Volume 2, Section 10 Snake Lake Reservoir Expansion Project Environmental Impact Assessment Vegetation and Wetlands

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Executive Summary

The Eastern Irrigation District (EID) is applying for approval under the *Environmental Protection and Enhancement Act* and the Alberta *Water Act* to construct the proposed Snake Lake Reservoir (SLR) Expansion Project (the Project). The baseline assessment provides details on vegetation and wetlands resources in a local and regional study area, based on requirements provided in the Final Terms of Reference (FTOR; Volume 2, Appendix A) for the Project issued by Alberta Environment and Protected Areas, and following the Guide to Preparing Environmental Impact Assessments in Alberta (Government of Alberta [GOA], 2013b). This section of the Environmental Impact Assessment examines vegetation communities, wetlands, rare plants, traditional use plants, weeds, and fragmentation, presenting baseline data as well as summarizing residual impacts. A Cumulative Effects Assessment was also completed.

Field data were collected within a Terrestrial Local Study Area (TLSA), including the Project footprint plus a 500 m buffer, to describe and map vegetation communities and wetland features. Regional data and information were gathered from published sources to describe and map a Terrestrial Regional Study Area (TRSA) based on the planned expansion plus 15 km buffer. The Project, once constructed, will be a permanent 827 ha feature, including the flooded area and berms. Construction will require the removal of wetlands and waterbodies, native grassland, and potential rare plants within the expansion footprint. A scoping exercise was completed to determine resources and indicators for detailed assessment. The following indicators were selected: community classes and area, rare plant communities, plant species composition, fragmentation and connectivity, rare plant species, species richness, native grasslands, traditionally used plants, weeds, wetlands, and other water features. Fieldwork and vegetation/wetland mapping were completed to understand the local area.

A pre-field community map was developed from Grassland Vegetation Inventory, showing preliminary grassland and community classes, including dry grassland, mesic grassland, cultivated fields, non-native grassland, low shrub, tall shrub, woodland, and various disturbance classes. Wetlands were examined on historical aerial photography from 1950 to 2018, and all potential wetlands were mapped to guide field assessments. Fieldwork was completed by a team of two vegetation specialists in June and July 2021. Grassland field sites were measured based on Conservation Assessments in Native Grasslands, and included collection of site, soil, and vegetation data (species and percent cover); 91 plots were sampled at predetermined sites. Following fieldwork, any collected species were identified, and plant community data were entered into a spreadsheet for analysis. Range community classes for the *Dry Mixedgrass Range Plant Community Guide* were mapped based on dominant species, soil, and site conditions. Wetland field assessments occurred in June 2021 and August 2022. The field surveys included validation of potential wetland boundaries identified during the desktop review, and documentation of wetland classification, size, substrate, vegetation, and wildlife species. Wetlands and waterbodies were identified and delineated in accordance with the *Alberta Wetland Identification and Delineation Directive* to meet the requirements of the Alberta Wetland Policy, classified using the *Alberta Wetland Classification System*, and assessed using the *Alberta Wetland Rapid Evaluation Tool-Actual* (ABWRET-A) to determine relative wetland values.

The TLSA covers 1,657.9 ha, and is 76% native grasslands, 9% cultivated lands, 11% wetlands and other water classes, and 3% disturbances. The most common ecological range sites were

Blowouts, Saline Lowlands, and Loamy soil areas, and the most common community types were found to be DMGB7 (Foxtail Barley [*Hordeum jubatum*]/Kentucky Bluegrass [*Poa pratensis*]/Western Wheat Grass [*Pascopyrum smithii]*), and DMGC11 (Sagebrush [*Artemisia* sp.]/Needle and Thread Grass [*Hesperostipa comata]*/Blue Grama Grass [*Bouteloua gracilis]*). The next most common community type was DMGC9 (Saltbush [*Atriplex truncata*]/Poverty Weed [Iva axillaris]/Western Wheat Grass): a plant community found in saline lowlands. While most communities were found to be native grasslands a few non-native grassland communities were also identified on previously disturbed areas. These included MGB5 (Kentucky Bluegrass/Common Dandelion [*Taraxacum officinale*]/Smooth Brome [*Bromus inermis]*) and communities that had been seeded with agronomic species. Community classes that did not match the community guides included Aspen Woodland, Aspen/Balsam Poplar Woodland, and Willow Shrubland classes. Plant communities within the TLSA were grouped into one of six ecological community types for later comparison to the TRSA, including native grassland, cultivation, wetlands/waterbodies, anthropogenic water, woody, and disturbances.

Species richness was assessed and compared between classes. Total richness among communities ranged from 12 to 65 species and the highest mean richness (per plot) was 18 species. Disturbances include all land classes of anthropogenic origin, including cultivated lands, seeded hay land, dugouts, oil and gas infrastructure, ditches, canals, railroads, and access roads. Disturbances totalled 137 ha or 8.2% of the TLSA, and are primarily cultivated land areas, followed by reservoir and oil and gas sites. Fragmentation was assessed by the distribution of patches by size class. Both the total number and total area of patches in small to large patches were summarized. The summary showed the TLSA is highly patchy, but there is a large area in small to medium sized patches. Connectivity was measured to examine whether remaining patches will be located further apart after construction. Disturbances also include changes within communities from grazing. Heavy grazing was evident during field investigations with the greatest effect being pugging in wetland areas. Three noxious weeds, Canada Thistle (*Cirsium arvense)*, Perennial Sow Thistle (*Sonchus arvensis)*, and Field Bindweed (*Convolvulus arvensis)*, plus two prohibited noxious weeds, Hoary Alyssum (*Berteroa incana)* and Nodding Thistle (*Carduus nutans)*, were observed, as well as several other non-native species. The tracked rare plant community, Red Samphire (*Salicornia rubra*) Emergent Marsh was not observed within the Project footprint but was seen within the 500 m buffer; this is ranked as an S2 plant community in Alberta. Rare plants observed within the Project footprint were all ranked S3 but are not tracked by the Alberta Conservation Information Management System (ACIMS). These included Silver Saltbush (*Atriplex argentea)*, Endolepis (*Atriplex suckleyi)*, Hoary Aster (*Dieteria canescens)*, Prairie Rocket (*Erysimum asperum)*, Cushion Cactus (*Escobaria vivipara)*, Western Water-horehound (*Lycopus asper)*, Wild Begonia (*Rumex venosus)*, Wild Tomato (*Solanum triflorum)*, Moquin's Sea-blite (*Suaeda nigra)*, and Red Samphire. Forty-eight potential Traditionally Used species (specific to the Blackfoot Confederacy) were identified, based on published records of plant species use. The observed species have potential uses as medicines, dyes, food, crafts/building materials, or have spiritual values as per publications reviewed. This assessment may not reflect the true number of species used for traditional purposes, nor does it consider the value of species based on location or other measures of quality. Wetlands and waterbodies in the TLSA occur in defined basins or low topographic areas; they included Temporary Marshes, Seasonal Marshes, Intermittent Shallow Open Water, Ephemeral Waterbodies, Shrubby Swamps, and Ephemeral Draws, as well as ditches, canals, dugouts and reservoirs. 84 ha of

wetlands (i.e., marshes, swamps, and shallow open water classes) were present covering 5% of the TLSA. Of these wetlands, 26% were assessed under ABWRET-A as high value (A), 63% as medium value (B) and 11% as moderately low value (C). These values will be used in the assessment of wetland replacement value a future *Water Act* application.

In the TRSA, native grassland, cultivated agricultural lands, anthropogenic disturbances, wetlands, treed and shrubby classes, and anthropogenic waterbodies (i.e. reservoirs, canals, and dugouts) were identified. The TRSA covers 88,404.9 ha and is 51% native prairie, 33% cultivated, 9% wetlands, 5% disturbed lands, and 2% anthropogenic water. The total anthropogenically affected area – including disturbances, cultivated lands and anthropogenic water was 35,059.3 ha or 39.7% of the TRSA. Fragmentation was also assessed and a similar pattern to the TLSA was observed. Regional wetlands were summarized from the Alberta Merged Wetland Inventory and Hydrological Base Mapping data. This showed that marshes cover 5.1% of the TRSA, followed by open water wetlands (3.5%) and 0.4% for other wetland classes.

The resources which showed residual effects from Project activities after all mitigations include Natural Waterbody/Wetland Areas, Native Grassland Area, and Plant Species of Conservation Concern. These showed a medium negative impact and were selected for cumulative effects assessments. Only Wetlands and Native Prairie can be quantitatively assessed. The cumulative effect of the Project along with past and future projects in the TRSA is expected to be a loss of 3,130.9 ha of native prairie and a loss of 482.3 ha of wetlands within the TRSA. For native prairie this amounts to a 41% loss over the TRSA and is considered a high cumulative effect. There is a loss in wetlands of 11% within the TRSA which is considered a moderate cumulative effect. Construction of the reservoir expansion will result in the loss of 703.4 ha of native prairie and 66.6 ha of natural waterbodies/wetlands. This amounts to a low relative Project contribution of 3% to loss of native grassland and a medium relative contribution of 8% to loss of wetlands in the TRSA.

The loss of native grassland in the Project footprint will be partially offset by reclaiming the berms, soil storage area, and any temporary workspaces to native grassland. A detailed restoration plan discusses strategies for achieving functional restoration and includes a monitoring program to examine grassland restoration progress.

The loss of wetlands in the Project footprint will be a permanent impact. As per the *Alberta Wetland Policy* (GOA, 2013a), these impacts can either be offset by paying an in-lieu fee to support wetland replacement, or can follow the permitee-responsible replacement method, in which new functioning wetland areas are developed to offset the losses. For this assessment, the EID plans to follow the latter approach, by developing shallow wetlands in the reservoir. As this approach requires field data to assess wetland development, a monitoring program will be instituted to observe and measure wetland indicators and functions in these areas.

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Abbreviations

ABWRET-A	Alberta Wetland Rapid Evaluation Tool-Actual
ACA	Alberta Conservation Association
ACIMS	Alberta Conservation Information Management System
Alberta EPA	Alberta Environment and Protected Areas
ANPC	Alberta Native Plant Council
AWCS	Alberta Wetland Classification System
CEA	Cumulative Effects Assessment
COSEWIC	Committee on the Status of Endangered Wildlife Species in Canada
DMG	Dry Mixedgrass
DMNS	Dry Mixedgrass Natural Subregion
DUC	Ducks Unlimited Canada
EIA	Environmental Impact Assessment
EID	Eastern Irrigation District
EPEA	*Environmental Protection and Enhancement Act*
FTOR	Final Terms of Reference
FWMIS	Fish and Wildlife Management Information System
GIS	Geographic Information Systems
GPS	Global Positioning System
GOA	Government of Alberta
GOC	Government of Canada
GVI	Grassland Vegetation Inventory
NCC	Nature Conservancy Canada
PHD	Partners in Habitat Development
RWV	Relative Wetland Value
RWVAU	Relative Wetland Value Assessment Unit
SARA	*Species at Risk Act*
SD	Standard Deviation
SLR	Snake Lake Reservoir
TLSA	Terrestrial Local Study Area
TRSA	Terrestrial Regional Study Area
WAIR	Wetland Assessment and Impact Report

10.1 INTRODUCTION

The Eastern Irrigation District (EID) is applying for approval under the *Environmental Protection and Enhancement Act* (EPEA; Government of Alberta [GOA], 2000a) and the Alberta *Water Act* (GOA, 2000b) to construct the proposed Snake Lake Reservoir (SLR) Expansion Project (the Project) which will increase water storage from the current 19.25 million m^3 (15,600-acre feet) to a total of 87.4million m^3 (73,200-acre feet). As part of the approval process, this section of the Environmental Impact Assessment (EIA) examines wetlands, vegetation communities, and rare plants and the impacts the Project will have on these resources.

The Project, located on privately-owned grass/pastureland within the Dry Mixedgrass Natural Subregion (DMNS) in sections 29, 30, 31, and 32-19-16 W4M, is in Newell County, 19 km northwest of the City of Brooks, Alberta (see Appendix H1, Figure H1-1). Field data were collected within a Terrestrial Local Study Area (TLSA), including the Project footprint plus a 500 m buffer, to describe and map vegetation communities and wetland features. Regional data and information were gathered from published sources to describe and map a Terrestrial Regional Study Area (TRSA), based on a 15 km buffer around the edges of the Project footprint.

10.1.1 Purpose

The purpose of this baseline assessment and EIA is to identify what vegetation and wetland resources are present, which ones will be altered or removed by development of the Project, and address the level of effect, both at the local Project level and regional (cumulative effects) level. The Project, once constructed, will be a permanent 827 ha feature on the landscape and will require the removal of wetlands and waterbodies, native grassland, and potential rare plants within the expansion footprint. To evaluate the impacts of the Project, a quantitative and qualitative baseline of vegetation, wetlands, and rare plant species is required for comparison to predicted conditions during construction and operations. Mitigations and offsets, including reclamation of functioning grassland ecosystems, and wetland replacement, may be used to reduce effects. Monitoring programs can be designed to examine long term effects compared to baseline conditions.

The effects assessment of vegetation and wetlands has been completed in accordance with the Final Terms of Reference (FTOR; Volume 2, Appendix A) for EID's Proposed SLR Expansion Project (Eastern Irrigation District, 2023) and the Guide to Preparing Environmental Impact Assessment Reports in Alberta (GOA, 2013b).

10.1.2 Project Setting

The proposed Project and regional study area occurs within the DMNS of the Grassland Natural Region of Alberta (GOA, 2006). The Dry Mixedgrass, the largest subregion within the Grassland Region, is in the southeast portion of the province. The subregion accounts for 47% of the native Grassland Natural Region and 7% of Alberta (Adams, et al., 2013a). It consists of level to gently rolling semi-arid prairie landscapes intermixed with coulees, valleys, badlands, and dune fields. Slopes range from level to very steep depending on features of the local landscape (e.g., plains and coulees). The climate of this subregion is warm and dry, with a mean annual summer temperature of 18.5°C, and a mean winter temperature of -10.2°C. Mean annual precipitation is 333 mm, the lowest of any natural subregion in Alberta (GOA, 2006). Many native plants in the

region are deep rooted and short lived or have developed physiological traits which allow them to assume a dormant condition during dry periods. These traits have allowed vegetation to adapt to drying winds, low precipitation levels in the summer, high summer temperatures, and intense sunshine which creates significant moisture deficits (GOA, 2006). Agriculture is important in this area, either in areas that are naturally moist or where irrigation is used. Within the Project footprint, livestock grazing has been the agricultural practice for decades. Effects of cattle grazing, during spring through fall of most years, includes trails, pugging in wetlands, and bare erosion areas. Additionally, to ensure year-round water is available for cattle, low areas and wetlands have often been modified into open water dugouts.

The dominant soil types found in the DMNS include Brown Chernozemic and Solonetzic soils. Parent materials are primarily derived from glaciolacustrine materials (clay soils) and morainal till (rocky/sandy soils), with characteristic features such as rolling hills, reworked aeolian features (dunes), and glaciofluvial or fluvial deposits in valley areas. Cultivated lands typically occur on productive Chernozemic soils with deep brown topsoil, although Regosolic or Rego-chernozemic soils are also used. A mixture of Humic, Orthic, and Luvic Gleysols can be found in wetlands (GOA, 2006). Some areas have extremely saline and/or alkaline soils with salt crusts in some wetland and waterbody areas and hardpan conditions in Solonetzic soils. As per Adams, et. al. (2013b), grassland vegetation communities in the DMNS are grouped by Ecodistricts and dominant Soil Series. The Project area is within the Bow City Plain Ecodistrict which contains the following Soil Series: Halliday (HDY), Hemaruka (HUK), Ronalaine (ROL), Dishpan (DHP), and Pemukan (PUN). Common ecological range site communities include blowouts (on Solonetzic soils) characterized by an impervious hardpan layer caused by excess sodium (Na+), and a land surface characterized by eroded pits (HDY, HUK), saline lowlands which contain salt enriched soils at a level that can retard most plant growth (DHP), and loamy soils, which applies to all non-saline soils with fine or very fine textures such a clay and silty clay (ROL) (Adams, et al., 2013a). For a more in-depth discussion on the soils found in the Project area, refer to Volume 2, Section 9 – Soil and Terrain.

Trees are uncommon in the subregion except for areas associated with river systems or deep coulees, or in areas where soil moisture is higher such as near irrigation canals or where they are planted as shelterbelts. Typical vegetation of the DMNS includes drought-tolerant grasses (Blue Grama Grass [*Bouteloua gracilis]*, Needle and Thread Grass [*Hesperostipa comata]*, June Grass [*Koeleria macrantha]*, and Western Wheat Grass [*Pascopyrum smithii]*), shrubs (Silver Sagebrush [*Artemisia cana]*, Silverberry [*Elaeagnus commutate]*, Buckbrush [*Symphoricarpos occidentalis]*, and Prickly Rose [*Rosa acicularis]*) and forbs like Moss Phlox (*Phlox hoodii)*, Pasture Sagewort (*Artemisia frigida)*, and Prairie Selaginella (*Selaginella densa)*. The native vegetation communities of the Dry Mixedgrass Subregion follow an environmental gradient from cooler, wetter conditions to warmer, drier conditions. Respectively, these are:

- Graminoid wetlands on poorly drained Gleysols;
- Riverine “gallery” forests of plains cottonwood and willow on variable-textured, well to imperfectly drained Regosols;
- Low shrublands (Buckbrush, Silverberry, Silver Sage, Prickly Rose) on imperfectly drained Brown or Dark Brown Chernozems;
- Western Wheat Grass-June Grass on fine textured, moderately well to imperfectly drained Brown Chernozemic or Solonetzic soils;

- Needle grasses, Blue Grama Grass, and Western Wheat Grass with Brown Chernozemic or Solonetzic soils on moist lower slopes;
- Needle and Thread Grass-Blue Grama Grass on moderately well drained mid to lower slope positions, on medium to fine textured Brown Chernozems;
- Blue Grama Grass-Needle and Thread Grass on well drained upper slope positions with Brown Chernozemic soils; and
- Sand Grass (*Calamovifa longifolia*), June Grass, and Needle and Thread Grass on sand dunes and plains with Regosols and Rego Chernozems (GOA, 2006).

Wetlands and natural waterbodies are not common in the DMNS. Typical wetlands and waterbodies include ephemeral waterbodies, marshes, shrubby swamps, and shallow open water wetlands (GOA, 2006). Wetland classes in Alberta are described in the Alberta Wetland Classification System (GOA, 2015a). Wetlands are areas with high water tables, with soil, terrain and vegetation features typical of temporarily to permanently saturated soil conditions. Wetlands on the prairies include marshes and shrubby swamps, dominated by hydrophytic species such as sedges, spike rushes, and willows along with salt tolerant plants such as Red Samphire (*Salicornia rubra*) and Salt Grass (*Distichlis spicata)*. Deep water habitats (lakes and rivers) are uncommon but are important for the maintenance of aquatic life and provide highly productive riparian habitat and water resources for upland species. In Alberta, wetlands have been subject to alteration, degradation, and loss due to a variety of activities including agriculture and urban expansion, forestry, oil and gas exploration and development, and mining.

Wetlands and grasslands provide diversity and structure to an ecosystem, offering a range of functions. Wetlands are natural water filters, purifying and regulating water quality and recharging groundwater, while also serving as flood buffers. They are critical rest stops or breeding grounds for migratory birds and other wildlife species, supporting biodiversity and providing habitats for plants and animals. Grasslands help sequester carbon, maintain and protect soil health, and provide food for herbivores and pollinators.

Native grasslands in the DMNS have been subject to land use changes for agricultural purposes including conversion to tame pasturelands, croplands, and irrigated croplands. Other land uses and disturbances are less common but include feedlots, landfills, farmsteads, and oil and gas infrastructure. Natural water systems have been supplemented by the development of a system of reservoirs and canals providing additional aquatic habitat areas. Provincial guidelines for the preservation of native grasslands are provided in the South Saskatchewan Regional Plan under the Provincial Land Use Framework (GOA, 2018a). This specifies that grassland areas are to be preserved on Crown lands and as a best management practice should be maintained on private lands where possible. Native and non-native grasslands are classified following the Conservation Assessment of Prairie Grasslands (GOA, 2018b). Ecological grassland communities are classified as per the Dry Mixedgrass Range Plant Community Guide Second Approximation (Adams, et al., 2013b)

In comparison to other grassland subregions of Alberta, the DMNS has a relatively high percentage of remaining native grasslands (47% of townships have >50% native grassland cover; (GOA, 2018b) compared to the other grassland subregions: Foothills Fescue – 17%, Mixedgrass – 24% and Northern Fescue – 25%. In addition, lands in the DMNS are relatively protected as 42% of the subregion is Crown land (Provincial: 36.7%, Federal: 5.7%). Government planning in the late 20th Century only considered native grasslands on Crown for protection (GOA, 1997a).

This was in part because much of these grasslands are relatively intact. In contrast, the native grasslands in the Project area are relatively fragmented due to roads, canals, ditches, and utility corridors.

The need for preservation of wetlands is outlined in Alberta's Wetland Policy in which the goal is to protect and manage wetlands and to preserve their environmental benefits (GOA, 2013a). The policy supports a comprehensive, cumulative effects-based management approach in which several concepts are considered, of which the two primary ones are:

1. Relative Wetland Value – each wetland can be assigned a ranked value from Low (D) to High (A) based on their hydrologic and ecological functions and human benefits.
2. Wetland Mitigation Hierarchy – the preferred methods to preserve wetlands include (from most to least preferred):
    a. Avoidance,
    b. Minimization, and
    c. Replacement.

10.1.3 Regulatory Context

This baseline assessment is guided by provincial and federal legislative requirements for the management and protection of vegetation resources and wetlands (Table 10-1).

Table 10-1: Regulations and guidelines for assessment and protection of vegetation and wetlands in Alberta

Regulation or Guideline	Context
Species at Risk Act (SARA)	The federal *Species at Risk Act* governs activities that may impact any federally listed species at risk (Government of Canada [GOC], 2002). This legislation applies to projects on federal lands, to Schedule 1 Species which are protected under the *Migratory Birds Convention Act* and Schedule 1 aquatic species regardless of ownership or jurisdiction. Other rare plants fall under provincial jurisdiction.
Alberta Wildlife Act and Regulations	The provincial *Wildlife Act (GOA, 2000c)* and Regulations *(GOA, 1997b)* requires protection of species of management concern including species listed federally under *SARA* as well as species, including plants, listed as endangered or threatened under the Wildlife Regulation.
Public Lands Act	All permanent and naturally occurring bodies of water are Crown lands in Alberta *(GOA, 2000d)*. This includes only deep permanent natural waterbodies or flowing watercourses.
Alberta Weed Control Act and Regulations	The Alberta Weed Control Regulation lists plants as prohibited noxious or noxious that have a negative economic impact and degrade native plant communities *(GOA, 2008; 2010a)*. Landowners and disposition holders are required to destroy regulated weeds listed as prohibited noxious and control populations of plants listed as noxious.
Water Act	Supports and promotes the conservation and management of water, through the use and allocation of water in Alberta. It requires the establishment of a water management framework and sets out requirements for the preparation of water management plans. Any impacts to wetlands must first be approved under this *Act.*

Regulation or Guideline	Context
Alberta Wetland Policy	The Policy objectives are to conserve, restore, protect, and manage wetlands in the province *(GOA, 2013a)*. There is a hierarchy of desirable actions including avoidance, minimization, or replacement.
Alberta Wetland Classification System	This system provides a standardized classification system for wetlands throughout Alberta *(GOA, 2015a)*.
Alberta Wetland Identification and Delineation Directive	Provides guidance on how to identify wetlands and delineate their ecological boundaries *(GOA, 2015b)*.
Alberta Wetland Mitigation Directive	Provides approaches to minimize negative impacts to wetlands and, where necessary, to replace lost wetland area and value.
Guide for Assessing Permanence of Wetlands	Provides a methodology for determining the permanence of wetlands which may be claimable by the Crown under Section 3 of the *Public Lands Act.*
South Saskatchewan Regional Plan	Policy for the management of land and water in southeastern Alberta, including Crown land requirements and best management practices for private lands including preservation of waterways, watersheds, and native grasslands *(GOA, 2018a)*.
Dry Mixedgrass Range Plant Community Guide Second Approximation	Provides plant community classes for the DMNS based on soils, hydrology, and vegetation species dominance *(Adams, et al., 2013a)*.
Conservation Assessment in Native Grasslands	Provides guidance for the field measurements of native grasslands and for classification of grasslands as native or non-native *(GOA, 2018b)*.
Alberta Native Plant Council Guidelines for Rare Vascular Plant Surveys in Alberta-2012 Update.	Provides a standardized approach to the assessment of lands for the presence of rare vascular plant species *(Alberta Native Plant Council, 2012)*.
Alberta Conservation Information Management System (ACIMS)	Provincial database on ecological communities and sites, and location, status and trends for sensitive elements (i.e., rare plants) *(GOA, 2022)*.
Grassland Vegetation Inventory	A comprehensive inventory of native and cultivated grasslands in the White Area of Alberta. The inventory is publicly available and can be used to develop maps of grasslands and soils for community classification and to help manage grasslands for agricultural or other uses *(GOA, 2019)*.

10.1.4 Issue Scoping

Scoping for this EIA is a process that includes:

- identifying Project activities that may alter or remove resources or indicators;
- developing a list of resources or indicators for vegetation and wetlands;
- identifying the risks, issues, or concerns regarding these effects;
- determining what assessments to include (ones where effects are likely), and which to exclude (effects are likely to be negligible or trivial); and

Screening based on data/information available for the assessment to help determine if the issue can be assessed locally and or regionally. Table 10-2 is a summary of issue scoping for vegetation and wetland resources impacted by the Project.

Table 10-2: Issue scoping for vegetation and wetlands resources

Project Activities and Risks	Resources	Indicators or Measures	Potential Issues	Screening
• Clearing of vegetation and topsoil in the new reservoir area. • Compaction or smothering vegetation and soils surrounding the development. • Removal of native vegetation including species or communities of concern. • Removal of and lost viability of propagules of native plants. • Establishment and spread of non-native grassland species or weeds. • Removal of wetlands and drainages. • Altered water table and seepage surrounding the new reservoir. • Altered water quality in surrounding wetlands due to silt and saline interactions. • Air emissions and dust effects on vegetation during construction. • Reclamation and planting/establishment of new vegetation communities in outer berm areas.	• Vegetation communities	• Area of range community classes. • Rare plants and communities of conservation concern. • Number of plant species per community class. • Mean and variability of community patch sizes.	• Loss of native vegetation/habitat.	• Likely – large areas will be permanently cleared.
			• Loss of plant communities of conservation concern.	• Likely – communities of concern will be removed and unlikely to re-establish in reclaimed areas.
			• Increase of disturbed/non-native plant communities.	• Likely – reclaimed areas may not be composed of native plant species.
			• Fragmentation of vegetation communities.	• Likely – the Project will divide community patches around the reservoir edge.
			• Reduced connectivity between vegetation communities.	• Likely – connectivity between community types will be reduced when vegetation areas are cleared.
	• Plant species of conservation concern	• Number of observations. • Plant species richness by communities.	• Loss of species of conservation concern. • Decrease or change in plant species richness in remaining communities or in reclaimed communities	• Likely – livestock grazing practices and existing land uses may have reduced baseline species of conservation concern.; further effects may occur due to loss of grasslands and change to landscape structure • Likely – Loss of saline habitats may decrease rare plant communities • Likely – species diversity is likely to decrease reclaimed area compared to native grasslands
	• Native grassland	• Composition of native grassland species. • Site and soil characteristics of native grasslands.	• Degradation of native grassland. • Loss of native grassland area.	• Likely – Project will remove several hectares of native grassland. Reclaimed grassland may not be able to sustain high native species cover. Native grassland patches

Project Activities and Risks	Resources	Indicators or Measures	Potential Issues	Screening
		• Area of native grassland.	• Fragmentation of native grassland areas[1]. • Connectivity of native grassland areas.	are likely to be reduced in size locally, however, native grassland areas are likely to stay connected to neighbouring grassland areas.
	• Traditionally used plants	• Occurrence, distribution, and percent cover of traditionally used plant species.	• Loss of traditionally used plants. • Reduced cover and distribution of traditionally used plant species.	• Likely – Traditionally used plants currently found in the TLSA may not successfully re-establish in reclaimed areas.
	• Native plant diversity/weed establishment	• Occurrence, distribution, and percent cover of noxious or prohibited noxious weed species, and other non-native or invasive plant species.	• Increase in weeds on the reservoir surface prior to filling. • New weed species establishment and persistence in reclaimed berm areas and aquatic habitats • Increase in weeds in reclaimed berm areas.	• Likely – weed establishment is rapid and common on disturbed soils and aquatic weeds may establish through disturbance and/or contamination by soiled equipment. Native plant diversity will take time to establish as weeds are controlled.
	• Wetlands and other natural water features	• Area of wetland classes. • Area of ephemeral waterbodies. • Length and pattern of flow in ephemeral draws.	• Direct loss of wetland area or change in wetland type from vegetation clearing. • Alteration of surface flow patterns and loss of drainages • Alteration of offsite wetlands by runoff, deposition of dust, or subsurface seepage • Increase of on- or offsite wetlands	• Likely – natural wetlands will be lost in the Project footprint and gained in the reservoir or surrounding areas as per replacement requirements • Likely – drainages will be altered in the footprint and may cease to function in offsite areas due to loss of source waters • Offsite effects may occur if mitigations are not successful

The Project's FTOR (Volume 2; Appenidx A) identifies the need to assess the current state of native grasslands and the effects of Project development on this resource. More than 75% of native grasslands have been removed or converted in Alberta to facilitate agriculture, infrastructure, municipal and industrial development (Nature Conservancy Canada, 2023). The *South Saskatchewan Regional Plan* identifies the importance of native grasslands requires conservation of native grasslands on Crown lands as a priority and recommends conservation on private lands (GOA, 2018a).

At present, native grasslands have been lost to cropland conversion and to other land uses. Grasslands have been modified in the planned Project area by past land uses and disturbances, including grazing, transportation infrastructure, oil and gas well sites and pipelines, irrigation infrastructure, utility lines, gravel extraction, and the establishment of aggressive non-native species which, in combination with grazing and other land use practices, have displaced native species. The Project will require the removal of a large area of native grasslands for development of the reservoir. Grasslands along the Project boundaries may be reclaimed to native or non-native species on new berm areas, and outer zones may be affected by equipment used to construct the reservoir, by soil and vegetation scarring, rutting, compaction, and introduction of non-native plants and weeds. Grasslands are fragmented and additional fragmentation is not expected as few or no new linear developments are planned; however, connectivity between native grassland patches will be affected due to the planned size of the new reservoir, and by continuing cumulative effects of agricultural conversion.

Based on Table 10-2, the following Resources, and Indicators were selected for detailed assessment:

- Vegetation Communities
  - area of vegetation community classes
  - area of communities of conservation concern
  - plant species composition and cover in natural and reclaimed communities
  - fragmentation (patch size distribution) and connectivity between communities
- Plant Species Diversity
  - plant species of conservation concern observations
  - plant species richness in natural and reclaimed communities
- Native Grassland
  - composition of native grassland species
  - site and soil characteristics of native grasslands
  - area of native grassland
- Traditionally Used Plants
  - occurrence, distribution, and percent cover of traditionally used plant species
- Native plant diversity
  - occurrence, distribution and percent cover of weeds and other non-native plants which can impact native plant diversity
- Wetlands and Other Water Features
  - area of wetland classes
  - area of ephemeral waterbodies
  - length and flow patterns in ephemeral draws

10.2 BASELINE ASSESSMENT METHODS

10.2.1 Study Areas

Baseline conditions and potential Project effects were assessed at both a local (project-specific) scale and a regional (cumulative effects) scale by examining resources or indicators in a Local and Regional Study Area. The study areas for vegetation and all other terrestrial disciplines were defined as:

- Terrestrial Local Study Area (TLSA) – Project boundary + 500 m buffer (see Appendix H1, Figure H1-2)
- Terrestrial Regional Study Area (TRSA) – Project boundary + 15 km buffer (see Appendix H1, Figure H1-3)

Terrestrial Local Study Area

The Project footprint encompasses the planned reservoir expansion area (879 ha) and a contiguous soil storage area northeast of the planned reservoir expansion of 41.3 ha. The permanent footprint (dam plus reservoir) is 827 ha. The TLSA (see Appendix H1, Figure H1-2) includes all lands within the expansion Project footprint in Sections 29, 30, 31, and 32-19-16 W4M, plus lands planned for topsoil storage in sections 4 and 5 of 20-16 W4M. A 500 m buffer surrounds these areas, totalling 1,657.9 ha (Table 10-3). The Project footprint and the adjacent area are more likely to experience environmental effects from Project activities. Land classes including natural and anthropogenic areas are identified in Table 10-3. Most of this area (76%) is native grasslands, with 9% cultivated lands, 6% wetlands, 6% anthropogenic water, and 3% disturbances.

Table 10-3: Summary of baseline indicators for the Terrestrial Local Study Area and Terrestrial Regional Study Area

Land Class	TLSA[1]		TRSA[2]	
	Area (ha)	%	Area (ha)	%
Native Grasslands	1,232.3	74.3	45,250.5	51.2
Cultivated Lands	184.3	11.1	29,352.8	33.2
Woody (shrubby/treed)	9.8	0.6	57.6	0.1
Anthropogenic Water (reservoir, dugouts, canals, ditches)	91.4	5.5	1,467.0	1.7
Wetlands/Waterbodies (including watercourses)	94.4	5.7	8,037.4	9.1
Disturbances (roads, rail lines, municipal, etc.)	45.6	2.8	4,239.5	4.8
Total	**1,657.9**	**100**	**88,404.9**	**100**

1 Terrestrial Local Study Area
2 Terrestrial Regional Study Area

Terrestrial Regional Study Area

The TRSA was developed as a land base for the cumulative effects assessment to address how Project effects may interact with past, present, and future activities on regional resources or indicators. The TRSA includes a 15 km radius around the edges of the Project footprint (see Appendix H1, Figure H1-3). The 15 km radius was chosen to match what was used in a recent EIA for assessment of terrestrial resources (Stantec Environmental Consulting Ltd., 2018). This

will allow the assessment to determine the potential for regional level impacts on environmental sensitivities which includes cumulative effects and any widespread effects from the Project. These study areas have been parametrized with existing disturbances and land uses. The TRSA is an area in which effects from the Project footprint could overlap/accumulate with other Project/operation effects. The TRSA covers 88,404.9 ha. In comparison to the TLSA, only 51% is native prairie, 33% is cultivated, 9% is wetlands, 5% is disturbed, and 2% is anthropogenic water.

10.2.2 Plant Community Classification

Prior to fieldwork, a preliminary plant community map was developed from Grassland Vegetation Inventory (GVI). GVI is a spatial dataset of vegetation and soils information within prairie areas of Alberta, mapped from aerial photography (GOA, 2019). This inventory is available publicly from the Government of Alberta. GVI polygons include attributes of vegetation and soil characteristics. GVI for the TLSA was then classified into preliminary grassland community classes, including dry grassland, mesic grassland, cultivated fields, non-native grassland, low shrub/grassland, tall shrub, woodland, and various disturbance classes. In addition, classes for wetlands (mapped separately following Alberta Wetland Policy methods), blowouts, reclaimed gravel pits, dugouts, saline lowlands, and transition zones were mapped. Selected locations were then chosen for field verification. In addition, potential grassland communities in the DMNS were reviewed and a list of the most likely communities and their species was compiled as an aid to help identify grassland communities (Adams, et al., 2013a).

Fieldwork for vegetation community description and mapping verification was completed by a team of two vegetation specialists. Fieldwork occurred on the following dates: June 11-20, 2021, and July 23-26, 2021. Each pre-selected sample site was measured using a modified protocol based on Conservation Assessments in Native Grasslands guidelines (GOA, 2018b) including collection of site, soil, and vegetation data on data sheets and/or field notes. Measurements included native and non-native species and percent cover, topsoil conditions to 30 cm depth including horizon classes, depths, soil texture, and colour, and site characteristics including slope, aspect, elevation, terrain class, site position, and moisture regime. Photographs were taken of each site recording the site number, direction of view, and location. As per the guidelines, three types of measurements were used:

- detailed transects made up of subplots summarized to determine total species present and average cover of dominant species; transects included a detailed site description and 30 cm deep topsoil pit;
- rapid assessment plots, in which a single plot was measured per site to verify the community classification; and
- visual plots, in which a visual check was used to see if the community type in the field matched the pre-field mapping.

In addition to preselected sites, while crews were onsite, any habitat area that appeared to have a different appearance from surrounding habitat was also examined.

Quality control on collected data was completed by reviewing data sheets at the end of each days' work to check for errors and missing data. Any errors were corrected by reviewing site photographs, or if needed – by revisiting the site.

Following fieldwork, plant community data were entered into a spreadsheet. Accuracy of data entry was ensured by completing a random sample of data sheets which were compared to the entered data to determine if errors in attributes, species, or measured cover values were present and how frequently these occurred. These were fixed as needed and if systemic errors were found a full review of field data sheets was then completed.

Range community classes were then re-mapped based on dominant species, soil, and site conditions. Each sample site was classified to reference communities from the Dry Mixedgrass Range Plant Community Guide, or in some cases, to the Mixedgrass Plant Community Guide (Adams, et al., 2013b). This was justified as the Project occurred close to the border of the Mixedgrass Natural Subregion and in some cases, the classes were found to better match the communities in this classification. Each sampled polygon was then reclassified based on the field plots; where more than one plot occurred in a single polygon, community polygons were subdivided to reflect different community measures in different parts of the polygon.

Once mapped, the areas (in hectares) of community classes in the TLSA were calculated. Next, existing mapped disturbances, including permanent infrastructure and altered or reclaimed vegetation surfaces, developed from a variety of sources, were overlain on the communities. An overall summary of baseline community and disturbance classes was then determined. Field data were also analyzed to determine the average site, soil, and vegetation community conditions (i.e., dominant vegetation species and species richness) observed in each community class.

For the TRSA, its size limits the ability to map vegetation communities so only broad vegetation community classes can be mapped using the GVI data base without field confirmation.

10.2.3 Species Richness Assessment

Species richness is the total number of species observed in a defined area. Species richness was calculated for each rangeland plant community by compiling a species list for each sample site among all plots within a community. The baseline species richness of native grassland communities can be compared to future reclaimed areas determined through post-reclamation monitoring. Both the total number of plant species (total species richness) and mean number of species per sample plot (mean species richness) were calculated. While mean richness tells how many species are likely to be found at any one site for a given community, it does not reflect the true species richness for the community, which can be much higher, or lower, as many species are only found sporadically. Total species richness shows the size of the known pool of species present for each community; however, it is highly affected by low sample sizes. Thus, both measures were examined in addition to sample size to understand which communities had relatively higher or lower species richness.

10.2.4 Native Grassland Assessment

Classification of each site as native or non-native grassland was based on guidance from Conservation Assessments in Native Grasslands which states native grassland status can be determined from (GOA, 2018b):

- the percent composition of native versus non-native species;
- the area (ha) of native grassland;
- composition of native grassland species;

- descriptive site characteristics (soil, salinity, moisture, etc.); and
- weed presence and densities.

Total vegetation species cover was summed for each plot and used to assess the percent composition of native and non-native plants. Following this guidance, sites with >30% native plant cover were assessed as native grassland, and those with <30% were assessed as non-native grassland. The area in hectares (ha) of native and nonnative grasslands was then determined.

