in Volume 3A, Section 11.4.4.2.

Question 435

Volume 3A, Section 11.2.2.4, Page 11.28

EBA 2010 reference in Volume 3A as well as project monitoring confirmed grizzly bear movement east west in the project and local area.

a. Why were impacts to this movement and risk not further assessed or discussed? Explain rationale and included detail on grizzly movements in the Elbow river valley.

Response 435

a. The Project residual effects on grizzly bear movement (including east-west movement) are discussed in Volume 3A, Section 11.4.3.3, page 11.60. A summary of the conclusions can be found in Volume 3A, Section 11.7.2, page 11.88.

Terrestrial
May 2019