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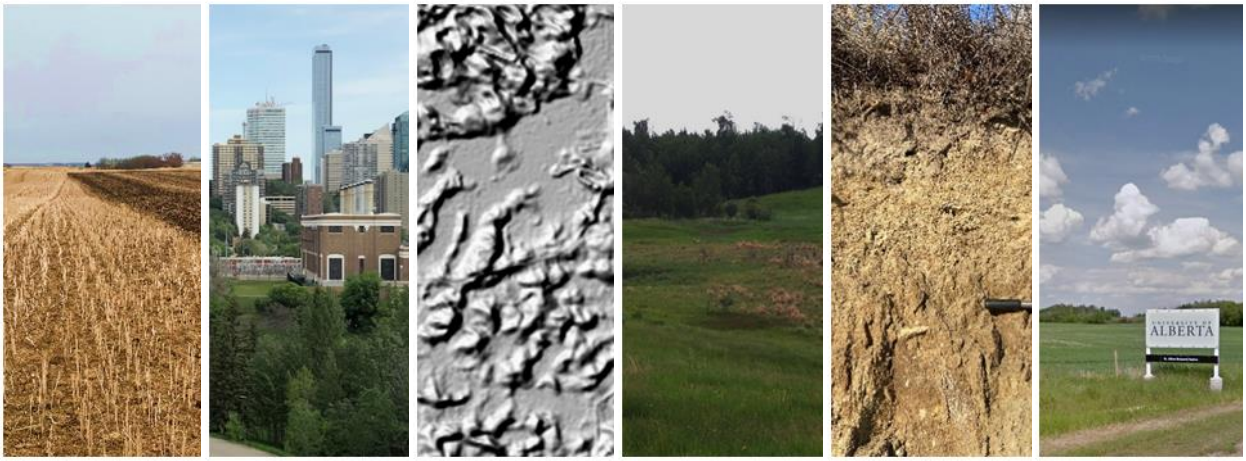
CSSS ASSW 2022

Guidebook for

The Mid-Conference

Edmonton Capital Region Soils Tour

May 26, 2022



2022 JOINT CANADIAN SOCIETY OF SOIL SCIENCE (CSSS) ANNUAL MEETING AND ALBERTA SOIL SCIENCE WORKSHOP (ASSW)

GUIDEBOOK FOR

THE MID-CONFERENCE EDMONTON CAPITAL REGION SOILS TOUR

May 26, 2022

Alberta Soils Tour Committee

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ABBREVIATIONS

^{14}C ..... Radioactive isotope of carbon with isotope mass 14
AGRASID ..... Agricultural Regions of Alberta Soil Inventory Database
ASSW ..... Alberta Soil Science Workshop
ATV ..... All-Terrain Vehicle
CSSS ..... Canadian Society of Soil Science
et al. ..... And others
Hwy ..... Highway
masl ..... Metres above sea level
MMO ..... Malmo Soil Series
MNT ..... Manatokan Soil Series
NA ..... Natural Area
NCC ..... Nature Conservancy of Canada
NP ..... National Park of Canada
P.Ag. ..... Professional Agrologist
Ph.D. ..... Doctor of Philosophy
POK ..... Ponoka Soil Series
PRA ..... Provincial Recreation Area
PRM ..... Primula Soil Series
SCA ..... Soil Correlation Area
Twp ..... Township
UCS ..... Uncas Soil Series
UNESCO ..... United Nations Educational, Scientific and Cultural Organization
UTM ..... Universal Transverse Mercator projection
WGS84 ..... World Geodetic System 1984 projection

ACKNOWLEDGEMENTS

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We greatly appreciate the support of the following land managers in accommodating the 2022 CSSS-ASSW Mid-Conference Tour at their properties:

- Hastings Creek – Delaney Schlemko, Natural Area Manager, Northeast Alberta, Nature Conservancy of Canada
- Bruderheim Dunes – Keith Johnston, Executive Director, Shiloh
- St. Albert Research Station, University of Alberta – James Willis, Farm Manager and Clint Lysgaard, Crops Foreman

We greatly appreciate the support of the following companies in providing services necessary for making the 2022 CSSS-ASSW Mid-Conference Tour successful:

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- Shiloh Youth Ranch, Strathcona County, Alberta
- University of Alberta, Department of Renewable Resources, Faculty of Agricultural, Food and Nutritional Sciences, Edmonton, Alberta

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SPONSORS

We thank the following sponsors for helping to make the 2022 CSSS-ASSW Post-Conference Tour possible:

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1 PREFACE

This guidebook provides participants with information to follow during the soils Tour and for reference afterwards. The Tour focuses on soils and environmental factors such as climate, topography and geology that influence soil development at the various locations visited. This guidebook contains general information in the introductory portion followed by site-specific descriptions. Also included is a road log identifying sites visited and locations of general interest along the Tour route.

This Tour follows portions of the tours associated with the 11th Congress of the International Society of Soil Science held in Edmonton in 1978. A large part of this guidebook utilizes materials copied from the existing Guidebook for a Soils and Land Use Tour in the Edmonton Region (Crown and Greenlee 1978). We greatly appreciate the efforts put into the preparation of the 11th Congress tours. References to the original publication are provided throughout the text.

2 ROAD LOG (BUS A)

Sequence Number	Location (km from origin)	Description
A01	0.0	***Northern Alberta Jubilee Auditorium***, Edmonton staging area. The auditorium was built in 1957 to celebrate the 50th anniversary of Alberta. It is owned and operated by the Government of Alberta. The auditorium is home to the Edmonton Opera, Ukrainian Shumka Dancers and the Alberta Ballet. For many years it has hosted Broadway shows, stand-up comedians, theatre productions, bands, orchestras, dance festivals and awards ceremonies.
A02	2.1	Crossing the North Saskatchewan River on the recently constructed Walterdale Bridge. This is an arch bridge which replaced the previous Walterdale Bridge in 2017. The new bridge has three lanes for northbound vehicular traffic and improved pedestrian and cyclist crossings. Edmonton downtown with Legislature Building ahead.
A03	3.6	Crossing the North Saskatchewan River on the James MacDonald Bridge. Construction of the bridge began in the early 1960s and was completed in 1971. The bridge was named after city engineer James MacDonald. Edmonton's downtown with the Macdonald Hotel to the left (north) and the Muttart Conservatory to the right (south). The Muttart has one of Canada's largest indoor botanical collections and is an Edmonton landmark.
A04	10.0	West end of Refinery Row. Entering Strathcona County and the western extent of Sherwood Park. Refinery Row is the unofficial name given to the concentration of refineries just east of the City of Edmonton. One of the major facilities here is the Suncor Refinery, which processes feedstock from Suncor's oil sands operations. The 146,000 barrel per day refinery produces gasoline, diesel, jet fuel and aviation gasoline; it supplies most of Western Canada by truck, rail and pipeline. Two major pipelines, Trans Mountain and Enbridge Mainline, start in Refinery Row. Sherwood Park is a large hamlet within Strathcona County that is recognized as an urban service area (Wikipedia 2022a). As of 2016, the population of Sherwood Park was 70,618.