10.2.5 Rare Plant Surveys

The Alberta Native Plant Council (ANPC) defines a rare plant as a "native species which, due to biological or geographical characteristics, is found in restricted areas, or at the edge of its range, or for other reasons is found in low numbers within the province of Alberta or in very restricted areas in Alberta" (Alberta Native Plant Council, 2012). A rare ecological community refers to ecosystems that are uncommon within a particular geographical area. They are naturally occurring (GOA, 2022). These rare communities contain species, which on their own may not be rare but in certain combinations or degree of dominance are considered rare and appear on the provincial tracking list (GOA, 2022). The Alberta Conservation Information Management System (ACIMS) Tracking List denotes seven ranks of rarity for vascular and nonvascular plants and plant communities where the plants are evaluated and ranked on their global and provincial status based on the number of verified observations, population centers, and other known information of the biological status of the species. Ranking is based primarily on the number of recorded occurrences, since that is often the only information available. Information, such as population size and trend, life history and reproductive strategies and current threats are considered in the ranking when this information is available. In Alberta the ranking system is as follows:

- S1: Known from five or fewer occurrences or especially vulnerable to extirpation because of other factor(s).
- S2: Known from twenty or fewer occurrences or vulnerable to extirpation because of other factors.
- S3: Known from 100 or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factors.
- S4: Apparently secure. Taxon is uncommon but not rare. Potentially some cause for long term concern due to declines or other factors.
- S5: Secure – taxon is common, widespread, and abundant.
- SNA: Not applicable. A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities. For example, introduced species.
- SNR: Not ranked. Conservation Status not yet assessed (GOA, 2022)
- SU: Currently unrankable due to lack of information or substantially conflicting information.

Plants of Conservation Concern (Rare Plants) were defined to include species:

- listed as "Endangered", "Threatened", or "Special Concern" under Schedule 1 of the federal *Species at Risk Act*, or
- listed as "Endangered", "Threatened", or "Special Concern" by Committee on the Status of Endangered Wildlife Species in Canada (COSEWIC), or
- listed as "Threatened" or "Endangered" in the Alberta Wildlife Regulation, or

- ranked from S1 to S3 by the ACIMS. This corresponds to the definition of rare plants in *Rare Native Plants of Alberta, 2nd Edition* (Fryer, et al., 2022).

The FTOR (Volume 2; Appendix A) requires plants listed as “At Risk,” “May Be At Risk,” and “Sensitive” in The General Status of Alberta Wild Species however it should be noted that this listing does not include plants.

Prior to fieldwork, a comprehensive list of potential rare plants and rare plant communities was developed based on ACIMS Rare Elements for the DMNS (Appendix H2). This list included tracked and watch list plants and communities and all plants ranked from S1 to S3, plus any records of rare plants and communities within the TLSA and the surrounding Township. The list was refined by examining published range maps in various botanical publications to determine species and communities most likely to occur in the TLSA.

Rare plant surveys were conducted following the Guidelines for Rare Vascular Plant Surveys in Alberta – 2012 Update (Alberta Native Plant Council, 2012). These surveys involved biologists determining the presence and location of observable and detectable rare plant species on a survey site. A rare plant survey can confirm the presence of rare species on a site, but it cannot rule out the existence of rare species there (Alberta Native Plant Council, 2012). Biologists must time the surveys to coincide with the flowering window for rare plants likely in the area. Thus, biologists must ensure that a rare plant survey meets a minimum standard and is conducted during the appropriate season(s) when most species at a given site are likely to display characteristics detectable by an experienced rare plant specialist. Following the guidance of the Alberta Native Plant Council, a rare plant survey should be completed by:

- determining the potential rare plant species based on those known to occur in and around the study area and those known to occur on similar habitats to those within the study area. Observations of previously observed rare plant species within a specific location may be downloaded from the ACIMS website (Appendix H2);
- determining the typical habitat types, dates of collection, and plant phenology for all recorded rare plants, and then determining, based on published plant accounts or herbarium collections a list of potential rare plant species, and their habitat requirements and identifying features;
- researching the flowering periods (phenology) of plants to establish the best timing to conduct a rare plant survey, determining the habitat types with greatest potential for the rare species to occur, and using this information, and any available mapping, to identify high priority sampling sites; and
- using a sampling technique to best achieve the identification of rare plant species that are present and detectable in an area, given constraints of budget and timing.

Based on the above research, the best times to survey the Project area were determined to be early to mid-June for early flowering plants and mid to late July for late flowering plants. Early and late season rare plant surveys were conducted from June 11-20, 2021, and July 23-26, 2021, respectively. For this Project, plotless floristic surveys were completed by meandering throughout target areas in and around the proposed Project footprint. The biologists searched the various habitat areas, and microsites within these areas. This method was used to increase the likelihood that sensitive species were observed and identified. The biologists referred to identification guidebooks to field classify common species. Species considered to be common were typically

only recorded once each, while species suspected to be rare were recorded from multiple locations. Common species may have been recorded more than once if they showed different stages of flowering or fruiting during the surveys. As there are many potential rare species in this area, a targeted search was also completed for species previously recorded in the area, by maintaining reference sheets with photographs and descriptions of these plant species. In addition to recording occurrences of rare plants, a full floristic list of observed vascular plants was recorded including incidental observations of noxious or prohibited noxious weeds and other non-native plants.

All surveys were completed with the aid of a Global Positioning System (GPS) unit to record observed locations of rare plant species and photographs were taken of search areas and any observed species. Plants of conservation concern were assessed in terms of presence within the TLSA based on field surveys, or by known observations within the searchable online ACIMS database within the TRSA.

10.2.6 Traditionally Used Species

Many native plants have been used by Indigenous Peoples in various aspects of their culture and way of life including, medicines, dyes, food, crafts/construction and for various spiritual purposes. A literature review was conducted to identify plants in the DMNS which may have been traditionally used by the Blackfoot Peoples and identified within the Project footprint. We recognize that this method is reliant on previously published studies and may not reflect the true number of different species used on Traditional Lands, nor does it consider the value of species in this area based on local collection needs nor species quality or whether these species would have value. However, it does provide a list of species that have previously been identified as important to the Blackfoot Nation and addresses if these species have been found onsite.

10.2.7 Wetlands and Waterbodies

Alberta Environment and Protected Areas (Alberta EPA) defines wetlands as land saturated with water long enough to promote formation of water altered soils, growth of water tolerant vegetation, and various kinds of biological activity that are adapted to the wet environment (GOA, 2015a). Common identifying features of wetlands are hydric soils and hydrophytic vegetation, although the vegetation may not always be present if biotic or anthropogenic factors have removed them or prevented their development (National Research Council, 1995).

All surface hydrological features on the Project site have been identified, classified, and delineated, including wetlands and ephemeral waterbodies, drainages, watercourses, and anthropogenic water bodies. Wetlands and ephemeral waterbodies were classified based on definitions in the Alberta Wetland Classification System [AWCS] (GOA, 2015a). Watercourses and ephemeral draws were classified based on the Alberta Public Lands Glossary of Terms (GOA, 2023a) and the Alberta Timber Harvest Planning Operating Ground Rules Framework (GOA, 2024a). Anthropogenic waterbodies, including features such as dugouts, reservoirs, ditches, and industrial/stormwater ponds, were classified based on aerial imagery observations such as linear edges and observed changes over the historical record, and field confirmed.

Wetlands and waterbodies were identified, and boundaries were delineated in accordance with the Alberta Wetland Identification and Delineation Directive (GOA, 2015b). The Alberta Merged Wetland Inventory (GOA, 2021a) and hydrological mapping (e.g., Fisheries and Wildlife Information System [FWMIS], Base Features Mapping) were reviewed to identify possible onsite wetlands and waterbodies. Wetland boundaries were then delineated using a Geographic Information System (GIS) prior to fieldwork using imagery obtained from the Alberta EPA Informatics Branch, Air Photo Distribution and from ESRI®.

Aerial photographs were selected within the growing season (April to October) to represent a range of wet, average, and dry conditions to assess changes in wetland sizes, hydroperiod, and classification for as far back as records were available. The imagery was also examined to identify changes in local disturbances and land uses on, and adjacent to, the Project site. In addition, any disturbance to waterbodies (e.g., cultivation, dugouts, impoundment, infilling, cleared patches, or built infrastructure) was recorded. Aerial photographs were selected for the following dates and assessed site moisture conditions based on the combination of season, and historical precipitation recorded for the site leading up to the arial photograph capture date:

- May 12, 1950 (Average conditions)
- October 1, 1962 (Dryer than average)
- April 5, 1970 (Average)
- September 28, 1973 (Average)
- September 12, 1977 (Average)
- August 9, 1981(Wetter than Average)
- August 16, 1991 (Average)
- July 15, 2012 (Average)
- June 9, 2015 (Average)
- 2018 (Average)[1]

[1]Actual date not known but in growing season as evidenced by leafed out trees.

Determination of average, wetter than average, or dryer than average moisture conditions were based on a combination of season of capture, plus annual, monthly, and more recent rainfall records preceding the date of capture of each aerial photograph. Table 10-4 below is a summary of rainfall conditions of each aerial photograph. Average rainfall was 334 mm ± 1 standard deviation (SD).

Table 10-4: Precipitation conditions at time of aerial photos

Date of Aerial Photo	Precipitation Conditions[1]	Date of Aerial Photo	Precipitation Conditions[1]
May 12, 1950	1950: 374 mm (Average)[2] April: 14 mm (Average)[3]	August 9, 1981	1981: 365 mm (Average) July: 84 mm (Wet)
October 1, 1962	1962: 237 mm (Dry) Sept: 42 mm (Average)	August 16, 1991	1991: 368 mm (Average) July: 18 mm (Average)
April 5, 1970	1970: 394 mm (Average) March: 17 mm (Average)	July 15, 2012	2012: 372 mm (Average) June: 140 mm (Wet)
September 28, 1973	1973: 331 mm (Average) September: 16 mm (Dry)	June 9, 2015	2015: 268 mm (Average) May: 10 mm (Dry)
September 12, 1977	1977: 346 mm (Average) August: 48 mm (Average)	2018	2018: 320 mm (Average)

1 (GOA, 2023b)
2 Annual rainfall (1950 to 2023) Mean (334.2 mm) ± 1 standard deviation (sd; 80.1 mm) is average, rainfall above 1 sd is wet, and below 1 sd is dry
3 Monthly rainfall (1950-1982 for each month was assessed as mean ± 1 standard deviation is average, rainfall above 1 sd is wet, and below 1 sd is dry

Each potential waterbody was delineated on every year of available aerial imagery by drawing a polygon around the edge of wet areas as identified by change in texture, colour, or observed terrain, soil, water, saline surface, or vegetation boundaries. Delineations for each year were amalgamated and the largest composite area, excluding outlier conditions for each potential waterbody, was used to determine a 'best-fit' desktop delineated boundary. This method is intended to demonstrate the average size of the waterbodies over the period of photographic records.

Delineated wetlands were then field confirmed as wetland, waterbody, or upland classes based on observed topography, vegetation, and soil conditions. Wetland functional assessments were completed using the Alberta Wetland Rapid Evaluation Tool-Actual (ABWRET-A).

A field assessment was conducted in June 2021, and August 2022. As is required by the Alberta Wetland Assessment and Impact Report Directive (GOA, 2017a), fieldwork was completed within the growing season (between April and October). The field survey included validation of potential wetland boundaries identified during the desktop review, and documentation of wetland classification, size, substrate, vegetation, and wildlife species.

10.2.8 Habitat Fragmentation and Disturbance

A major consequence of landscape disturbances is that previously large areas of natural habitats have areas removed (direct losses) are fragmented (split into smaller patches), and have altered connectivity, or distance between similar patches. These changes can erode the integrity of an ecosystem, resulting in a landscape at risk of losing native species, while gaining increasing cover of non-native species and weeds. The habitat value for wildlife and vegetation can change, with the greatest risk being to sensitive or endangered species that rely on large, connected patches of habitat. Additionally, disturbances can occur within community patches, such as when a community area sustains losses due to grazing, mowing, vegetation cutting, rutting, minor excavations, and other anthropogenic activities.

Direct losses are summarized as part of the plant community classification. At baseline, the existing loss of any individual community is not known, only the area of existing disturbed land.

Fragmentation occurs when natural community classes become divided into smaller patches within a matrix of anthropogenically modified land-disturbances such as cultivated fields, canals, rail lines, ditches, roads, etc. A patch analysis focused on natural habitat classes (wetlands, native grassland, woody areas). These were grouped into one of six size classes: 0-5, 5-15, 15-30, 30-50, 50-100, and >100 ha. Patches are therefore community classes that are divided by disturbances. Metrics included total patch number and area (ha) per size class and the mean patch area in the study area. Patch sizes were examined in the TLSA and TRSA.

Connectivity was measured by the mean distance (m) between natural community patches (edge to edge). A GIS patch analysis tool pack was used to compute these distances.

As the lands within the TLSA have been used for livestock grazing, an analysis of impacts on grasslands through over-grazing on arid lands has also been examined, through literature review.

10.2.9 Native Grassland Conservation Offsets

Conservation offsets have been examined in Alberta to reduce the effects of land developments by improving previously disturbed lands or formally preserving offsite lands (Alberta Association for Conservation Offsets, 2024). The process for implementing native grassland conservation offsets is relatively new, and policies or regulatory processes to implement these or receive credit for offsets have not been developed, however, a conservation offset trial could be implemented as part of the reclamation of dam embankments. Conservation offsets for native grassland areas could also take the form of reclaiming and restoring a former native grassland site that has been disturbed by past industrial or agricultural activities or that has changed slowly due to introgression of non-native grass species. The offsetting could be achieved by:

- actively naturalizing a degraded or previously cultivated and planted pasture through targeted seed or plug plantings of native species;
- restoring a cultivated field or industrial land by planting a native plant seed mix with the addition of native plants as plugs and potted plants; and
- preserving lands that would otherwise be developed or further degraded, possibly through the partnership with a Land Trust or similar agency such that land can be formally protected through transfer of title or placement of a conservation easement on the land.

A concept for a grassland conservation offset program was examined by the Alberta Conservation Association (ACA), Ducks Unlimited Canada (DUC), and Nature Conservancy of Canada (NCC) (ACA, DUC, NCC, 2015). They examined possible ways to deliver an offsetting program, possibly through collection of an *in-lieu* fee for lost natural areas to allow industries and agencies to pay into a fund to support preservation of offsite lands. A pilot process (i.e., Southeast Alberta Conservation Offset Pilot 2011-2015) was examined in southern Alberta and developed recommendations for private land offsets, including (GOA, 2015c):

- quantifying the offset requirements for industrial developments;
- targeting voluntary offsets on private lands with the best potential for improving the landscape;
- determining landowner willingness to provide offsets through reputable third-party contracts; and
- determining the roles and costs for a qualified third party to facilitate landowner project development and obligations.

A grassland restoration plan has been developed for the new berms, temporary workspaces and soil storage areas to partially offset the loss of native grassland from the reservoir expansion and can be found in Appendix H9.

10.3 TLSA BASELINE ASSESSMENT RESULTS

10.3.1 Vegetation Communities

Field Sample Sites

Table 10-5 summarizes plots sampled by community class. A total of 91 plots were sampled. As plots were sampled at predetermined sites, the final community classes were not known until after the data were analyzed. Thus, some community classes are represented by only 1 to 2 plots,

while more common communities have 3 or more plots. Appendix H1, Figure H1-4 shows the location of sample plots within the TLSA. Appendix H3 is a summary of sample sites by coordinate location and community class. Appendix H4 provides the dominant plant species observed in each community class.

Table 10-5: Vegetation plots sampled by community classification

Vegetation Community	Native Yes/No	Description[2]	Number of Plots
DMGA10	Y	Blue Grama Grass/Needle and Thread Grass	3
DMGA36	Y	Blue Grama Grass/Salt Grass/Needle and Thread Grass/Nutall's Atriplex	1
DMGA37	Y	Sagebrush/Needle and Thread Grass/Blue Grama Grass/June Grass	1
DMGA45	Y	Western Wheat Grass/Salt Grass/ Curly-cup Gumweed	2
DMGA48	Y	Western Wheat Grass/Pasture Sagewort/Prickly Pear Cactus	2
DMGA52	Y	Western Wheat Grass/Blue Grama Grass	4
DMGA8	Y	Western Wheat Grass/Pasture Sagewort/Prickly Pear Cactus	1
DMGB1	N	Crested Wheatgrass	2
DMGB3	N	Crested Wheatgrass/Alfalfa	1
DMGB7	Y	Foxtail Barley/Kentucky Bluegrass/Western Wheat Grass	10
DMGC11	Y	Sagebrush/Needle and Thread Grass/Blue Grama Grass	25
DMGC9	Y	Saltbush/Poverty Weed/Western Wheat Grass	9
DMGA45	Y	Saltbush/Poverty Weed/Western Wheat Grass / Western Wheat Grass/Salt Grass/ Curly-cup Gumweed	3
MGA29	Y	Saltgrass/Foxtail Barley/Western Wheat Grass	1
MGA30	Y	Foxtail barley/June grass/Goosefoot	1
MGB1	N	Crested Wheatgrass/Prairie Sagewort	1
MGB2	N	Tufted Hairgrass/Kentucky Bluegrass/Buckbrush	5
MGB5	N	Kentucky Bluegrass/Common Dandelion/Smooth Brome	3
Anthropogenic	N	Disturbed by roads, oil and gas, etc.	2
Aspen Woodland	N	Trembling Aspen	1
Aspen/Balsam Poplar Woodland[1]	Y	Trembling Aspen/Balsam Poplar	2
Wetland	Y	Ephemeral Waterbody, Intermittent Shallow Open Water, Temporary Marsh or Seasonal Marsh, as per Alberta Wetland Classification System	4
Willow Shrubland[1]	Y	Willow/Sedge	7
		Total	**91**

[1] Though comprised of native species, these communities would not exist in dry prairie settings as they are normally found in association with riverbanks or wetlands. Seepage from the canal has allowed them to establish in the TLSA.
[2] See Appendix H6 for scientific names of each species

Site Conditions

A combination of environmental review and fieldwork was summarized to describe the onsite conditions of the SLR expansion area. The most common ecological range site communities for the planned Project site included Blowouts, Saline Lowlands, and Loamy soil areas. Blowouts occur on Solonetzic soils and are characterized by an impervious hardpan layer caused by excess sodium ions (Na+), and a land surface characterized by eroded pits. Saline lowlands are low elevation areas which contain salt enriched soils at a level that can retard most plant growth. Loamy areas are well drained non-saline soils on till or glaciofluvial parent materials with fine or very fine textures such as clay and silty clay (Adams, et al., 2013a). Overall, terrain is hummocky to undulating with low to medium relief landforms (GOA, 2016). This area has experienced average to below average precipitation for the past five years (See Section 10.3.4) resulting in dry soils and drying wetlands. Drought conditions were present in 2021 during data collection.

Vegetation communities in the TLSA have been subjected to a variety of disturbances including grazing, oil and gas infrastructure, sand and gravel extraction, access roads and trails, canals, ditches, and dugouts. Native grassland communities were composed of native grassland species (e.g., Blue Grama Grass, Porcupine Grass [*Hesperostipa spartea]*, Western Wheat Grass, June Grass, and Thread-leaved Sedge [*Carex filifolia]*), mixed with non-native (agronomic) grasses such as Kentucky Bluegrass (*Poa pratensis)* and Crested Wheatgrass (*Agropyron cristatum)*, as well as other agronomic species.

Dominant Species by Community Type

Twenty-one detailed vegetation transects, 23 rare plant survey sites, and 47 rapid assessments were recorded. Of these, species lists sufficient for species richness assessment were completed on 75 plots. Appendix H1, Figure H1-4 shows the location of plots within the TLSA. In each transect, 9 quadrats were assessed for the percent cover of each species and averaged for the transect. The dominant species for each transect was compared to the reference sites in the Range Plant Communities Guidelines (Adams, et al., 2013a) for the Dry Mixedgrass Subregion and the best fit range plant community was determined and mapped.

The standard classification system for plant communities in the grasslands of Alberta are Natural Subregion-based guides, with each community including a code for the subregion (e.g., DMG for Dry Mixedgrass), letter (A, B, or C identifying grass, forb or shrub dominated), and numeric value for the specific reference community. Some communities were observed that did not fit any of the DMG communities but did fit Mixedgrass (MG) communities. As the Project site is relatively close (15 km) from the MG Natural Subregion, this was considered a suitable alternative to trying to fit communities into unlike DMG classes. Other communities did not match either the DMG or MG classes; these communities were classified based on dominant species present and/or the type of community (e.g., Aspen Woodland).

The most common community types were DMGB7 (Foxtail Barley [*Hordeum jubatum*]/Kentucky Bluegrass/Western Wheat Grass), and DMGC11 (Sagebrush [*Artemisia*]/Needle and Thread Grass/Blue Grama Grass). DMGB7 is common in overflow and saline lowland areas which have an influx or presence of water during part of the year. It is likely that many of these community areas are also ephemeral waterbodies (see Section 10.3.4 - Wetlands) and tend to occur in depressions or along the edges of marshes; however, these may not match the ephemeral waterbodies delineations as different methods and criteria are used for mapping. Plants in this community can tolerate some alkalinity and salinity. Saline soils have a pH less than 8.5 and a higher percentage of soluble salts, especially sodium, while alkaline soils have a pH greater than 8.5 and are clay-based soils. DMGC11 is the reference plant community (which represents the modal community on blowout range sites) in the DMG Community Guide. These communities are limited by available moisture and/or soluble salts which have an adverse effect on plant growth.

The next most common community type was DMGC9 (Saltbush [*Atriplex truncata*]/Poverty Weed [*Iva axillaris]*/Western Wheatgrass), a reference plant community of saline and alkaline soils found in saline lowlands (Adams, et al., 2013a). Poverty Weed is often found associated with Salt Grass in soils with chemical properties too harsh for other plant species to thrive.

Three plant communities classified using the Mixedgrass Range Plant Community Guide (Adams, et al., 2013b) include communities found in overflow or loamy areas with greater moisture content.

MGB5 (Kentucky Bluegrass/Common Dandelion [*Taraxacum officinale*]/Smooth Brome [*Bromus inermis]*) is a modified plant community with non-native and disturbance adapted species and weeds. MGB1 and MGB2 are also modified plant communities which have been seeded with agronomic species. Community classes that did not match the DMG or MG community guides included Aspen Woodland, Aspen/Balsam Poplar Woodland, and Willow Shrubland classes.

Plant communities within the TLSA were grouped into one of six ecological community types for comparison to the TRSA. These ecological community types were native grassland, cultivation, wetlands/waterbodies, anthropogenic water, woody (shrublands and woodlands), and disturbances.

Table 10-6 shows the vegetation types and communities within the TLSA and the dominant plant species. Reference to field photographs of selected communities is provided; these are included in Appendix H5.

Table 10-6: Vegetation communities and wetland cover in the Terrestrial Local Study Area

Community Type	Community Class	Community Area (ha)	%	Type Area (ha)	%	Photo[1]
Native Grassland	DMGA10	254.8	15.4	1,232.3	74.3	-
	DMGA36	1.6	0.1			-
	DMGA37	15.1	0.9			-
	DMGA45	5.1	0.3			-
	DMGA52	20.0	1.2			-
	DMGA8	10.5	0.6			Plate H5-1
	DMGB7	523.7	31.6			-
	DMGC11	299.0	18.0			-
	DMGC9	83.7	5.0			-
	MGA30	2.5	0.1			-
	MGB1	14.8	0.9			Plate H5-2
	MGB2	1.5	0.1			-
Woody	Aspen/ Balsam Poplar Woodland	3.9	0.2	9.8	0.6	Plate H5-3
	Willow Shrubland	5.5	0.3			Plate H5-4
	Aspen Woodland	0.5	<0.1			Plate H5-5
Wetlands/ Waterbodies	Wetland	94.4	5.7	94.4	5.7	Plates H5-6 to H5-9
Anthropogenic Water	Anthropogenic Water	91.4	5.5	91.4	5.5	Plate H5-10
Cultivation	Cultivated Cropland	154.7	9.3	184.3	11.1	-
	DMGB1	14.0	0.8			Plate H5-11
	DMGB3	15.4	0.9			-
	MGB5	0.3	<0.1			-
Disturbance	Disturbance	45.6	2.8	45.6	2.8	Plate H5-12
Total		**1,657.9**	**100.0**	**1,657.9**	**100.0**	

[1] Photo Plates in Appendix H5

Within the TLSA, 74.3% of the land is composed of native grassland communities, 11.1% is cultivated, including croplands and older cultivated areas maintained as non-native grasslands, The remaining areas are composed of natural wetlands and waterbodies (5.7%) anthropogenic waterbodies (5.5%), woody communities (0.6%), and the remaining 2.8% are disturbances such as roads, ditches, and oil and gas development areas (Figure 10-1). The agricultural lands are primarily outside of the Project footprint within the TLSA with small patches of hay land within the Project footprint.

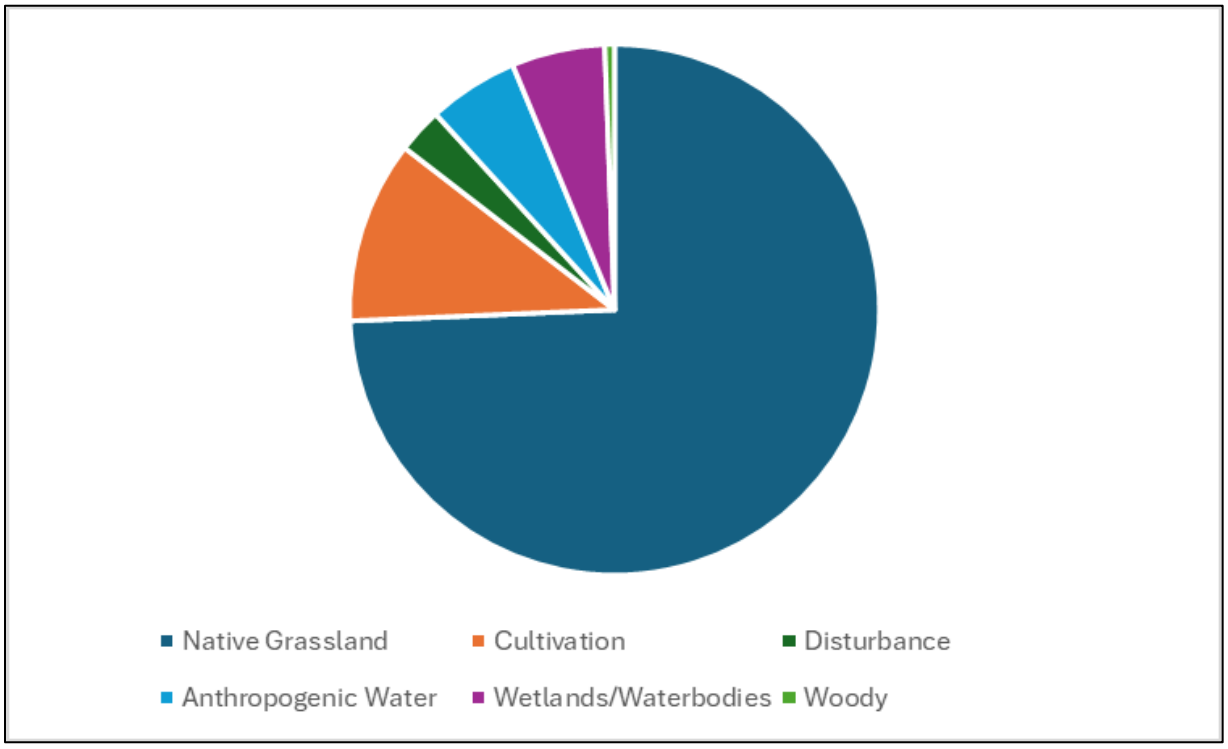

Figure 10-1: Percentage of ecological community types within the Terrestrial Local Study Area

Species Richness

Among upland community classes, 75 plots had sufficient species information to assess species richness. Total species richness ranged from 12 to 65 species, with the greatest number of unique species in DMGC11 and the least in DMGA36. However, the data shows that this result is highly related to the number of sample plots, with the higher number of plots associated with more species observations. Mean species richness is the best value for examining richness for this Project; although this does not convey the total species richness present, it provides a target number of species to be observed at any one site. DMGA8 and DMGA45 had the highest mean richness (18 species each) with 36 different species documented over 1 and 2 plots respectively. DMGA52 had 4 plot areas sampled and had mean species richness of 17.3 species; this community class is a late-stage class with species that can grow with limited resources and survive grazing pressures (Adams, et al., 2013a).

The community class with the greatest number of sites sampled was DMGC11. With a sample number of 25 plots, this community class had mean species richness of 16. Table 10-7 below shows the species richness of grassland communities.

Table 10-7: Species richness of each grassland community class in the Terrestrial Local Study Area

Community Class	Sum of Species Among Plots	Number of Sample Plots	Mean Species Richness	Total Richness (Unique Species Among Plots)
DMGA10	62	5	12.4	30
DMGA36	12	1	12.0	12
DMGA45	18	1	18.0	18
DMGA52	69	4	17.3	32
DMGA8	18	1	18.0	18
DMGB1	20	2	10.0	18
DMGB7	138	10	13.8	48
DMGC11	320	25	12.8	65
DMGC9	75	9	8.3	34
MGB1	14	1	14.0	14
MGB2	62	4	15.5	38
MGB5	28	3	9.3	20
Treed	27	2	13.5	20
Shrubby	83	7	11.9	39

Appendix H6 lists 163 plant species identified within the TLSA. Of these, 125 species are native, 35 are non-native, and 3 species were identified to genus only and cannot be grouped into native or non-native categories. Excluding the three identified to genus only, 77% were of native origin.

Disturbance and Fragmentation

Disturbances include all land classes that are anthropogenic in origin, including anthropogenic plant communities. The total disturbed area includes dugouts, oil and gas infrastructure, ditches, canals, railroad, and access roads. Also included are cultivated lands and seeded hay land. Disturbances total 321.4 ha or 19.4% of the TLSA. Total disturbed area will increase following reservoir development. In addition, a new reclaimed and restored grassland class will be developed on the outer berms which will partially offset the loss of native grassland from reservoir expansion. Table 10-8 shows the distribution of disturbance classes in the TLSA. Fragmentation occurs when linear disturbances divide communities into smaller patches. Community patches may be composed of multiple natural vegetation or wetland classes surrounded by linear disturbances. Community patches are shown in Appendix H1, Figure H1-5. Patches were grouped into 6 size categories. Table 10-9 summarizes patch size and distribution in the TLSA. Mean patch size for the TLSA is 4.7 ha. Of the 322 patches identified in the TLSA, 81% are in the 0-5 ha size (Figure 10-2). However, 45.3% of the patches are greater than 30 ha in size (Figure 10-3).

Table 10-8: Disturbance classes in the Terrestrial Local Study Area

Disturbance Class	Area (ha)	Coverage (%)
Agriculture	154.7	9.3
Anthropogenic	0.6	<0.1
Canal	43.2	2.6
Ditch	3.6	0.2
DMGB1	14.0	0.8
DMGB3	15.4	0.9
Dugout	10.2	0.6
MGB5	0.3	<0.1
Pipeline	12.9	0.8
Railway	9.8	0.6
Reclaimed Wellsite	0.9	0.1
Reservoir	34.4	2.1
Road	18.0	1.1
Trail	3.3	0.2
Wellsite	<0.1	<0.1
Total	**321.4**	**19.4**

Table 10-9: Summary of patch distribution in the Terrestrial Local Study Area

Patch Size Class (ha)	Patch Count	% of Patches	Mean Patch Area	Total Patch Area (ha)	% of Patch Area
0-5	261	81.1	0.8	211.5	13.9
5-10	13	4.0	9.1	319.7	21.0
15-30	8	2.5	21.9	285.0	18.7
30-50	35	10.9	41.8	334.7	22.0
50-100	5	1.6	74.0	369.9	24.3
>100	0	0.00	0.0	0.0	0.0
Total	322	100.0		1,520.9	100.0
Mean Size (ha)					4.7

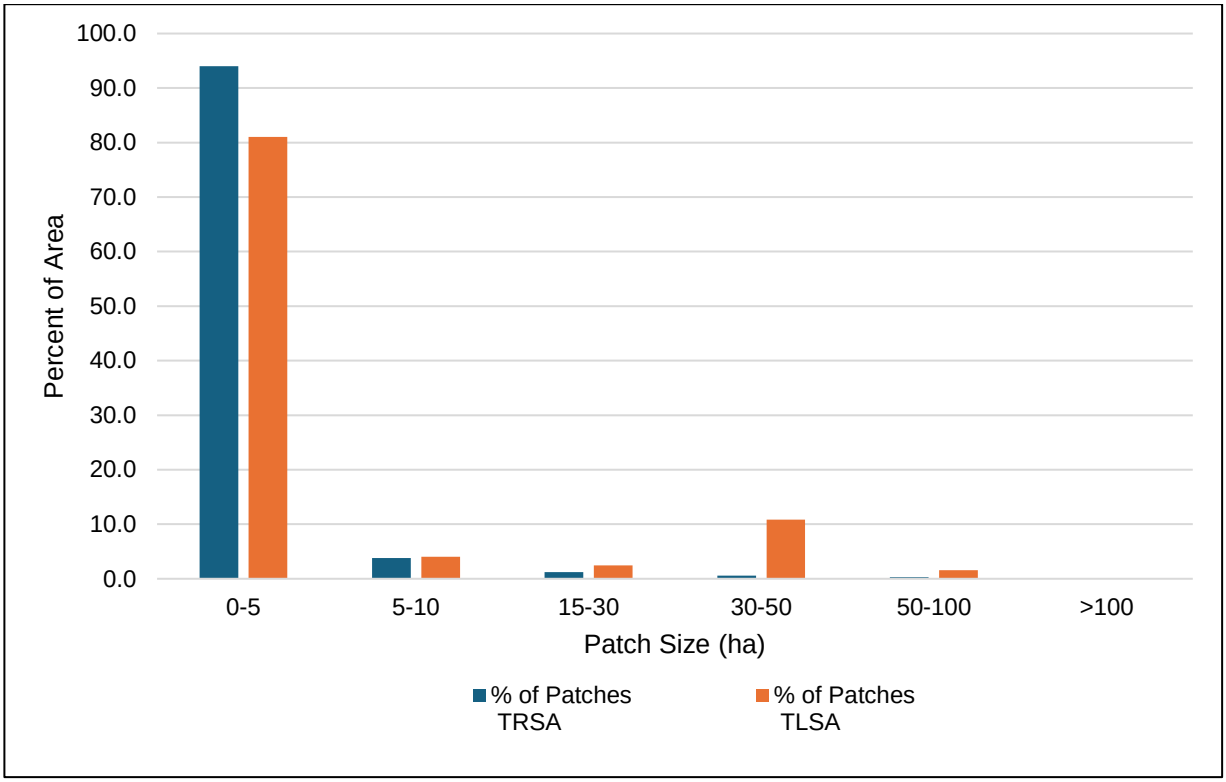

Figure 10-2: Percent of patches by size class in the Terrestrial Local Study Area showing the Terrestrial Regional Study Area for comparison

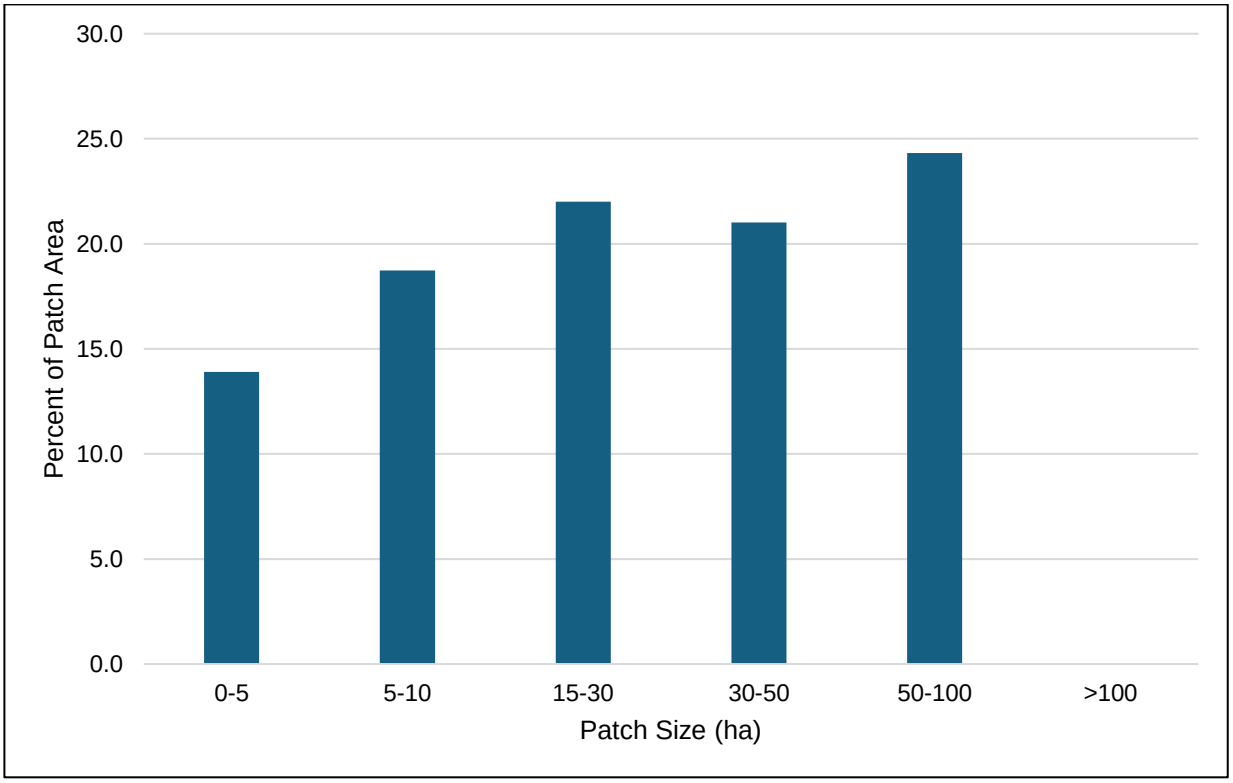

Figure 10-3: Percent of patch area by size class in the Terrestrial Local Study Area

Heavy grazing was evident during field investigations along with extensive pugging in wetlands. Pugging is the creation of depressions or channels in a wetland caused by the trampling of vegetation and soils by livestock. If grazing is not managed properly, there can be negative impacts to an ecosystem. Wetland characteristics (soils, vegetation, hydrology) predominantly respond negatively to the effects of grazing. Positive and neutral effects have also been reported such as controlling the biomass of undesirable or competitive plant species. Effects on wetlands include changes to vegetation and invasive flora (composition, health and structure), water (regime and quality), and soil (physical form and properties), however the degree of impact is variable (Morris & Reich, 2013).

A quantitative synthesis of studies conducted in arid North American rangelands showed that heavy grazing or grazing in arid ecosystems can be related to significantly greater levels of soil erosion and significantly reduced organic cover and soil infiltration rates (Jones, 2000). Studies highlighted that seedling survival, grass and shrub cover, litter cover, biomass, and total vegetation biomass were all significantly reduced when compared to data collected in ungrazed areas (Jones, 2000). Eldridge et al. (2016) reported that grazing had larger negative impacts in arid systems when considering plant biomass, cover, and soil function. Morris and Reich (2013) have outlined the four processes involved with livestock grazing that alter wetland conditions: treading, transportation of seeds, depositing feces and urine, and herbivory.

Weeds

Three noxious weeds, Canada Thistle (C*irsium arvense;* see Appendix H5, Plate H5-13), Perennial Sow Thistle (*Sonchus arvensis;* see Appendix H5, Plate H5-14), and Field Bindweed (*Convolvulus arvensis*; see Appendix H5, Plate H5-15), plus two prohibited noxious weed, Hoary Alyssum (*Berteroa incana*; see Appendix H5, Plate H5-16), and Nodding Thistle (*Carduus nutans*; see Appendix H5, Plate H5-17) were observed.

Several other non-native weedy and agronomic species were observed. See Appendix H6 for lists of native and non-native plants. Many of the non-native species are agricultural species and are the result of deliberate planting or spread by livestock. Canada thistle was found in dense populations along anthropogenic disturbances like ditches and roads.

10.3.2 Species and Communities of Conservation Concern

Several rare plants and one rare plant community were observed in the TLSA (see Appendix H1, Figure H1-6). A total of 10 S3 ranked plants were observed in the TLSA (Table 10-10). None of the plants are tracked or on the watch list of ACIMS, however, as noted in the methods, all plants of S1 to S3 rank are assessed as rare plants in Alberta (Fryer, et al., 2022). These species are known in Alberta from 100 or fewer populations and may be vulnerable due to diminishing habitat. None of these species are federally listed by COSEWIC or Species at Risk Act (*SARA).*

The tracked rare plant community, Red Samphire Emergent Marsh was observed in the TLSA (GOA, 2022). This community can be found in saline flats where Red Samphire is the dominant species. This is ranked as an S2 plant community in Alberta (GOA, 2022). It was not observed within the planned Project footprint but was seen within the 500 m buffer in LSD 12-33-19-16 W4 and LSD 14-20-19-16 W4 (see Appendix H1, Figure H1-6). Within the footprint, Red Samphire was seen in combination with Moquin's Sea-blite (*Sueda nigra*): an S3 ranked species of concern.

This combination of plants is not considered to be a rare ecological community as Red Samphire was not the dominant species in the community.

Though the Project footprint contains ecological ranges for rare plants, grazing has made the possibility of rare plant establishment and identification less likely. For example, the S3 ranked Wild Begonia was observed on the Project footprint one day and then had been grazed by cattle the next day.

Most of the native and rare plants observed in the TLSA are those found in highly saline conditions such as the blowout and saline lowland ecosites common to the area. Western Water Horehound was found in the swamp wetland which is the result of seepage from the canal and so has taken the opportunity to establish due to anthropogenically created wet conditions. The overall salinity of the soils in the area do provide habitat for those rare plants adapted to saline conditions. As Solonetzic soils are common in the region especially within the TLSA, habitats remain to support these native and rare species.

Table 10-10: Plant species and communities of conservation concern in the Terrestrial Local Study Area

Scientific Name	Common Name	Provincial Rank	Federal Rank		Habitat
		ACIMS[1]	COSEWIC[2]	SARA[3]	
Atriplex argentea	Silver Saltbush	S3	N/A	N/A	Dry plains and saline flats, southern prairies
Atriplex suckleyi	Endolepis	S3	N/A	N/A	Moist saline lakeshores
Dieteria canescens	Hoary Aster	S3	N/A	N/A	Dry grasslands
Erysimum asperum	Prairie Rocket	S3	N/A	N/A	Dry open prairie grasslands
Escobaria vivipara	Cushion Cactus	S3	N/A	N/A	Dry prairie grasslands
Lycopus asper	Western Water-horehound	S3	N/A	N/A	Moist open areas,
Rumex venosus	Wild Begonia	S3	N/A	N/A	Roadsides, dry soils and sand dunes
Solanum triflorum	Wild Tomato	S3	N/A	N/A	Waste areas and cultivated crops and other disturbed soil such as badger and gopher mounds
Suaeda nigra	Moquin's Sea-blite	S3	N/A	N/A	Edges of saline marshes, and saline flats
Salicornia rubra	Red Samphire	S3	N/A	N/A	Saline lakes and ponds
Salicornia rubra emergent marsh	Samphire Emergent Marsh community	S2	N/A	N/A	Saline lakes and ponds

[1] (GOA, 2022) [2] (GOC, 2023) [3] (GOC, 2002)

10.3.3 Traditional Use Species

Based on published sources (Jonnston, 1970; Galileo Educational Network, 2016; Stantec Environmental Consulting Ltd., 2018) for species likely to be traditionally used by the Blackfoot Confederacy, traditional use plant species occur within the TLSA including species used for foods, ceremonial purposes, medicines, clothing or crafts (Table 10-11, details of uses in Appendix H7). This analysis only identifies if species are present and does not assess their quality or usage level. A Traditional Environmental Knowledge and Use study would need to be conducted to

confirm if these species were/are used traditionally or if they have value to Blackfoot community members or other Indigenous communities.

Plant species known to have been use by Indigenous Peoples can be readily found throughout the DMG subregion.

Table 10-11: Traditionally Used plant species observed in the Terrestrial Local Study Area

Scientific Name	Common Name	Scientific Name	Common Name
Aquatic / Wetland Plants		**Broadleaf Herbs**	
Bolboschoenus maritimus	Prairie Bulrush	*Achillea millefolium*	Common Yarrow
Carex aquatilis	Water Sedge	*Allium textile*	Prairie Onion
Juncus balticus	Wire Rush	*Artemesia spp.*	Wormwood, Sage
Lycopus asper	Western Water-horehound	*Artemisia frigida*	Pasture Sagewort
Mentha canadensis	Wild Mint	*Chamaenerion angustifolium*	Common Fireweed
Potentilla anserina	Silverweed	*Gaillardia aristata*	Brown-eyed Susan
Schoenoplectus acutus	Great Bulrush	*Galium boreale*	Northern Bedstraw
Triglochin maritima	Seaside Arrow-grass	*Geum triflorum*	Three-flowered Avens
Typha latifolia	Common Cattail	*Glycyrrhiza lepidota*	Wild Licorice
Prairie Grasses		*Grindelia squarrosa*	Curly-cup Gumweed
Bouteloua gracilis	Blue Grama Grass	*Gutierrezia sarothrae*	Broomweed
Elymus sp.	Wheatgrasses	*Lygodesmia juncea*	Skeletonweed
Hesperostipa comata	Needle and Thread Grass	*Phlox hoodii*	Moss Phlox
Trees and Shrubs		*Ratibida columnifera*	Prairie Coneflower
Artemisia cana	Silver Sagebrush	*Rumex venosus*	Wild Begonia
Cornus sericea	Red-osier Dogwood	*Solanum triflorum*	Wild Tomato
Escobaria vivipara	Cushion Cactus	*Solidago canadensis*	Canada Goldenrod
Elaeagnus commutata	Silverberry	*Sphaeralcea coccinea*	Scarlet Mallow
Opuntia polyacantha	Prickly-pear Cactus	*Symphyotrichum falcatum*	Creeping White Prairie Aster
Populus balsamifera	Balsam Poplar	*Thermopsis rhombifolia*	Golden Bean
Populus deltoides	Plains Cottonwood	*Zigadenus venenosus*	Death Camas
Populus tremuloides	Trembling Aspen	**Introduced or Agronomic Species**	
Rosa acicularis	Prickly Rose	*Chenopodium album*	Lamb's-quarters
Rosa arkansana	Prairie Rose	*Plantago major*	Common Plantain
Salix exigua	Narrow-leaf Willow	*Rumex crispus*	Curled Dock
Salix spp.	Willows	*Trifolium repens*	White Clover
Symphoricarpos occidentalis	Buckbrush		

10.3.4 Wetlands

Basin Topography

Wetlands in the TLSA occur in defined basins or in low topographic areas. Temporary and seasonal marshes and intermittent shallow open water wetlands are primarily in defined basins (see Appendix H5, Plate H5-8). Near the center of the Project footprint is a large ephemeral draw which begins at the toe of the east dam and runs east to end at Range Road 164 within SE 32-19-16 W4. Other low basins and ephemeral draws occur which support wetlands and waterbodies.

Hydrology and Catchment

Precipitation data was obtained for the TLSA from the Alberta Climate Information Service (GOA, 2023b). Average yearly precipitation (in rainfall equivalent) for the area is 334 mm with June as

the wettest month. Figure 10-4 below demonstrates the yearly precipitation in rainfall equivalent for the Project area from 1950 to 2023. Precipitation has been below average to average since 2021, when field data collection began. Precipitation was considered average if it was within one standard deviation of the mean among years, while above average (wet) and below average (dry) years were assessed as years greater than or less than one standard deviation of the mean, respectively.

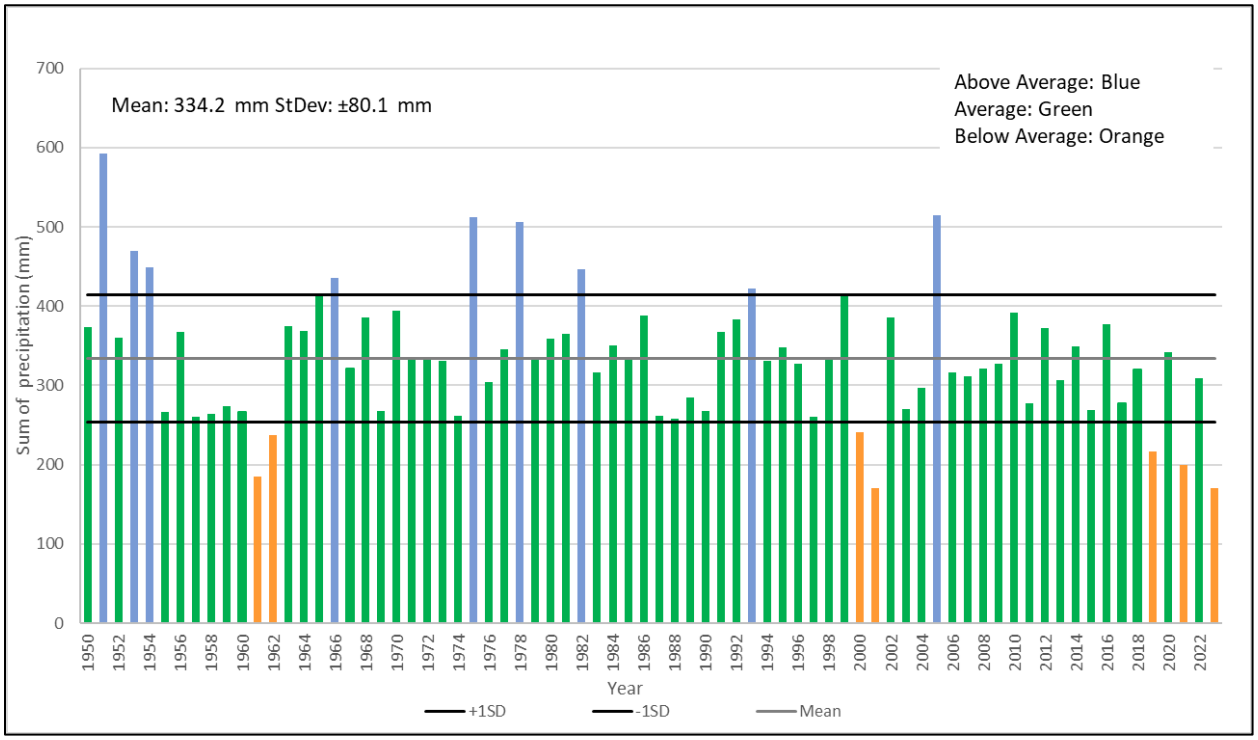

Figure 10-4: Average yearly precipitation amounts

Wetland and Waterbody Classification and Delineation

Wetlands and waterbodies within the Project area, were identified following the Alberta Wetland Identification and Delineation Directive (GOA, 2015b), by first doing desktop delineations on a series of aerial photographs, to ensure all possible wetland features were visited in the field. This was especially relevant as conditions were very dry in 2021 and may have otherwise resulted in several wetlands being overlooked. Once observed and described in the field, using a thorough data sheet for information collection, the wetlands were classified based on the AWCS (GOA, 2015a). Throughout this assessment, some features thought to be wetlands on aerial imagery were reclassified as uplands or ephemeral waterbody areas; for example, some blowouts or disturbed areas appeared to be wetlands, prior to field verification. A total of 32 wetlands were identified and classified in the TLSA (see Appendix H8). Only four classes of wetland were observed: temporary graminoid marshes, seasonal graminoid marshes, intermittent shallow open water, and swamp wetlands. These wetland classes are described as follows:

- Intermittent Shallow Open Water: Deep water is intermittently present with a central zone that is typically devoid of emergent vegetation. Algae crusts and/or salt crusts are apparent once dry. Poor water movement/drainage results in salt accumulation and dominance of

salt tolerant plants. May be associated with springs or occur in other areas where water occurs intermittently (see Appendix H5, Plate H5-8).

- Temporary Marshes: shallow (<50 cm) basins or draws covered by standing or slow flowing water that is typically present for a few weeks after snowmelt or for a few days after heavy rain. Water is retained long enough to allow the establishment of low wetland vegetation (usually less than 30 cm tall), and soils show indicators of saturation, usually below 20 cm when the surface is dry (see Appendix H5, Plate H5-9).
- Seasonal Marshes: shallow to medium depth (<100 cm) basins or draws covered by standing or slow flowing water with water present for a few weeks to months, usually throughout the early parts of the growing season. Wetland vegetation (usually <60 cm tall) and soil indictors of saturation typically within 10 cm of surface. Drainage after heavy rainfall is slower than in temporary marshes (see Appendix H5, Plate H5-10).
- Swamps: a wetland with water levels above, at, or near surface level which can fluctuate during the year. Shrub, tree, or a combination of both comprises at least 25% of the area (see Appendix H5, Plate H5-11).

A spring or seep was noted within the main drainage that crosses the length of the Project footprint (see Appendix H1, Figure H1-7). Springs/seeps can become wetlands; however, the observed spring was emerging from the side slope of the drainage feature so water cannot accumulate for any length of time to create wetland conditions. As water will not be diverted from the spring for use, it does not require approval under the *Water Act* (GOA, 2002).

Drainages were classified according to Government of Alberta classes (2023a; 2024a) as ephemeral draws, ditches and watercourses. The TLSA had several ephemeral draws, and two ditches (see Appendix H1, Figure H1-7). Ephemeral draws usually have a gentle to strong gradient that sustain overland flow during spring melts or during/after high rainfall events and are typically dry outside of these events. Water is typically not present long enough or does not flow fast enough to cause scouring of the surface layer. Some of these drainages also had wetlands present in low areas where water can pool. Watercourses flow intermittently to perennially and have a distinct channel with banks and often a riparian area surrounds the feature. No watercourses were present.

In addition to wetlands and drainages, there were 17 confirmed ephemeral waterbodies (see Appendix H5, Plate H5-7). These features are upland areas that occasionally pool after large rainfall or snowmelt events but otherwise maintain native grassland communities. These waterbodies were classified for features identified through desktop delineation that had occasional flooding through the years, and which occurred in a low area, ephemeral drainage, or basin, but lacked typical soil and vegetation indicators of wetlands. Features were confirmed to be ephemeral waterbodies when they had the following:

- observed in aerial imagery, usually in wet spring conditions only (or after a rainfall);
- occur in shallow basins, flats, depressions or at wetland edges;
- no wetland soil indicators in the upper 30 cm; and
- typically dominated by facultative to upland plant species (species that are not specifically adapted to waterlogged soils and often include some salt tolerant species.

Anthropogenic waterbodies also occur in this area. These include dugouts, canals, and reservoirs; dugouts are shallow to deep pits dug into the ground that either fill with groundwater, or that are filled with water from an external source (canal or ditch; see Appendix H5, Plate H5-6). Reservoirs are formed when a drainage is impounded behind one or more dams. Canals and ditches are anthropogenic drainages that convey water for irrigation or other purposes. They usually hold water throughout the growing season. Table 10-12 shows the breakdown of wetlands, and waterbodies within the TLSA.

Characteristics of 32 field confirmed wetlands and 17 ephemeral waterbodies within the planned Project footprint are in Appendix H8.

Table 10-12: Classification and area of wetlands and waterbodies within the Terrestrial Local Study Area

Class	Community Count	Area ha	% of Total Water Area	% of TLSA[1]
Intermittent Shallow Open Water	13	12.6	6.8	0.8
Seasonal Marsh	6	36.4	19.6	2.2
Temporary Marsh	20	34.5	18.7	2.1
Shrubby Swamp	1	0.8	0.4	<0.1
Ephemeral Waterbody	17	10.8	5.8	0.7
Reservoir	1	34.4	18.5	2.1
Dugouts	8	10.2	5.5	0.6
Canals	2	43.2	23.2	2.6
Ditches	2	3.6	1.9	0.2
Ephemeral Drainages	25	N/A	N/A	N/A
	Total	**185.8**	**100**	**11.2**

1 Terrestrial Local Study Area

Description by Zone

Temporary marsh wetlands have only a single zone – the wet meadow zone where water is present for days to weeks each year and species are dominated by facultative-wet to facultative species, including grasses and sedges tolerant of both dry and flooded conditions. Seasonal marshes have a central shallow marsh zone with water present for several weeks to months each year, and this may be surrounded by a wet meadow zone in shallower conditions. As per the AWCS, the shallow marsh zone must make up at least 25% of a seasonal wetland. The shallow marsh zone is dominated by water tolerant plants such as sedges and rushes. Intermittent shallow open water wetlands include a mainly unvegetated central basin subject to periodic flooding and can alternate between open water and exposed bare soil. When dry they have a saline crust in a poorly vegetated basin. Some wetlands contain an intermittent alkali zone which alternates between saline open water and exposed bare soil or salt flats.

Functional Assessment

The functionality of wetlands are those processes (physical, chemical, biological) associated with temporarily to permanently saturated soil areas that provide ecological services (Hanson, et al., 2008). Examples of ecological services include water filtration, flood control, stream water source, nutrient storage, wildlife habitat, carbon sequestration, ground water recharge, and recreational opportunities. There are little socio-economic benefits of wetlands in the TLSA as they have not been accessible by the public for hunting, bird watching or any other recreational activity. Within

pastureland, wetlands can provide different foraging opportunities for livestock and sources of water if surface water is present.

In Alberta, a wetland's functions are evaluated through the ABWRET-A. ABWRET-A is a standardized method for rapidly assessing some of the more important natural functions of wetlands present in the White or Green Areas of Alberta. The "A" stands for "actual", meaning it uses on-site observations and off-site spatial data to determine the regulatory value of a wetland as part of the Wetland Mitigation Directive (GOA, 2018c). The ABWRET-A generates a score for a wetland's function which is used to assign a Relative Wetland Value (RWV). Values range from "A" (highest value) to "D" (lowest value). The criteria for assigning wetlands to a value are based on science and policy, through a combination of onsite observations by a qualified wetland biologist and the use of models to generate scores representing 14 wetland functions (GOA, 2015d). Historical trends in the loss of wetland numbers and area within a Relative Wetland Value Assessment Unit (RWVAU) are separately estimated and then factored into a wetland's final RWV by assigning an abundance factor of 1, 0, or -1. The abundance factor increases or decreases assessed wetland values to one value higher, no change, or one value lower. The Project area occurs in a RWVAU with high historical losses and is assigned the value of 1; for example, a wetland initially assessed as a D gets increased to a C, a C to B and a B to an A. The values assigned to wetlands are used to assess replacement cost or offset areas for permitting wetland disturbance through a *Water Act* approval process. Wetlands with an A value, the most valued wetland class, require a compelling argument for removal or they may not be approved for removal in some cases.

Field-collected ABWRET-A data for each wetland were submitted to Alberta EPA for review and analysis, and a RWV for the wetlands was provided. RWVs are summarized in Table 10-13.

Table 10-13: Alberta Wetland Rapid Evaluation Tool-Actual Scores

Wetland Value[1]	Relative Wetland Value in the TLSA[2]	
	Area (ha)	Coverage (%)
High (A value)	23	26
Moderate (B value)	55	63
Moderately Low (C value)	10	11
Low (D Value)	0	0
Total	88*	100

1 (GOA, 2015d)
2 Terrestrial Local Study Area
* The Wetland Assessment and Impact Report (WAIR) will address that some wetlands are anthropogenic in nature and would not require compensation under the *Water Act*. If this is accepted total wetland area lost will be 67 ha.

Ephemeral waterbodies, drainages, and dugouts are not wetlands; therefore, these features are not given values and do not require protection or compensation under the Alberta Wetland Policy (GOA, 2013a). However, wetlands may form within ephemeral drainages, or dugouts may have been constructed within a wetland; in these cases, an ABWRET-A value will be assigned. These features are also regulated under the *Water Act* and may require approval to alter or remove these features.

10.4 TRSA BASELINE ASSESSMENT RESULTS

10.4.1 Vegetation Communities

Broad Vegetation Class Area

Detailed vegetation and wetland surveys were not completed in the TRSA. Instead, existing vegetation and wetland inventories were accessed and analyzed to map and classify broad vegetation and wetland groups. These groups included native grassland, cultivated agricultural lands (agriculture), anthropogenic disturbances, wetlands, treed and shrubby (woody) classes, and anthropogenic waterbodies (i.e. reservoirs, canals, dugouts; see Appendix H1, Figure H1-8). Using the GVI database, the native grassland community group was determined to be any mapped polygon with greater than 50% native prairie component. Agriculture was deemed to be the remaining lands with under 50% native prairie. Disturbances included developments (e.g. towns, feedlots, and farmsteads), roads, and oil and gas infrastructure. Wetlands and waterbodies were assessed based on the Alberta Merged Wetland Inventory and other hydrological mapping sources and were also grouped (Table 10-14).

Table 10-14: Terrestrial Regional Study Area broad ecological community classes

Community Type	Description	Total Community Area (ha)[1]	Percentage of TRSA[2]
Native Grasslands	Native grassland communities with >30% coverage of native species.	45,250.5	51.2
Cultivated Lands	Agricultural lands including crops and hayfields	29,352.8	33.2
Woody	Treed and shrubby communities	57.6	0.0
Anthropogenic Water	Reservoir, dugouts, canals, ditches	1,467.0	1.7
Wetlands/Waterbodies	Marshes, intermittent shallow open water, ephemeral waterbodies, watercourses	8,037.4	9.1
Disturbances (roads, rail lines, municipal, etc.)	Roads, rail lines, municipal developments, oil and gas, etc.	4,239.6	4.8
	Total	**88,404.9**	**100.0**

1 Sourced from GVI (GOA, 2019)
2 Terrestrial Regional Study Area

Figure 10-5 demonstrates the percent coverage of each community type in the TRSA. Native Grassland, like in the TLSA, is the largest community type with cultivation the next most common.

Figure 10-6 compares the relative distribution of broad level community classes between the TLSA and TRSA. Grassland dominates both the TLSA and TRSA with the TLSA having a larger proportion of native grassland. The TRSA contains a larger percentage of cultivated land compared to the TLSA.

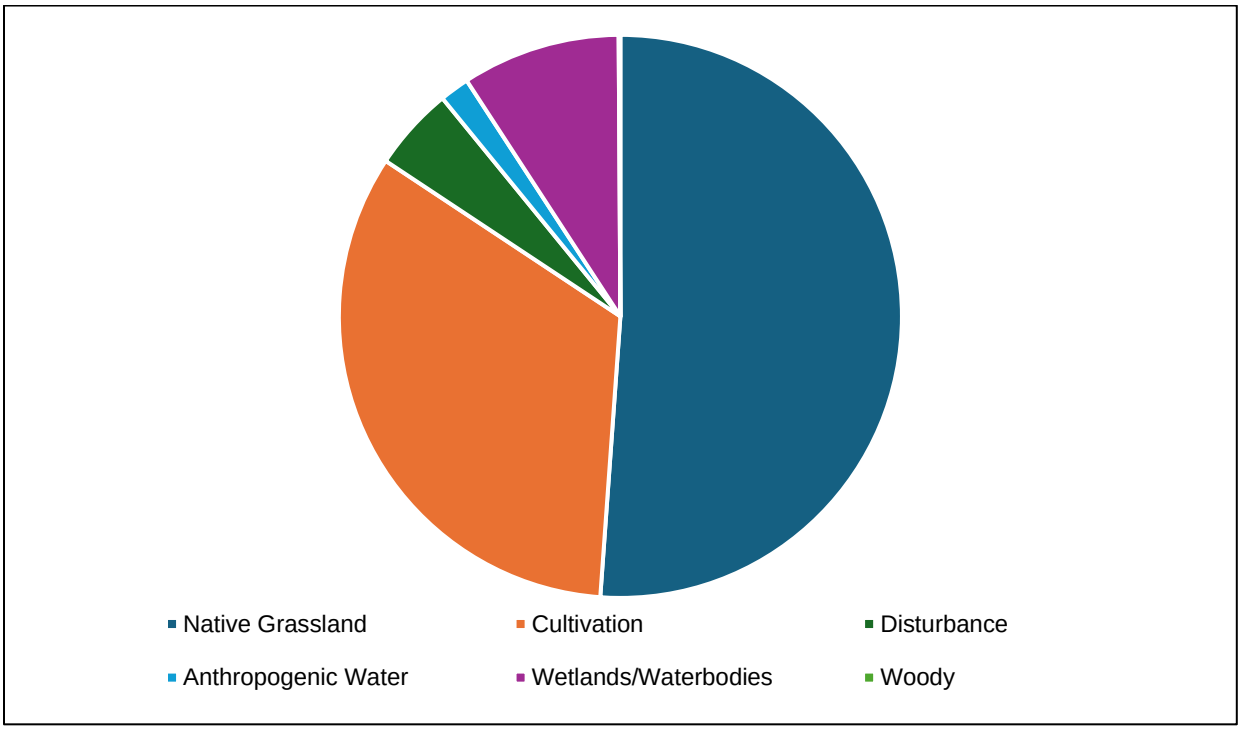

Figure 10-5: Percentage of ecological community types within the Terrestrial Regional Study Area

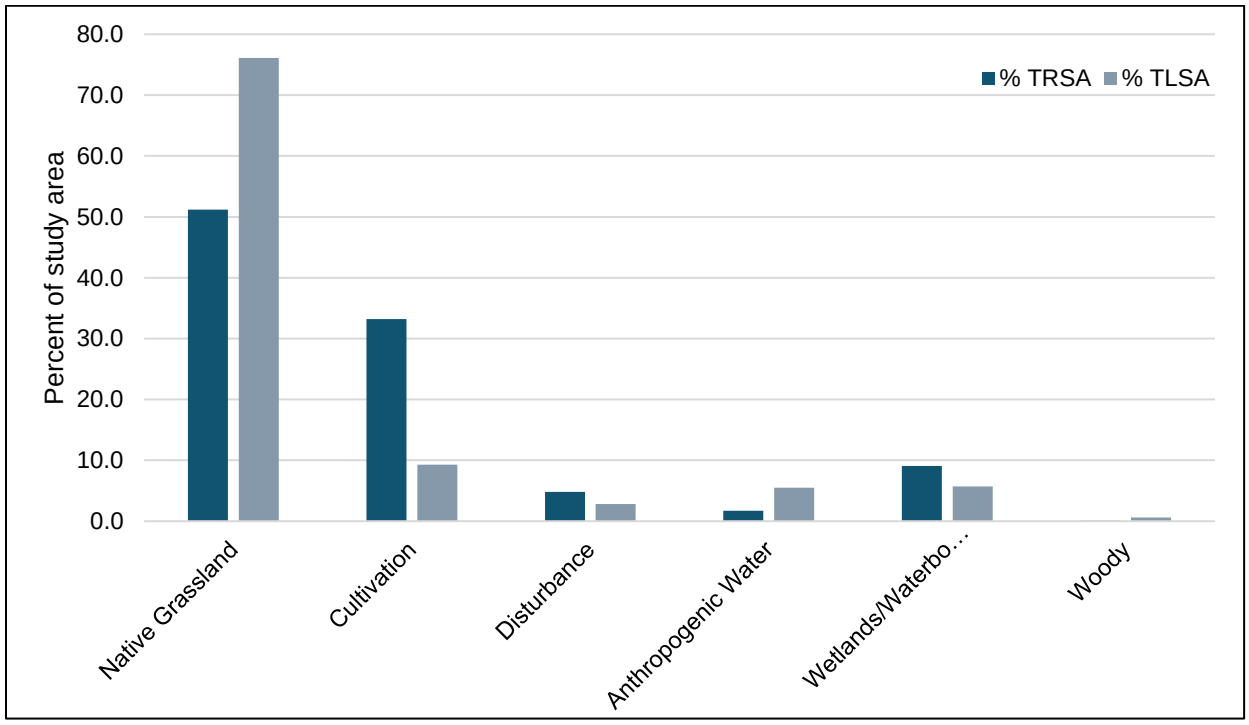

Figure 10-6: Land class comparison Terrestrial Local Study Area versus Terrestrial Regional Study Area

Disturbance and Fragmentation

For the TRSA, total disturbance included the disturbance classes in the TLSA combined with industrial, residential and wellsite areas. Disturbances included are shown in Table 10-15. The total disturbed area totals 35,058.2 ha or 39.7% of the TRSA.

Baseline fragmentation was assessed by counting the number of natural patches created by linear disturbances or by natural drainages (see Appendix H1, Figure H1-9). Linear disturbances include canals, ditches and watercourses that transect the TSRA as well as roads and watercourses.

Community patches may be composed of multiple classes surrounded by linear or area disturbances. Patches were determined using spatial analysis, where a patch was defined as all habitat surrounded by anthropogenic disturbance. Patches were summarized into 6 size classes: 0 to 5 ha, 5 to 15 ha, 15 to 30 ha, 30 to 50 ha, 50 to 100 ha, and greater than 100 ha. Patch area, number, and mean patch size were examined. An area with a high proportion of small patch sizes is more fragmented than an area with larger patch sizes. Table 10-16 shows fragmentation in the TRSA.

Table 10-15: Disturbance classes and areas within the Terrestrial Regional Study Area

Baseline Disturbance Class	Area ha	% of Study Area
Abandoned Railway	83.6	0.1
Canal	645.9	0.7
Ditch	76.7	0.1
Dugout	197.5	0.2
Industrial	604.8	0.7
Pipeline	923.7	1.0
Railway	174.8	0.2
Reclaimed Wellsite	140.9	0.2
Reservoir	623.6	0.7
Residential	878.9	1.0
Road	1,008.0	1.1
Trail	114.2	0.1
Water Pipeline	83.0	0.1
Wellsite	149.8	0.2
Agriculture	29,352.8	33.2
Subtotal Disturbed	**35,058.2**	**39.7**
Undisturbed	53,346.6	60.3
Total	**88,404.8**	**100.0**

Table 10-16: Summary of Patch distribution in the Terrestrial Regional Study Area

Patch Size Class (ha)	TRSA[1]				
	Patch Count	% of Patches	Mean Patch Size (ha)	Patch Area (ha)	% of Patch Area
0-5	51,087	94.0	0.3	16,788.7	20.3
5-15	2,074	3.8	8.5	17,638.8	21.3
15-30	656	1.2	21.0	13,754.7	16.6
30-50	304	0.6	38.6	11,740.5	14.2
50-100	155	0.3	65.6	10,168.1	12.3
>100	72	0.1	175.1	12,607.4	15.2
Total	**54,348**	**100.0**	**-**	**82,698.3**	**100.0**

1 Terrestrial Regional Study Area

Mean patch size for the TRSA is 1.5 ha. Of the 54,348 patches in the TRSA, 94% are in the 0-5 ha size (Figure 10-7). However, 48% of all patches are over 30 ha in size (Figure 10-8).

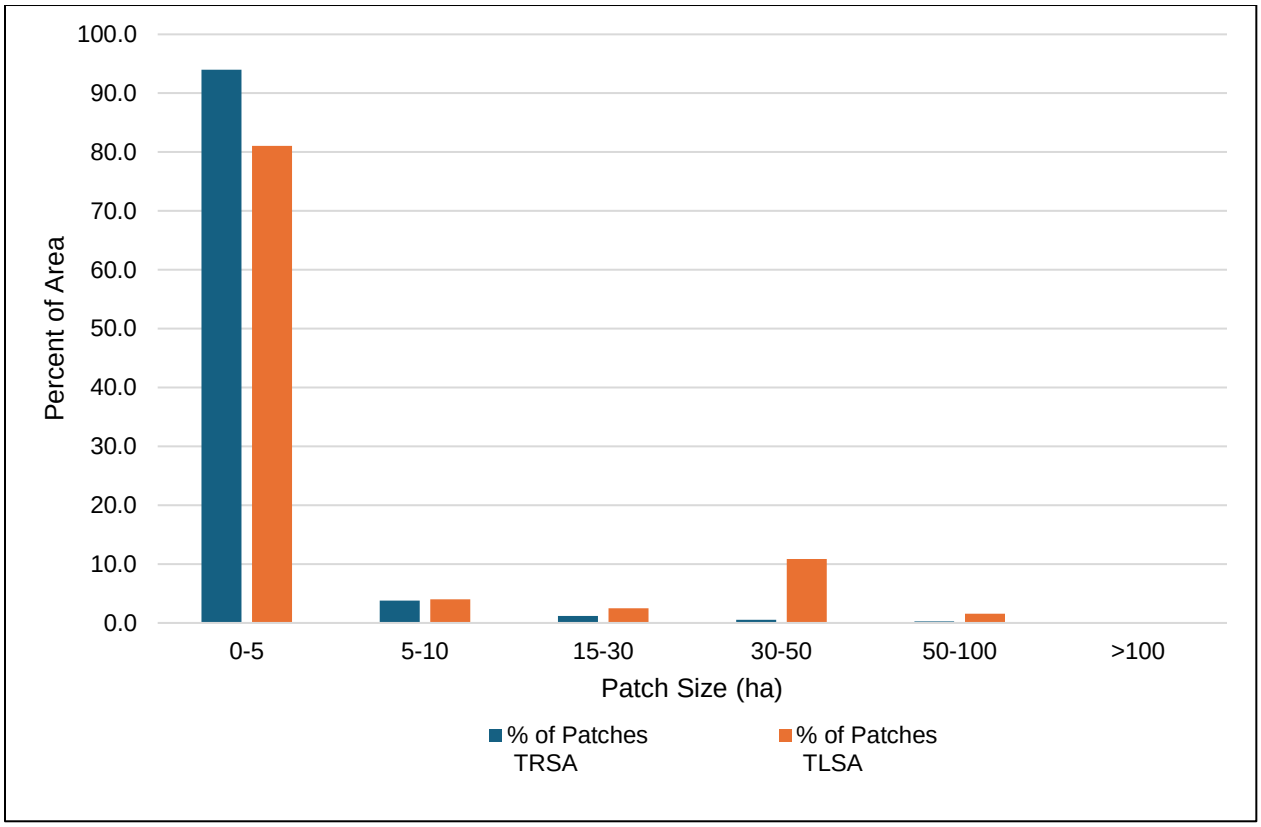

Figure 10-7: Patch distribution within the Terrestrial Regional Study Area also showing the Terrestrial Local Study Area for comparison

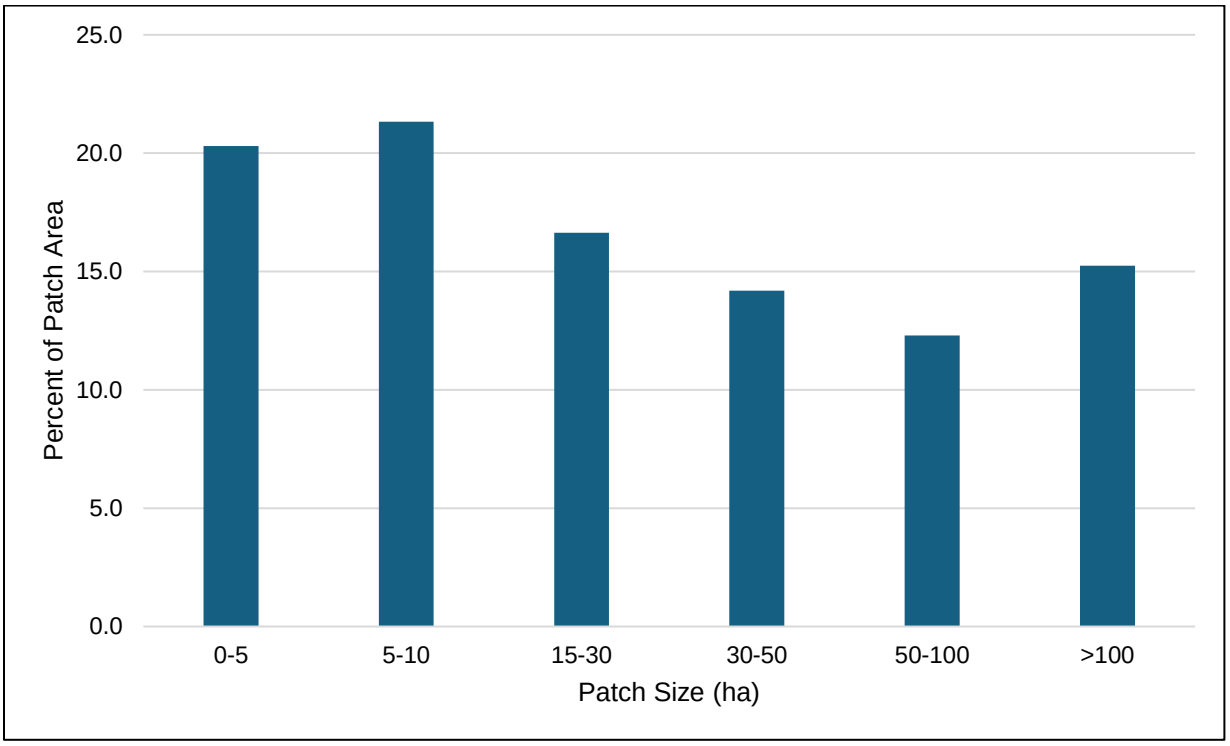

Figure 10-8: Percent of patch area by size class in the Terrestrial Regional Study Area.

10.4.2 Wetland and Waterbody Distribution

Class Area

Regional wetlands were summarized from the Alberta Merged Wetland Inventory and Hydrological Base Mapping data (GOA, 2017b). Wetlands in this inventory are only classified to the class level (i.e., Marsh, Swamp, Fen, Bog, Shallow Open Water), and not to hydroperiod types (i.e., temporary to permanent) as in the TLSA. In the TRSA wetlands included Marsh, Swamp, and Shallow Open Water. Springs do not occur in the TRSA. Table 10-17 summarizes the area of each class within the TRSA. Refer to Appendix H1, Figure H1-10 to see the distribution of each class within the TRSA.

Table 10-17: Classification and area of wetlands and waterbodies within the Terrestrial Regional Study Area

Class	Area ha	% of Total Water Area	% of TRSA[1]
Canal	645.9	6.8	0.7
Dugout	197.5	2.1	0.2
Marsh	4,515.7	47.5	5.1
Open Water	3,099.2	32.6	3.5
Reservoir	623.6	6.6	0.7
Swamp	3.3	0.0	0.0
Watercourse	57.2	0.6	0.1
Other Wetlands	362.0	3.8	0.4
Total	**9,504.4**	**100.0**	**10.8**

1 Terrestrial Regional Study Area

10.5 IMPACT ASSESSMENT

This section describes the predicted impacts on vegetation and wetland resources as a result of Project activities. Assessing potential effects from Project activities, implementing appropriate mitigation measures to offset those effects, and then assessing the residual impacts remaining can determine the overall impact to the environment. For a full description of the EIA Approach including the assessment methods and EIA criteria see Volume 2, Section 2.

10.5.1 Project Impacts

Project impacts were assessed by comparing baseline conditions (Baseline Case) to Project conditions in a Project Case, including a full construction (maximum impact scenario), and a future operations scenario (including all mitigation, reclamation, and any offsets), for assessing residual impacts.

A worst-case scenario and a residual-impact scenario were then developed; the worst-case scenario (typically the maximum construction footprint) identifies the maximum extent of change that will occur among any of the Project stages prior to implementation of mitigations, while the residual-impact scenario (typically the operations footprint) identifies the change which remains after all mitigations, reclamation, and offsets (if any) are implemented. While both Project Cases were assessed (compared to baseline), the impact assessment rating was determined from the residual-impact scenario.