Sequence Number	Location (km from origin)	Description
A05	13.0	Turing right (south) on Anthony Henday Drive (Edmonton Ring Road, Hwy 216), traversing Looma Upland. Pointe-aux-Pins Plain located in the basin of the former proglacial Lake Edmonton can be seen to the north and east. Looma Upland (Central Parkland Natural Subregion) with an undulating morainal landscape is dominated by Dark Gray Chernozems and Dark Gray Luvisols developed on medium-textured Laurentide till. A band of Dark Gray Chernozemic soils to the east parallels the Tour route and represents the transitional zone between prairie vegetation to the west and forest vegetation to the east. The area is partially covered by urban development.
A06	24.7	Tour leaves the urban area via Hwy 14 east. Entering the UNESCO Beaver Hills Biosphere Reserve which was established in 2016. See Section 4 of this guidebook for details about the Biosphere Reserve.
A07	35.9	Leaving Looma Upland and entering Beaverhills Upland (Dry Mixedwood Natural Subregion). Beaverhills Upland features the same glacial deposits as the Looma Upland. The primary difference is a more prominent hummocky topography (knob and kettle moraine). Soils are predominantly Dark Gray Luvisols with lesser occurrences of Chernozems on the uplands and a higher proportion of Gleysols and Organic soils in poorly drained depressions.
A08	54.0	Exiting Hwy 14 and taking Twp Road 512 east across knob and kettle topography of the Beaverhills Upland; farms on both sides of the road.
A09	57.4	Passing a small protected area called the Parkland NA, to the right (south). Aspen forests cover much of this NA, with shrubby grasslands found only on south-facing slopes. There are small, rounded hills (knobs), with numerous ponds and wetlands (kettles) scattered throughout. Many of the kettles provide homes for beaver and nesting areas for ducks. This area is part of the Beaverhills Upland and the Cooking Lake Moraine.
A10	62.5	***Hastings Creek site***. The area lies within the Beaverhills Upland and Dry Mixedwood Natural Subregion. Soils examined are a Dark Gray Luvisol found on fine loamy Edmonton Formation till deposited by the Laurentide Ice Sheet in an upland site, and a Terric Mesisol in a nearby organic fen. Agricultural Land Suitability for uplands is Class 6T with extremely severe limitations due to hummocky topography. The adjacent wetland has the Agricultural Suitability Class 6W due to very poor drainage. Refer to Section 4 of this guidebook for site-specific information.
A11	81.3	Passing the Blackfoot-Cooking Lake PRA to the right (east). This 97 km^2 PRA contains forests, pastures and wetlands. It is a multi-use area that supports a variety of activities including agriculture, wildlife management, natural gas extraction and outdoor recreation. Active wildlife management programs in the area have created diverse habitats that support numerous wildlife species. Recreational opportunities include horseback riding, cross-country skiing, hiking, mountain biking and snowmobiling. The area provides excellent wildlife viewing opportunities along its more than 170 km of equestrian and cross-country ski trails. This PRA serves as a buffer zone for Elk Island NP.

Sequence Number	Location (km from origin)	Description
A12	85.9	Passing Elk Island NP to the right (east). Elk Island NP (established 1913, 194 km^2) lies within the Dry Mixedwood Natural Subregion and is a sanctuary of rolling woodlands and meadows dotted with lakes, bogs and ponds, 48 km east of Edmonton. Public interest in the conservation of rapidly dwindling wildlife led to the establishment of a reserve for elk in 1906, which later became Elk Island NP. This park constitutes the core area of the Beaver Hills Biosphere Reserve (refer to Section 4.2 for more details).
A13	90.9	Turning left (west) at the intersection from Range Road 210 onto the Yellowhead Highway (Hwy 16).
A14	99.1	Turning right (north) from Hwy 16 onto secondary Hwy 830.
A15	103.5	Leaving Beaverhills Upland (Dry Mixedwood Natural Subregion) and entering Partridge Plain (Central Parkland Natural Subregion). The Tour is leaving the Beaver Hills Biosphere Reserve and entering a prime agricultural area (Agricultural Land Suitability Class 2H). Partridge Plain has an undulating landscape consisting of Black Chernozems developed on medium-textured Laurentide till.
A16	114.8	Hamlet of Josephburg. Tour is entering the Pointe-Aux-Pins Plain for a 5 km stretch. This plain is formed in the Glacial Lake Edmonton basin and is dominated by Black Chernozems on fine-textured glaciolacustrine deposits. Tour will return back to the Partridge Plain just before the intersection with Hwy 15.
A17	132.1	Leaving Partridge Plain and entering Redwater Plain (Dry Mixedwood Natural Subregion). The Redwater Plain has an undulating to ridged topography and includes the Bruderheim Dune Field. Soils within the dune field are a complex of Brunisols with a high proportion of Organic soils. Black Chernozems developed on coarse-textured sediments dominate in areas surrounding the dune field. This boundary will be crossed heading south (from Redwater Plain back to Partridge Plain) after leaving the Bruderheim Dunes site.
A18	135.1	Astotin Creek links two important conservation areas in central Alberta, the North Saskatchewan River valley and Elk Island NP, providing an important corridor for wildlife migration (Chen 2009).
A19	135.8	Bruderheim Dune Field. Roadcut, seen to the left (west) exposes multiple eolian dunes. The dune field is dominated by transverse dunes however parabolic and barchan dunes are common as well (Refer to Section 5 of this guidebook for site-specific information).
A20	137.4	***Bruderheim Dunes site*** within Redwater Plain (Dry Mixedwood Natural Subregion). Soils examined are an Eluviated Eutric Brunisol on the upper slope of a transverse dune, and a Terric Humic Mesisol in a nearby depression. Agricultural Land Capability of the land is very low. Uplands have extremely severe limitations for sustained crop production (subclass 6MT) and depressions are not suitable for crop production (subclass 7WBV). Refer to Section 5 of this guidebook for site-specific information.

Sequence Number	Location (km from origin)	Description
A19, A18, A17		After leaving the Bruderheim Dune site, the Tour backtracks on Hwy 830 south to Hwy 15 east.
A21	156.1	Leaving Partridge Plain and entering Pointe-aux-Pins Plain. Pointe-aux-Pins Plain has an undulating landscape with predominantly Black Chernozems developed on fine-textured glaciolacustrine sediments that were deposited in the basin of former Glacial Lake Edmonton. This proglacial lake, which covered most of the Edmonton region, was impounded by the margin of the Laurentide Ice Sheet to the north and east of this site, and as new drainage routes opened, such as along the Gwynne outlet and the North Saskatchewan River valley, its level rapidly lowered. As the lake receded, water remained longest in the center of the basin, so this is where the thickest sediments are located. Glacial Lake Edmonton sediments range from about 30 m to less than one metre and include bedded silt and clay containing ice-rafted debris (dropstones) in the deeper parts of the basin, to sands along its margins. These sediments are underlain by till except in very small areas where the till eroded before the lake formed.
A22	158.1	City limits of Fort Saskatchewan. Fort Saskatchewan is a mid-sized city along the North Saskatchewan River. Its population in 2021 was 27,088. The city was founded as a North-West Mounted Police fort and was later home to a large provincial jail. The original fort was located across the river from the hamlet of Lamoureux, and Fort Saskatchewan opened a replica of the fort next to its original site in 2011. Fort Saskatchewan is bordered by Strathcona County to the south and east, Sturgeon County to the north and west, and the City of Edmonton to the southwest. Sturgeon County is located across from the North Saskatchewan River. The city is best known for its proximity to petrochemical facilities of major companies, including Dow Chemical, Sherritt International, Nutrien (formerly Agrium) and Shell Canada. It is also known for its flock of 50 or so sheep that roam the Fort Heritage Precinct throughout the summer months, eating the grass and invasive weeds.
A23	161.5	Dow Chemical plant evident to the right (north-east). The Dow Chemical Company is a multinational chemical corporation headquartered in Midland, Michigan, United States and is a subsidiary of Dow Inc. The company is among the three largest chemical producers in the world. Dow manufactures plastics, chemicals and agricultural products. With a presence in about 160 countries in addition to Canada, it employs about 54,000 people worldwide. Dow has been called the "chemical companies' chemical company", considering its sales are to other industries rather than directly to end-use consumers (Wikipedia 2022b).
A24	163.7	North entrance off Hwy 15 to major industrial plants, such as Sherritt International and Nutrien Fertilizer. Mixed sulphides are transported to the Sherritt International refining facilities in Fort Saskatchewan. Resulting nickel and cobalt products are sold to various markets, primarily in Europe, Japan and China. Nutrien is a Canadian fertilizer company based in Saskatoon,

Sequence Number	Location (km from origin)	Description
		Saskatchewan (Wikipedia 2022d). It is the largest producer of potash and the third largest producer of nitrogen fertilizer in the world (Wikipedia 2022c).
A25	166.3	Turning right (north-west) off Hwy 15 through Fort Saskatchewan's commercial and residential areas.
A26	167.5	Entering the North Saskatchewan River Valley (Central Parkland Natural Subregion) on Hwy 15. The North Saskatchewan River valley is about 50 m deep and includes the river, its confined floodplain and the steep slopes of the valley. Regosols developed on alluvium in the valley bottom and colluvium on valley slopes are dominant. Minor soils include Black Chernozems and Gleysols. The river valley was a major meltwater channel during regional deglaciation, serving as a drainage route during the final stages of Glacial Lake Edmonton.
A27	168.7	Leaving the North Saskatchewan River Valley and entering Namao Plain (Central Parkland Natural Subregion). Namao Plain is located on an undulating landscape with predominantly Black Chernozems. Soils are developed on fine- to medium-textured glaciolacustrine sediments deposited in the former Glacial Lake Edmonton basin.
A28	170.0	Exiting Hwy 15 and taking Hwy 37 west. Sturgeon Industrial Park containing one of the major refineries (NWR Sturgeon Refinery) and other facilities evident to the right.
A29	189.4	Sturgeon River. The Sturgeon River is a 260 km long watercourse comprising a major tributary of the North Saskatchewan River. The river crosses Sturgeon County, which was named after this river.
A30	195.2	Turning left (south) from Hwy 37 onto Hwy 2. Morainal landscape (Morinville Plain) with patches of forest evident a distance to the north (right) of the Tour route marks an edge of the Glacial Lake Edmonton basin.
A31	198.4	Entrance off Hwy 2 to the St. Albert Research Station. Located just north of St. Albert, the St. Albert Research Station is an 800 acre farm given to the University of Alberta in 2008 as a gift from the Bocock family. The farm is primarily used for agronomic and environmental research.
A32	199.3	***St. Albert Research Station site*** (Central Parkland Natural Subregion). Soils examined are an Eluviated Black Chernozem developed on a medium-textured glaciofluvial esker, and an Eluviated Black Chernozem developed on fine-textured glaciolacustrine sediments. Refer to Section 6 of this guidebook for site-specific information.
		Tour returns to the Hwy 2 after leaving the St. Albert Research Station
A33	200.9	Entering the northern limits of the City of St. Albert (population 68,232). St. Albert is located on the Sturgeon River northwest of the City of Edmonton. It was originally settled as a Métis community and is now the second largest city in the Edmonton Capital Region. St. Albert first received its town status in 1904 and was reached by the Canadian Northern Railway in 1906. Originally St. Albert was separated from Edmonton by several miles of farmland. The

Sequence Number	Location (km from origin)	Description
		1980s expansion of Edmonton's city limits placed St. Albert immediately adjacent to Edmonton.
A34	207.1	Sturgeon River.
A35	210.7	Crossing Anthony Henday Drive (Hwy 216) and entering the City of Edmonton heading south.
A36	219.9	Entering the North Saskatchewan River valley on the winding Groat Road.
A01	223.8	***Northern Alberta Jubilee Auditorium***, end of Tour.

3 TOUR AREA

This Mid-Conference Edmonton Capital Region Soils Tour features the central part of Alberta and covers two distinctly different Natural Subregions and land use regions, each with its own soils, climate, geology and vegetative characteristics. The eastern portion of the Tour area demonstrates hummocky topography, the northeastern portion an eolian dune field, and the northwestern portion the former Glacial Lake Edmonton basin.

The Tour illustrates the major soils, terrain, land use patterns and interesting features of the Edmonton Capital Region, an area in central Alberta representative of the forest-grassland transition zone of the Great Plains of Canada currently referred to as the Central Parkland Natural Subregion. In addition, the Tour will explore the soils and landscapes of the southern extension of the Dry Mixedwood Natural Subregion in the north-east and a unique outlier east of Edmonton, which is represented by the Beaverhills Upland, comprising the Cooking Lake and Beaver Hills moraines. The Tour showcases the variety of soil types in the immediate Edmonton area: a Gray Luvisolic toposequence developed on medium-textured glacial till in the Beaverhills Upland, a Eutric Brunisolic toposequence developed on very coarse-textured eolian dunes in the northeast, and a Black Chernozemic lithosequence developed on glaciolacustrine and glaciofluvial sediments north of Edmonton (Figures A-4 and A-5 in Appendix A).

3.1 The Edmonton Region

Edmonton began as a fur trade post of the Hudson's Bay Company in 1795. No significant settlement or agricultural activity began in the area until a century later. Its population in 1878 was 148. Following the formation of the Dominion of Canada in 1867 and the completion of the first transcontinental railway in 1885, settlers began to arrive in large numbers from Europe, the United States and eastern Canada. By 1904, when the city was incorporated, its population was 8,350. The fertile soils in the area supported extensive and ongoing agricultural activities. The province of Alberta was created as part of the Dominion in 1905. By 1912, over 50,000 people lived in Edmonton and its suburbs. At the time of the 11th Congress of the International Society of Soil Science in 1978, the population was already over 500,000. As of 2021, Edmonton had a city population of 1,010,899 and a metropolitan population of 1,418,118, making it the fifth largest city and sixth largest metropolitan area in Canada.

The discovery of oil in the Leduc area in 1947 and the spectacular Atlantic No. 1 well, which "blew out" and caught fire in 1948, started an oil boom in Alberta. As of 2019, there were tens of thousands of oil and gas wells in the area. Major oil and chemical processing facilities were built in and around Edmonton, increasing employment opportunities in the Edmonton Capital Region.

3.2 Physiography and Topography

The Tour area mainly lies within the Parkland Natural Region (Central Parkland Subregion) with the Boreal Forest Region (Dry Mixedwood Subregion) encroaching in the northeast and east (Figure A-2 in Appendix A; Natural Regions Committee 2006). Elevations across the Tour area range from a minimum of approximately 600 masl in the North Saskatchewan River valley in the north to a maximum of approximately 750 masl at the highest portion of the Beaverhills Upland in the east.

3.3 Bedrock Geology

Bedrock geological units underlying the Tour area are comprised of Upper Cretaceous sedimentary rocks occupying the eastern limb of the Alberta Syncline (Lindsay et al. 1968). The bedrock dips gently to the southwest, so that successively younger units appear in that direction (St. Onge 1972). The three bedrock formations described below are present in the Tour area (Prior et al. 2013; Figure A-3 in Appendix A).