In addition to Project effects, where relevant, there will be an assessment of accidents and climate change which may induce changes in some resources and indicators. These will be based on predicted changes to major Project related accidents or events such as dam or canal leak, overflow, or breach situations, and effects of climate change based on predictions from models for the Project area. For vegetation resources, the impacts of climate change assessed may include the change in communities if soils become drier and growing seasons longer. In addition, shifts in climate conditions can alter plant community composition and productivity. Warmer temperatures and changing precipitation patterns may favor invasive species, altering the native vegetation around the reservoir and potentially reducing habitat quality for local wildlife.

10.5.2 Assessment Criteria

Assessment methods and EIA criteria (see Volume 2, Section 2) were used to examine and assess Project construction and residual impacts (i.e., the remaining impacts after all mitigations and offsets are implemented) and cumulative effects on vegetation and wetland resources. The assessment criteria (Table 10-18), which describe attributes of the impact to each resource or indicator, were combined for each assessed change to determine a Residual Impact Rating. Note that magnitude is rated for both the maximum impact scenario and the future operations scenario.

Table 10-18: Assessment criteria for the Environmental Impact Assessment and Cumulative Effects Assessment

Criteria	Description	Ratings
Direction	Qualitative examination as to whether the change benefits (improves the resource), is detrimental (has negative consequences on the resource), or if the effect is neutral (no change to the resource)	Positive, Negative, Neutral
Geographic Extent	The spatial area within which direct and/or indirect effects on the resource occur	Footprint, Local, Regional
Magnitude	The severity of the effect, or the amount of change relative to baseline	Negligible (neutral effects), Low (<5%), Medium (5-25%), High (>25%)
Duration	Total time the resource remains different from baseline levels	Temporary (<1 month), Short-term (up to 5 years) Medium term (5-25 years beyond start of operations), Long term (>25 years)
Confidence	The ability to assess if a change has occurred, given uncertainty in the data and analysis used to derive results and conclusions, or uncertainty in the pace or outcome of natural processes that need to occur.	High, Medium, Low

In addition to the assessed criteria, the Ecological Context is considered. This consideration addresses whether a higher or lower impact should be assessed given the importance of the Project site for maintaining ecological values. For example, if a site is an ecological hot spot for a given resource, even a small effect could have severe consequences. If the affected area is highly disturbed or modified, effects of new disturbances on the same disturbed area may be muted. If the effects occur in one of the few remaining undisturbed areas, the effects may be greater. For example, if a community area can withstand, buffer, or naturally compensate for changes, the site has high resiliency and may experience lower effects, whereas if the community is easily disturbed it has poor resiliency and may experience greater effects.

Two important mitigations that will affect the residual impact magnitude are also discussed. These include offsite (permittee responsible) replacement for wetlands, to offset losses, and native grassland restoration:

- Off site replacement – Under the Alberta Wetland Policy, the loss of wetlands is compensated by paying an in-lieu fee towards wetland education, research and replacement or undertaking permittee responsible wetland replacement. These options help to offset the impacts of wetland loss.
- Grassland Restoration – The loss of native prairie can be off-set through restoration of completed berms with native prairie vegetation.

Once the above criteria and considerations are rated, the residual impact rating is assessed for each resource or indicator as positive, negative or neutral in direction and as Low, Moderate, or High in magnitude. Table 10-19 is a breakdown of quantitative residual changes to resources in the TLSA. Table 10-20 shows the residual changes to resources in the TRSA.

Table 10-19: Project effects on waterbodies, native grassland and vegetation class area in the Terrestrial Local Study Area

Resource Indicator	Baseline	Project Construction Case			Residual Effect Case		
	Resource Area (ha)	Resource Area After Development (ha)	Impact Area Removed or Gained (ha)	Change (%)	Resource Area After Reclamation (ha)	Impact Area Removed or Gained (ha)	Change (%)
Natural Waterbody Area	94.4	68.5	-25.9	-27	70.0	-24.4	-25.8
Native Grassland Area	1,262.0	805.6	-456.4	-36.2	836.3	-425.7	-33.7
DMGA10	254.8	114.1	-140.7	-55.2	114.1	-55.2	-55.2
DMGA36	1.6	0.0	-1.6	-100.0	0.0	-100.0	-100.0
DMGA37	15.1	3.2	-11.9	-78.8	3.2	-78.8	-78.8
DMGA45	5.1	5.1	0.0	0.0	5.1	0.0	0.0
DMGA52	20.0	20.0	0.0	0.0	20.0	0.0	0.0
DMGA8	10.5	10.5	0.0	0.0	10.5	0.0	0.0
DMGB1	14.0	11.8	-2.2	-15.7	11.8	-15.7	-15.7
DMGB3	15.4	7.4	-8.0	-51.9	7.4	-51.9	-51.9
DMGB7	523.7	304.4	-219.3	-41.9	304.4	-41.9	-41.9
DMGC11	299.0	249.6	-49.4	-16.5	249.6	-16.5	-16.5
DMGC9	83.7	63.3	-20.4	-24.4	116.3	+53.0	+63.3
MGA30	2.5	0.0	-2.5	-100.0	0.0	-2.5	-100.0
MGB1	14.8	14.8	0.0	0.0	14.8	0.0	0.0
MGB2	1.5	1.0	0.5	-33.3	53.3	+52.3	+3553.3
MGB5	0.3	0.3	0.0	0.0	0.3	0.0	0.0
Treed	4.3	2.0	-2.3	-53.5	2.3	-2.3	-53.5

Table 10-20: Project effects on vegetation and waterbody area in the Terrestrial Regional Study Area

Resource Indicator	Baseline	Project Construction Case			Residual Effect Case		
	Resource Area (ha)	Resource Area After Development (ha)	Impact Area Removed or Gained (ha)	Change (%)	Resource Area After Reclamation (ha)	Impact Area Removed or Gained (ha)	Change (%)
Native Grassland Area	45,250.5	44,450.5	-800.0	-1.8	44,555.8	-694.7	-1.5
Natural Waterbody Area[1]	7,980.1	7,906.5	-73.6	-0.9	7,951.3	+44.8	+0.6

1 includes wetlands and ephemerals

10.5.3 Impact Assessment Considerations

Reclamation of the new berms, temporary workspaces and soil storage area will offset grassland loss. These areas will be seeded with a native seed mix(es) and managed for weeds (see Appendix H9). Without grazing pressure from livestock, it is expected native grassland will be restored. Recovery usually shows natural succession within the first three to five years. Over this time, seeds will germinate and develop through the pioneer and into the early-seral stages, if seeding was efficient. Regular monitoring over the first 3 to 5 years is recommended to ensure germination is proceeding effectively. Re-seeding will be conducted, if necessary, in areas that are not recovering properly, as well as managing invasive species if they become prevalent on site. Full recovery of the reclaimed area will likely take between 15 to 20 years to reach late seral succession conditions. It is not possible to know what community types will establish initially as it will be dependent on hydrological regimes and other growing conditions. Species richness and diversity will not initially be the same as baseline conditions.

Within the Project footprint, 32 wetlands will be removed including 13 temporary marshes, 8 seasonal marshes, 10 intermittent shallow open water wetlands, and a shrubby swamp. Under the *Water Act,* compensation is required for their loss and is based on their relative value rather than class (i.e., temporary vs seasonal). An explanation will be provided to the Alberta EPA that 3 of the wetlands have been anthropogenically created and therefore are not naturally occurring and do not require compensation. The Wetland Assessment and Impact Report (WAIR), to be submitted as part of a *Water Act* approval at the same time as the EIA, will go into more details on the status of wetlands in the Project footprint. Ephemeral waterbodies and drainages will also be removed by the Project, but these features do not require compensation under the *Water Act.*

The edge of the new reservoir will contain shallow water of less than 2 m and is expected to partially offset wetland loss by developing into a semi-permanent marsh.

Appendix H1, Figure H1-11 demonstrates the grassland and wetland areas to be removed by the Project. Appendix H1, Figure H1-12 visualizes how the 50 ha of new wetland (littoral area) and 105.3 ha of reclaimed berm will offset losses due to the Project. It also shows best fit community classes, DMGA10 (sloped berms) and DMGC11 (flat areas) that may develop after reclamation.

The land use within the Project footprint will be permanently changed from pasture to irrigation infrastructure. Livestock grazing will never occur in the area post-construction, so site reclamation to native grassland is expected to be an improvement over pastureland which contained non-native agronomic plant species.

The increased availability of water from the reservoir expansion is meant to provide resiliency to the current irrigation needs within the EID. The expansion is necessary in response to climate change and increasing drought frequency. The same water volume will be provided to downstream irrigable lands as at baseline. Thus, there will be no new conversion of native grassland to native pasture or cultivate lands associated with the Project.

Grassland communities which will be removed by the Project, do occur outside the footprint in the TLSA. At baseline, communities are patchy and fragmented. Reclamation post construction will

initially reduce patchiness as only two different native grass seed mixes will be use creating similar communities.

Several smaller wetlands removed from the landscape will be replaced by larger wetland(s) and increased open water which also decreases the fragmentation of these resources.

To facilitate development; the entire reservoir and temporary workspaces will need to be stripped and removed. However; the topsoil storage area, which is on native grassland, will not be stripped and could be protected with landscape fabric or matting to preserve the native soil. All native grassland area outside of the Project footprint will be avoided and left undisturbed by equipment or vehicle traffic.

Rare plants and communities have been documented outside of the Project footprint. Though there will be a loss of rare plants during Project development, they will continue to exist within the TLSA. None of the rare plants observed within the Project footprint are tracked or appear on federal watch lists. There are no regulatory requirements or authorizations required prior to their removal.

Vegetation of the site, once restored, will protect runoff water quality and provide habitat for plant species to reestablish. Replaced wetland areas in the reservoir will help promote aquatic ecology by maintaining the conditions for wetland development, specifically, the presence of water and development of wetland soils. Erosion potential will be mitigated as per information outlined in the Conceptual Conservation and Reclamation Plan (Volume 1, Section 10) and the Mitigation Measures, Management Practices (Volume 1, Section 11).

The above considerations are part of the mitigations which will be put into place to decrease the effects of Project development.

10.6 MITIGATIONS AND RESIDUAL EFFECTS

A summary of Project impacts that cannot be avoided, minimized, or completely mitigated are addressed in Table 10-21. Residual effects are expected with land development as the area will be permanently altered from natural or pasture lands and waterbodies to a reservoir.

Once residual impacts are determined, overall residual impact can be identified. Residual effects are then assessed based on the overall direction of impact (positive or negative) geographic extent (Footprint, TLSA, TRSA) magnitude or severity of the impact, duration, and the level of confidence that the impact will occur (Table 10-22). The results of that assessment are then used to determine a rating of residual effects. Overall, residual effects for the proposed Project are anticipated to be low if mitigation and avoidance measures are followed.

Table 10-21: Mitigation measures to reduce potential effects on vegetation and wetlands

Environmental Element	Mitigation Strategies	Residual Effects
Vegetation Communities	Restrict Project activities to the approved footprint Restore berms to native grassland (See Appendix H9) Reclaim soil storage area and temporary workspaces to native grassland	Loss of communities from land clearing including communities of conservation concern Increase in disturbed/non-native plant communities Fragmentation of plant communities

Environmental Element	Mitigation Strategies	Residual Effects
	Preserve topsoil from clearing and use for reclamation as the native seed bank can assist in reestablishment of local vegetation communities	
Plant Species of Conservation Concern	Restrict Project activities to the approved footprint Monitor topsoil and subsoil piles for weed growth during construction and implement corrective measures (e.g., spraying, mowing, hand-pulling) to avoid growth and establishment of regulated weeds Do not apply herbicide within 30 m of plant species or ecological communities of management concern, wetlands or waterbodies. Spot spraying, mowing, or hand picking are acceptable measures for control of regulated weeds in this area Herbicides will be applied by a licensed applicator in compliance with procedures outlined in the Code of Practice for Pesticides (GOA, 2010b)	Loss of species of conservation concern Decrease or change in plant species richness in remaining communities or in reclaimed communities Diversity likely to decrease in reclaimed/seeded areas compared to native grasslands
Native Grassland	Restrict Project activities to the approved footprint Restore berms to native grassland Preserve topsoil cleared for the native seed bank and use for reclamation of berms, temporary workspaces, etc.	Native grassland loss due to clearing activities and berm construction Loss of connectivity of native grassland areas
Traditionally Used Plants	Preserve cleared topsoil with the native seed bank for reclamation	Loss of traditional use plants due to clearing Reduced cover and distribution of traditionally use plants
Native Plant Diversity	Only clean vehicles and equipment will be brought on site If equipment is working in a weedy area, soil and vegetation will be cleaned off with brooms and shovels before moving into a new area to prevent spread. Use a cover crop seed mix to assist in weed and erosion control on exposed soils Monitor topsoil and subsoil piles for weed growth during construction and manage weeds (e.g., spraying, mowing, hand-pulling) to avoid growth and establishment of regulated weeds Have a long term weed management plan in place which includes monitoring and control during reclamation. See Vol 1, Section 11 of the EIA for mitigations and monitoring	Listed weed species already present in the area will reestablish Weed establishment on disturbed soils is common.
Wetlands and Other Water Features	Completed and filled reservoir will have shallow areas where wetland function and vegetation can reestablish (see Appendix H1, Figure H1-13) Potential continued seepage from canals or new seepage from berms can create new wetland areas New road construction should allow for continued movement of water to maintain off site wetlands Normal drainage patterns to offsite wetlands should be maintained to allow for their continued function Spill containment kits on site at all times during construction An ESC Plan will be prepared and implemented to prevent sediment/material movement into water bodies. ESC measures will remain in place during construction and until reclamation is complete	Direct loss of wetland area from land clearing and reservoir filling Direct loss or alteration of surface or groundwater flow patterns Indirect impacts to adjacent wetlands due to alteration of local hydrology Impacts to hydrology from accidental spills or erosion

Table 10-22: Analysis of potential residual effects on resources from Project activities

Resource	Impact description	Direction	Key Criteria			Modifiers		Residual Impact Rating
			Magnitude	Geographical Extent	Duration	Confidence	Ecological and Social Context	
Vegetation Communities	Loss of plant communities of conservation concern	Negative	Low	Footprint	Long-term	Medium	N/A	Medium Negative
	Increase in disturbed/non-native plant communities	Negative	Low	Footprint	Long-term	Medium	N/A	Medium Negative
	Fragmentation of plant communities	Negative	Low	Footprint	Long-term	Medium	N/A	Medium Negative
Plant Species of Conservation Concern	Loss of species of conservation concern	Negative	Low	Footprint	Medium-term	Medium	N/A	Low Negative
	Decrease or change in plant species richness in remaining communities or in reclaimed communities	Negative	Low	Footprint	Medium-term	Medium	N/A	Low Negative
	Decrease in diversity in reclaimed/seeded areas	Negative	Low	Footprint	Medium-term	Medium	N/A	Low Negative
Native Grassland	Native grassland area lost	Negative	Medium	Footprint	Medium-term	Medium	N/A	Medium Negative
	Loss of connectivity of native grassland areas	Negative	Medium	Footprint	Medium-term	Medium	N/A	Medium Negative
Traditional Use Plants	Loss of traditional use plants	Neutral						Neutral
	Reduced cover and distribution of traditionally use plants	Neutral						Neutral
Native Plant Diversity	Listed weed species already present in the area will re-establish	Negative	Low	Local	Medium-term	Medium	N/A	Low Negative
	Weed establishment on disturbed soils is common	Positive	Low	Local	Medium-term	Medium	N/A	Low Positive
Wetland and Other Water Features	Direct loss of wetland area from land clearing and reservoir filling	Negative	Low	Local	Short-term	High	High Importance	Medium Negative
	Direct loss of alteration of surface or groundwater flow patterns	Negative	Low	Local	Short-term	High	High Importance	Medium Negative
	Indirect impacts to adjacent wetlands due to alteration of local hydrology	Negative	Low	Local	Short-term	High	High Importance	Medium Negative
	Impacts of hydrology from accidental spills or erosion	Negative	Low	Footprint	Short-term	Low	N/A	Low Negative

As part of the assessment, wetlands and natural drainages were assessed to high importance in the "Ecological Context" criteria. These was considered high since wetlands have sustained much greater losses in this area (as per the ABWRET-A ranking for this site). Although grasslands in general are a diminishing resource, the DMNS has the greatest area of intact grassland in Alberta, and therefore grassland losses were not considered high in "ecological context". The residual impact rating for plants and plant communities is negative in direction. While the loss of native prairie due to construction of the new reservoir cannot be reclaimed, effects can be offset by restoring the berms and temporary construction activity areas to native grassland. By instituting a restoration and weed control program with monitoring, steps can be taken to return areas around the new reservoir to native grassland.

10.7 CUMULATIVE EFFECTS ASSESSMENT

This section assesses how the Project may interact with other past, present, or future projects and activities, and their combined impact on Vegetation and Wetland resources. For a full description of the Cumulative Effects Assessment Approach see Volume 2, Section 2.

Resources in which the Project is expected to result in high negative or medium negative residual impacts were assessed in the cumulative effects assessment (CEA). For vegetation and wetlands, this includes the following:

- Vegetation Communities;
- Native Grassland; and
- Wetlands and other Water Features.

Those resources that are not assessed in the CEA due to low negative, neutral, or positive residual impacts include:

- Plant Species of Conservation Concern;
- Traditionally Use Plants; and
- Native Plant Diversity.

10.7.1 Effects on Each Resource from Project Activities

Vegetation Communities

The Project footprint and temporary workspaces will remove several vegetation communities identified in Section 10.3 of the baseline study. Treed and shrub communities will no longer be present, and several grassland community types will be removed. An increase in disturbed/non-native plant communities will arise. Rapid weed establishment will help to prevent erosion until native pants can establish. As a result, once the berms have been reclaimed, diversity will be low until the natural seral progression of grassland occurs and the native seed bed germinates and re-establishes the communities that were present prior to clearing and construction. For the CEA, vegetation communities will be qualitatively assessed.

Native Grassland

There will be an overall loss of native grassland area with construction of the new reservoir as well as a negative impact on the connectivity between grasslands. With reclamation of the berms some loss will be offset, however, re-establishment of native grassland is a difficult undertaking

and reclamation efforts can fail. Native grassland community quality will require several years post-reclamation for native species to re-establish natural biodiversity.

Wetlands and other Water Features (Natural Waterbodies)

It is estimated that Alberta has lost between 60 to 70% of wetlands in the settled areas (GOA, 2024b). Wetlands in the DMG subregion cover 3% of the area (GOA, 2006). Project activities will result in the loss of 67 ha of wetlands in the Project footprint with a possible offset of 50 ha within the TLSA, leaving a net loss of wetland area.

10.7.2 Project Development Case

The Project Development Case for Vegetation and Wetlands was assessed through land use changes from 1950 to present day (historic), the application (i.e., land use changes as a result of the proposed SLR Expansion), and reasonably foreseeable future projects (to 2050). Table 10-23 is a summary of the cumulative change from baseline Project effects on native grassland and natural waterbodies (wetlands). Vegetation community effects in the CEA were considered equivalent to native grassland, so a separate assessment for communities was not completed.

Native Grassland and Vegetation Communities

Of the original 11.8 million hectares of native prairie in the DMG natural subregion, 43% remains today (Adams, et al., 2013b). The Project is within Newell County, of which 169,895.5 ha of land is cultivated (GOA, 2021b). This is an increase of 6.7% over five years. Of the total 88,404.9 ha of land in the TRSA, 51% is native prairie, 9% is wetlands and waterbodies, and 33% is cultivated. Any development has the potential to remove vegetation communities, especially if it is within native areas. Though this is difficult to track quantitatively, vegetation community types are closely linked to native prairie and wetland losses or gains.

Wetlands and other Water Features

While there was a calculated loss of 391 ha up to 2024 (Baseline Case), the Project will remove 67 ha of wetlands. This loss will be partially offset by 50 ha of new wetlands in the expanded reservoir. There is 47 ha of shallow area in the current reservoir which will also be applied for as an offset. Future projects within the TRSA have the potential to remove an additional 350 ha of wetlands.

Table 10-23: Summary of the cumulative change in ha from baseline of Project effects and foreseeable future projects in the Terrestrial Regional Study Area

Resource	Historical 1950 (ha)	Base Line 2024 (ha)	Project Activities (ha)	Future Activities (ha)	Change from Historical	Change from Baseline Due to Project (ha)	Change in Baseline Due to Future Projects (ha)	Cumulative Change from Baseline (ha)
Native Prairie	68,800.1	45,391.5	44,688.1	42,964.0	-23,408.6	-703.4	-2,427.5	-3,130.9
Natural Waterbodies[1]	8,371.2	7,980.13	7,913.5	7,564.49	-391.1	-66.6	-415.6	-482.3

[1] includes wetlands and ephemerals

10.7.3 Cumulative Effects

By using the earliest information available from 1950, the effects on native prairie and wetlands from past activities, current project activities and future activities can determine the cumulative effect on these resources and determine the overall significance of the impact. Table 10-24 below summarizes the cumulative effects on native prairie and wetlands.

Table 10-24: Rating contribution of projects on the cumulative effects for each resource

Project Type	Effect of Projects on Vegetation and Wetland Resources	
	Native Prairie	Natural Waterbodies
Past Projects and Activities	High (34% loss)	Low (5% loss)
Snake Lake Reservoir	Negligible (2% loss)	Negligible (1% loss)
Future Projects and Activities	Low (5% loss)	Low (5% loss)
Overall Cumulative Effect	**High (41% loss)**	**Moderate (11 % loss)**
Relative Project Contribution	**Low (3% contribution)**	**Medium (8% contribution)**

The cumulative effect of the Project along with past and future projects is expected to be a loss of 3,130.9 ha of native prairie and a loss of 482.3 ha of wetlands. Most of this loss occurred in the past. For native prairie this amounts to a 41% loss over the TRSA and is considered a high cumulative effect. There is a loss in wetlands of 11% within the TRSA which is considered a moderate cumulative effect.

10.7.4 Relative Project Contribution

Construction of the reservoir expansion will result in the loss of 703.4 ha of native prairie and 66.6 ha of natural waterbodies/wetlands. This amounts to a 3% relative contribution to native prairie loss, a low-level impact, and 8% relative contribution to the loss of wetlands in the TRSA which is a medium contribution.

10.8 OFFSET

The loss of native grassland in the Project footprint will be partially offset by reclaiming the berms, soil storage area, and any temporary workspaces to native prairie. Appendix H9 is an in-depth restoration plan which discusses the strategies and monitoring program to ensure successful grassland restoration.

The Alberta Wetland Policy and Wetland Mitigation Directives places emphasis on wetland avoidance and minimization of impacts to wetlands, especially to those wetlands given an A value, the highest value wetlands. As per the Overview – Volume 1, Section 2.12, alternate sites were considered for expanded reservoir capacity, however these alternatives were not feasible from either a construction or economic standpoint.

The loss of wetlands in the Project footprint will be a permanent impact. As per the Alberta Wetland Policy, these impacts can be offset by paying an in-lieu fee for wetland loss to be used for wetland research, restoration, or new wetland construction in the province (GOA, 2013a). The loss of wetlands can also be partially offset by new shallow areas in the reservoir which will, over

time develop into new wetland areas. A monitoring program will be instituted to observe and measure wetland indicators in these shallow areas.

The EID is highly invested in its regional area as it manages water and recreation activities, maintains lands leased for grazing, supports the oil and gas industry, and works cooperatively with the County of Newell to manage water and other surface resources in district lands. In support of this, the EID is involved in several regional and cooperative efforts to address environmental and socio-economic issues associated with regional development which include:

- The Partners in Habitat Development (PHD) initiative was developed together with many diverse organizations to enhance wildlife habitat within the cultivated areas of the EID. The PHD has supported over 500 projects including the planting of almost 1,000,000 trees and shrubs, the installation of over 180 kilometres of fence to control livestock access to habitat sites, development of 42 wetland projects, and seeding 60 hectares of dense nesting cover.
- For over 80 years, the EID has worked with Ducks Unlimited Canada (DUC) on water projects. The details of these projects can be found in Volume 1, Section 4.
- EID's Aquatic Invasive Species Prevention Program was launched in 2018. It aims to prevent the introduction and spread of invasive species into waterbodies managed by the EID. The EID also runs a seasonal pesticide application program to control noxious weeds throughout the EID.
- The EID has a Farm Improvement Policy that supports various initiatives to improve district infrastructure or better manage water resources. From 2018 to 2022, the EID approved over $7.5 million in Farm Improvement Grants. Updates to the program in 2024 provides funding for drain and canal relocation, infrastructure improvements (turnouts, canal or drain cattle crossing), and converting to more efficient irrigation methods.

Additional information on regional cooperatives and initiatives are found in Volume 1, Section 4.

10.9 CONCLUSION

At baseline, vegetation communities in the TLSA were determined by 21 detailed vegetation transects, 23 rare plant survey sites, and 47 rapid assessments in the field. Though determined to be native grassland based on percentages of native plant species present, decades of grazing and other anthropogenic disturbances have resulted in the widespread establishment of weeds and agronomic species not native to the subregion. In the TLSA, 74.3% of the land is composed of native grassland communities, 11.1% is cultivated, including croplands and older cultivated areas maintained as non-native grasslands. The remaining areas are composed of natural wetlands and waterbodies (5.7%), anthropogenic waterbodies (5.5%), woody communities (0.6%), and the remaining 2.8% are disturbances such as roads, ditches, and oil and gas development areas. The cultivated lands are primarily outside of the Project footprint within the TLSA, with small patches of hay land within the Project footprint.

Ten plant species considered to be rare (S3 ranking) were found within the TLSA. None of these species are tracked by the province nor are they on federal watch lists. These species exist outside of the Project footprint and will continue to be present where there are saline conditions. The same is true for traditionally used plant species which are commonly found in the TLSA and regionally.

Thirty-two wetlands will be removed by the Project, as well as 17 ephemeral waterbodies. Under the Aberta *Water Act,* loss of wetlands require compensation. Construction of the new reservoir will result in a relatively low loss of wetland area in comparison to historical and ongoing losses from other projects in the TRSA. It is anticipated that shallow areas in both the current and expanded reservoir will develop into wetlands, which will partially offset the loss of wetlands from construction of the expansion. The remaining wetland loss will be compensated for by an in-lieu fee payment to Alberta EPA.

In the TLSA, Native Grassland, Vegetation Communities, Plant Species of Conservation Concern, And Wetlands were identified as having a negative residual impact once mitigations are in place. There will be a net loss of 38.3 ha of wetlands within the Project area and 425.7 ha of native grassland. Further potential offset in the current reservoir is subject to approval by Alberta EPA. Vegetation Communities and Plant Species of Conservation Concern are not quantitatively assessed in the CEA, but impacts are medium negative and low negative respectively.

Weed establishment is considered a low positive as weeds are the pioneer species which will establish first and assist in reducing soil erosion of reclaimed areas. Once native plants begin to develop and a weed management plan is in place, it is expected weeds will decrease as the native plant community establishes.

Past projects from 1950 to 2024 have resulted in the greatest loss of native prairie within the TRSA. In comparison, construction of the new reservoir will have a relatively low impact on native prairie loss, which will be partially offset by reclaiming the new berms to grassland. As livestock grazing will no longer impact native vegetation and by instituting a weed management program, native grassland can be partially restored to the area to the benefit of the local ecology.

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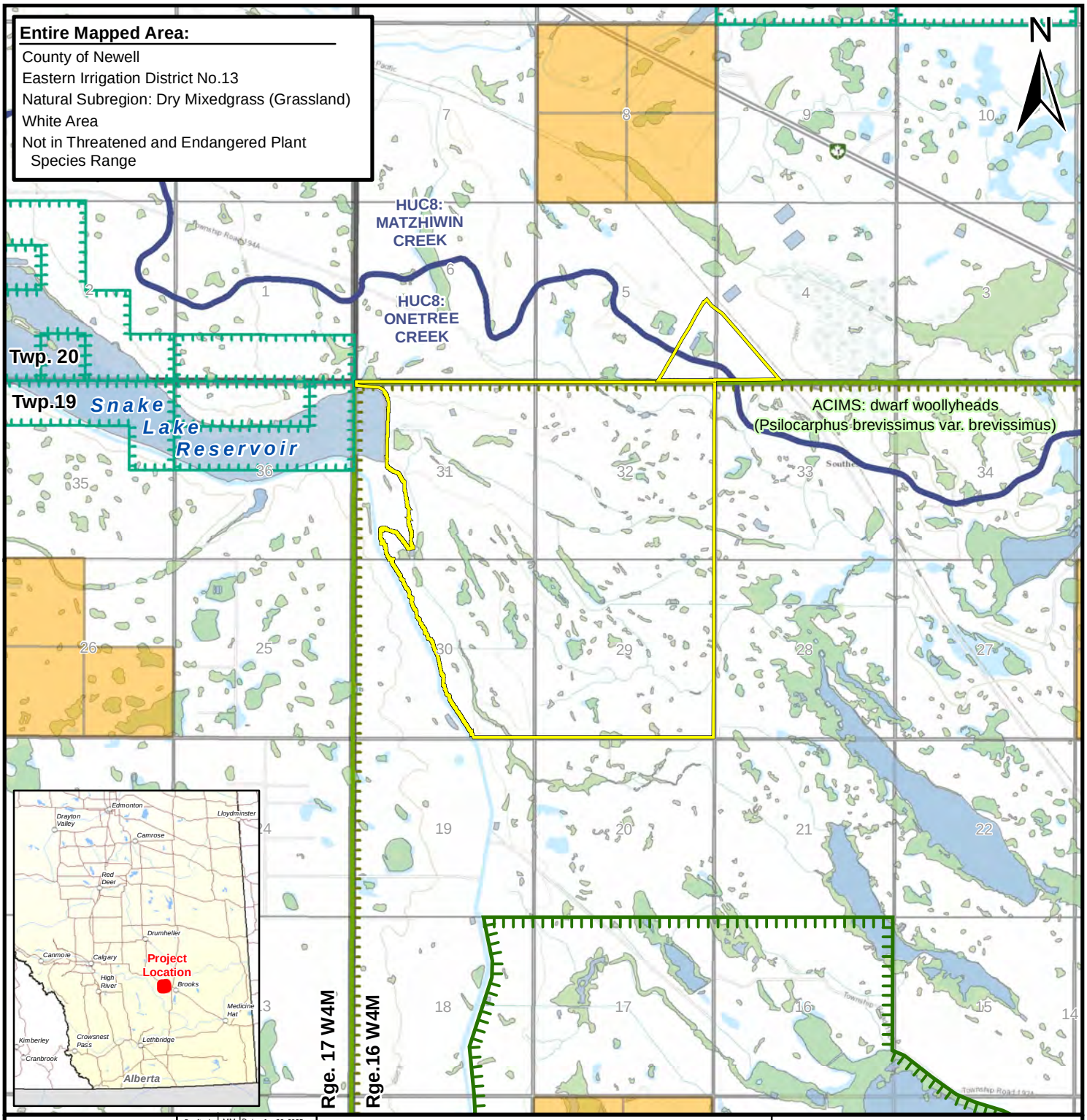
Appendix H

Appendices

Figures

Photo Plates

Appendix H1: Figures



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Approved:	LC	Revision:	0
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Survey Drawing		Revision:	0

Data Sources:
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ATS Grid: AltaLIS 2007.

*Alberta Merged Wetland Inventory

AAR Environmental Services

Please contact AARES for all other sources.

Please note that the topographic map is from 2010 (NRCAN) and although we have no reason to doubt the accuracy and completeness of it, users should be aware of that discrepancies may be present.

Legend

- Snake Lake Reservoir Expansion Project Area
- ACIMS: Sensitive Township Boundary
- HUC8 Watershed Boundary
- Crown Land (Provincial)
- HBC Lands
- Listing of Historic Resources

AMWI*: Marsh, Open Water

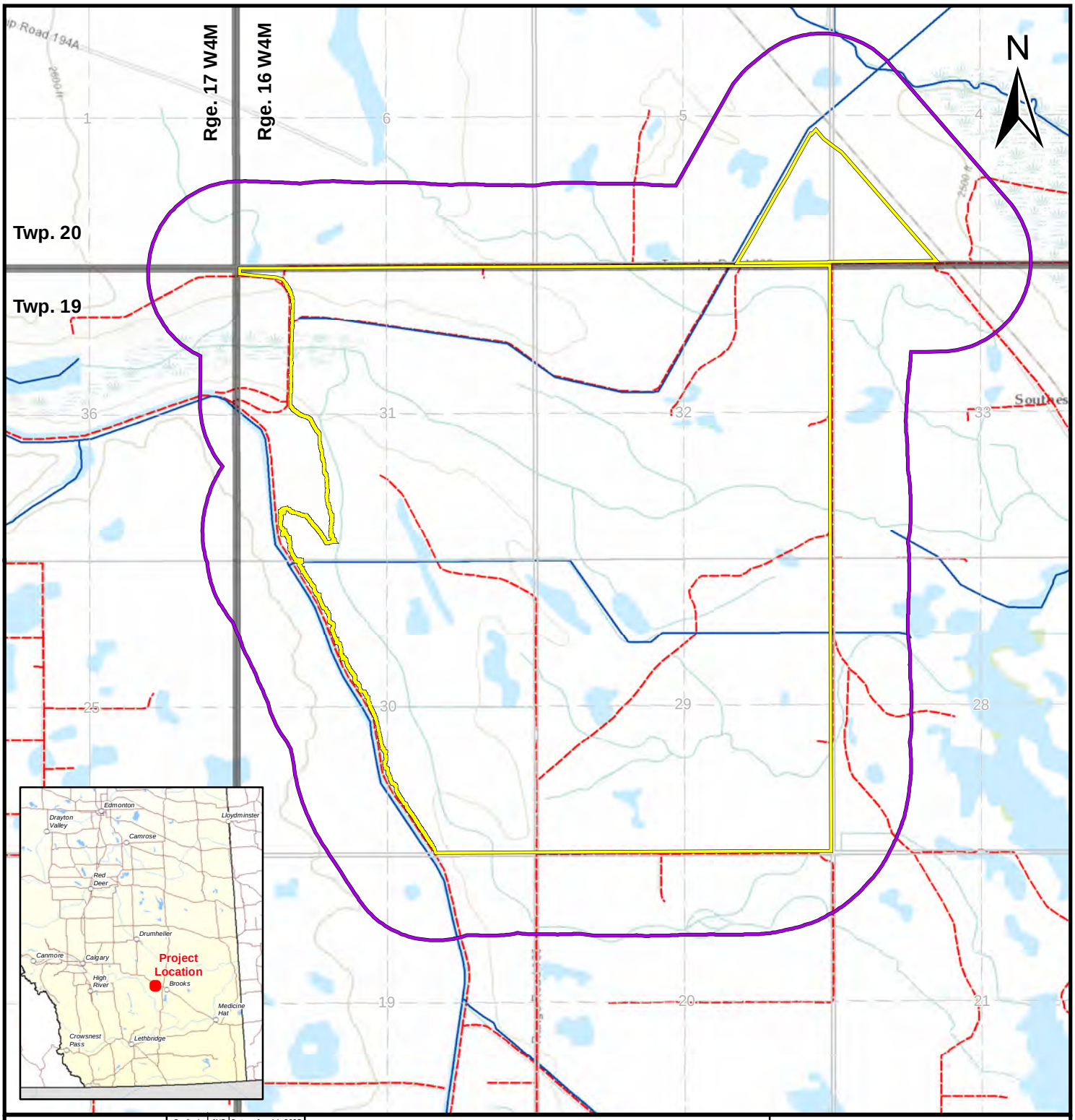
EID

Regional Location for the Proposed Snake Lake Reservoir Expansion

January 2025

REF.: AARES 21-127
(Vegetation)

Figure H1-1



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ESRI World Topographic Map
ATS Grid: AltaLIS 2007.

AAR Environmental Services

Please contact AARES for all other sources.

Please note that the topographic map is from 2010 (NRCAN) and although we have no reason to doubt the accuracy and completeness of it, users should be aware discrepancies may be present.

Legend

- Terrestrial Local Study Area
- Snake Lake Reservoir Expansion Project Area
- Basemap Waterbody
- Basemap Watercourse
- Unpaved Road
- Canal/Watercourse

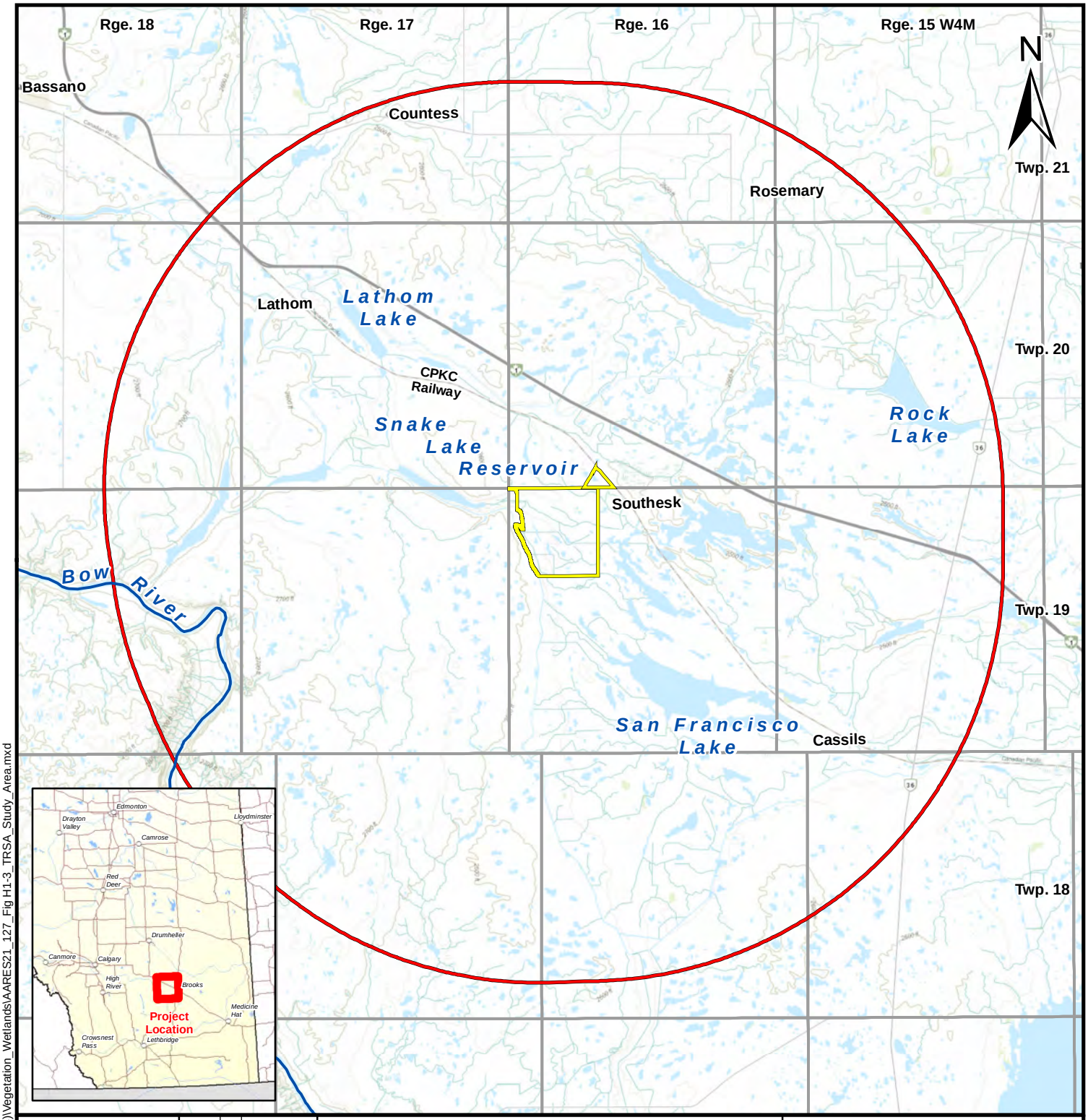
EID

Terrestrial Local Study Area

January 2025

REF.: AARES21-127
(Vegetation)

Figure H1-2



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Approved:	LC	Revision:	0
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CAD Survey		Revision:	0

Data Sources:
ESRI World Topographic Map
ATS Grid: AltaLIS 2007.