The oldest bedrock unit is the Belly River Group, which outcrops in the northeastern part of the area. This unit was formed approximately 75 to 82 million years ago (Alberta Geological Survey 2019). It consists of marginal marine to non-marine, fine- to coarse-grained sandstone, with minor beds of gray to brown carbonaceous siltstone, coal and bentonite.

The Belly River Group sandstone formation is overlain by the dark gray to brown-gray, marine to marginal marine mudstone of the Bearpaw Formation, which occupies a narrow (less than 10 km wide) arcuate outcrop that fringes the eastern and northern Beaverhills Upland between Tofield and Fort Saskatchewan, respectively. Predominantly mudstone, this formation also contains siderite and bentonite concretions, some of which yield ammonites. The Bearpaw Formation developed approximately 73 to 75 million years ago (Alberta Geological Survey 2019).

The youngest bedrock unit underlying the Tour area is the Horseshoe Canyon Formation which consists of a pale gray, fine-grained feldspathic sandstone interbedded with siltstone and bentonitic mudstone, with laterally continuous coal seams. Salinity is often associated with soils developed on or near outcrops of this formation, or on till derived mainly from it (Lindsay et al. 1968). The age of the Horseshoe Canyon Formation is 67 to 73 million years old (Alberta Geological Survey 2019).

The three groups already described were originally recognized collectively as the Edmonton Formation of the Upper Cretaceous age. Originally mapped as a formation from outcrops along the North Saskatchewan River in the City of Edmonton, it was later elevated to group status, in this region comprising the Horseshoe Canyon, Battle and Scollard formations (Prior et al. 2013), which overlie the older marine to marginal marine sandstones and mudstones of the Belly River and Bearpaw formations. Edmonton Formation is a term still used by pedologists to reference source materials incorporated into glacial till in the area (Alberta Soil Information Centre 2016).

3.4 Surficial Geology

The Laurentide Ice Sheet advanced over the entire area in a general southerly direction during the last glaciation, which culminated approximately 22,000 years ago. It deposited an extensive blanket of till of variable thickness, either directly across the bedrock surface, or above an intervening deposit of discontinuous preglacial fluvial gravels and sands belonging to the Empress Group.

Two tills have been recognized in the stratigraphic sequence of the Edmonton area. They are distinguished by differences in their depositional environments, with a lower, brown clay loam till having been deposited subglacially, and an upper, yellowish-brown till interpreted as having a melt-out origin, hence the higher concentration of coarser-grained material. The composition of these tills is in large part

controlled by the lithology of the underlying bedrock (Figure A-3 in Appendix A; Prior et al. 2013). Far-travelled, glacially transported pebbles to boulders from the Precambrian Shield of northeastern Alberta, as well as from quartzite gravels eroded from the Rocky Mountains by large preglacial river systems were combined with locally derived material to form the tills. The till materials are usually relatively impermeable and quite sticky, particularly when moisture content is high. Much of the clay-sized fraction in the tills is montmorillonite, which is derived from the local bedrock (Bayrock and Hughes 1962). Both tills contain diffused calcium and magnesium carbonate, usually one to three percent. Two distinct terrains are associated with the tills: (1) ground moraine, which forms a gently undulating till plain, and (2) stagnation moraine characterized by hummocky topography consisting of prairie mounds, knobs and kettles, eskers and local veneers of ice contact glaciolacustrine sediments deposited in small supraglacial lakes.

Lower lying areas north and east of the Beaverhills Upland are covered by a widespread blanket of rhythmically bedded, fine- to medium-grained silts and clays deposited within Glacial Lake Edmonton during deglaciation at the end of the last ice age (Utting and Atkinson 2019). As the Laurentide Ice Sheet retreated northwards from the Edmonton area, it blocked the regional drainage gradient, causing large volumes of water to infill topographic basins that were impounded by the ice margin. The meltwater within such proglacial lakes drained through spillways such as the Gwynne outlet to the south, and the North Saskatchewan River valley to the northeast, which opened after the Laurentide Ice Sheet retreated off the Beaverhills Upland. The coarser-grained deposits occur along the margins of Glacial Lake Edmonton, particularly in the western parts of the region, and are associated with three distinct landforms:

1. Kames and deltas, which resulted from the drainage of meltwater along the present-day Sturgeon River valley into Glacial Lake Edmonton. These features are commonly pitted, due to parts of the ice margin being buried by sediment. The subsequent melting of this ice would cause the collapse of material into thaw pits.
2. Alluvial features, such as bars and terraces along the North Saskatchewan River valley, are the result of incision and reworking of earlier sediments and landforms.
3. Sand dunes, which evolved after deglaciation, when limited vegetation and strong winds emanating from the retreating ice sheet mobilized sand from the kames and deltas, redepositing it in large dune fields. The Bruderheim Dune Field is dominated by parabolic dunes (refer to Figure 1 for dune types). However, barchan and transverse dunes are the most common near the Tour stop (Figure A-7 in the Appendix A).

Occasional alluvium and coarse-grained outwash deposits of a more recent origin are scattered throughout the area, as are the organic deposits currently forming in poorly drained sites.

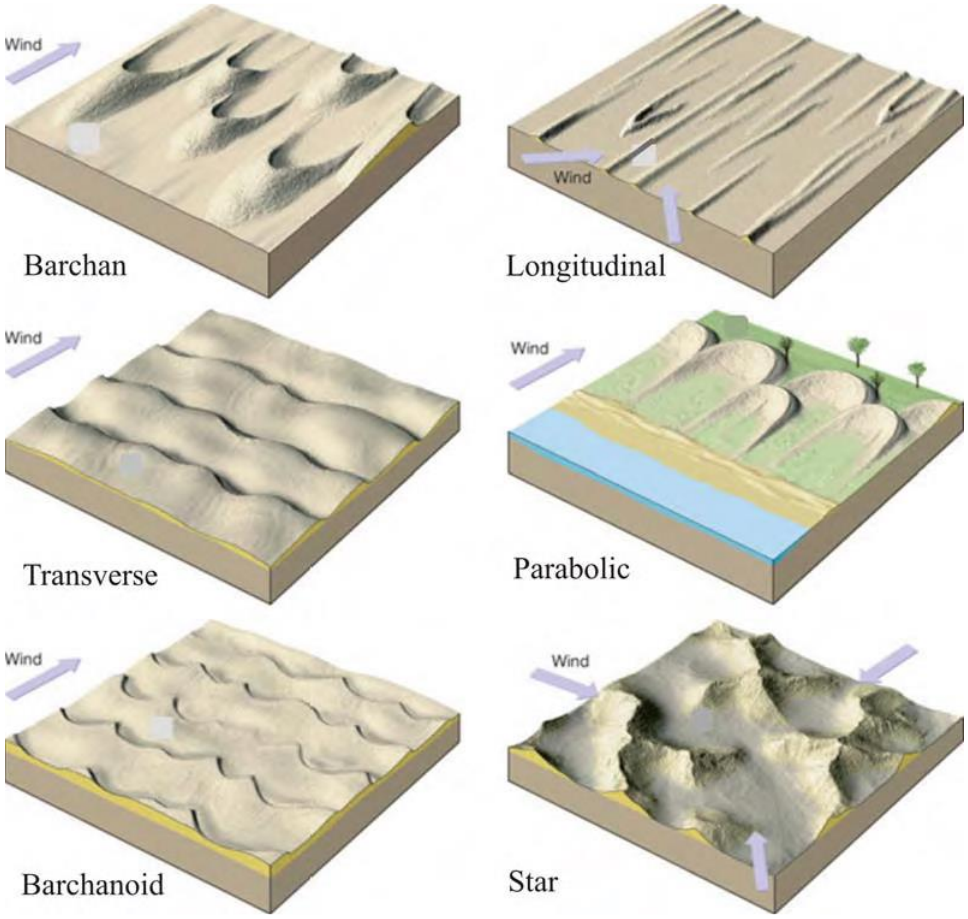
Figure A-4 in Appendix A provides the locations and extents of the various surficial deposits in the Tour area.

3.5 Climate and Vegetation

Vegetation and climate information is provided in Appendix C for the two Natural Subregions (Central Parkland and Dry Mixedwood) through which the Tour passes (Figure A-2 in Appendix A).

- The Tour begins in the Central Parkland (Parkland Natural Region) and passes through parts of the Dry Mixedwood (Boreal Natural Region).
- Two of the soil sites are in the Dry Mixedwood (Hastings Creek and Bruderheim Dunes); one (St. Albert Research Station) is in the Central Parkland.

Figure 1 Dune types (Brookfield 2011).



- The Tour maps show an island of Dry Mixedwood in the Beaverhills Upland (Figure A-2 in Appendix A). The name Beaverhills (a.k.a. Beaver Hills) is indicative of the higher elevations of this area. Much of Edmonton, St. Albert and Fort Saskatchewan's urban areas occur at elevations of less than about 700 masl. The transition to Dry Mixedwood from Central Parkland occurs at about this elevation east, north and west of Edmonton.
- Slightly cooler, somewhat moister conditions at higher elevations favour the development of aspen stands on uplands with medium-textured, moderately moist soils and pine-dominated and mixedwood stands on drier soils developed in coarse eolian deposits prevalent in the northeast. The frost-free period is shorter as well.
- Landform changes from clayey glaciolacustrine plains to hummocky till with numerous small lakes and wetlands in pothole depressions to occasional occurrences of coarse-textured sand dunes have also influenced soil development.
- Natural subregion polygons were defined in this area mainly by soil patterns because most of the native vegetation on arable lands has been removed over the last hundred years. The Black Chernozems that help to define the Central Parkland have developed on deep fine-textured glaciolacustrine soils, some of which occur at elevations above 700 masl. Dark Gray Luvisols characteristic of the Dry Mixedwood in uplands have developed on fine- to medium-textured tills where topography limits cultivation, with organic deposits in numerous pothole wetlands.

- Most of the Tour area is within the Central Parkland that is mostly cultivated. Trembling aspen (*Populus tremuloides*) is dominant in scattered remnants of natural stands, with balsam poplar (*Populus balsamifera*) and some white birch (*Betula papyrifera*) on moist lowlands and in valleys. Grasslands and open meadow areas also occur infrequently, and native grasslands are uncommon except where they have been protected.
- The Dry Mixedwood north-east of Edmonton and associated with the Beaverhills Upland east of Edmonton (Figure A-2 in Appendix A) is a variable mixture of trembling aspen, balsam poplar, white birch and white spruce (*Picea glauca*) with the latter tree species being most abundant in mature stands. Open stands of jack pine (*Pinus banksiana*) with lichen understories are common on coarse-textured eolian dunes in the Bruderheim area northeast of Edmonton. In lower terrain positions, where surface water accumulates graminoid fens or black spruce (*Picea mariana*)-tamarack (*Larix laricina*) dominated wooded fens develop. The accumulation of peat is generally less than 100 cm deep.

The Central Parkland Natural Subregion is a dynamic ecotone between the grasslands to the south, the foothills to the west and the boreal forest to the north. In the past, the Parkland could have extended northward into the Boreal Forest Region, and the area around Edmonton could have been grassland (Schneider 2013). Pettapiece (1969) reviewed the literature and discussed the post-glacial environment of the forest-grassland transition zone of the Great Plains of Canada currently known as the Central Parkland Natural Subregion. Immediately after the last glaciation, which ended approximately 22,000 years ago, tundra conditions existed in this zone. This was reportedly followed by a rapid warming trend and a shift to prairie vegetation until approximately 5,000 years ago. During this warming period temperatures are believed to have been 2 to 3°C warmer than the maximum temperatures of today. By 4,000 years before present, a slightly cooler, moister climate like today's is believed to have been prevalent. In conjunction with this cooling trend, the boreal forest is believed to have shifted southward. From 1500 to 1850 a cooler climate than present (the Little Ice Age) is believed to have prevailed, and from 1850 to the present there has been a general warming trend.

3.6 Soils

The Tour area lies within SCA 10 of Alberta known as the Black/Dark Gray-Gray Soil Zone of Central and East-Central Alberta (Appendix B). This SCA is characterized by a complex of Black Chernozems, Dark Gray Chernozems, Dark Gray Luvisols and Gray Luvisols. The zonal soils of the Edmonton Region reflect their position within the Forest-Grassland Transition zone also known as the Central Parkland Natural Subregion. This region displays a shift in dominance from Chernozemic soils south of Edmonton with their thick humic horizons (Central Parkland Natural Subregion) to Luvisolic soils on the Beaverhills Upland to the east (Dry Mixedwood Natural Subregion). Within the Tour area, climate and vegetation conditions are such that Orthic Black Chernozemic soils have developed on sites that had continuous grass cover during the Holocene. At any given site, as the degree of forest cover increases both in time and space, eluviation processes become correspondingly stronger, giving rise firstly to Eluviated Black Chernozems, and subsequently to Dark Gray Chernozems. These soils are intimately associated, but in general the Orthic Black Chernozems reflect more arid conditions, while the more strongly eluviated types occupy more humid treed positions. The Luvisolic soils represent a stronger expression of eluviation. Dark Gray Luvisolic soils develop due to a shift in the vegetation community, with forest species dominating over grassland species. Where Gray Luvisols are dominant, it is likely that the deciduous forest plant community has occupied these areas on a relatively continuous basis for a longer period, such as in the Central Mixedwood Natural Subregion. While local relief in the Tour area is not great, it is sufficient to exert some control on the distribution of soils through its influence on vegetation and microclimate (Pettapiece 1969; Crown and Greenlee 1978).

Local site conditions, such as the nature of the parent material or the topographic position of the site, may have a greater influence on the type of soil formed than the zonal controls of climate and vegetation. Gleysols occupy a significant portion of the relatively flat terrain in the Glacial Lake Edmonton basin due to the low permeability of parent materials. Organic soils occupy wetlands in the hummocky moraine east of Edmonton where the wetter and cooler climate is accompanied by higher relief topography. Soils in the dune fields form a complex of Brunisols on uplands and Organic Soils in depressions. Eolian dunes formed during the deglaciation period of the Wisconsinan Glaciation along major meltwater channels are now stabilized by vegetation and are mostly forested. Deforestation resulting from human activities or forest fires may trigger reactivation of dune forming processes through wind erosion. Solonetzic soils occupy considerable portions of the Tour area and have developed where the soil's parent material has been influenced by the accumulation of soluble salts. This salinization resulted either from the discharge of groundwater high in soluble salts, or the presence of saline bedrock near the surface.