AAR Environmental Services

Please contact AARES for all other sources.

Please note that the topographic map is from 2010 (NRCAN) and although we have no reason to doubt the accuracy and completeness of it, users should be aware discrepancies may be present.

Legend

- Terrestrial Regional Study Area
- Snake Lake Reservoir Expansion Project Area
- Basemap Waterbody
- Basemap Watercourse
- Canal/Watercourse
- Baseline 30m Contours

EID

Terrestrial Regional Study Area

March 2025

REF.: AARES21-127 (Vegetation)

Figure H1-3

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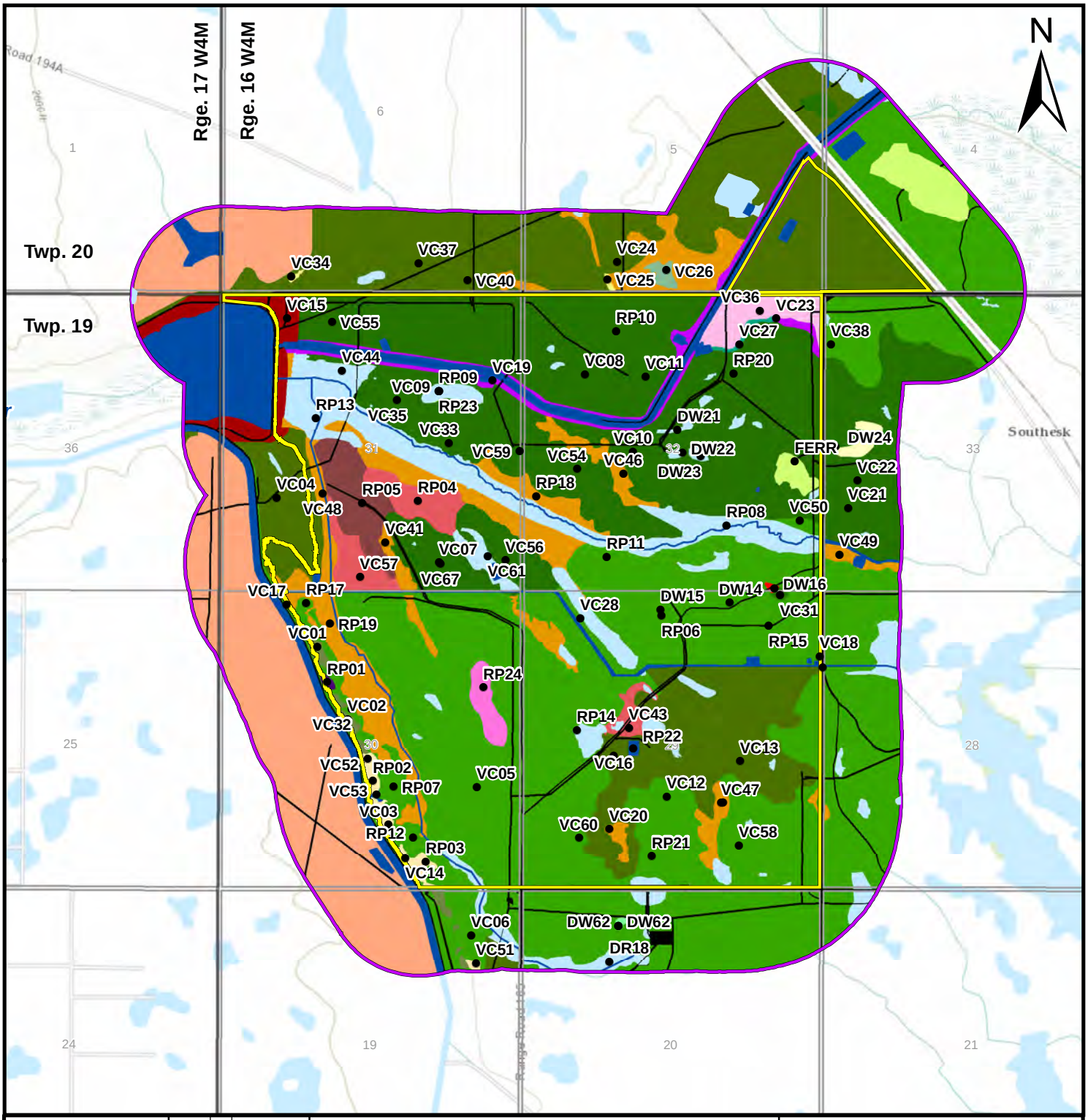

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Data Sources:
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ATS Grid: AltaLIS 2007.
GVI: Open Government Licence - Alberta
(https://open.alberta.ca/licence)

*Approximate location based on field survey.

AAR Environmental Services

Please contact AARES for all other sources.

Please note that the topographic map is from 2010 (NRCAN) and although we have no reason to doubt the accuracy and completeness of it, users should be aware discrepancies may be present.

Legend

Routing:

- Terrestrial Local Study Area (TLSA)
- Snake Lake Reservoir Expansion Project Area
- Vegetation Sample Location*

Vegetation Classes*:

DMGA10	DMGB7	Cultivated Cropland
DMGA37	DMGC11	Treed Aspen
DMGA45	DMGC9	Treed Aspen/ Balsam Poplar
DMGA52	MGB5	Willow Shrubland
DMGA8	MGB1	Disturbance
DMGB1	MGB2	Wetlands/Waterbodies
DMGB3	Anthropogenic	Drainage
	Water	

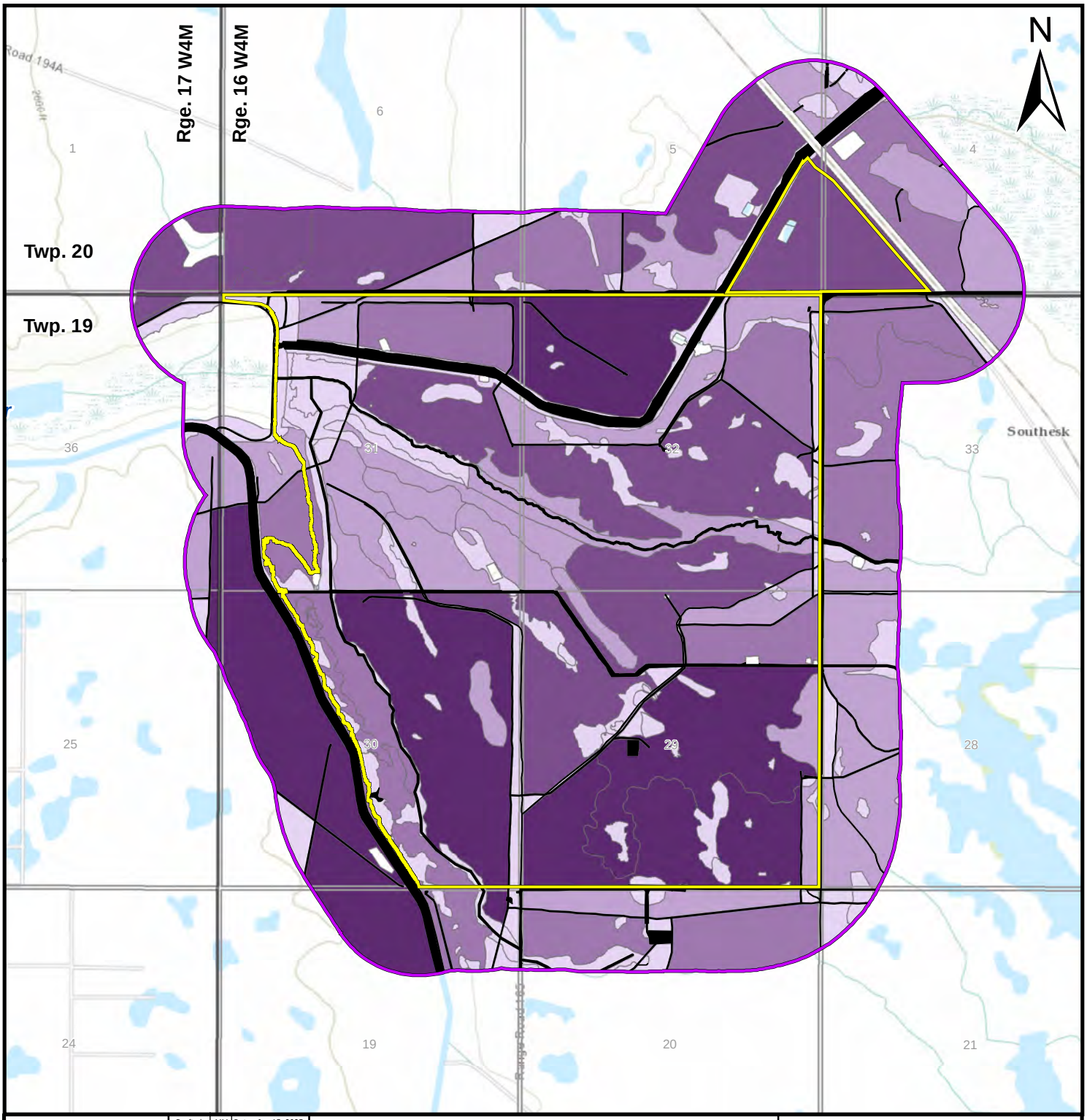
EID

Community Classes and Sample Sites in the Terrestrial Local Study Area

March 2025

REF.: AARES21-127 (Vegetation)

Figure H1-4



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Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
ESRI World Topographic Map
ATS Grid: AltaLIS 2007.

AAR Environmental Services

Please contact AARES for all other sources.

Please note that the topographic map is from 2010 (NRCAN) and although we have no reason to doubt the accuracy and completeness of it, users should be aware discrepancies may be present.

Legend

Routing:

- Terrestrial Local Study Area (TLSA)
- Snake Lake Reservoir Expansion Project Area

Patch Sizes:

- 0-5 ha
- 5-15 ha
- 15-30 ha
- 30-50 ha
- 50-100 ha
- Disturbance

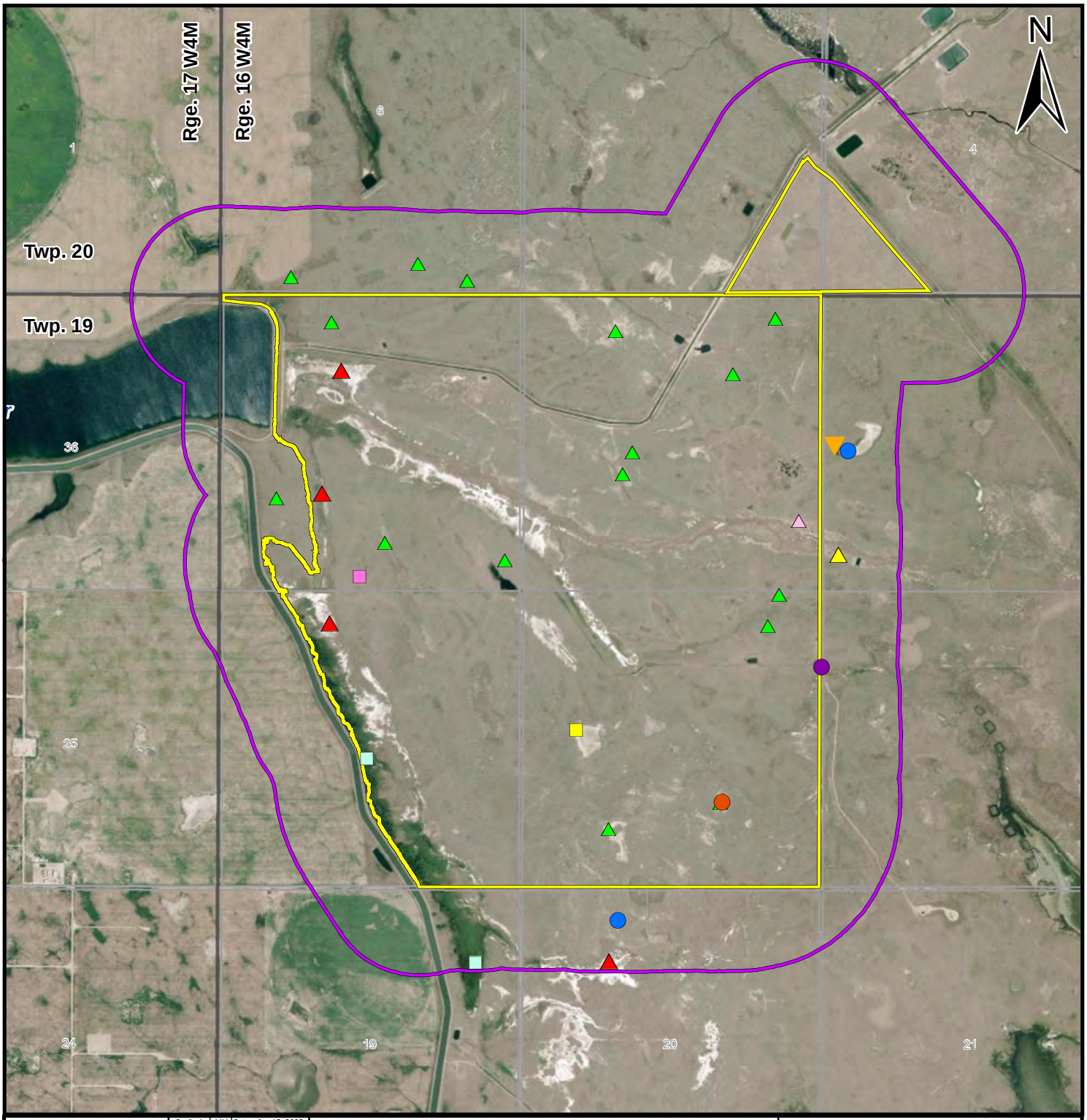
EID

Patch Size Distribution in the Terrestrial Local Study Area

January 2025

REF.: AARES21-127
(Vegetation)

Figure H1-5



SCALE: 1:30,000

200 0 200 400 m

Drafted:	MM	Date:	Jan 15, 2025
Approved:	WB	Revision:	0
Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
Imagery: ESRI. Date 2021/07/10
ATS Grid: AltaLIS 2007.

*Approximate location based on field survey.

AAR Environmental Services

Please contact AARES for all other sources.

Please note that the imagery is from 2021 and although we have no reason to doubt the accuracy and completeness of it, users should be aware that discrepancies may be present.

Legend

Routing:

- Terrestrial Local Study Area (TLSA)
- Snake Lake Reservoir Expansion Project Area

Biophysical Issues*:

- Cushion Cactus
- Endolepis/ Suckley's Saltbush
- Hoary Aster
- Moquin's Sea-blite
- Prairie Rocket
- Red Samphire
- Red Samphire Emergent Marsh
- Silver Saltbush
- Western Water-horehound
- Wild Begonia
- Wild Tomato

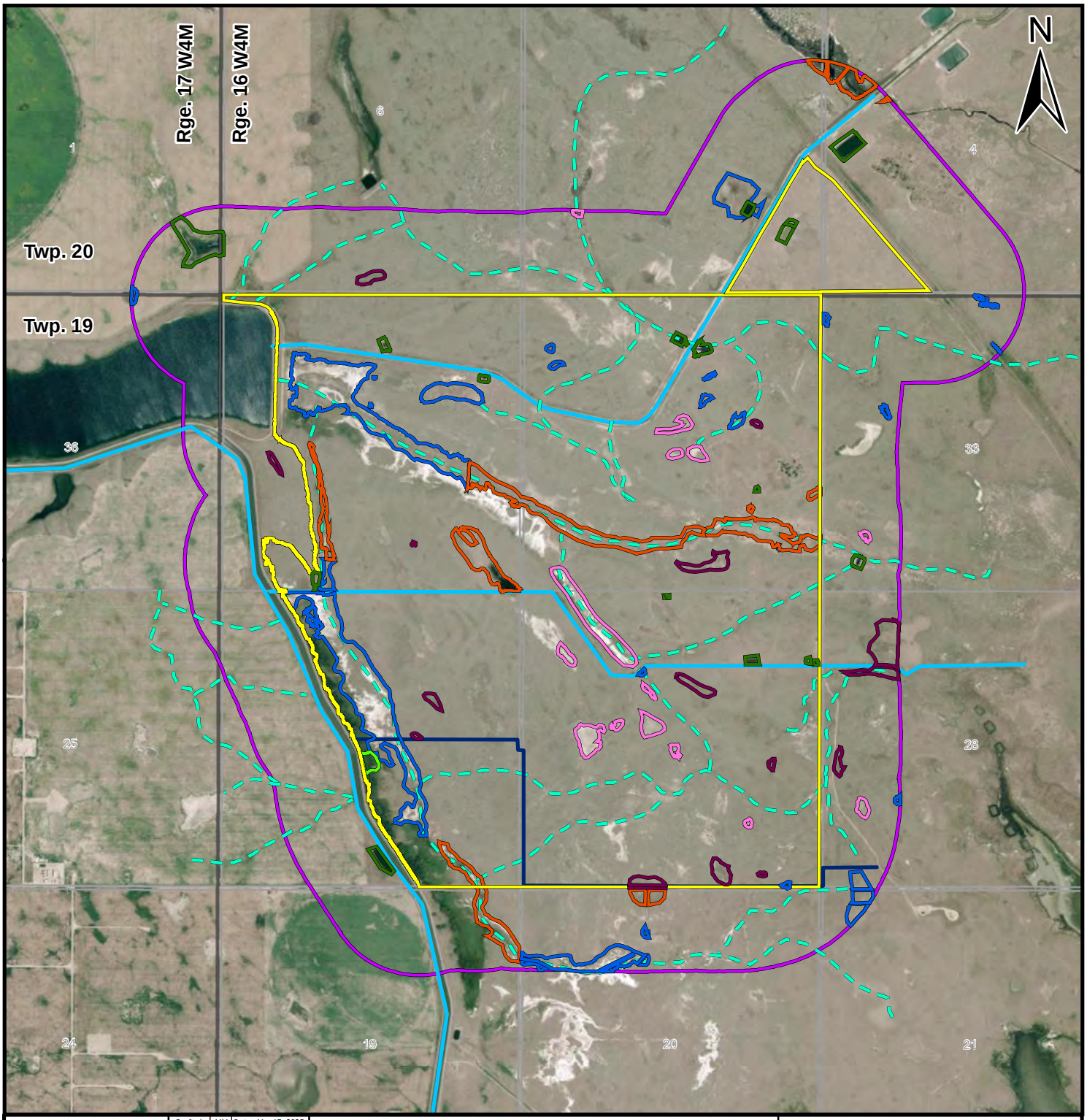
EID

Rare Plants and Communities in the Terrestrial Local Study Area

January 2025

REF.: AARES21-127 (Vegetation)

Figure H1-6



SCALE: 1:30,000

m
200 0 200 400

Drafted:	MM	Date:	Mar 17, 2025
Approved:	WB	Revision:	0
Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
Imagery: ESRI. Date 2021/07/10
ATS Grid: AltaLIS 2007.

*Approximate location based on field survey.

AAR Environmental Services

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Legend

Routing:

- Terrestrial Local Study Area (TLSA)
- Snake Lake Reservoir Expansion Project Area

Biophysical Issues*:

- Canal
- Ditch
- Ephemeral Drainage
- Temporary Marsh (M-G-II)
- Seasonal Marsh (M-G-III)
- Seasonal Swamp (S-S-III)
- Shallow Open Water (W-A-VI)
- Ephemeral Waterbody
- Dugout

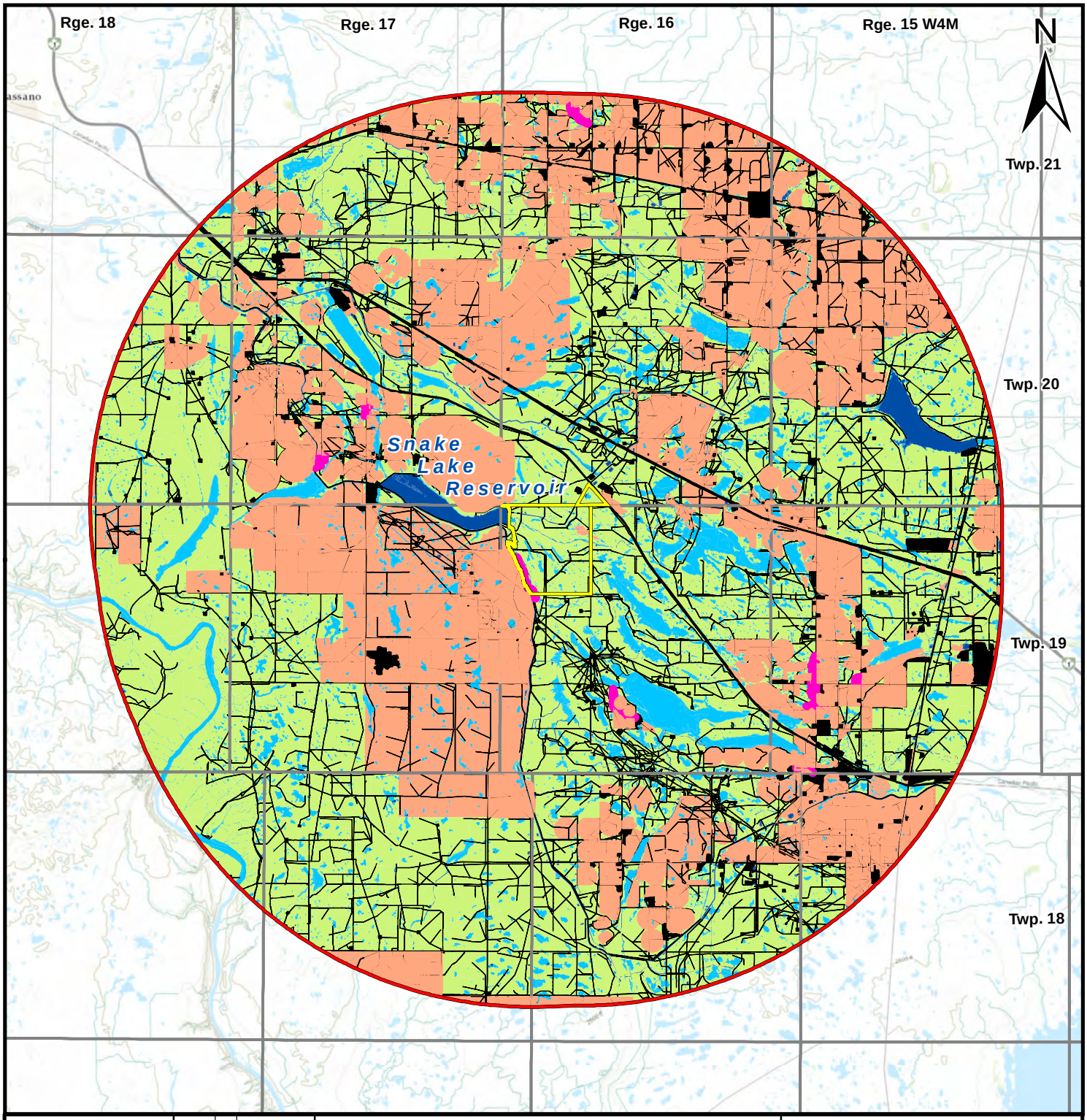
EID

Wetlands and Drainages in the Terrestrial Local Study Area

March 2025

REF.: AARES21-127
(Vegetation)

Figure H1-7



SCALE: 1:200,000

1 0 1 2 Km

Drafted:	JNB	Date:	Mar 17, 2025
Approved:	WB	Revision:	0
Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
ESRI World Topographic Map
ATS Grid: AltaLIS 2007.
GVI: Open Government Licence - Alberta
(https://open.alberta.ca/licence)

AAR Environmental Services

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Please note that the topographic map is from 2010 (NRCAN) and although we have no reason to doubt the accuracy and completeness of it, users should be aware discrepancies may be present.

Legend

Routing:

- Terrestrial Regional Study Area (TRSA)
- Snake Lake Reservoir Expansion Project Area

Regional Vegetation Classes:

- Disturbance
- Native Grassland
- Cultivation
- Wetlands/Waterbodies
- Anthropogenic Water
- Woody

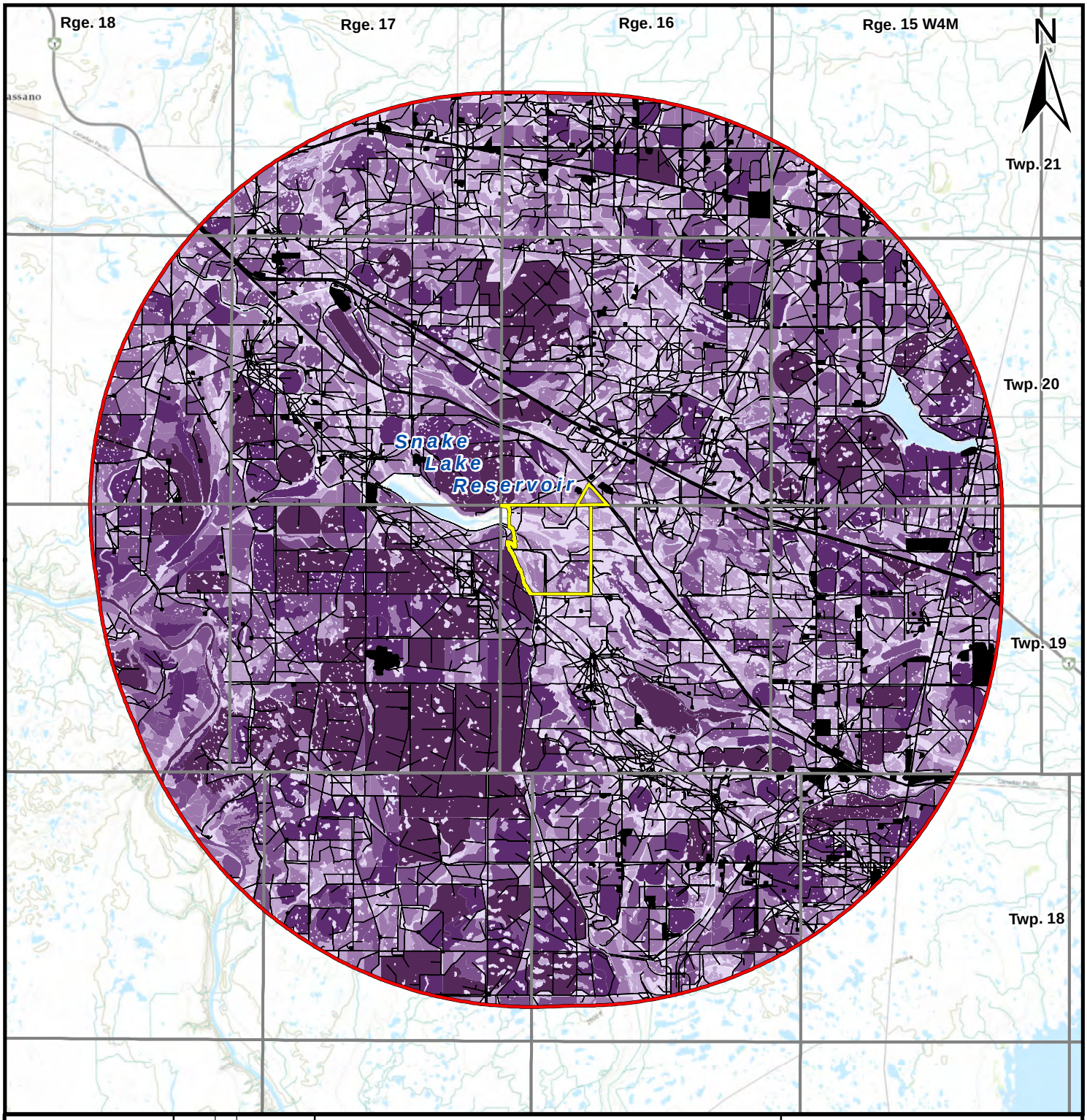
EID

Broad Ecological Community Classes in the Terrestrial Regional Study Area

March 2025

REF.: AARES21-127
(Vegetation)

Figure H1-8



SCALE: 1:200,000
Km
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Drafted:	JNB	Date:	Mar 17, 2025
Approved:	WB	Revision:	0
Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
ESRI World Topographic Map
ATS Grid: AltaLIS 2007.

AAR Environmental Services

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Legend

Routing:

- Terrestrial Regional Study Area (TRSA)
- Snake Lake Reservoir Expansion Project Area

Patch Sizes:

- 0-5 ha
- 5-15 ha
- 15-30 ha
- Disturbance
- 30-50 ha
- 50-100 ha
- >100 ha

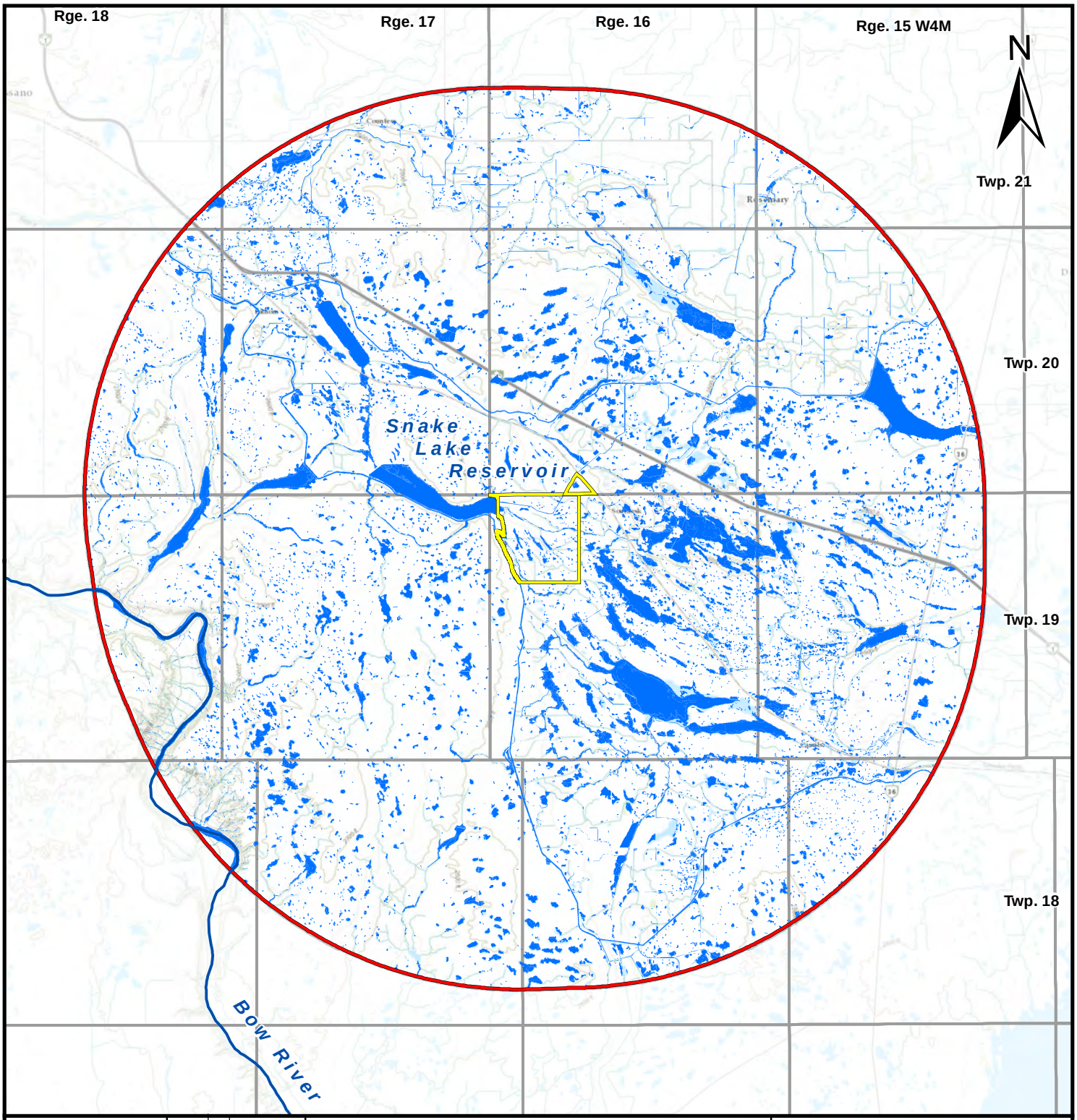
EID

Patch Size Distribution in the Terrestrial Regional Study Area

March 2025

REF.: AARES21-127
(Vegetation)

Figure H1-9



SCALE: 1:200,000

Km

2 0 2

Drafted:	MM	Date:	Jan 15, 2025
Approved:	WB	Revision:	0
Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
ESRI World Topographic Map
ATS Grid: AltaLIS 2007.

AAR Environmental Services

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Legend

- Terrestrial Regional Study Area
- Snake Lake Reservoir Expansion Project Area
- Wetlands and Waterbodies
- Canal/Watercourse
- Background Water

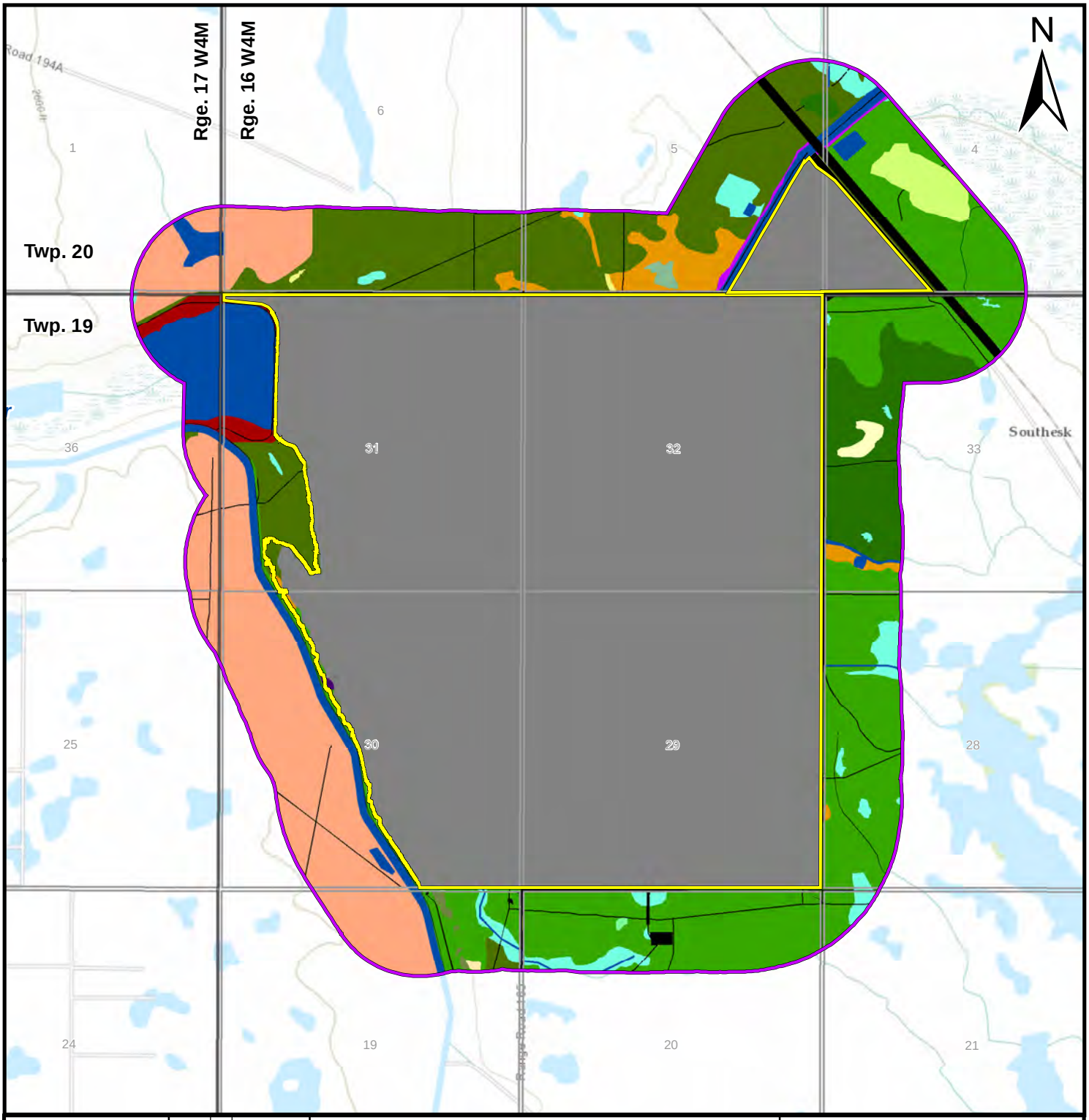
EID

Wetlands and Waterbodies in the Terrestrial Regional Study Area

January 2025

REF.: AARES21-127
(Vegetation)

Figure H1-10



SCALE: 1:30,000

m
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Drafted:	MM	Date:	Mar 17, 2025
Approved:	WB	Revision:	0
Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
ESRI World Topographic Map
ATS Grid: AltaLIS 2007.
GVI: Open Government Licence - Alberta
(https://open.alberta.ca/licence)

*Approximate location based on field survey.