Soils in the Tour area can also be categorized as part of Land Systems that "...depict landscapes of recurring, or distinctive patterns of geomorphology, geology, topography, soils and vegetation or land use at a scale of 1:250,000. The minimum size of a Land System is one township (93 km^2), with an average size of 3-5 townships (280 to 466 km^2)" (Government of Alberta 2022a). Land Systems are a derivative product of the Agricultural Regions of Alberta Soil Inventory Database (AGRASID; Government of Alberta 2022b). The Tour area outside of Edmonton and other major urban areas such as Fort Saskatchewan and St. Albert is covered by the following seven Land Systems (Figure A-5 in Appendix A):

- Looma Upland – Landscape is hummocky. Dark Gray Chernozems and Dark Gray Luvisols developed on medium-textured till. Minor soils include Gleysols and fine-textured soils.
- Beaverhills Upland – Landscape is hummocky. Dark Gray Luvisols developed on medium-textured till. Minor soils include Gleysols, Organic soils, Chernozems and fine-textured soils.
- Partridge Plain – Landscape is undulating. Black Chernozems developed on medium-textured till. Minor soils include Gleysols.
- Redwater Plain – Landscape is undulating with some dune complexes. Black Chernozems and Brunisols developed on coarse-textured sediments.
- Pointe-aux-Pins Plain – Landscape is undulating. Black Chernozems developed on fine-textured glaciolacustrine sediments.
- North Saskatchewan River Valley – Landscape is a wide valley with one or more terraces. Black Chernozems and Regosols developed on a variety of fluvial and colluvial materials include a significant proportion of eroded soils.
- Namao Plain – Landscape is undulating. Black Chernozems developed on fine- to medium-textured water-laid sediments.

3.7 Land Use

The dominant land use in the Edmonton region is agriculture; major crops include barley, tame hay, oats, wheat and canola. Many farmers also include some livestock production in their farming enterprises such as raising cattle, pigs, sheep, chickens and horses. Farm size is related to the legal subdivision of the land into sections (square miles) and quarter sections (257 and 64 ha, respectively). Most farms consist of one, two, or three quarter sections. Although hired labourers are occasionally employed, most farm families, using modern machinery, can handle operations themselves. The soil capability for agriculture in the Edmonton region is relatively high with the major limitations to agricultural production being steep topography in the Beaverhills Upland area and the scattered occurrence of soil salts elsewhere.

The oil and gas industry plays a major role in shaping economic activity in the Edmonton Area. Oil and gas wells occur scattered across farm fields. Multiple pipelines transport hydrocarbons from production areas north and west of the city to the upgraders and refineries in and around Edmonton. Upgraders are facilities that improve (or "upgrade") the quality of crude oil products such as bitumen, which is very viscous and dense, to synthetic crude oil. Refineries are facilities where crude oil is converted or "refined" into higher-value petroleum products like gasoline, diesel, aviation fuel and asphalt. There are also other industries such as those that produce chemical fertilizers.

One major land use issue in the Edmonton Region is the competition between urban and agricultural needs for land. The City of Edmonton is expanding onto what is prime agricultural land, particularly to the south. However, low-density housing developments are also occurring in areas where the land is less suited for agricultural production. Such is the case where acreages from 2 to 15 ha in size have been developed in the Beaverhills Upland, south and east of Sherwood Park. Recreational land uses are variable across the region. Elk Island NP and the Blackfoot-Cooking Lake PRA, located east of the city, provide summer recreational areas as well as excellent areas for cross-country skiing and snowshoeing in winter.

Another unique area that covers all of the Beaverhills Upland and a portion of the Looma Upland to the west is the Beaver Hills Biosphere designated as a biosphere reserve in 2016 by the United Nations Educational, Scientific and Cultural Organization (UNESCO; Figure A-1 in Appendix A). Refer to the Hastings Creek site description in the following section for further details about the reserve.

4 STOP 1: HASTINGS CREEK

4.1 Location

The site is situated 38 km southeast of the City of Edmonton, and 8 km northwest of the town of Tofield within the Beaver Hills Biosphere Reserve at 53°24' N Lat. and 112°47' W Long. The Beaverhills Upland also known as the Beaver Hills (Cree: *Amiskwaciy*, literally "beaver hills"), represents a hummocky to undulating upland region in Central Alberta. The Tour will examine a roadcut exposure, offering an east to west transect through a classic hummocky moraine landscape (the Cooking Lake Moraine). This exposure showcases the Uncas Series (UCS), a Dark Gray Luvisol developed on Edmonton Formation till (Bowser et al. 1962; Howitt 1988; Alberta Soil Information Centre 2016). The east-facing slope drops off into a narrow, confined channel occupied by Hastings Creek. The west-facing slope tapers into a typical kettle basin which is slightly elevated relative to Hastings Creek. A Terric Mesisol of Manatokan Series will be examined in this depression.

Morphological description and results of laboratory analyses of the Uncas soil at the upland site are presented in Tables 1 and 2 below.

Figure 2 Roadcut exposure through high relief hummock (HC1).

4.2 Land Use

The adjacent land is owned by the NCC (www.natureconservancy.ca). The land use is habitat conservation. The land is a part of the Beaver Hills Biosphere Reserve.

Delaney Schlemko, Area Manager, NCC, will give an onsite presentation about who the NCC is, and how they are helping keep the Beaver Hills wild by conserving and stewarding private land. The presentation will feature the securement history and stewardship projects currently underway on NCC's Kallal property.

The Beaverhills Upland or the Beaver Hills present a mix of land uses from rural communities and acreages to farm fields (predominantly hay fields and pasture), forested areas, wetlands and small lakes. Active conservation within the Beaver Hills dates back to the end of the 19th century. Recognition of the unique ecological values of the Beaver Hills resulted in some of the earliest commitments to conservation in Alberta and Canada by both provincial and federal agencies. The Beaverhills Timber Reserve (1880s) was the first of its kind in Canada and provided the basis for the Cooking Lake Forest Reserve (1899), Elk Park (1906; forerunner to Elk Island NP) and subsequent protected areas. Today, designated parks and protected areas account for a quarter of the region. Additional areas are secured through a variety of conservation mechanisms that help to safeguard the rich biodiversity and natural features of the region. In 2002, the staff at Elk Island NP identified the need to address unprecedented pressures from rapid growth and increased economic activity in and around Cooking Lake Moraine. The Beaver Hills was designated as a biosphere reserve in 2016 by UNESCO. UNESCO biosphere reserves are established to help foster and share scientific, indigenous and local knowledge to explore new ways of living that solve global challenges (www.beaverhills.ca, www.biospherecanada.ca/biosphere-reserves). To carry out the complementary activities of nature conservation and natural resource use, biosphere reserves are organized into three interrelated zones, known as the core area, the buffer zone and the transition area. The Tour will pass the core area of this reserve – the Elk Island NP and the Blackfoot-Cooking Lake PRA – after leaving the Hastings Creek site.

4.3 Field Description

HC1 (Upland Soil Pit)

- Soil Classification: Dark Gray Luvisol, Uncas Soil Series (UCS)
- Elevation: 725 masl
- Location: UTM E381564, N5917828, Zone 12U, Datum WGS84
  SE Sec 18, Twp 51, Range 19, W4M

HC2 (Wetland Soil Pit)

- Soil Classification: Terric Mesisol, Manatokan Soil Series (MNT)
- Elevation: 722 masl
- Location: UTM E381488, N5917845, Zone 12U, Datum WGS84
  SE Sec 18, Twp 51, Range 19, W4M

Climate and Ecosite

- The site is situated in the transitional zone from the Dry Mixedwood Natural Subregion to the Central Parkland Natural Subregion representing a grassland-boreal transition. The average frost-free period in this area is 100 days and the average annual precipitation is 460 mm (Natural Regions Committee 2006; refer to Appendix C for climate information).