AAR Environmental Services

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Legend

Routing:

- Terrestrial Local Study Area (TLSA)
- Snake Lake Reservoir Expansion Project Area
- Project Area Disturbance

Vegetation Classes*:

- DMGA10
- DMGA37
- DMGA8
- DMGB1
- DMGB3
- DMGB7
- DMGC11
- DMGC9
- MGB2
- Anthropogenic
- Water
- Cultivated Cropland
- Treed Aspen
- Treed Aspen/ Balsam Poplar
- Willow Shrubland
- Disturbance
- Wetlands/Waterbodies

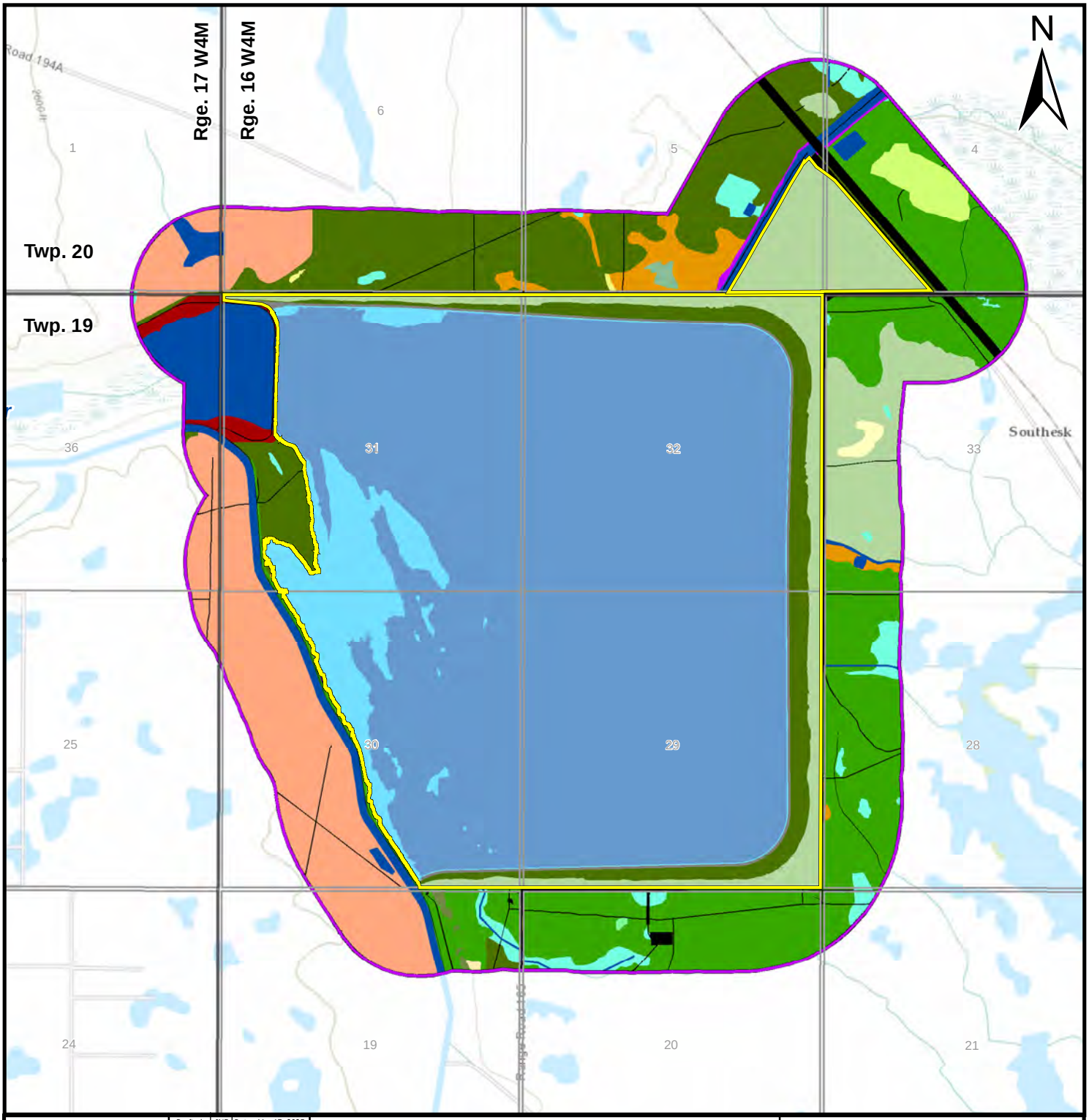
EID

Community Classes in the Terrestrial Local Study Area Project Case

March 2025

REF.: AARES21-127
(Vegetation)

Figure H1-11



SCALE: 1:30,000

200 0 200 400 m

Drafted:	JNB	Date:	Mar 17, 2025
Approved:	WB	Revision:	0
Route Source:		Date:	Feb 18, 2022
CAD Survey		Revision:	0

Data Sources:
ESRI World Topographic Map
ATS Grid: AltaLIS 2007.
GVI: Open Government Licence - Alberta
(https://open.alberta.ca/licence)

*Approximate location based on field survey.

AAR Environmental Services

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Please note that the topographic map is from 2010 (NRCAN) and although we have no reason to doubt the accuracy and completeness of it, users should be aware discrepancies may be present.

Legend

Routing:

- Terrestrial Local Study Area (TLSA)
- Snake Lake Reservoir Expansion Project Area

Vegetation Classes*:

- DMGA10
- DMGA37
- DMGA8
- DMGB1
- DMGB3
- DMGB7
- DMGC11
- DMGC9
- MGB2
- Anthropogenic
- Water
- Cultivated Cropland
- Treed Aspen
- Treed Aspen/ Balsam Poplar
- Willow Shrubland
- Disturbance
- Wetlands/Waterbodies

New Area Classes

- DMGA10
- DMGC11
- New Reservoir Area (Pelagic >3m)
- New Reservoir Area (Littoral)

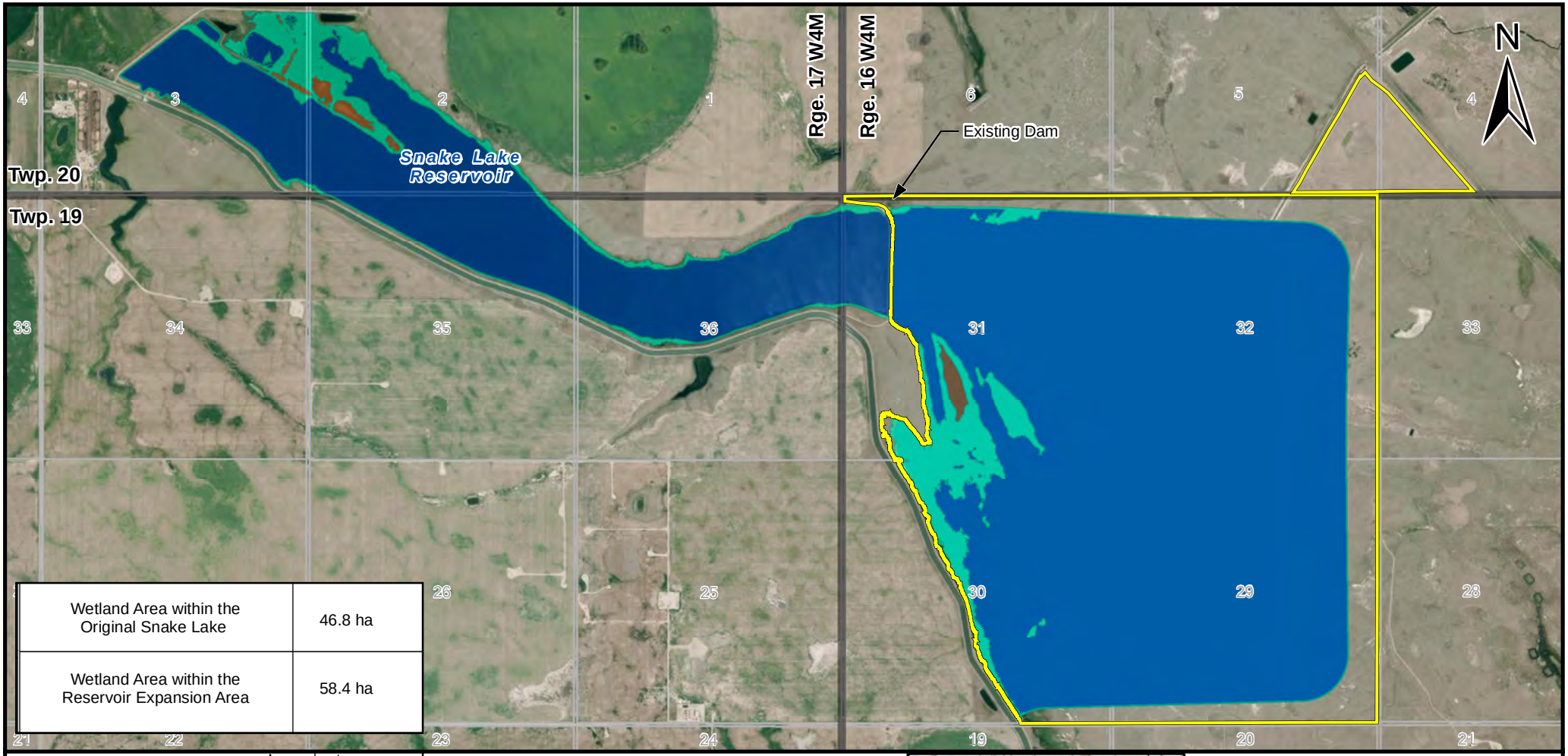
EID

Community Classes and Reclaimed Areas in the Terrestrial Local Study Area Project Case

March 2025

REF.: AARES21-127
(Vegetation)

Figure H1-12



Wetland Area within the Original Snake Lake	46.8 ha
Wetland Area within the Reservoir Expansion Area	58.4 ha

SCALE: 1:35,000

300 0 300 600 m

Drafted:	NM	*Date:* Feb 14, 2025	
Approved:	WB	*Revision:*	0
Route Source:		*Date:* Feb 09, 2024	
SHP		*Revision:*	0

Data Sources:
Imagery: ESRI. Date 7/10/2021.
ATS Grid: AltaLIS 2007.

AAR Environmental Services

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Please note that the imagery is from 2021 and although we have no reason to doubt the accuracy and completeness of it, users should be aware that discrepancies may be present.

Legend

- Snake Lake Reservoir Expansion Project Area
- Deep Water Habitat (Depth >2 m)
- Future Wetland Area at FSL (Depth 0-2 m)
- Area Above Water at FSL

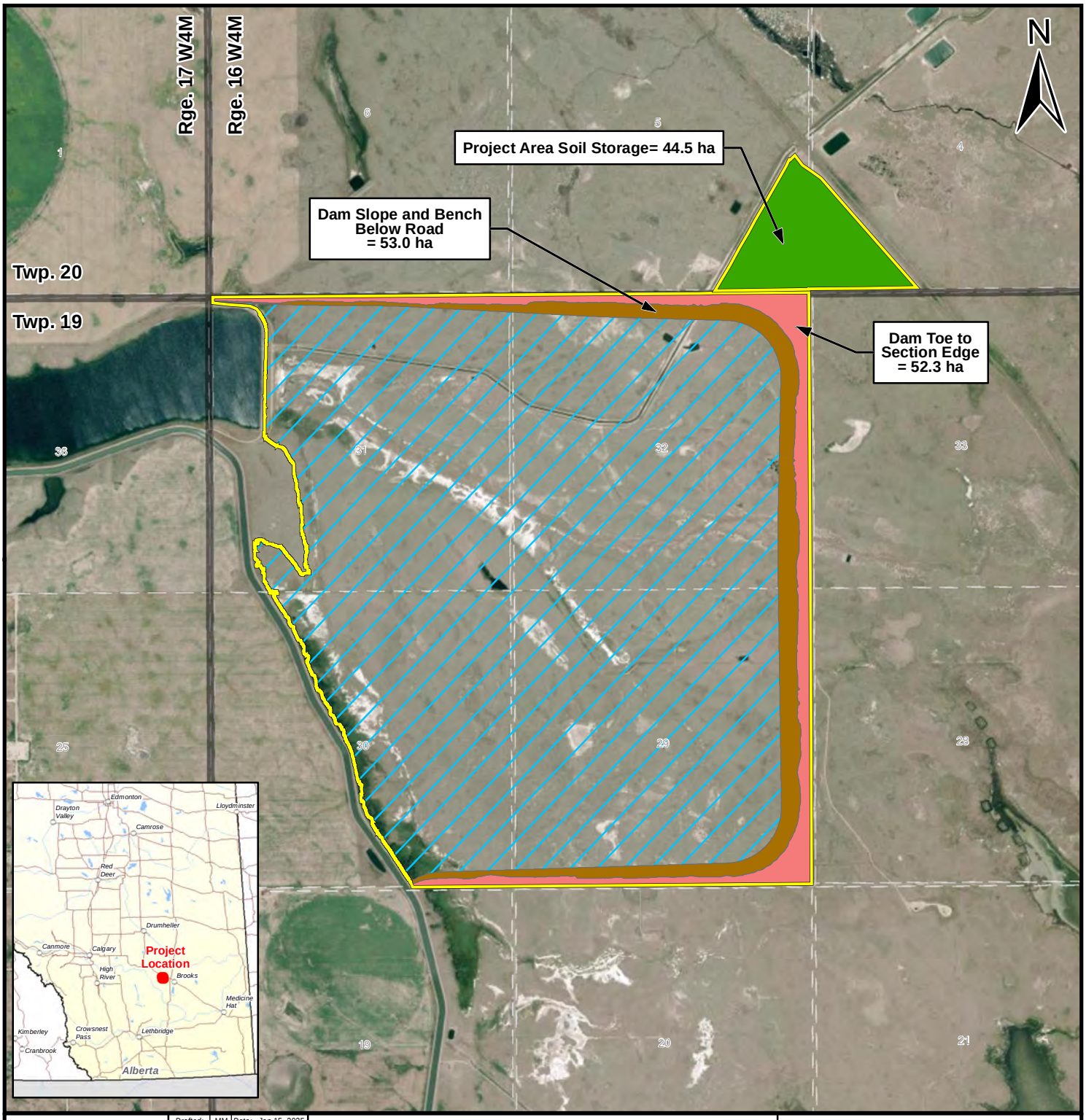
EID

Future Wetland Area Within the Snake Lake Reservoir Expansion

February 2025

REF.: AARES 21-127
(Vegetation)

Figure H1-13



SCALE: 1:30,000

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Drafted:	MM	Date:	Jan 15, 2025
Approved:	LC	Revision:	0
Route Source:		Date:	Feb 21, 2024
CAD Survey		Revision:	0

Data Sources:
Imagery Reference: ESRI 2021/07/10
ATS Grid: AltaLIS 2007

AAR Environmental Services

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Please note that the imagery is from 2021 and although we have no reason to doubt the accuracy and completeness of it, users should be aware that discrepancies may be present

Legend

- Snake Lake Reservoir Expansion Project Area
- Reclaimed Berm
- Soil Storage Area
- Reclaimed to Section
- Reservoir

EID

Grassland Restoration Plan

January 2025

REF.: AARES21-127 (Vegetation)

Figure H1-14

Appendix H2: Potential Rare Plant Species of the Dry Mixedgrass Subregion

Scientific Name	Common Name	S Rank[1]	N Rank[2]
Almutaster pauciflorus	Few-flowered Aster	S3	N4
Amaranthus californicus	Californian Amaranth	S2S3	N1N2
Ambrosia acanthicarpa	Bur Ragweed	S3	N2N3
Antennaria corymbosa	Corymbose Everlasting	S2	N1N2
Antennaria dimorpha	Cushion Everlasting	S2	N4
Aristida purpurea var. longiseta	Red Three-awn	S3	N4
Asclepias viridiflora	Green Milkweed	S1	N5?
Astragalus kentrophyta var. kentrophyta	Prickly Milk Vetch	S2	N2
Atriplex powellii	Powell's Saltbush	S2	N1N2
Atriplex truncata	Saltbush	S1	N4
Bacopa rotundifolia	Water Hyssop	S1	N1
Bidens frondosa	Common Beggarticks	S3	N5
Bidens vulgata	Tall Beggarticks	S1	N5
Boechera collinsii	Collins' Rockcress	S1	N5
Botrychium campestre	Field Grape Fern	S3	N2
Bupleurum americanum	Thorough-Wax	S2	N4N5
Carex nebrascensis[4]	Nebraska Sedge	S3	N2
Carex petasata	Pasture Sedge	S3	N5
Castilleja sessiliflora	Downy Paintbrush	S1	N5
Cerastium brachypodum	Short-stalk Mouse-ear Chickweed	S3	N4
Chenopodium desiccatum	Aridland Goosefoot	S3	N3N4
Chenopodium fremontii	Fremont's Goosefoot	S2	N5
Chenopodium incanum var. incanum	Mealy Goosefoot	S1	NNR
Chenopodium subglabrum[4,5]	Smooth Goosefoot	S2	N3
Chenopodium watsonii	Watson's Goosefoot	S2	N2
Corispermum americanum var. americanum	American Bugseed	S2	N4?
Corispermum hookeri var. hookeri	Hooker's Bugseed	S2	N4N5
Crepis atribarba	Slender Hawk's-beard	S2	N5
Crucihimalaya virgata	Slender Mouse-ear-cress	S2	N1N2
Cryptantha celosioides	Cock's-comb Cryptantha	S2S3	N4
Cryptantha kelseyana	Kelsey's Cat's Eye	S3	N2
Cryptantha minima[3,4,5]	Tiny Cryptantha	S2	N3
Cuscuta gronovii	Swamp Dodder	S1	N5
Cyperus squarrosus	Awned Nut-grass	S2	N4N5
Downingia laeta	Downingia	S3	N2
Tomostima reptans	Creeping Draba	S2	N3
Echinochloa muricata var. microstachya	Rough Barnyard Grass	S1	N5
Elatine triandra	Waterwort	S2	N3N4

Scientific Name	Common Name	S Rank[1]	N Rank[2]
Eleocharis engelmannii	Engelmann's Spike-rush	S2	N2
Elodea bifoliata	Two-leaved Waterweed	S2	N2N3
Elodea canadensis	Canada Waterweed	S2	N5
Elymus elymoides ssp. elymoides	Squirreltail	S2S3	N4
Epilobium campestre	Smooth Boisduvalia	S3	N2N3
Erigeron radicatus[4]	Dwarf Fleabane	S3	N2N3
Eriogonum cernuum	Nodding Umbrella-plant	S3	N2
Eutrema salsugineum	Mouse-ear Cress	S1	N5?
Gratiola neglecta	Clammy Hedge-hyssop	S3	N5
Heliotropium curassavicum	Spatulate-leaved Heliotrope	S3	N4?
Hordeum pusillum[4]	Little Barley	SH	NH
Juncus nevadensis	Nevada Rush	S1	N4
Leptosiphon septentrionalis	Northern Linanthus	S2	N4
Triglochin scilloides	Flowering-quillwort	S3	N2N3
Lithospermum occidentale	Western False Gromwell	S3	NNR
Lysimachia hybrida	Lance-leaved Loosestrife	S3	N5?
Lysimachia minima	Chaffweed	S2S3	N3N4
Marsilea vestita	Hairy Pepperwort	S3	N2N3
Microsteris gracilis ssp. gracilis	Slender Phlox	S1	N4N5
Mirabilis linearis	Narrowleaf Umbrella-wort	S2	N3
Munroa squarrosa	False Buffalo Grass	S3	N2
Neoholmgrenia andina	Upland Evening-primrose	S1	N2
Nothocalais cuspidata	Prairie False Dandelion	S2	N2N3
Nuttallanthus texanus	Canada Toad-flax	S2	N3
Oenothera flava	Low Yellow Evening-primrose	S3	N3
Oenothera serrulata	Shrubby Evening-primrose	S3	N5
Osmorhiza longistylis	Smooth Sweet Cicely	S3	N5
Phacelia linearis	Linear-leaved Scorpionweed	S3	N5
Physaria arctica	Arctic Bladderpod	S3	N4N5
Physaria spatulata	Spatulate Bladderpod	S2S3	N3
Picradeniopsis oppositifolia	Picradeniopsis	S1	N1N2
Potamogeton diversifolius	Water-thread Pondweed	SU	NNA
Potentilla lasiodonta	Sandhills Cinquefoil	S3	N3
Potentilla plattensis	Low Cinquefoil	S2	N4
Psilocarphus brevissimus var. brevissimus[4,5]	Dwarf Woollyheads	S2	N2N3
Ranunculus glaberrimus	Early Buttercup	S3	N5?
Rorippa curvipes	Blunt-leaved Watercress	S3	NNR
Rorippa sinuata	Spreading Yellow Cress	S2	N4?
Rorippa tenerrima	Slender Cress	S3	N3N4
Schedonnardus paniculatus	Tumble Grass	S2	N3
Scirpus pallidus	Pale Bulrush	S1	N4?

Scientific Name	Common Name	S Rank[1]	N Rank[2]
Shinnersoseris rostrata	Annual Skeletonweed	S3	N2N3
Sporobolus michauxianus	Prairie Cord Grass	S2	N5
Sporobolus neglectus	Annual Dropseed	S2	N4N5
Suaeda nigra	Moquin's Sea-blite	S3	N3
Suckleya suckleyana	Poison Suckleya	S3	N4?
Taraxia breviflora	Taraxia	S1	N1N2
Thelesperma subnudum var. marginatum	Greenthread	S1	N1
Tradescantia occidentalis[3,4,5]	Western Spiderwort	S1	N2
Tripterocalyx micranthus[3,4,5]	Sand Verbena	S2	N1N2
Viola pedatifida	Crowfoot Violet	S3	N4
Yucca glauca[3,4,5]	Soapweed	S1	N1
Zizania palustris var. palustris	Northern Wild Rice	S1	N4N5

[1] Provincial ranking (GOA, 2022)
S1- Known from five or fewer occurrences or especially vulnerable to extirpation because of other factor(s).
S2- Known from twenty or fewer occurrences or vulnerable to extirpation because of other factors.
S3- Known from 100 or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factors.
SH- Known only from historical records but still some hope of rediscovery. Evidence that the taxon may no longer be present but not enough to state this with certainty.
SNA- Not Applicable. A conservation status rank is not applicable because the community is not a suitable target for conservation activities.

[2] Federal ranking N1- Critically imperiled N2-Imperiled N3-Vulnerable N4-Apparently Secure N5-Secure NNR-Not Ranked (GOC, 2023)

[3] Threatened under the Alberta *Wildlife Act* (GOA, 2000c)

[4] Listed under COSEWIC (GOC, 2023)

[5] On Schedule 1 of SARA (GOC, 2002)

Appendix H3: Vegetation Community Sample Plots

Plot Name	Initial Community Type	UTM	Best Fit Community Class
DR18	Alkali Marsh	12U 415788 5608993	Wetland
DW14	Gravel Pit	12U 416467 5610934	DMGB7
DW15	Gravel Pit	12U 416089 5610901	DMGB7
DW16	Gravel Pit	12U 416710 5611011	MGB5
DW21	Wetland	12 U 416193 5611879	DMGA45
DW22	Wetland	12 U 416221 5611753	DMGC9/DMGA45
DW23	Wetland	12 U 416319 5611731	MGA29
DW24	Wetland	12 U 417118 5611749	MGA30
DW62	Saline Lowland	12U 415839 5609188	DMGC9/DMGA45
DW62	Wetland/Intermittent Shallow Open Water	12U 415839 5609188	DMGC9/DMGA45
FERR	Gravel Pit/Treed	12 U 416830 5611700	DMGA37
RP01	Treed	12 U 414273 5610530	Treed Aspen
RP02	Treed/ Shrubby	12 U 414517 5609991	Willow shrubland
RP03	Shrubby	12 U 414797 5609549	Willow shrubland
RP04	Dry Grassland	12 U 414779 5611509	DMGA52
RP05	Dry Grassland	12 U 414477 5611501	MGB1
RP06	Dry Grassland/Gravel Pit	12 U 416094 5610869	DMGB7
RP07	Dry Grassland	12 U 414628 5609959	DMGB7
RP08	Saline Lowland	12 U 416453 5611354	Wetland
RP09	Dry Grassland	12 U 414909 5612110	MGB2
RP10	Saline Lowland	12 U 415867 5612417	DMGC11
RP11	Dry Grassland	12 U 415801 5611193	DMGC11
RP12	Wetland/Shrubby/Anthro	12 U 414731 5609682	Willow shrubland
RP13	Wetland	12 U 414230 5611966	Wetland
RP14	Dry Grassland	12 U 415414 5610253	DMGA52
RP15	Dry Grassland	12 U 416676 5610807	DMGC11
RP17	Mesic Grassland/Wetland	12 U 414164 5610962	Wetland
RP18	Saline Lowland	12 U 415409 5611530	DMGC9
RP19	Saline Lowland	12 U 414292 5610849	DMGC9
RP20	Dry Grassland	12 U 416501 5612178	DMGC11
RP21	Dry Grassland	12 U 416026 5609563	DMGC11
RP22	Dry Grassland	12 U 415826 5610111	DMGA48
RP23	Riparian	12 U 416727 5612471	MGB2
RP24	Dry Grassland	12 U 415121 5610491	DMGA45
VC01	Treed	12 U 414223 5610725	Treed Aspen/Balsam Poplar
VC02	Treed	12 U 414384 5610327	Treed Aspen/Balsam Poplar
VC03	Shrubby	12 U 414597 5609752	Willow shrubland
VC04	Dry Grassland	12 U 414011 5611534	DMGA10
VC05	Dry Grassland	12 U 415079 5609952	DMGC11

Plot Name	Initial Community Type	UTM	Best Fit Community Class
VC06	Anthropogenic Grassland	12 U 415038 5609146	MGB5
VC07	Dry Grassland	12 U 414890 5611174	DMGC11
VC08	Dry Grassland	12 U 415695 5612185	DMGC11
VC09	Dry Grassland	12 U 416209 5610926	DMGA10
VC10	Dry Grassland	12 U 415950 5611763	DMGC11
VC11	Dry Grassland	12 U 416024 5612167	DMGC9
VC12	Dry Grassland	12 U 416111 5609886	DMGC11
VC13	Dry Grassland	12 U 416511 5610074	DMGA48
VC14	Shrubby	12 U 414686 5609571	Willow shrubland
VC15	Anthropogenic/Hayfield	12 U 414081 5612508	DMGB3
VC16	Anthropogenic Grassland	12 U 415931 5610152	Anthro
VC17	Anthropogenic	12 U 414057 5610954	DMGB7
VC18	Dry Grassland	12 U 416949 5610636	DMGC11
VC19	Anthropogenic	12 U 415191 5612157	DMGB1
VC20	Saline Lowland	12 U 415796 5609713	DMGC9
VC21	Anthro/Dry Grassland	12 U 417114 5611439	DMGC11
VC22	Dry Grassland	12 U 417168 5611590	DMGC11
VC23	Anthropogenic Grassland	12 U 414880 5609072	DMGB1
VC24	Dry Grassland	12 U 415876 5612795	DMGA10
VC25	Dry Grassland/Ephemeral	12 U 415823 5612699	MGB2
VC26	Saline Lowland	12 U 416144 5612745	DMGA36
VC27	Riparian	12 U 416534 5612336	Riparian
VC28	Mesic Grassland	12 U 415653 5610860	DMGB7
VC31	Dry Grassland	12 U 416739 5610974	DMGC11
VC32	Dry Grassland	12 U 414404 5610384	MGB5
VC33	Dry Grassland	12 U 414950 5611820	DMGC11
VC34	Dry Grassland/Wetland	12 U 414105 5612737	MGB2
VC35	Dry Grassland	12 U 414672 5612056	DMGC11
VC36	Dry Grassland	12 U 416648 5612518	DMGA8
VC37	Dry Grassland	12 U 414798 5612801	DMGC11
VC38	Dry Grassland	12 U 417032 5612333	DMGB7
VC40	Dry Grassland	12 U 415064 5612705	DMGC11
VC41	Saline Lowland	12 U 414599 5611287	DMGC9
VC43	Saline Lowland	12 U 415908 5610261	DMGA52
VC44	Saline Lowland	12 U 414373 5612222	DMGB7
VC46	Saline Lowland/Dry Grassland	12 U 415896 5611642	DMGC9
VC47	Saline Lowland	12 U 416405 5609849	DMGC9
VC48	Saline Lowland	12 U 414262 5611555	DMGC9
VC49	Saline Lowland	12 U 417064 5611190	DMGC9
VC50	Saline Lowland	12 U 416850 5611376	DMGB7
VC51	Shrubby	12 U 415062 5608993	Willow shrubland

Plot Name	Initial Community Type	UTM	Best Fit Community Class
VC52	Shrubby Swamp	12 U 414486 5610110	Willow shrubland
VC53	Dry Grass/Anthropogenic	12 U 414533 5609918	Anthro
VC54	Dry Grassland	12 U 415644 5611672	DMGC11
VC55	Dry Grassland	12 U 414325 5612487	DMGB7
VC56	Dry Grassland	12 U 415250 5611181	DMGC11
VC57	Dry Grassland	12 U 414460 5611100	DMGA52
VC58	Dry Grassland	12 U 416498 5609616	DMGC11
VC59	Dry Grassland	12 U 415334 5611775	DMGC11
VC60	Dry Grassland	12 U 415631 5609667	DMGC11
VC61	Dry Grassland	12 U 415153 5611206	DMGC11
VC67	Dry Grassland	12 U 414896 5611164	DMGC11

Appendix H4: Dominant Species Per Community Class

Polygon ID	Field Vegetation Inventory	Best Fit Community Class [1,2]	Vegetation of Class	Rational for Class Assignment
VC04	Kentucky Bluegrass/Blue Grama Grass/Crested Wheatgrass/Thread-leaved Sedge	DMGA10	Blue Grama Grass/Needle and Thread Grass/Thread-Leaved Sedge/Western Wheat Grass	Closest fit considering introduced species in native prairie.
VC09	Blue Grama/Porcupine Grass/Kentucky Bluegrass			
VC24	Kentucky Bluegrass/Blue Grama Grass/Thread-leaved Sedge/Western Wheatgrass			
VC26	Colorado Rubber Plant/June Grass/Salt Sage/Blue Grama Grass	DMGA36	Blue Grama Grass/Salt Grass/Needle and Thread Grass/Nutall's Atriplex	Similar to reference community.
FERR	Peppergrass/June Grass/Porcupine Grass/Foxtail Barley	DMGA37	Silver Sage Brush/Needle and Thread Grass/Blue Grama Grass/June Grass	Reclaimed gravel pit. Best fit for a disturbed site with non-native planted trees
RP24	Foxtail Barley/Tufted Hairgrass/Gumweed/June Grass/Poverty Weed	DMGA45	Western Wheatgrass/Salt Grass/Gumweed	Best fit for a reclaimed area
RP04	Kentucky Bluegrass/Blue Grama Grass/Western Wheatgrass	DMGA52	Western Wheat Grass/ Blue Grama Grass	Predominately Western Wheat Grass and Blue Grama Grass. Polygons disturbed with introduction of nonnative grass.
RP14	Blue Grama Grass/June Grass/Western Wheatgrass/Kentucky Bluegrass			
VC43	Blue Grama Grass/Western Wheatgrass			
VC57	Blue Grama Grass/Western Wheatgrass/ Kentucky Bluegrass/Porcupine Grass			
VC36	Western Wheatgrass/Blue Grama Grass/June Grass/Tufted Hair Grass	DMGA8	Western Wheat Grass/Pasture Sagewort/Prickly Pear Cactus/June Grass/Prickly Pear	Very similar to reference community.
VC19	Crested Wheatgrass/Yellow Sweet Clover/Western Wheatgrass	DMGB1	Crested Wheatgrass	Crested Wheatgrass is the dominant grass with introduced species.
VC23	Crested Wheatgrass/Kentucky Bluegrass			
VC15	Crested Wheatgrass/Alfalfa	DMGB3	Crested Wheatgrass/Alfalfa	Similar to reference community

Polygon ID	Field Vegetation Inventory	Best Fit Community Class [1,2]	Vegetation of Class	Rational for Class Assignment
DW14	Kentucky Bluegrass/Blue Grama Grass/Baltic Rush	DMGB7	Foxtail Barley/Kentucky Bluegrass, Western Wheat Grass, Perennial Sow Thistle	Disturbed community similar to reference community
DW15	Kentucky Bluegrass/Thread-leaved Sedge/June Grass			
RP06	Kentucky Bluegrass/Thread-leaved Sedge/June Grass			
RP07	Foxtail Barley/Kentucky Bluegrass/Blue Grama Grass/Thread-leaved Sedge			
VC17	Kentucky Bluegrass/Foxtail Barley/Crested Wheatgrass/Western Wheatgrass			
VC28	Kentucky Bluegrass/Perennial Sow Thistle/Western Wheatgrass			
VC38	Kentucky Bluegrass/Thread-leaved Sedge/June Grass/Blue Grama Grass			
VC44	Red Samphire/Foxtail Barley/Western Wheatgrass			
VC50	Kentucky Bluegrass/Foxtail Barley/June Grass			
VC55	Blue Grama Grass/Thread-leaved Sedge/Kentucky Bluegrass			
RP10	Blue Grama Grass/June Grass/Porcupine Grass	DMGC11	Silver Sagebrush/Western Porcupine Grass/Blue Grama Grass/June Grass	Similar to reference community but disturbed with introduced species
RP11	Blue Grama Grass/Porcupine Grass/Kentucky Bluegrass			
RP15	Blue Grama Grass/Porcupine Grass/Western Wheatgrass			
RP20	Blue Grama Grass/Kentucky Bluegrass/June Grass			
RP21	Blue Grama Grass/Porcupine Grass/Kentucky Bluegrass			
VC05	Blue Grama Grass/June Grass/Porcupine Grass			
VC07	Porcupine Grass/Blue Grama Grass			
VC08	June Grass/Blue Grama Grass/Porcupine Grass			
VC10	Blue Grama Grass/Porcupine Grass			

Polygon ID	Field Vegetation Inventory	Best Fit Community Class [1,2]	Vegetation of Class	Rational for Class Assignment
VC12	Blue Grama Grass/Kentucky Bluegrass/Porcupine Grass			
VC18	Blue Grama Grass/June Grass/Porcupine Grass/Alfalfa			
VC21	Blue Grama Grass/Porcupine Grass/Western Wheatgrass			
VC22	Blue Grama Grass/Porcupine Grass/Western Wheatgrass			
VC31	Foxtail Barley/Blue Grama Grass/Porcupine Grass			
VC33	Blue Grama Grass/June Grass/Rye Grass			
VC35	Blue Grama Grass/Kentucky Bluegrass/Thread-leaved Sedge/Rye/Porcupine Grass			
VC37	Blue Grama Grass/Porcupine Grass			
VC40	Blue Grama Grass/Porcupine Grass/Kentucky Bluegrass/Plains Reed Grass			
VC54	Blue Grama Grass/Porcupine Grass/Thread-leaved Sedge/June Grass			
VC56	Blue Grama Grass/Porcupine Grass/Foxtail Barley			
VC58	Blue Grama Grass/Kentucky Bluegrass/Porcupine Grass			
VC59	Blue Grama Grass/Porcupine Grass/Kentucky Bluegrass/Western Wheatgrass			
VC60	Blue Grama Grass/Porcupine Grass/June Grass			
VC61	Blue Grama Grass/Porcupine Grass			
VC67	Blue Grama Grass/Porcupine Grass			
RP18	Western Wheatgrass/Poverty Weed/Salt Sage	DMGC9	Greasewood/Poverty Weed/Western Wheatgrass/Nuttal's Atriplex	Similar to reference community
RP19	Western Wheatgrass/Kentucky Bluegrass/Salt Sage/Red Samphire			
VC11	Blue Grama Grass/Poverty Weed/Salt Sage			

Polygon ID	Field Vegetation Inventory	Best Fit Community Class [1,2]	Vegetation of Class	Rational for Class Assignment
VC20	Poverty Weed/Foxtail Barley			
VC41	Timothy/Creeping Spike Rush/Foxtail Barley/Poverty Weed			
VC46	Western Wheatgrass/June Grass/Salt Sage			
VC47	Western Wheatgrass/Poverty Weed			
VC48	Western Wheatgrass/Poverty Weed/Salt Sage/Red Samphire			
VC49	Western Wheatgrass/Foxtail Barley/June Grass/Salt Sage			
RP22	Blue Grama Grass			
VC13	Porcupine Grass/Blue Grama Grass/Kentucky Bluegrass			
DW24	Foxtail Barley/June Grass/Oak-leaved Goosefoot	MGA30	Western Porcupine Grass/ Northern Wheatgrass/ June Grass	Ephemeral waterbody with a more mesic population
RP05	Blue Grama Grass/Kentucky Bluegrass/Crested Wheatgrass	MGB1	Crested Wheatgrass/Pasture Sage Wort	Disturbed grassland with introduced Kentucky Bluegrass.
RP09	Tufted Hair Grass/Kentucky Bluegrass/Foxtail Barley/Blue Grama Grass	MGB2	Snowberry/Kentucky Bluegrass/Tufted Hairgrass	Similar to reference community.
RP23	Tufted Hair Grass/Sedge/Kentucky Bluegrass/June Grass/Sloughgrass			
VC25	Tufted Hairgrass/Kentucky Bluegrass/Baltic Rush/Creeping Spike Rush			
VC34	Tufted Hair Grass/Kentucky Bluegrass/Foxtail Barley/June Grass/Fescue			
DW16	Kentucky Bluegrass/Crested Wheatgrass/Smooth Brome/June Grass	MGB5	Kentucky Bluegrass/Dandelion/Smooth Brome	Best fit for a disturbed area predominately of Kentucky Bluegrass.
VC06	Kentucky Bluegrass/Smooth Brome/Sweet Clover/Baltic Rush			

Polygon ID	Field Vegetation Inventory	Best Fit Community Class [1,2]	Vegetation of Class	Rational for Class Assignment
VC32	Kentucky Bluegrass/Baltic Rush/Thread-leaved Sedge/Perennial Sow Thistle/Sweet Clover			
VC01	Trembling Aspen/Balsam Poplar/Dogwood/Bebb's Willow	Treed	Treed Aspen/Balsam Poplar	No community class for non-grasslands
VC02	Trembling Aspen/Balsam Poplar/Bebb's Willow			
RP02	Kentucky Bluegrass/Bebb's Willow/Prickly Rose/Balsam Poplar/Trembling Aspen	Shrubby	Willow Shrubland	No community class for non-grasslands
RP03	Narrow Leaf Willow/Trembling Aspen/Bebb's Willow/Prickly Rose			
RP12	Silverberry/Bebb's Willow/Trembling Aspen/Balsam Poplar			
VC03	Bebb's Willow/Trembling Aspen/Balsam Poplar/			
VC14	Bebb's Willow/Trembling Aspen/Buckbrush			
VC51	Bebb's Willow/Kentucky Bluegrass/Sedges Sp./Fireweed			
VC52	Bebb's Willow/Trembling Aspen/Balsam Poplar/Water Sedge			

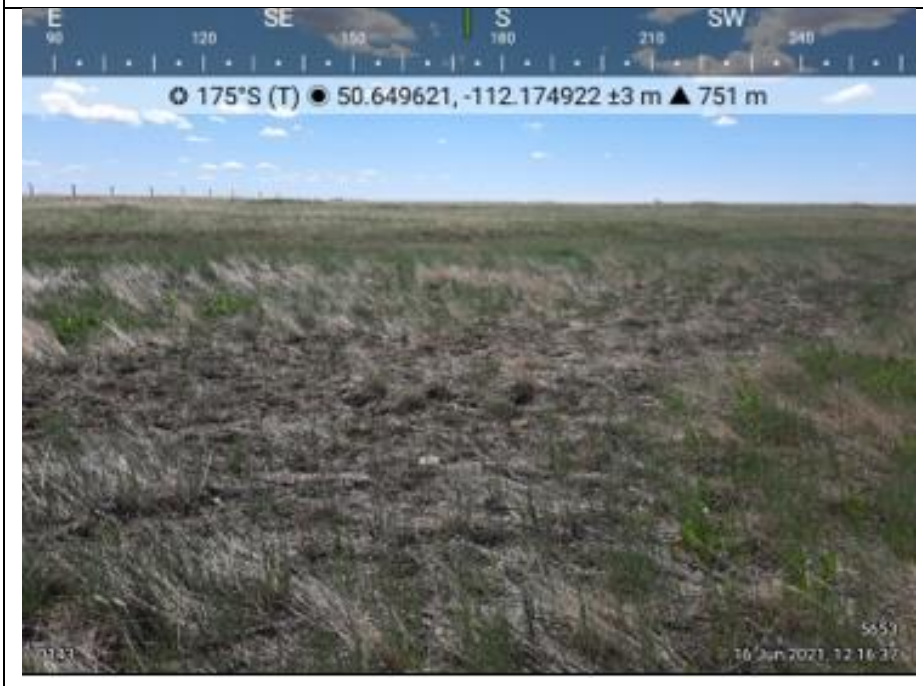
1 (Adams, et al., 2013a) 2 (Adams, et al., 2013b)

Appendix H5: Photo Plates

	Plate H5-1: Example of a native Dry Mixedgrass community within the Terrestrial Local Study Area. (Plot VC05, Community Class DMGC11) (June 12, 2021; 12N 415077 5609952; 8-30-19-16 W4M)
	Plate H5-2: Example of native Mixedgrass community within the Terrestrial Local Study Area (Plot VC32, Community Class MGB5) (June 11, 2021; 12N 414398 5610385; 11-30-19-16 W4M). Note this area is adjacent to the treed communities along the west canal which receives seepage from the canal

	Plate H5-3: Aspen/Balsam Poplar Woodland community within the Terrestrial Local Study Area. (June 12, 2021; 12N 414509 5609988; 7-30-19-16 W4M)
	Plate H5-4: Willow shrubland community within the Terrestrial Local Study Area (July 23, 2023; 6-30-19-16 W4M). Standing water was present in this community under drought conditions, affirming seepage from the west canal has created an environment where a shrubby willow swamp could establish

	Plate H5-5: Aspen Woodland community within the Terrestrial Local Study Area. (June 11, 2021; 12N 414288 5610523; 11-30-19-16 W4M).
	Plate H5-6: Example of an ephemeral waterbody within the Terrestrial Local Study Area. (June 16, 2021; 12N 416251 5611908; 10-32-19-16 W4M). This is a low area which occasionally holds water and is subject to pugging by cattle. Water is not present long enough to allow wetland soil or vegetation to establish.

	Plate H5-7: Example of an intermittent shallow open water wetland within the Terrestrial Local Study Area. (June 11, 2021; 3-29-19-16 W4M)
	Plate H5-8: Example of a temporary graminoid marsh within the Terrestrial Local Study Area. (June 16, 2021; 12N 416938 5611521; 8-32-19-16 W4M)

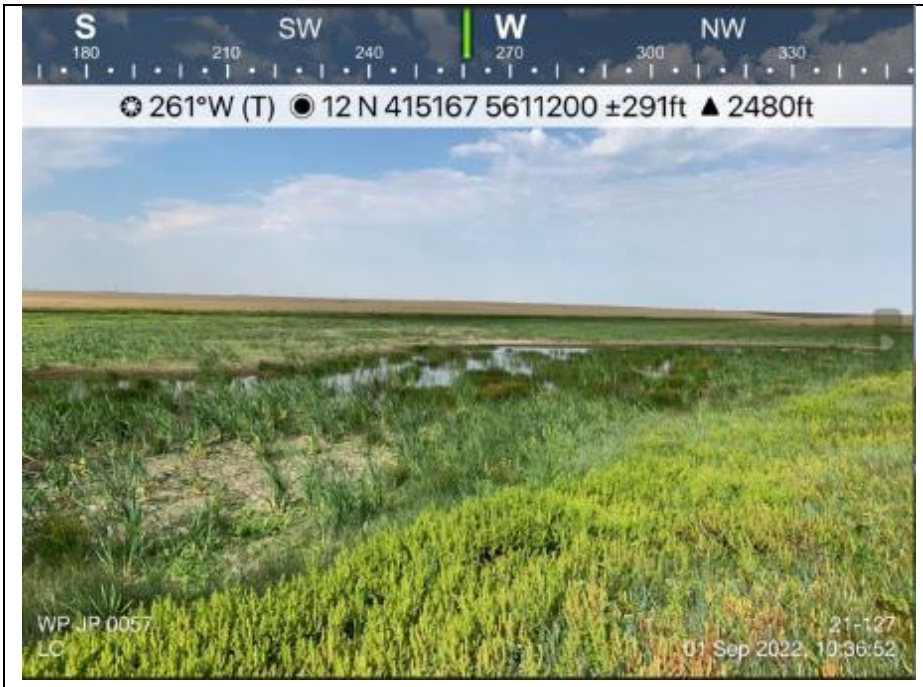
	Plate H5-9: Example of a seasonal graminoid marsh within the Terrestrial Local Study Area (September 1, 2022; 1-31-19-16 W4M)
	Plate H5-10: Example of a dugout within the Terrestrial Local Study Area. (June 14, 2021; 12N 414609 5612393; 15-31-19-16 W4M)

	Plate H5-11: Crested Wheatgrass *(Agropyron cristatum)* community (DMGB) within the Terrestrial Local Study Area. (August 29, 2022; 13-31-19-16 W4M)
	Plate H5-12: Anthropogenic/disturbed weedy Perennial Sow Thistle (*Sonchus arvensis*) community within the Terrestrial Local Study Area. (July 23, 2021; 11-30-19-16 W4M).

	Plate H5-13: A noxious species Canada Thistle (*Cirsium arvense*) observed within the Terrestrial Local Study Area. (Source: Alberta Invasive Species Council)
	**Pl**ate H5-14: Noxious weed species Perennial Sow Thistle (*Sonchus arvensis*) observed within the Terrestrial Local Study Area. (June 12, 2021; 12N 414301 5611894; 11-31-19-16 W4M)

	Plate H5-15: Noxious weed species Field Bindweed (*Convolvulus arvensis*) observed within the Terrestrial Local Study Area. (Source: Alberta Invasive Species Council)
	Plate H5-16: Prohibited noxious weed Hoary Alyssum (*Berteroa incana*) observed within the Terrestrial Local Study Area. (Source: Alberta Invasive Species Council)

Plate H5-17: Prohibited noxious weed (Nodding Thistle (*Carduus nutans*) observed within the Terrestrial Local Study Area.

(Source: Alberta Invasive Species Council)

Appendix H6: Species Present Within the Terrestrial Local Study Area

Scientific Name	Common Name	Origin	S Rank[1]	Weed Status
Strata: Graminoid				
Agropyron cristatum	Crested Wheatgrass	Exotic	SNA	-
Agrostis sp.	Bentgrass	N/A	N/A	-
Beckmannia syzigachne	Slough Grass	Native	S5	-
Bolboschoenus maritimus	Prairie Bulrush	Native	S4	-
Bouteloua gracilis	Blue Grama Grass	Native	S5	-
Bromus inermis	Smooth Brome	Exotic	SNA	-
Calamagrostis canadensis	Bluejoint Grass	Native	S5	-
Calamagrostis montanensis	Plains Reed Grass	Native	S5	-
Carex aquatilis	Water Sedge	Native	S5	-
Carex prairea	Prairie Sedge	Native	S5	-
Carex filifolia	Thread-leaved Sedge	Native	S5	-
Danthonia sp.	Oat Grass	Exotic	SNA	-
Deschampsia cespitosa	Tufted Hair Grass	Native	S5	-
Distichlis spicata	Salt Grass	Native	S3	-
Eleocharis acicularis	Needle Spike-rush	Native	S5	-
Eleocharis palustris	Creeping Spike-rush	Native	S5	-
Elymus lanceolatus	Northern Wheat Grass	Native	S5	-
Elymus trachycaulus	Slender Wheat Grass	Native	S5	-
Festuca idahoensis	Bluebunch Fescue	Native	S5	-
Festuca ovina	Sheep Fescue	Exotic	SNA	-
Glyceria grandis	Common Tall Manna Grass	Native	S5	-
Glyceria striata	Fowl Manna Grass	Native	S5?	-
Hesperostipa comata	Needle And Thread Grass	Native	S5	-
Hesperostipa spartea	Porcupine Grass	Native	S3	-
Hordeum jubatum	Foxtail Barley	Native	S5	-
Juncus balticus	Wire Rush	Native	S5	-
Koeleria macrantha	June Grass	Native	S5	-
Lolium perenne	Perennial Ryegrass	Exotic	SNA	-
Pascopyrum smithii	Western Wheat Grass	Native	S5	-
Phalaris arundinacea	Reed Canary Grass	Native	S5	-
Phleum pratense	Timothy	Exotic	SNA	-
Poa pratensis	Kentucky Bluegrass	Exotic	SNA	-
Poa secunda	Sandberg Bluegrass	Native	S5	-
Schoenoplectus acutus	Great Bulrush	Native	S5?	-
Schoenoplectus pungens	Three-square Rush	Native	S4	-
Schoenoplectus tabernaemontani	Common Great Bulrush	Native	S5	-
Typha latifolia	Common Cattail	Native	S5	-

Scientific Name	Common Name	Origin	S Rank[1]	Weed Status
Strata: Forb				
Achillea millefolium	Common Yarrow	Native	SNA	-
Allium textile	Prairie Onion	Native	S5	-
Androsace septentrionalis	Northern Fairy Candelabra	Native	S5	-
Antennaria parvifolia	Small-leaved Everlasting	Native	S5	-
Antennaria umbrinella	Brown-bracted Mountain Everlasting	Native	S4	-
Arnica fulgens	Shining Arnica	Native	S4	-
Artemisia absinthium	Absinthe Wormwood	Exotic	SNA	-
Artemisia campestris	Plains Wormwood	Native	S5	-
Artemisia frigida	Pasture Sagewort	Native	S5	-
Artemisia ludoviciana	Prairie Sagewort	Native	S5	-
Astragalus flexuosus	Slender Milkvetch	Native	S4	-
Astragalus pectinatus	Narrow-leaved Milk Vetch	Native	S5	-
Atriplex argentea	Silver Saltbush	Native	S3	-
Atriplex gardneri	Gardner's Saltbush	Native	S4	-
Atriplex prostrata	Prostrate Saltbush	Exotic	SNA	-
Atriplex suckleyi	Endolepis	Native	S3	-
Berteroa incana	Hoary Alyssum	Exotic	SNA	Prohibited
Blitum nuttallianum	Spear-leaved Goosefoot	Native	S5	-
Carduus nutans	Nodding Thistle	Exotic	SNA	Prohibited
Chamerion angustifolium	Common Fireweed	Native	S5	-
Chenopodium album	Lamb's-quarters	Exotic	SNA	-
Oxybasis glauca ssp. salina	Oak-leaved Goosefoot	Native	S5	-
Cichorium intybus	Chicory	Exotic	SNA	-
Cirsium arvense	Canada Thistle	Exotic	SNA	Noxious
Cirsium vulgare	Bull Thistle	Exotic	SNA	-
Convolvulus arvensis	Field Bindweed	Exotic	SNA	Noxious
Crepis atribarba	Slender Hawk's-beard	Native	S2	-
Crepis tectorum	Annual Hawk's-beard	Exotic	SNA	-
Descurainia pinnata	Green Tansy Mustard	Native	S4	-
Descurainia sophia	Flixweed	Native	S5	-
Dieteria canescens	Hoary Aster	Native	S3	-
Drymocallis arguta	White Cinquefoil	Native	S4	-
Epilobium palustre	Marsh Willowherb	Native	S4	-
Equisetum arvense	Common Horsetail	Native	S4	-
Erigeron sp.	Fleabane	N/A	N/A	-
Erucastrum gallicum	Dog Mustard	Native	S5	-
Erysimum asperum	Prairie Rocket	Native	S3	-
Erysimum cheiranthoides	Wormseed Mustard	Native	S5	-
Escobaria vivipara	Cushion Cactus	Native	S3	-

Scientific Name	Common Name	Origin	S Rank[1]	Weed Status
Fallopia convolvulus	Wild Buckwheat	Exotic	SNA	-
Gaillardia aristata	Blanket Flower	Native	S5	-
Galium boreale	Northern Bedstraw	Native	S5	-
Geum aleppicum	Yellow Avens	Native	S5	-
Geum triflorum	Three-flowered Avens	Native	S5	-
Glycyrrhiza lepidota	Wild Licorice	Native	S4	-
Gnaphalium palustre	Marsh Cudweed	Native	S3	-
Grindelia squarrosa	Curly-cup Gumweed	Native	S4S5	-
Heterotheca villosa	Golden Aster	Native	S5	-
Hymenoxys richardsonii	Colorado Rubber-plant	Native	S4	-
Iva axillaris	Povertyweed	Native	S4	-
Bassia scoparia	Summer-cypress	Exotic	SNA	-
Lactuca serriola	Prickly Lettuce	Exotic	SNA	-
Lathyrus ochroleucus	Yellow Peavine	Native	S5	-
Lycopus asper	Western Water-horehound	Native	S3	-
Lygodesmia juncea	Skeleton Plant	Native	S5	-
Lysimachia maritima	Sea Milkwort	Native	S4	-
Maianthemum amplexicaule	False Solomon's-seal	Native	S5	-
Medicago lupulina	Black Medick	Exotic	SNA	-
Medicago sativa	Alfalfa	Exotic	SNA	-
Melilotus officinalis	Yellow Sweet-clover	Exotic	SNA	-
Mentha canadensis	Wild Mint	Native	S5	-
Menyanthes trifoliata	Bog Buckbean	Native	S5	-
Mertensia paniculata	Tall Lungwort	Native	S5	-
Neslia paniculata	Ball Mustard	Exotic	SNA	-
Oenothera suffrutescens	Scarlet Butterflyweed	Native	S4	-
Opuntia polyacantha	Prickly-pear	Native	S5	-
Oxytropis campestris	Northern Locoweed	Native	S4	-
Packera cana	Prairie Groundsel	Native	S5	-
Parnassia palustris	Northern Grass-of-parnassus	Native	S5	-
Penstemon nitidus	Smooth Blue Beardtongue	Native	S5	-
Penstemon procerus	Slender Blue Beardtongue	Native	S5	-
Petasites frigidus var. sagittatus	Arrow-leaved Coltsfoot	Native	S5	-
Phlox hoodii	Moss Phlox	Native	S5	-
Plantago major	Common Plantain	Exotic	SNA	-
Plantago patagonica	Woolly Plantain	Native	S5	-
Polygonum aviculare	Prostrate Knotweed	Exotic	SNA	-
Potentilla anserina	Silverweed	Native	S5	-
Potentilla bipinnatifida	Plains Cinquefoil	Native	S4	-
Potentilla concinna	Early Cinquefoil	Native	S4	-

Scientific Name	Common Name	Origin	S Rank[1]	Weed Status
Potentilla pensylvanica	Prairie Cinquefoil	Native	S5	-
Pyrola asarifolia	Common Pink Wintergreen	Native	S5	-
Ranunculus sceleratus	Celery-leaved Buttercup	Native	S5	-
Ratibida columnifera	Prairie Coneflower	Native	S4	-
Rumex crispus	Curled Dock	Exotic	SNA	-
Rumex pseudonatronatus	Field Dock	Exotic	SNA	-
Rumex venosus	Wild Begonia	Native	S3	-
Salicornia rubra	Red Samphire	Native	S5	-
Selaginella densa	Prairie Selaginella	Native	S5	-
Sisyrinchium montanum	Common Blue-eyed Grass	Native	S5	-
Solanum triflorum	Wild Tomato	Native	S3	-
Solidago canadensis	Canada Goldenrod	Native	SU	-
Solidago missouriensis	Low Goldenrod	Native	SNA	-
Sonchus arvensis	Perennial Sow Thistle	Exotic	SNA	Noxious
Spergularia salina	Sand Spurry	Native	S5	-
Sphaeralcea coccinea	Scarlet Mallow	Native	S5	-
Stachys pilosa	Marsh Hedge-nettle	Native	S5	-
Stellaria longipes	Long-Stalked Chickweed	Native	S5	-
Stellaria media	Common Chickweed	Exotic	SNA	-
Symphyotrichum falcatum	Creeping White Prairie Aster	Native	S5	-
Taraxacum officinale	Common Dandelion	Exotic	SNA	-
Thermopsis rhombifolia	Golden Bean	Native	S5	-
Tragopogon dubius	Common Goat's-beard	Exotic	SNA	-
Trifolium pratense	Red Clover	Exotic	SNA	-
Trifolium repens	White Clover	Exotic	SNA	-
Triglochin maritima	Seaside Arrow-grass	Native	S5	-
Vicia americana	Wild Vetch	Native	S5	-
Viola canadensis	Western Canada Violet	Native	S5	-
Zigadenus venenosus	Death Camas	Native	S4	-
Strata: Shrub				
Artemisia cana	Silver Sagebrush	Native	S5	-
Cornus sericea	Red-osier Dogwood	Native	S5	-
Elaeagnus commutata	Silverberry	Native	S4	-
Gutierrezia sarothrae	Broomweed	Native	S5	-
Rosa acicularis	Prickly Rose	Native	S5	-
Rosa arkansana	Prairie Rose	Native	S5	-
Rubus idaeus	Wild Red Raspberry	Native	S5	-
Salix bebbiana	Beaked Willow	Native	S5	-
Salix exigua	Narrow-leaf Willow	Native	S3S4	-
Suaeda nigra	Moquin's Sea-blite	Native	S3	-

Scientific Name	Common Name	Origin	S Rank[1]	Weed Status
Symphoricarpos occidentalis	Buckbrush	Native	S5	-
Strata: Tree				
Populus balsamifera	Balsam Poplar	Native	S5	-
Populus deltoides	Plains Cottonwood	Native	S3	-
Populus tremuloides	Trembling Aspen	Native	S5	-
Strata: Lichen				
Cladonia rangiferina	Gray Reindeer Lichen	Native	S3S5	-
Scoliciosporum sarothamni	Crustose Lichen	Native	SU	-
Strata: Moss				
Pohlia nutans	Copper Wire Moss	Native	S5	-

[1]Provincial ranking (GOA, 2022)

S1- Known from five or fewer occurrences or especially vulnerable to extirpation because of other factor(s).
S2- Known from twenty or fewer occurrences or vulnerable to extirpation because of other factors.
S3- Known from 100 or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factors.
S4- Apparently Secure-Uncommon but not rare
S5- Secure-Common and widespread in the province
SNA- Not Applicable. A conservation status rank is not applicable because the community is not a suitable target for conservation activities.
SU- Currently unrankable due to lack of information or substantially conflicting information.

Appendix H7: Traditionally Used Plant Species within the Terrestrial Local Study Area

Ref	Latin Name	Common Name	Significance					Reported Traditional Blackfoot (Siksikaitsitapi) Uses
			Spiritual	Dyes	Food	Medicinal	Cultural	
1, 2, 3	*Achillea millefolium*	Common Yarrow				x		Medicinal tea; insect repellent
1, 2, 3	*Allium textile*	Prairie Onion			x	x	x	Bulbs to deodorize quivers and shine arrows; boiled with meat or preserved; medicinal tea
1, 3	*Artemesia spp.*	Wormwood, Sagebrush	x			x	x	Ceremonial plant and incense; weathered leaves powdered for baby rash relief; horse medicine; eaten for stomach aches;
1	*Artemisia cana*	Silver Sagebrush				x	x	Leaves chewed to relieve thirst; decoction for hair growth; fall and winter horse forage
1, 2	*Artemisia frigida*	Pasture Sagewort	x	x		x	x	Used in Blackfoot ritual; leaves for toilet paper; stalks for fans and mats in tipis; medicinal tea; flower petals to stop nose bleeds; smudge for insect repellent.
1	*Bolboschoenus maritimus*	Prairie Bulrush			x			Tubers used for food
1	*Bouteloua gracilis*	Blue Grama Grass					x	Used to predict winter severity depending on number of fruit spikes
1	*Carex aquatilis*	Water Sedge					x	Used as insulation (*Carex spp.* in general, not water sedge specifically)
2	*Chamerion angustifolium*	Common Fireweed		x	x	x		Roots rich in Vitamin C and beta-carotene; dry stems made into powder to protect skin from cold; flowers rubbed on rawhide for waterproofing
1	*Chenopodium album*	Lamb's-Quarters		x	x			Young shoots for green dye; seeds as food
1, 2, 3	*Cornus sericea*	Red-osier Dogwood	x		x	x	x	Inner bark part of tobacco mixture (narcotic effect); used to make gambling wheels; berries are a snack reserved for men (poisonous if consumed excessively); medicinal tea
1	*Escobaria vivipara*	Cushion Cactus			x			Ripe fruits as food
1, 2	*Elaeagnus commutata*	Silverberry			x	x	x	Bark for rope; seeds as beads; fruits as famine food; medicinal bark
1	*Elymus sp.*	Wheatgrasses					x	Beds made during war parties
2	*Gaillardia aristata*	Brown-eyed Susan			x	x	x	Flower head as spoon for serving sick people; flower head absorbs grease off soups; medicinal tea
1	*Galium boreale*	Northern Bedstraw		x				Red dye from roots
1, 2	*Geum triflorum*	Three-Flowered Avens				x	x	Seeds for perfume; tea applied to swollen eyes; dried foliage mixed with other plants to make tonic; many medicinal uses
1	*Glycyrrhiza lepidota*	Wild Licorice			x	x	x	Roots chewed like candy; horse poultice; chew for toothache; tea for earache and fever; chewed roots for throat-coat to improve singing
1	*Grindelia squarrosa*	Curly-Cup Gumweed				x		Resin used as expectorant, and respiratory treatment; tea for medicine
1	*Gutierrezia sarothrae*	Broomweed				x		Boiled, inhaled steam for respiratory treatment
1	*Hesperostipa comata*	Needle And Thread Grass					x	Indicator of buffalo condition
1	*Juncus balticus*	Wire Rush		x				Brown-green dye from stems
1	*Lycopus asper*	Western Water-Horehound				x		Used with other plants to treat children's colds
1	*Lygodesmia juncea*	Skeletonweed			x	x		Chewed for flavour; medicinal tea
1, 2, 3	*Mentha canadensis*	Wild Mint			x	x	x	Disguising scent on animal traps; flavouring meat; medicinal tea; insect repellent; chewed leaves for chest pain
1, 2	*Opuntia polyacantha*	Prickly-Pear Cactus		x	x	x		Juice used to fix colours; fleshy stems used to clear muddy water; stems as famine food; peeled stems bound to wounds as dressing; fruit eaten raw; wart removal; curing by inundating body part with spines and then lighting them on fire
2	*Phlox hoodii*	Moss Phlox		x		x		Yellow dye for fabric; tea for laxative
3	*Plantago major*	Common Plantain			x	x		May have been used as food or poultice for skin ailments.
2	*Populus balsamifera*	Balsam Poplar			x	x	x	Building materials and firewood; sap used to disguise warrior's scent; medicinal tea
1, 2	*Populus deltoides*	Plains Cottonwood	x		x	x	x	Burial places; ceremonial lodges centered on poplar tree; ceremonial pipe lighting with inner bark; shelter; firewood; horse feed (inner bark); sap for scent disguise; inner bark contains Vitamin-C and salicin
1, 2	*Populus tremuloides*	Trembling Aspen			x	x	x	Distilled into perfume; inner bark eaten in spring; young bark was winter horse feed; inner bark as famine food; tea for medicine
1	*Potentilla anserina*	Silverweed			x			Roots eaten boiled or roasted
1, 3	*Ratibida columnifera*	Prairie Coneflower		x				Yellow-orange dye from roots
1, 2, 3	*Rosa acicularis, Rosa arkansana*	Prickly Rose, Prairie Rose			x	x	x	Tea for medicinal use; fruits eaten after seeds removed; dried fruit on bushes as famine food; fruits used as beads
1	*Rumex crispus*	Curled Dock				x		Leaves bound on boils to draw out suppuration
1	*Rumex venosus*	Wild Begonia		x				Burnt orange dye from roots
1, 2, 3	*Salix spp.: Salix exigua*	Narrow-Leaf Willow	x			x	x	Sweat-lodge building materials. Salix spp. in general: baskets; arrow shafts; medicinal tea; tanning hides

Ref	Latin Name	Common Name	Significance					Reported Traditional Blackfoot (Siksikaitsitapi) Uses
			Spiritual	Dyes	Food	Medicinal	Cultural	
1	*Schoenoplectus acutus*	Great Bulrush			x			Roots were eaten raw and cooked
1	*Solanum triflorum*	Wild Tomato				x		Berries boiled for tea to treat diarrhea
3	*Solidago canadensis*	Canada Goldenrod				x		May have been used for many medicinal functions.
1	*Sphaeralcea coccinea*	Scarlet Mallow				x		Chewed and applied to wounds as healing salve
1	*Symphoricarpos occidentalis*	Buckbrush			x	x	x	Twigs for arrow shafts; shrub for brooms; fruits as famine food; fire made with green twigs would blacken new pipes; liquid from boiled berries given to horses as a diuretic; medicinal tea
2	*Symphyotrichum falcatum*	Creeping White Prairie Aster		x		x		Flowers for colouring arrows; medicinal tea
1	*Thermopsis rhombifolia*	Golden Bean					x	Indicator of buffalo movement to summer grazing area
1	*Trifolium repens*	White Clover				x		Medicinal tea; prophylactic
1	*Triglochin maritima*	Seaside Arrow-grass			x			Foliage contains HCN; seeds parched and eaten
1, 3	*Typha latifolia*	Common Cattail			x	x		Down for bedding and dressings for burns; pads used as diapers; stocks rich in starch and edible
1	*Zigadenus venenosus*	Death Camas				x		External cure for boils, rheumatism, sprains and bruises

1 (Jonnston, 1970) 2 (Galileo Educational Network, 2016) 3 (Stantec Environmental Consulting Ltd., 2018)

Appendix H8: Wetlands and Waterbodies Within the Terrestrial Local Study Area

ID	Wetland Location	Wetland Area (ha)	Wetland Class[1]	Dominant Vegetation[2]	Topography	Water Presence During Field Survey?
JP_20210617_0174	NE 29-19-16 W4M	0.93	Ephemeral Waterbody	Dominant Species (>10% cover) • Creeping Spike Rush (OBL) • Foxtail Barley (FAC-WET) • Tufted Hair Grass (FAC) • Kentucky Bluegrass (FAC-WET)	Low area	No
LC-53	NE 29-19-16 W4M	0.20	W-A-VI	Dominant Species (>10% cover) • Poverty Weed (FAC)	Defined basin, primarily rocky bare ground	No
LC-92	NE 29-19-16 W4M	0.56	W-A-VI	Dominant Species (>10% cover) • Creeping Spike Rush (OBL) • Foxtail Barley (FAC-WET) Additional Species (<10% cover) • Poverty Weed (FAC)	Milky water present in a defined DR-basin	Yes
DW-18	NE 29-19-16 W4M, SW 29-19-16 W4M	1.84	W-A-VI	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) • Poverty Weed (FAC) Additional Species (<10% cover) • Slender Wheat Grass (FAC-UP)	Defined basin, primarily rocky bare ground with mud cracks	No
DR-20	NE 30-19-16 W4M NW 30-19-16 W4M SE 30-19-16 W4M SW 30-19-16 W4M	19.37	M-G-II	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) • Silver Salt Bush (X) Additional Species (<10% cover) • Baltic Rush (FAC-WET)	Low area with overland flow. Dry with pugging	No
DW-36	NE 30-19-16 W4M	5.11	Ephemeral Waterbody	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) Additional Species (<10% cover) • Curled Dock (FAC) • Gum Weed (UPL)	Low area	No
JP_20210613_0038	NE 30-19-16 W4M	0.11	Ephemeral Waterbody	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) • Blue Grama Grass (X) Additional Species (<10% cover) • Gumweed (UPL) • Canada Thistle (FAC-UP) • Prickly Pear Cactus (X)	Low area with pugging	No
JP_20210613_0050	NE 30-19-16 W4M	0.42	Ephemeral Waterbody	Dominant Species (>10% cover) • Slender Wheat Grass (FAC-UP) • Kentucky Bluegrass (FAC-UP) Additional Species (<10% cover) • Gum Weed (UPL) • Silver Salt Bush (X)	Low area with some pugging	No
JP_20210613_0060	NE 30-19-16 W4M	0.55	Ephemeral Waterbody	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) • Timothy (FAC-UP)	Low area	No

ID	Wetland Location	Wetland Area (ha)	Wetland Class[1]	Dominant Vegetation[2]	Topography	Water Presence During Field Survey?
				Additional Species (<10% cover) • Dandelion (FAC-UP) • Gum Weed (UPL) • Curled Dock (FAC)		
DW-55	NE 31-19-16 W4M	2.62	M-G-II	Dominant Species (>10% cover) • Baltic Rush (FAC-WET) • Foxtail Barley (FAC-W) • Slender Hair Grass (OBL) Additional Species (<10% cover) • Curled Dock (FAC) • Western Wheat Grass (FAC-UP)	Low area, very dry with a saline edge	No
JP_20210614_0079	NE 31-19-16 W4M	0.25	Ephemeral Waterbody	Dominant Species (>10% cover) • Kentucky Bluegrass (FAC-UP) • Slender Wheat Grass (FAC-UP) Additional Species (<10% cover) • Curled Dock (FAC) • Dandelion (FAC-UP)	Low area with some pugging	No
LC-43	NE 31-19-16-W4M	0.01	M-G-II	Dominant Species (>10% cover) • Foxtail Barley (FAC-W) • Algae mats Additional Species (<10% cover) • Silver Salt Bush (X) • Slender Wheat Grass (FAC-UP)	Low area with overland flow, dry with pugging.	No
DR-52	NE 32-19-16 W4M	0.09	M-G-II	Dominant Species (>10% cover) • Tufted Hair Grass (FAC) • Foxtail Barley (FAC_WET) Additional Species (<10% cover) • Gum Weed (UPL)	Low area with pugging	No
DW-40	NE 32-19-16 W4M	0.38	M-G-II	Dominant Species (>10% cover) • Foxtail Barley (FAC_WET) Additional Species (<10% cover) • Curled Dock (FAC) • Gum Weed (UPL)	Low area with pugging	No
DW-41	NE 32-19-16 W4M	0.22	M-G-II	Dominant Species (>10% cover) • Foxtail Barley (FAC_WET) • Tufted Hair Grass (FAC) Additional Species (<10% cover) • Creeping Spike Rush (OBL) • Gum Weed (UPL)	Low area with overland flow and pugging	No
JP_20210614_0078	NE 32-19-16 W4M	0.25	Ephemeral Waterbody	Dominant Species (>10% cover) • Slender Wheat Grass (FAC-UP) • Kentucky Bluegrass (FAC-UP) Additional Species (<10% cover) • Smooth Beardtongue (UPL) • Dandelion (FAC-UP)	Low area	No
DW-17	NW 29-19-16 W4M	5.12	W-A-VI	Dominant Species (>10% cover) • Red Samphire (OBL)	Highly pugged,	No

ID	Wetland Location	Wetland Area (ha)	Wetland Class[1]	Dominant Vegetation[2]	Topography	Water Presence During Field Survey?
				• Hardstem Bulrush • Creeping Spike Rush Additional Species (<10% cover) • Perennial Sow Thistle (FAC) • Dandelion (FAC-UP)	defined basin	
DW-19	NW 29-19-16 W4M	1.14	W-A-VI	Dominant Species (>10% cover) • Foxtail Baley (FAC-WET) Additional Species (<10% cover) • Creeping Spike Rush (OBL)	Defined basin, primarily rocky bare ground, algae crusts	No
LC-50	NW 29-19-16 W4M	0.08	M-G-II	Dominant Species (>10% cover) • Foxtail Barley (FAC_WET) Additional Species (<10% cover) • Moquin's Sea-blite (X) • Creeping Spikerush (OBL) • Gumweed (UPL) • Sow Thistle (FAC-UP)	Highly pugged, adjacent to a bermed ditch	No
LC-54	NW 29-19-16 W4M	0.23	W-A-VI	Dominant Species (>10% cover) • Poverty Weed (FAC)	Defined basin, primarily rocky bare ground	No
LC-46	NW 31-19-16-W4M	0.02	M-G-II	Dominant Species (>10% cover) • Poverty Weed (FAC) • Foxtail Barley (FAC-WET) • Saltgrass (FAC-WET) Additional Species (<10% cover) • Silver Salt Bush (X) • Slender Wheat Grass (FAC-UP) • Common Cattail (OBL)	Low area with pugging, no standing water	No
LC-33	NW 31-19-16-W4M, SW 31-19-16-W4M, NE 31-19-16-W4M, SE 31-19-16 W4M	23.70	M-G-III	Dominant Species (>10% cover) • Perennial Sow Thistle (FAC) • Red Samphire (OBL) Additional Species (<10% cover) • Sea Milkwort (OBL) • Sedges (X) • Baltic Rush (FAC-WET)	Low area with overland flow, at base of dam	No
DR-46	NW 32-19-16 W4M	0.19	M-G-II	Dominant Species (>10% cover) • Tufted Hair Grass ((FAC) • Creeping Spike Rush (OBL) Additional Species (<10% cover) • Curled Dock (FAC) • Silver Salt Bush (X)	Low area collects overland flow	No
DR-47	NW 32-19-16 W4M	0.13	M-G-II	Dominant Species (>10% cover) • Kentucky Bluegrass (FAC-UP) • Sedges (X) Additional Species (<10% cover) • Silver Salt Bush (X) • Curly Dock (FAC)	Shallow basin	No
DR-75	NW 32-19-16 W4M	8.13	Ephemeral Waterbody	Dominant Species (>10% cover) • June Grass (X) Additional Species (<10% cover) • Poverty Weed (FAC) • Gum Weed (UPL)	Low area	No

ID	Wetland Location	Wetland Area (ha)	Wetland Class[1]	Dominant Vegetation[2]	Topography	Water Presence During Field Survey?
				• Canada Goldenrod (FAC-UP) • Salt Grass (FAC-WET)		
DW-21	NW 32-19-16 W4M NE 32-19-16 W4M	0.73	W-A-VI	Dominant Species (>10% cover) • Foxtail Barley (FAC-W) Additional Species (<10% cover) • Creeping Spike Rush (OBL)	Defined basin, primarily rocky bare ground	No
JP_20210620_0238	NW23-19-16 W4M	8.09	Ephemeral Waterbody	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) Additional Species (<10% cover) • Curled Dock (FAC) • Moquin's Sea-blite (FAC-WET) • Kochia (UPL)	Low area	No
JP_20210620_0241	SE 29-16-16 W4M	0.09	Ephemeral Waterbody	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) Additional Species (<10% cover) • Gumweed (UPL) • Dandelion (FAC-UPL) • Pasture Sagewort (X)	Low area with some pugging	No
DR-64	SE 29-19-16 W4M	0.23	W-A-VI	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET)	Defined basin, primarily rocky bare ground	No
JP_20210617_0225	SE 29-19-16 W4M	0.15	Ephemeral Waterbody	Dominant Species (>10% cover) • Kentucky Bluegrass (FAC-UP) • Baltic Rush (FAC-WET) Additional Species (<10% cover) • Thread-leaved Sedge (X) • Prickly Rose (UPL) • Common Yarrow (FAC-UP)	Low area	No
JP_20210618_0192	SE 29-19-16 W4M	0.86	Ephemeral Waterbody	Dominant Species (>10% cover) • Kentucky Bluegrass (FAC-UP) • Foxtail Barley (FAC-WET) Additional Species (<10% cover) • Gumweed (UPL) • Dandelion (FAC-UPL)	Low area	No
DR-19	SE 30-19-16 W4M NE 19-19-16 W4M	4.65	M-G-III	Dominant Species (>10% cover) • Creeping Spike Rush (OBL) • Hardstem Bulrush • Tufted Hair Grass (FAC) • Red Samphire (OBL) Additional Species (<10% cover) • Seaside Arrowgrass (OBL) • Curled Dock (FAC) • Marsh Hedgenettle (X)	Pugging, standing water at centre of wetland with brackish water. Seepage from canal as well as runoff	Yes
JP-57	SE 31-19-16 W4M	3.96	M-G-III	Dominant Species (>10% cover) • Cattails (OBL) • Sedges (OBL) Additional Species (<10% cover) • Arum-leaved Arrowhead (OBL)	Low area with water present. Receives overland flow	Yes, after very wet spring in 2022

ID	Wetland Location	Wetland Area (ha)	Wetland Class[1]	Dominant Vegetation[2]	Topography	Water Presence During Field Survey?
				• Water Plantain (OBL)		
DW-23	SE 32-19-16 W4M	0.62	W-A-VI	Dominant Species (>10% cover) • Poverty Weed (FAC) • Foxtail Barley (FAC-W) Additional Species (<10% cover) • Northern Wheat Grass (FAC-UP)	Defined basin, primarily rocky bare ground	No
DW-33A	SE 32-19-16 W4M	0.01	M-G-III	Dominant Species (>10% cover) • Foxtail Baley (FAC-WET) • Western Wheat Grass (FAC-UP) Additional Species (<10% cover) • Sedges (OBL) • Silver Salt Bush (X)	Low area receives drainage from upland	No
DW-33B	SE 32-19-16 W4M	5.32	M-G-II	Dominant Species (>10% cover) • Sedges (X) • Foxtail Barley (FAC-WET) Additional Species (<10% cover) • Hardstem Bulrush (OBL) • Curled Dock (FAC) • Gum Weed (UPL)	Shallow basin, with a wetter central marsh portion.	No
DW-42	SE 32-19-16 W4M	0.06	M-G-III	Dominant Species (>10% cover) • Baltic Rush (FAC-WET) • Spike Rush (OBL) Additional Species (<10% cover) • Wild Mint (FAC-WET) • Silverweed (FAC-WET) • Cursed Crowfoot (OBL)	Low area, very rocky	No
DW-56	SE 32-19-16 W4M	0.28	M-G-II	Dominant Species (>10% cover) • Foxtail Barley (FAC_WET) • Tufted Hair Grass (FAC) Additional Species (<10% cover) • Gum Weed (UPL)	A road has split the wetland, pugging	No
JP_20210617_0154	SE 32-19-16 W4M	1.41	Ephemeral Waterbody	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) • Kentucky Bluegrass (FAC-UP) Additional Species (<10% cover) • Gumweed (UPL) • Timothy (FAC-UP)	Low area with some pugging	No
JP_20210618_0200	SW 28-19-16 W4M	0.49	Ephemeral Waterbody	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) • Baltic Rush (FAC-WET) • Kentucky Bluegrass (FAC-UP) Additional Species (<10% cover) • Gumweed (UPL) • Dandelion (FAC-UPL)	Low area	No
DR-61	SW 29-19-16 W4M, SE 29-19-16 W4M	0.245	W-A-VI	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) Additional Species (<10% cover) • Creeping Spike Rush (OBL) • Gum Weed (UPL)	Defined basin, primarily rocky bare ground, algae crusts	No

ID	Wetland Location	Wetland Area (ha)	Wetland Class[1]	Dominant Vegetation[2]	Topography	Water Presence During Field Survey?
JP-26	SW 30-19-16 W4M, SE 30-19-16 W4M	0.75	S-S-III	Dominant Species (>10% cover) • Bebb's Willow (FAC-WET) Additional Species (<10% cover) • Softstem Bulrush (OBL) • Common Cattail (OBL) • Silver Weed (FAC-WET) • Marsh Grass of Parnassus (OBL)	Standing water present with extreme pugging. Probable seepage from canal	Yes
JP_20210612_0010	SW 31-19-16 W4M	0.28	Ephemeral Waterbody	Dominant Species (>10% cover) • Slender Wheat Grass (FAC-UP) • Kentucky Bluegrass (FAC-UP) Additional Species (<10% cover) • Dandelion (FAC-UP)	Low area	No
DW-33E	SW 31-19-16-W4M	0.84	M-G-II	Dominant Species (>10% cover) • Baltic Rush (FAC-WET) Additional Species (<10% cover) • Water Plantain (FAC-Wet)	Low area with overland flow. Dry with pugging	No
DW-33F	SW 31-19-16-W4M	1.66	M-G-II and drainage	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) • Sow Thistle (FAC) Additional Species (<10% cover) • Common Cattail (OBL) • Sedges (X) • Curled Dock (FAC)	Low area with pugging	No
DW-22	SW 32-19-16 W4M SE 32-19-16 W4M	0.33	W-A-VI	Dominant Species (>10% cover) • Poverty Weed (FAC) • Foxtail Barley (FAC-WET) Additional Species (<10% cover) • Tufted Hair Grass (FAC)	Defined basin, primarily rocky bare ground	No
DW-33D	SW 32-19-16 W4M	12.76	M-G-II	Dominant Species (>10% cover) • Foxtail Barley (FAC_WET) Additional Species (<10% cover) • Poverty Weed (FAC) • Curled Dock (FAC)	Low area with overland flow	No
JP_20210620_0233	SW 33-19-16 W4M	2.15	Ephemeral Waterbody	Dominant Species (>10% cover) • Moquin's Sea-blite (FAC-WET) Additional Species (<10% cover) • June Grass (X) • Foxtail Barley (FAC-WET) • Oak-leaved Goosefoot (FAC)	Low area	No
JP_20210620_0228	SW 6-20-16 W4M	0.70	Ephemeral Waterbody	Dominant Species (>10% cover) • Foxtail Barley (FAC-WET) • Wheat Grass (FAC-UP) Additional Species (<10% cover) • Curled Dock (FAC) • Gumweed (UPL)	Low area	No

[1] M-marsh, G-graminoid, W-water, S-swamp, S-shrubby, A-submersed and/or floating aquatic vegetation, II-temporary, III-seasonal, VI-intermittent, (GOA, 2015b).