- This locality is situated within SCA 10 known as the Thick Black/Dark Gray-Gray Soil Zone of Central and East-Central Alberta (refer to Appendix B for details). SCA 10 is characterized by a mix of thick Black Chernozems under grasslands, and Dark Gray Chernozems and Gray Luvisols under aspen forests. Depressions are typically occupied by Gleysols with a minor proportion of Organic Soils (Alberta Soil Information Centre 2016; Government of Alberta 2022c). Typical soils for the Dry Mixedwood Natural Subregion are Orthic Gray Luvisols under moderately-well drained aspen forests. Significant areas of Dark Gray Luvisols are dominant, particularly in cultivated areas (Natural Regions Committee 2006).
- The current AGRASID database indicates an Agricultural suitability subclass of 2H for upland areas within the 65 km^2 polygon that includes the Hastings Creek site (Alberta Soil Information Centre 2016). This 2H subclass land has slight limitations that may restrict the growth of small-grain crops due to insufficient growing degree days. Locally, the hummocky topography severely limits agricultural suitability due to steep slopes and complex landscape pattern (subclass 5TK). Depressions occupy 20 to 60 percent of the area and are class 5W landscapes with severe limitations due to excess water (Kjearsgaard 1967; Agronomic Interpretations Working Group 1995).

Vegetation

The Dry Mixedwood Natural Subregion is characterized by aspen forests and cultivated landscapes, with fens commonly occurring in low-lying areas. Vegetation at the Hastings Creek site is represented by a natural stand of trembling aspen mixed with balsam poplar and scattered white spruce veterans in the tree layer. The understory includes beaked hazelnut (*Corylus cornuta*), red-osier dogwood (*Cornus stolonifera*) and wild prickly rose (*Rosa acicularis*). The forest floor is mostly covered by leaf litter, with patches of bunchberry (*Cornus canadensis*) and sarsaparilla (*Aralia nudicaulis*). The site is disturbed by a road cut, a fence and several decades of cattle grazing, but it is now under some protection for habitat conservation since it was purchased by the NCC. Wetland at the HC2 site is a graminoid fen with low shrub cover. The peripheral part of the depression is forested and is dominated by willow (*Salix* sp.), white birch and balsam poplar.

Parent Materials

Fine-loamy Edmonton Formation till of Laurentide origin is the parent material at this site (Alberta Soil Information Centre 2016). Table 1 shows that the till contains five to 10 percent coarse fragments, is 10 to 30 m thick and is moderately calcareous (Howitt 1988). This till contains shale fragments that originated from the Upper Cretaceous Bearpaw Formation (Bowser et al. 1962). Glacial deposits in the Hastings Creek area are assigned to the Cooking Lake till, one of four types of tills analyzed across west-central Alberta by Twardy et al. (1974). The closest location analyzed in their article is located 5 km northwest of the Tour stop (Twardy et al. 1974). Depressions in the hummocky landscape at the Hastings Creek site feature veneers of organic fen peat and fine-grained glaciolacustrine sediments overlying the Edmonton Formation till.

Landform

A hummocky landscape with knob and kettle topography formed during the melting and disintegration of a stagnant ice mass (Figure A-6 in Appendix A). This morainal landscape has class 5 slopes (10 to 15%) with high relief topography. The upland site is located mid-slope with a west aspect and represents a roadcut cross-section of a morainal hummock (knob) (Figure 2). Fens and marshes with bowl and horizontal surface expressions occupy depressions.

Drainage

Well-drained soils in upper and mid-slope positions. Poorly and very poorly drained soils in surrounding depressions. The landscape has a very abrupt transition from well-drained to poorly drained soil.

Table 1 Morphological description of Uncas Soil Series (HC1).

Horizon Depth (cm)	Depth (cm)	Description
LFH	1-0	Fresh and moderately decomposed forest floor, boreal mixedwood, leaf litter, 0-2 cm thick
Ahe1	0-10	Black (10YR2/1.5m), dark gray (10YR4/1.5d) silt loam to very fine sandy loam, friable, moderate, fine to medium granular structure, 10 to 15% subrounded gravels with some cobbles and stones, non-calcareous, strong micro-faunal pedoturbation, 4-15 cm thick
Ahe2	10-20	Very dark brown (10YR2/2m), dark grayish brown (10YR4/2d) silt loam to very fine sandy loam, friable, moderate, medium granular to moderate, fine to very fine subangular blocky structure, 10 to 15% subrounded gravels with some cobbles and stones, non-calcareous, diffuse lower boundary, 11-14 cm thick
Ae	20-35	Very dark grayish brown (10YR3/2m), light brownish gray (10YR6/2d) sandy loam, friable, weak, very fine platy structure, 10 to 15% subrounded gravels with some cobbles and stones, non-calcareous, clear, wavy lower boundary, 9-17 cm thick
BA	35-48	Brown (10YR4/3 m, 10YR5/3d) sandy clay loam, slightly hard, moderate, strong very fine subangular blocky structure, 10 to 15% subrounded gravels with some cobbles and stones, non-calcareous, diffuse, wavy lower boundary, 11-23 cm thick
Bt	48-123	Dark brown (10YR3/3m), brown (10YR4/3d) sandy clay loam, hard, strong medium blocky grading into strong coarse blocky structure with depth, good clay skins, ped surfaces darker than the matrix (up to 10YR3/2), 10 to 15% subrounded gravels with some cobbles and stones, abundant fine to very fine exped roots, non-calcareous, diffuse wavy lower boundary, 55-83 cm thick
BCk	123-141	Dark olive brown (2.5Y3/3m), light yellowish brown (2.5Y6/3d) sandy clay loam, hard, prismatic to coarse blocky structure, 10 to 15% subrounded gravels with some cobbles and stones, strongly calcareous, diffuse lower boundary, cleavage planes in the till material, 14 to 20 cm thick
Ckgj	141-150	Dark olive brown (2.5Y3/3m), light yellowish brown (2.5Y6/3d) sandy clay loam, slightly hard, massive, 10 to 15% subrounded gravels with some cobbles and stones, common, fine to medium, faint to distinct mottles, strongly calcareous, white streaks of free carbonates visible in the matrix

Table 2 Laboratory analyses of Uncas Soil Series (HC1)

Horizon	Depth (cm)	pH H_2O	C Total (%)	N Total (%)	Base Sat. (%)	Exchangeable Cations (meq/100 g)				
						Total	Ca	Mg	Na	K
LFH	1-0	7.4	31.61							
Ah	0-10	7.5	4.39	0.29	110	31	23.0	6.2	<0.2	1.86
Ahe	10-20	7.4	2.54	0.17	100	17	12.8	3.4	<0.2	0.64
Ae	20-35	7.9	0.49	0.05	93	7	5.5	1.8	<0.2	0.17
BA	35-48	7.6	0.65	0.09	100	19	13.0	5.8	<0.2	0.39
Bt	48-123	7.5	0.69	0.07	120	22	15.4	6.6	<0.2	0.35
BCk	123-141	7.8								
Ckgj	141-150	8.2								

Horizon	Depth (cm)	$CaCO_3$ Equiv. (%)	Particle Size Distribution (% <2 mm fraction)			Textural Class
			Sand	Silt	Clay	
LFH	1-0					
Ah	0-10		48	36	16	Loam
Ahe	10-20		49	35	16	Loam
Ae	20-35		55	30	15	Sandy Loam
BA	35-48		40	28	32	Clay Loam
Bt	48-123		43	25	32	Clay Loam
BCk	123-141	3.96	44	26	30	Clay Loam
Ckgj	141-150	3.74	46	28	26	Sandy Clay Loam

5 STOP 2: BRUDERHEIM DUNES

5.1 Location

The site is situated 37 km northeast of the City of Edmonton and 7 km north of the town of Bruderheim at 53°52' N Lat. and 112°58' W Long. Located 2 km south of the North Saskatchewan River, the site showcases an eolian dune field with transverse, barchan and parabolic dunes formed during the deglaciation of the Wisconsin Glaciation, about 12,000 ^{14}C (radiocarbon dated) years ago (Dalton et al. 2020). The soil complex in this dune field consists of sandy Brunisols on rapidly drained dunes and Organic soils in very poorly drained depressions. Brunisols are dominated by the Primula Soil Series (Eluviated Eutric Brunisol). Depressions are occupied by a variety of Organic soils with some Gleysols in transitional areas (Government of Alberta 2022c). Previously, this soil complex was mapped as Orthic Regosols on eolian sands with Organic soils in depressions (Bowser et al. 1962). Brunisols of the Primula Soil Series and a Mesisol of the Manatokan Soil Series will be examined during the Tour.