[2] Vegetation noted at the deepest portion of the wetland basin. Wetland Indicator status: FAC- Facultative: plant is equally likely to occur in wetlands or non-wetlands (probability 34%-66%). FAC-UPL- Facultative Upland: plant usually occurs in non-wetlands (probability 67-99%), but occasionally found in wetlands (probability 1%-33%). FAC-WET-Facultative Wetland: plant usually occurs in wetlands (probability 67%-99%), but occasionally found in non-wetlands. OBL-Obligate Wetland: plant occurs almost always in wetlands (probability > 99%). UPL- Obligate Upland: plant may occur in wetlands but occurs almost always in non-wetlands (probability > 99%). (Native Plant Trust, 2023).

Appendix H9: Grassland Restoration Proposal

APPENDIX H9:
GRASSLAND RESTORATION PROPOSAL

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Abbreviations

DMNS	Dry Mixedgrass Natural Subregion
GOA	Government of Alberta
GPS	Global Positioning System
TWS	Temporary Workspace
PLS	Pure Live Seeds

1 BACKGROUND

This section of the Environmental Impact Assessment examines Grassland Restoration processes to partially offset the loss of native prairie and the monitoring and follow-up actions to ensure the restoration goals are achieved. Refer to Section 10.3 Terrestrial Local Study Area Baseline Assessment Results for precipitation and growing conditions for the Project area.

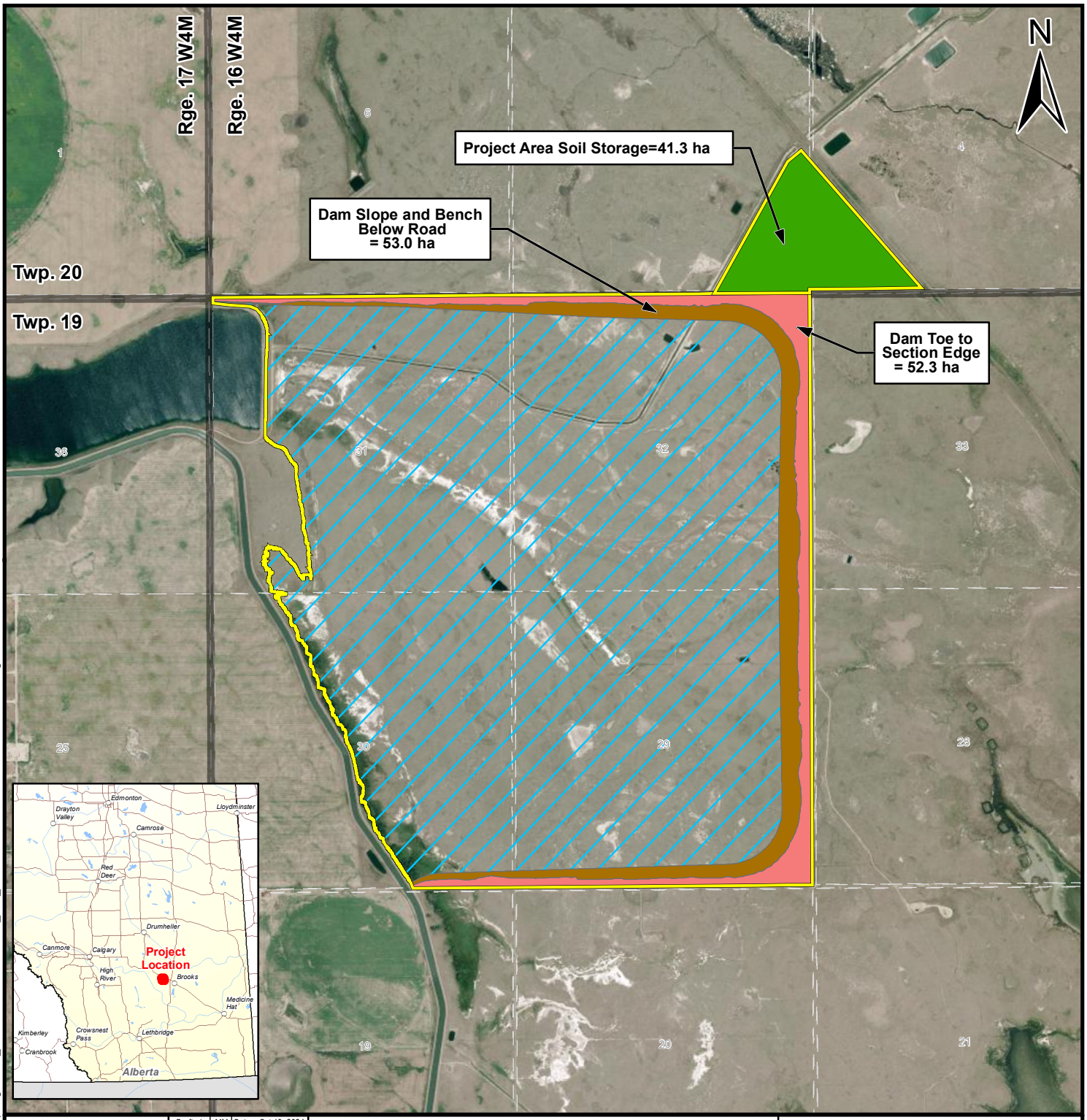
2 RESTORATION

Native grasslands are the natural landscape most altered by land use practices in Alberta (Government of Alberta [GOA], 2016). To partially offset native grassland removed by the Project, grassland restoration (seeding stripped soil areas) will occur on 146.6 ha of reclaimed berms (53.0 ha), temporary workspace (TWS; 52.3 ha) and soil storage (41.3 ha) areas (Figure H9-1). Challenges associated with grassland restoration in this area include steep slopes (up to 33% on the outer berms) dry climate, and nearby reclaimed areas composed of non-native grasses. Restoration is the process by which a degraded ecosystem is assisted in its recovery allowing native plant communities - suited to the ecological range site - to re-establish via natural succession, culminating in an equivalent community to those in surrounding areas (GOA, 2016).

Reclamation, discussed in the Conceptual Conservation and Reclamation Plan (see Volume 1, Section 10), has a goal to reclaim and protect grassland soils and achieve a vegetation cover that provides equivalent land capability, as per the Conservation and Reclamation Regulation of the *Environmental Protection and Enhancement Ac*t (GOA, 2000). This requires suitable topsoil at a needed depth that will not slump or erode, and which will support grassland cover to protect soil and ecosystem functions. This restoration plan was developed as an extension of that plan, with a goal to further achieve a diverse native grassland, similar to native grasslands present in the Dry Mixedgrass Natural Subregion (DMNS), that will meet grassland restoration requirements (GOA, 2018a) and partially offset Project-related native grassland losses.

The goal of this restoration plan is to provide initial plant cover that will increase the probability that native grassland communities will be established on the reservoir berms and temporary workspace areas. Native grasslands in Alberta are defined as communities with >30% native species cover (GOA, 2018a). During restoration, a newly seeded site ideally transitions through several development stages to a stable and self-sustaining (climax) ecosystem. These stages are referred to as successional or seral stage plant communities.

It is expected that most restored sites will develop from a pioneer community to a mid to late seral community as outlined in Table H9-1 below, which includes definitions of successional (seral) stages for recovering plant communities in the DMNS [modified from the Grassland Restoration Forum (Recovery Strategies for Industrial Development in Native Grassland for the Dry Mixedgrass Natural Subregion of Alberta-Second Edition, 2023)]. Ideally, the mid to late seral stage will then develop into a reference or climax plant community, which can only occur if non-native plant species can be kept out of the site while native grasses are establishing; if not, the restored community may become colonized by non-native grasses such as Kentucky bluegrass (*Poa pratensis*) or crested wheatgrass (*Agropyron cristatum*) and develop toward a disclimax community state. As these species are rhizomatous and persistent, a modified grassland community with less than 30% native species cover may develop. In this case, additional efforts may be required to help establish a modified native plant community dominated by non-native plants but achieving > 30% native grass cover.



SCALE: 1:30,000

200 0 200 400 m

Drafted:	MM	Date:	Oct 10, 2024
Approved:	LC	Revision:	0
Route Source:		Date:	Feb 21, 2024
CAD Survey		Revision:	0

Data Sources:
Imagery Reference: ESRI 2021/07/10
ATS Grid: AltaLIS 2007

AAR Environmental Services

Please contact AARES for all other sources.

Please note that the imagery is from 2021 and although we have no reason to doubt the accuracy and completeness of it, users should be aware that discrepancies may be present

Legend

- Project Footprint
- Reclaimed Berm
- Soil Storage Area
- Temporary Work Space
- Reservoir

EID

Grassland Restoration Plan

October 2024

REF.: AARES21-127 (Overview)

Figure H9-1

Map Location: Y:\01_GISProject\AARES_21\AARES21_127 (5653)\Vegetation_Wetlands\EIA\AARES21_127_Snake Lake Grassland Restoration Plan Figure1.mxd

Table H9-1: Phases of recovering grassland communities following topsoil reclamation and restoration seed mix planting

Successional Stage	Description
Bare ground	Initial state immediately following site reclamation and seed planting, with less than 5% live vegetation cover.
Pioneer	Site dominated by annual weeds and/or native forb species. If planted, site may be dominated by a cover crop of quickly establishing annual or decreaser species[1] such as slender wheat grass (*Elymus trachycaulus*).
Early seral	Site dominated by disturbance forbs and cover crop decreaser species, but long lived seeded species and colonizing native grasses beginning to establish.
Mid-seral	Cover of long-lived seeded and colonizing native grasses greater than that of disturbance forbs. Most cover crop species are no longer present.
Late seral[2]	Cover of long-lived and colonizing native grasses expanding; slower establishing native species (grasses, sedges, and forbs) recruiting into the site.
Trending to modified[3]	A primarily native plant community where non-native species are increasing over time and occupy greater than 5% of the total live cover.
Disclimax 1: modified grassland	A disclimax native plant community where non-native species dominate the site and native grass and forb species make up less than 30% of the total cover.
Disclimax 2: modified native grassland	A disclimax native plant community where non-native species dominate the site but native grass and forb species make up 30% to 49% of the total cover, meeting the definition for native grasslands.
Reference or climax grassland	Community closely resembles the ecological site potential natural community described in the Range Plant Community Guide. The site is dominated by native grass and forb species (>50% cover)

[1] Decreaser species are expected to disappear over time.
[2] Late seral communities may develop within 20 years if conditions are favourable (Adams, et al., 2013)
[3] Invasive non-native species that are known to replace native species

2.1 Soil Storage to Protect Soil Function

Using healthy topsoil for restoration is a strategy that can improve revegetation and establishment of plants. The Conservation and Reclamation Plan discusses how only suitable (loamy, non-saline or degraded) topsoil from upland grassy areas will be stockpiled and used for reclamation. Ideally, this soil will contain a seed bank of viable propagules and other living biota (e.g., fungi) adapted to local conditions, that will enhance the recovery of native species and development of healthy soil function. To maintain soil health, soils should be stripped when conditions are moist, and stored in stockpiles to sustain soil microorganisms, which survive best in the upper 60 cm of soil (Goodwin et al., 2006). Because the soil will be stored for many months to a few years, the soil will be seeded with a native cover crop to protect soils from eroding and maintain biotic function. An invasive weed monitoring and control program will also be used to reduce seed-set and spread of weeds (Goodwin et al., 2006). Refer to Section 3 of this appendix for monitoring requirements and weed removal methods. The reclamation plan has determined the volume of soil to be stripped to cover the reclamation areas to a depth of 50-60 cm. See Volume 1, Section 10 Conservation and Reclamation Plan for detailed information on soils.

2.2 Restoration with Seeding

Seeding will be the primary method for restoration along the outside berm, TWS, and topsoil storage area (if needed). Within the reservoir, a natural recovery strategy will be used to support the development of shallow wetland areas, allowing them to revegetate without seeding. Seeding

should be scheduled to occur within a few days following topsoil replacement (Goodwin et al., 2006). Seeding in the spring will catch rains and avoid the hot dry conditions of summer Late fall seeding is acceptable when using seeds that require freezing conditions prior to germination.

Site preparation of the seedbed is a crucial step prior to any seeding operations for better revegetation success. Heavy equipment and high vehicle traffic can cause soil compaction and a smooth hard soil surface. Soil compaction can inhibit root growth (GOA, 2003); if soils are heavily compacted, soils should be tilled.

2.3 Seed Selection

For successful restoration of native prairie, suitable seed mixes developed for the natural subregion are required. Mixes will be developed to result in initial grassland communities that should succeed toward baseline community conditions for the grasslands in the terrestrial local study area. Guidance for choosing a seed mix has been developed by Tannas et. al (2016):

- Build the seed mix based on an adjacent plant community.
- Use plant community guides to determine desired plant species for the targeted area.

Following this guidance, potential species were identified for reclamation seed mix development based on species observed in baseline vegetation plots, including:

- Western Wheatgrass (*Pascopyrum smithii*)
- Slender Wheatgrass (*Elymus trachycaulus*)
- Northern Wheatgrass (*Elymus lanceolatus*)
- Green Needle Grass (*Nassella viridula*)
- June Grass (*Koeleria macrantha*)
- Sandberg Bluegrass (*Poa secunda secunda*)
- Nuttall's Alkali Grass (*Puccinellia nuttalliana*)
- Salt Grass (*Distichlis spicata*)
- Blue Grama Grass (*Bouteloua gracilis*)
- Needle and Thread Grass (*Hesperostipa comata*)

Seed mixes should include species adapted to the physical and chemical properties of the soil that will provide rapid cover to reduce erosion, provide species with different heights, root types, and growth characteristics, and result in species and structural diversity to help withstand seasonal climate variation and herbivory (Grassland Restoration Forum, 2023).

The use of a protective cover crop during soil storage and once topsoil is replaced will be a crucial step in ensuring the overall success of revegetating the site. Protective cover crops can provide erosion control via root soil holding capacities as well as weed control through competition for nutrients in the soil (Morgan et al.,1995; Goodwin et al., 2006). Additionally, they will offer shade to soils which will help retain soil moisture, as well as protect seedlings from sun damage (Morgan et al., 1995). Slender Wheatgrass may be an ideal option as a cover crop. It is a short-term native species with rapid establishment, and because it does not persist in the community and typically disappears after 5 years following seeding, this allows for the establishment of other native plants (Kestrel Research Inc. & Graminae Services Ltd., 2011).

The process for developing seed mixes include a) selecting suitable species, b) determining end goal percentages for final communities, c) using known characteristics of the species from

restoration guides, including germination potential and seed weights, and d) calculating the seed percentages and final mass per unit area using the seeding formula calculation method as described below.

2.3.1 Acquiring Seeds

- When acquiring seeds, a certificate of authenticity should be obtained from the source (Tannas, et al., 2016).
- Use both scientific and common names when ordering seeds to avoid mistakes.

2.3.2 Seed Certification

- Use seeds from a Canadian seed grade lot that have been through a percentage test or a purity test (Tannas, et al., 2016).
- Calculate the Percentage of Pure Live Seeds (PLS) (Tannas, et al., 2016)
    - ***% Germination x % Purity (100% - % Inert Material) = % Pure Live Seeds (PLS)***
    - Always order seeds in PLS.

2.3.3 Seeding Rates/Methods

Seeding rates are calculated based on mass per unit area (kg/ha). Seeding rates should be calculated to a PLS per unit area (PLS/m^2) to achieve the desired plant community composition. To convert kg/ha to PLS/m^2, see Hammermeister (Seeding Rate Conversion Charts for Using Native Species in Reclamation Projects, 1998).

The formula used is as follows:

$$\frac{\boldsymbol{Desired\ Live\ Plants/m^2 x\ 10^*}}{\frac{\boldsymbol{seeds}}{\boldsymbol{gram}}\boldsymbol{x}\ \%\ \boldsymbol{P.L.S}} = \boldsymbol{Seeds}\left(\frac{\boldsymbol{kg}}{\boldsymbol{ha}}\right)$$

* Conversion factor (g/m^2 to kg/ha), % P.L.S. = % Pure Live Seed

2.3.4 Landscape Position

Elevation, slope, aspect and hydrology as well as flooding potential will play a role in how successfully plants establish. It is important to know which species are adapted to potential conditions. For example, Canada Wildrye (*Elymus canadensis*) should only be used in site that have higher soil moisture, while Western Wheatgrass can be used in low areas that may flood, as this species can tolerate spring flooding.

2.3.5 Community Seed Mix Development

Given the study area and plans for reclamation, three different communities will be restored within the Project area; the protective cover crop for the soil storage area, the dry mixed grass community and saline/wet meadow mix. The protective cover crop will be planted on the soil storage area, with an assumed area of 41.3 ha. The amount of seed required will depend on the total surface area once the soil pile height is known. The dry mixed grass community will be seeded in the majority of the restoration area, whereas the saline/wet meadow mix will be used in the outer drainage ditch and low areas where wetter conditions are expected. The dry mixed grass community will be planted over an assumed 142.6 ha, and the saline/wet meadow mix will

be planted over an assumed 4 ha of land. The desired species and final percent covers are listed below:

Dry mixed grass community

- Blue Grama Grass (20%)
- Needle & Thread (20%)
- Northern Wheatgrass (10%)
- Western Wheatgrass (10%)
- Sandberg Bluegrass (20%)
- June Grass (20%)

Saline/wet meadow mix

- Northern Wheatgrass (20%)
- Saltgrass (20%)
- Nuttall's Alkali Grass (20%)
- Alkali Bluegrass[1] (20%)
- Sandberg Bluegrass (20%)

[1] *Poa secunda juncifolia*

If Needle and Thread Grass is not available or in short supply, Canada Wildrye and/or Indian Rice Grass (*Ericoma hymenoides*) can be added as these species provide tall structure and are decreasers, expected to disappear over time. Green Needle Grass is not a substitute for Needle and Thread Grass. Blue Grama Grass can be substituted for June Grass or Sandberg Bluegrass (GOA, 2001). Indian Rice Grass does require cold stratification to break dormancy which can be provided with a fall seeding.

Final seed mixes will be refined closer to the reclamation date. Based on seed availability and cost, the mix may need to be rebuilt with alternative species.

2.3.6 Seed Mix Quantity Determination

Tables H9-2 and Table H9-3 demonstrate how the final seed mixes and seeding rates were determined. Seeding rate calculations were made for drill seeding and broadcast or hydroseeding. Broadcast seeding and hydroseeding require twice the rate of drill seeding. Note that Table H9-3 shows the final composition of each species included in the seed mix as percentages. Once seeding rates are determined, this assists seed suppliers when developing the seed mixes. They base the final amount of seed required on the percent make up of each species and multiply by the total amount of seeds (kg) to get the required kg for each species. It should be noted that assumptions have been made on the percentages of pure live seed as this is determined by the seed supplier. Total amount of seed (kg) required was calculated for each species based on the assumed hectares where each mix will be planted and the rate of seeding (Table H9-2).

The seed mixes will be refined closer to the reclamation date, and if needed will be rebuilt with alternative species. At least a full year lead time is needed prior to ordering a mix to ensure a supplier can provide enough seed of each species. Determining which species are available at the time of seeding and which species are cost prohibitive should be considered. Additionally, once a seed supplier can provide the germination rate of the seeds, the PLS can be updated in the seed mix calculation, affecting the final seed percentages in each mix.

Table H9-2 Calculations for determining seed mixes and seeding rates for both drill and broadcast seeding

Community	Scientific Name	Common Name	Seed s/g	% P.L.S*	Desired Percent Cover	Desired Live Plants (Plants/m^2)	Conversion Factor[1]	Drill Seeding		Broadcast Seeding[2]		Total Mix seed compositi on (%)
								Seeding Rate (kg/ha)	Total kg required	Seeding Rate (kg/ha)	Total kg Required	
Protective Cover Crop	*Elymus trachycaulus*	Slender Wheatgrass	350	80	100	225	10	8.0	331.9	16.1	663.8	100
Dry Native Grassland on Loamy Sites	*Bouteloua gracilis*	Blue Grama Grass	1,820	80	20	225	10	0.3	44.1	0.6	88.1	6.3
	Hesperostipa comata	Needle and Thread Grass	250	80	20			2.3	320.9	4.5	641.7	45.5
	Elymus lanceolatus	Northern Wheatgrass	340	80	10			0.8	118.0	1.7	235.9	16.7
	Pascopyrum smithii	Western Wheatgrass	240	80	10			1.2	167.1	2.3	334.2	23.7
	Poa secunda secunda	Sandberg Bluegrass	2,040	80	20			0.3	39.3	0.6	78.6	5.6
	Koeleria macrantha	June Grass	5,100	80	20			0.1	15.7	0.2	31.5	2.2
							TOTAL:	**4.9**	**705.0**	**9.9**	**1,410**	**100**
Saline / Wet Meadow Seed Mix	*Elymus lanceolatus*	Northern Wheatgrass	340	80	20	225	10	1.7	6.6	3.3	13.2	59.3
	Distichlis spicata	Salt Grass	1,150	80	20			0.5	2.0	1.0	3.9	17.5
	Puccinellia nuttalliana	Nuttall's Alkali Grass	6,140	80	20			0.1	0.4	0.2	0.7	3.3
	Poa secunda juncifolia	Alkali Bluegrass	2,022	80	20			0.3	1.1	0.6	2.2	10.0
	Poa secunda ssp. secunda	Sandberg Bluegrass	2,040	80	20			0.3	1.1	0.6	2.2	9.9
							TOTAL:	**2.8**	**11.2**	**5.6**	**22.3**	**100**

*% P.L.S = % Pure Live Seed
[1]Conversion factor for kg/ha to g/m^3
[2]Includes Hydroseeding rates

Table H9-3: Seed mixes and seeding rates for drill and broadcast seeding

Seed Mix	Scientific Name	Common Name	Species Composition (%)[1]	Drill Seeding		Broadcast Seeding	
				Total Seeding Rate (kg/ha)	Supply Required (kg)	Total Seeding Rate (kg/ha)	Supply Required (kg)
Protective Cover Crop	*Elymus trachycaulus*	Slender Wheatgrass	100	8.0	331.9	16.1	663.8
Dry Native Grassland on Loamy Sites	*Bouteloua gracilis*	Blue Grama Grass	6.3	4.9	705.0	9.9	1,410
	Hesperostipa comata	Needle and Thread Grass	45.5				
	Elymus lanceolatus	Northern Wheatgrass	16.7				
	Pascopyrum smithii	Western Wheatgrass	23.7				
	Poa secunda ssp. secunda	Sandberg Bluegrass	5.6				
	Koeleria macrantha	June Grass	2.2				
Saline/Wet Meadow Seed Mix	*Elymus lanceolatus*	Northern Wheatgrass	59.3	2.3	11.2	5.6	22.3
	Distichlis spicata	Salt Grass	17.5				
	Puccinellia nuttalliana	Nuttall's Alkali Grass	3.3				
	Poa secunda ssp. juncifolia	Alkali Bluegrass	10.0				
	Poa secunda ssp. secunda	Sandberg Bluegrass	9.9				

[1]Substitutions: if Needle-and Thread is not available or in short supply: Canada Wild Rye and/or Indian Rice Grass can be added as these species provide tall structure and are decreasers, expected to disappear over time. Green Needle Grass is not a substitute for Needle and Thread Grass. Blue Grama Grass can be substituted for June Grass or Sandberg Bluegrass (GOA, 2001). Indian Rice Grass does require cold stratification to break dormancy which can be provided with a fall seeding.

2.4 Seeding Methods

There are three seeding methods that will be suitable for the Project; however, the appropriate method will vary based on economic factors, site conditions including slope and moisture content of soil, and the type of seeds included in the seed mix. Each site within the Project footprint to be restored will require an evaluation of environmental conditions to determine which seeding method and seed mixture are appropriate.

The outer berm will have flat areas along the crest with a second step or stability berm, with slopes in between. The berms will be developed at a 3:1 slope. Slopes are expected to have a greater potential for erosion than flat surfaces. The flat surfaces on the stability berm, as well as the slopes are likely to have drier soil conditions, and the TWS and soil storage area may have wetter soil conditions due to water run-off from the berms as well as surrounding environmental conditions (drainage feature at the toe of the stability berm).

Drill seeding is the preferred method as it has the best seed to soil contact, protects seeds from erosion and has the best seedling establishment. Other benefits include minimal soil disturbance, accurate seeding depth and rates and can be used on flat and moderately sloped areas (Goodwin et al., 2006). Packing the soil prior to drill seeding is important as compacted soil creates a crust at the soil surface, resulting in reduced evaporation from deeper in the soil. Packing also ensures good seed to soil contact. Grassland seed drills will plant different seed types as they have multiple seed boxes, and most seed drills are able to adjust planting depth for different seed requirements (USDA, 2018).

Broadcast seeding can be used on steep slopes that cannot be accessed by heavy equipment. Broadcast seeding is the process of applying seeds often from an aerial or fertilizer spreader system (USDA, 2018). As it leaves the seeds on the surface of the soil, loss of seeds to weather conditions is common, and it is deemed a less desirable seeding method (Tannas, et al., 2016). Due to variation of size and shape of seeds, it is recommended to add a carrier (i.e., sand) to the seed mix to aid in even seed distribution (USDA, 2018). As the germination rate/seedling establishment is lower, seeding rates are doubled compared to drill seeding. For best results, seedbed preparation by harrowing the soil should be completed (Goodwin et al., 2006). Additionally, the site should be harrowed after seed application to ensure the seeds are mixed into the soil (GOA, 2003).

Hydroseeding uses a liquid slurry that is sprayed over the desired area with a tackifier to aid in containing any potential erosion (GOBC, 2023). Hydroseeding is a better method for steep slopes with bare soil as the emulsion helps to stabilize the soil. This method is known to create poor soil contact with high seedling mortality without additional pre-seeding management strategies. As this method is known to have a higher mortality rate, and is a method of broadcast seeding, seeding rates must be similarly doubled (Goodwin et al., 2006). Hydroseeding is an effective seeding approach for slopes of 3:1 or higher as with the steeper portions of the berms to be constructed for the new reservoir (refer to Figure 2A-4 of the Project Description). To ensure seeds are properly distributed in the soil, the berms should be prepared by roughening, harrowing, or scarification to create microsites for moisture accumulation and protection from erosion (Goodwin et al., 2006). Hydroseeding also allows for the addition of a fibrous mulch to aid in the germination and establishment of the plant community. Using a rake, chain drag or harrows after seeding to incorporate the seed is recommended (Morgan et al., 1995).

To summarize: drill seeding should be used on the flat surfaces of the berm, the TWS, and the soil storage area (if required). Broadcast seeding is a more affordable seeding method when compared to hydroseeding, however hydroseeding is beneficial if seeding occurs in very dry conditions or if the risk of erosion is too high. Broadcast seeding should be the preferred method on sloped areas of the berm, however if the soil moisture levels are too low or the slopes are too steep, hydroseeding should be used.

2.5 Mowing to Prevent Invasion of Non-native Grasses

As there are previously reclaimed areas with a high percentage of non-native species, including Crested Wheatgrass, preparation for seeding must include mowing to prevent seed set of non-native grass areas. Otherwise, the highly invasive grasses may seed into the site and result in failure of the restoration program. It will be important to map areas with high percentage of invasive species and ideally mow these areas within 500 m of the restoration site if access is available.

2.6 Timing of Seeding

Timing of seeding can be variable due to weather conditions in the months prior to seeding activities (Tannas, et al., 2016). Vegetation can be classified into two main growth seasons: cool and warm. Cool season grasses generally begin establishment in early spring and become dormant by the hottest part of the summer, whereas warm season plants establish late spring and continue development throughout the summer into early fall. As the cool season plants establish, warm season seeds begin to germinate and establish when the cool season vegetation becomes dormant. Generally, best practice is seeding in April to mid-May as it allows the seeds to germinate and establish during a warm, higher precipitation season (Tannas, et al., 2016; GOA, 2003). Seeding can occur throughout the spring and early summer as each section of the berm is complete and ready for seeding activities. If fall seeding is to occur, seeding should take place when the soil temperatures drop below 10°C for 1 to 2 weeks, to prevent germination (Goodwin et al., 2006). Seeding rates may need to be increased for fall seeding to compensate for expected seed mortality over winter.

2.7 Fertilization

Fertilization during reclamation processes is not common practice for native plants and is not recommended for this Project (GOA, 2001). In native grassland restoration, fertilization would only be suitable for infertile soils. These sites should be fertilized either prior to seed plantation or during planting activities (GOA, 2003). If fertilization is planned, the site should be tested for fertility first to help develop an appropriate fertilization plan.

2.8 Protection of Restoration Sites

Newly restored grassland needs time to germinate and develop before further disturbance is introduced. There are no current plans to graze these lands in the future, however if grazing is reinstated it should be deferred for two years post-reclamation to provide the best opportunity for grassland development (Goodwin et al., 2006).

An erosion and sedimentation control plan, as per the Mitigation, Management and Monitoring section (see Volume 1, Section 11) will be implemented to limit seed run-off and protect the soil so slower establishing plants have an opportunity to grow. This may include hydroseeding with

addition of mulch as previously discussed to limit the loss of soil and seed from wind or run-off. Another form of mulching is the use of native hay or weed free straw. Mowing of native grasses and forbs adjacent to the Project area and using the cuttings as mulch over bare soil can be used as an extra seed source. The mulch also helps to conserve moisture and protects the soil surface from erosion. It is important to mow native areas free of invasive plants, especially Crested Wheatgrass, and to time the mowing when the dominant grass species is in the mature seed set stage (Grassland Restoration Forum, 2023).

Coconut matting is an effective resource in reducing run-off and wind erosion on steeper slopes (Grassland Restoration Forum, 2023). Coconut matting is a fibrous, biodegradable material that is placed over the recently seeded slope, which holds in moisture and prevents erosion, allowing the vegetated community to develop (Mapa, 1996). Coconut matting should be used on areas of the berm with steeper slopes, particularly where slumping occurs.

2.9 Recovery Succession

Recovery is expected to follow a natural pattern of succession from pioneer to late seral classes, trending toward a native grassland community. Ideally this will also be a reference or climax community, equivalent to nearby native grassland communities; however, the goal here is to achieve native grassland status, which may be manifested as a modified native grassland rather than the true climax state.

Natural succession from pioneer to mid seral communities is expected within the first 3 to 5 years. Within this time frame, pioneer species (including weed species) will likely be established within the first 1 or 2 years, and bare ground may be present up to three years following disturbance. Within 2-3 years a mid seral plant community will develop, and within 3 to 5+ years the community will transition into an early to mid seral stage (Grassland Restoration Forum, 2023). Over this time, seeds will germinate and develop through the pioneer and into the early-seral stages, if seeding was effective. Regular monitoring over the first 3 to 5 years will ensure germination is proceeding successfully or if re-seeding is needed in areas that are not recovering as expected. Monitoring will also address coverage of listed weed species and allow for controls to be implemented if they become prevalent on site (Goodwin et al., 2006). Full recovery of the reclaimed area will likely take between 15 to 20 years to reach late seral succession conditions (Kestrel Research Inc. & Graminae Services Ltd., 2011). Because of the long timeline, monitoring programs will be devised to occur in the first few years to record the initial successional stages, followed by monitoring at approximately 5 year intervals, as stated in Section 3 below.

3 MONITORING

Reclamation success is determined by comparing the reseeded areas to representative site conditions such as adjacent undisturbed or reference plant communities as well as documented pre-disturbance conditions of the Project footprint (GOA, 2018b). Proper site monitoring identifies problems that could prevent or interfere with a successful revegetation project. Following each year of monitoring, a report will be submitted to Eastern Irrigation District to itemize locations with restoration issues and describe actions needed to address these. Potential issues may include:

- species abundance or compositional changes
- invasion or re-establishment of weeds
- foraging or damage by wildlife

- erosion
- vegetation failure (i.e., bare areas)
- unfavorable moisture (i.e., excessive pooling or drought)

Once any problems are identified, steps can be taken to remediate issues such as:

- Weed control, during and after seeding. It is expected that the first two years of the restoration Project will be dedicated to weed management as the site was moderately infested with invasive species. Weed control will only target listed weeds that may become persistent, as other non-native species are expected to decrease over time and provide organic matter to the soil.
- Further mulching to protect seeds, prevent soil erosion, and conserve soil moisture.
- Re-seeding bare areas.
- Drainage modifications to reduce pooling in wet areas.

Monitoring will also be used to assess whether restored areas have met the native grasslands criteria according to Conservation Assessments in Native Grasslands (GOA, 2018a).

Monitoring can range from quick visual inspections with photo documentation to an in-depth study of species composition, distribution, and density. Monitoring frequency will depend on Project goals and site conditions. A site prone to low moisture, high erosion, or weed invasion should be monitored frequently as many native species germinate and establish slowly (Goodwin et al., 2006). This report outlines the concepts to develop a monitoring plan. Once the Project is approved, a full monitoring program will be developed, which will include specific methods to collect and analyze data.

The restoration monitoring program should aim to be completed 15 to 20 years following seeding efforts (Morgan et al., 1995). If some areas are not successfully reclaimed over this period, a new seed mix may be developed followed by reseeding. Following this, additional monitoring would occur.

3.1 Data Collection and Analysis

The monitoring plan may include procedures to establish permanent monitoring plots representing all aspects of the berms (slope, elevation, direction, moisture level, etc.) as well as 1 or 2 control plots in adjacent, undisturbed grassland. In these plots, data can be collected for:

- Mean cover and species richness
    - original seed mix vs newly recruited species after 2/5/10/(15/20) years
    - native vs non-native species composition
    - comparison between monitored sites and baseline and/or control sites
- Seral stages (recovery strategies)
    - relative dominance of early seral vs climax indicator species
    - structural assessment of site conditions and successional stages, including bare ground, pioneer, early, mid and late seral stages, (Kestrel Research Inc. & Graminae Services Ltd., 2011)
- Noxious or Prohibited Noxious weed species occurrence and cover
- Soil compaction areas
- Observations of erosion and overland flow areas
- Status of restoration materials (matting/mulch state of decay)

3.1.1 Field Measurement Methods

Establish permanent observation and photograph points and establish transects for detailed site measurements. Transect sites will be selected by:

- conducting reconnaissance of the restored areas to find potential sites for monitoring investigations and nearby control sites;
- identification of issues at each site as well as site conditions (e.g., sloped and flat areas); and
- using stratified random sampling or other methods to select a subset of the reconnaissance sites, covering different slopes, aspects, and soil conditions.

Once selected, transects will be established throughout the reclaimed areas. To ensure the same sites will be measured at reach monitoring period, Global Positioning System (GPS) coordinates will be recorded and start, and end points will be staked.

During each monitoring session, photographs will be captured to visually show growth changes, and detailed site measures of vegetation and soil conditions will be recorded, such as:

- measuring plant composition and cover using transects and quadrats;
- recording field notes on site conditions such as slope, aspect, soil texture and bulk density, presence of litter or thatch, rooting depth, or other observations; and
- collecting field samples (vegetation/soil/water) if necessary.

3.1.2 Measurement Timing

A monitoring schedule will be developed to include periods such as:

- 4 to 6 weeks after germination;
- end of the first growing season;
- annual midseason sampling yearly for the next four to five years;
- sampling at year 10, 15, and 20 if warranted.

Site visits to conduct vegetation inventories should be done when grasses are showing panicles (depends on species-usually June to July) which his when they are easiest to identify.

3.1.3 Qualifications of Personnel

Professional environmental specialists leading the monitoring must be experienced native prairie assessments and species identifications (GOA, 2018a). Key qualifications should include:

- ability to identify grasses and native forbs with a dichotomous taxonomic key;
- ability to identify all common grass and forb species in the region in both a vegetative and flowering state; and
- ability to identify plant communities following the Range Plant Community Guide for the Dry Mixed grass Subregion (Adams, et al., 2013).

3.1.4 Analyses

Analyses should be conducted following each year of monitoring, building on the previous measurement years in each subsequent year. These analyses may include:

- comparing annual composition and cover levels for different transect locations, conditions and seed mixes;

- comparing seral stages for plots and seed mixes and if different recovery strategies were employed (e.g., drill seeding vs. broadcast seeding, irrigation vs. non irrigation, etc.;
- comparing annual growth and cover to total precipitation records for the year, or to other environmental variables;
- assessing the long-term change in species richness and diversity and composition of early successional versus late succession species; and
- identifying the long term change in weed diversity and density.

3.2 Management

A post-seeding issues management program should be implemented and in place until reclamation is deemed to be successful, as determined by achievement of Equivalent Land Capability. For the first three years after seeding, the program can include site inspections up to four times per year to identify noxious or prohibited noxious weeds, soil erosion, water damage or other site concerns, as well as any follow up activities.

Weed control can involve mechanical and chemical methods including:

- Mowing annual weeds prior to seed set.
- Controlling invasive/noxious weeds before they become problematic.
- Only applying herbicides that van target specific species and that will not affect the planted species
- Where possible, herbicide use should be avoided in the first five years unless noxious weeds or persistent nonnative perennial grasses are present that need to be controlled; some non-native plants such as Common Dandelion (*Taraxacum officinale*), Lamb's-quarters (*Chenopodium album*), *Atriplex sp*., and Flixweed (*Descuraninia sophia*) may be unsightly but do not need to be controlled as they should decrease in abundance as the native grasses develop into a dense sod over time. Even some noxious weeds such as Perennial Sow Thistle (*Sonchus arvensis*) may be allowed to flourish as they should decrease in the dry grassland sites over time (however, this species should be controlled in wet meadow areas).
- When required, herbicides should be spot sprayed onto the targeted species rather than blanket sprayed, specifically for Canada Thistle (*Cirsium arvense*) (or most other noxious or prohibited noxious weeds). Perennial Sow Thistle will not be targeted during hand spraying as this species is expected to decrease over the course of site recovery, and it will add important organic matter to the soil. Additionally, nonnative species such as weedy *Atriplex sp.* and Flixweed are important to overall restoration of the site and thus will not be targeted for weed removal. If used, herbicide applications must be supervised by a certified applicator and must follow the Alberta Environmental Code of Practice for Pesticides (GOA, 2025).

Mowing of unwanted species can occur if they are inhibiting the growth of desirable species, however it should only occur if native species are not producing seed heads to avoid damaging the native plants. Mowing should be done at a height of at least 15 cm (GOA, 2001).

Crested Wheatgrass occurrences have been documented throughout the Project and surrounding areas and managing this species will be necessary. A study comparing different methods of controlling Crested Wheatgrass found that three years of mowing prior to seed set, which

simulates the effects of grazing, can reduce Crested Wheatgrass to a similar degree when comparing the effects of seven years of herbicide application (Wilson & Partel, 2003).

4 CONCLUSION

Once berm construction has been completed, grassland reclamation will be initiated by covering all areas with topsoil and upper subsoil that was salvaged from the Project footprint. Prior to seeding, soil will be prepared as per Volume 1, Section 10 Conservation and Reclamation Plan. Once the final seed mix has been chosen as well as the method of seeding according to site and seed requirements, Successful establishment will require a weed management program and regular monitoring to identify and mitigate any deficiencies.

Native prairie establishment is a lengthy process. Restoration is considered to be successful when soils have been stabilized from erosion, there are a sufficient number of plants and cover to ensure protection of the berms from future erosion, listed noxious and prohibited noxious weeds are controlled/destroyed and are no more abundant than on adjacent lands, vegetation on reclaimed areas is growing along expected successional trends, and vegetation productivity is the same or better than that of adjacent undisturbed lands (GOA, 2003).

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