Morphological description and results of laboratory analyses of the Primula and Manatokan soils are presented in Tables 3, 4 and 5 below.

5.2 Land Use

Agricultural Land Capability of the land is very low. Uplands have extremely severe limitations for sustained crop production due to very coarse soil textures and the steep slopes typical of the dunes in this area. Depressions are not suitable for crop production due to excess water (Figure 4).

The land in this region provides valuable natural resources. Sand and gravel exploration along the North Saskatchewan River expands into this dune field. Walls of a small borrow pit will be examined at the Tour stop (Figure 3). A larger, partially reclaimed borrow pit can be seen on the map immediately north of the Tour stop. Another valuable resource in the area is water from the nearby North Saskatchewan River. The water is used by industrial facilities, such as upgraders and refineries. The Shell Scotford upgrader and the NWR Sturgeon refinery are situated west of the site on land with very limited agricultural potential. Oil and gas wells are scattered across the dune field.

The area includes dunes that are prone to wind erosion and wetlands that provide valuable wildlife habitat. Land conservation activities include the creation of multiple Natural Areas (North Bruderheim NA, Astotin Creek NA, etc.) and the promotion of environment-friendly activities (hiking, biking, equestrian, etc.). An example of the latter is the Shiloh Youth Ranch, which is hosting the Tour at this site (www.shilohhope.com/summer-camp). Recreational activities in the area also include the use of ATVs, which have resulted in significant damage to parts of the landscape.

Figure 3 Primula Soil Series profile (BD1)

Figure 4 Graminoid fen (BD2)

5.3 Field Description

BD1 (Upland Soil Pit)

- Soil Classification: Eluviated Eutric Brunisol, Primula Soil Series (PRM)
- Elevation: 634 masl
- Location: UTM E370255, N5970003, Zone 12U, Datum WGS84
  SE Sec 30 Twp 56 Range 20 W4M

BD2 (Wetland Soil Pit)

- Soil Classification: Terric Humic Mesisol, Manatokan Soil Series (MNT)
- Elevation: 629 masl
- Location: UTM E370315, N5970032, Zone 12U, Datum WGS84
  SE Sec 30 Twp 56 Range 20 W4M

Climate and Ecosite

- The site is situated in the Dry Mixedwood Natural Subregion representing a grassland-boreal transition. The average frost-free period in this area is 100 days and the average annual precipitation is 460 mm (Natural Regions Committee 2006; refer to Appendix C for climate information).
- This locality is situated within SCA 10 of Alberta known as the Thick Black/Dark Gray-Gray Soil Zone of Central and East-Central Alberta. SCA 10 is characterized by a mix of thick Black Chernozems under grasslands and Dark Gray Chernozems and Gray Luvisols under aspen forests. Depressions are typically occupied by Gleysols with inclusions of Organic Soils. Brunisols that are dominant in the Bruderheim Dune Field comprise a minor proportion of SCA 10 because of the limited extend of eolian sands within this large SCA (Alberta Soil Information Centre 2016; Government of Alberta 2022c).
- Agricultural suitability subclass 6MT for upland soils indicates extremely severe limitations for sustained production of small-grain crops due to coarse soil textures and the steep topography of the dunes. Annual cultivation is not recommended even on an occasional basis. Wetlands, which occupy approximately 50 percent of the area, are class 7W land and are not suitable for agriculture due to excess water (Agronomic Interpretations Working Group 1995; Alberta Soil Information Centre 2016).

Vegetation

The Dry Mixedwood Natural Subregion is characterized by aspen forests and cultivated landscapes, with fens commonly occurring in low-lying areas. Vegetation at the Bruderheim dunes field is a complex of jack pine and mixedwood forests on uplands and graminoid fens in depressions.

The area was affected by the Bruderheim forest fire in May 2009. That fire burned over 2,800 ha of forests in the dune field. Some burned trees are still visible at the site. Vegetation at the BD1 soil pit is mostly graminoid with small jack pine stands. Shrubs are predominantly bearberry (*Arctostaphylos uva-ursi*) with some bog cranberry (*Vaccinium vitis-idaea*) and prickly rose. The wetland site (BD2) is a graminoid fen dominated by marsh reed grass (*Calamagrostis canadensis*), northern reed grass (*C. inexpansa*) and sedges (*Carex* sp.), with a low percent shrub cover dominated by willows (Figure 3). The transitional zone to the upland community is dominantly forested by white birch, willow, and balsam poplar. Trembling aspen and white spruce make a smaller contribution to the vegetation in the transitional zone.

Parent Materials

Very coarse-textured eolian deposits dominated by fine to medium sand (Alberta Soil Information Centre 2016). Depressions in this ridged landscape feature organic fen peat over eolian sands.

Landform

Transverse dunes form ridges with slope class 6 (15-30%) topography; depressions between ridges have organic bowl topography with slope class 1 to 2 (0-2%) (Figure A-7 in Appendix A). The upland site is located on an upper slope of a transverse dune with an east aspect.

Drainage

Rapidly drained soils occur in upper and mid-slope positions; very poorly drained soils occupy depressions between ridges. The landscape has a very abrupt transition from rapidly drained to very poorly drained soil.

Table 3 Morphological description of Primula Soil Series (BD1)

Horizon Depth (cm)	Depth (cm)	Description
LF	1-0	Discontinuous layer of weakly decomposed foliage
Ah	0-4	Very dark brown (10YR2/3m) to dark brown (10YR3/3d) moist very friable loamy sand, weak medium granular structure, abundant fine and very fine random roots, no coarse fragments, non-calcareous, no mottles, wavy boundary, 2 to 7 cm thick.
Aej	4-19	Brown (10YR4/3m) to pale brown (10YR6/3d) dry loose loamy sand, single grain, few fine and medium random roots, wavy boundary, 17 to 23 cm thick
Bm	19-65	Dark yellowish brown (10YR3/4m) to yellowish brown (10YR5/4d) dry slightly hard loamy sand, weak medium subangular blocky structure, few medium vertical roots, no coarse fragments, non-calcareous, no mottles, gradual boundary 45 to 60 cm thick.
BC	65-92	Dark yellowish brown (10YR4/4m) to yellowish brown (10YR5/4d) dry loose loamy sand, single grain, few medium vertical roots, no coarse fragments, non-calcareous, no mottles, wavy boundary 10 to 20 cm thick.
Ck	92-120	Brown (10YR4/3m) to pale brown (10YR6/3d) dry slightly hard medium sand, single grain, very few medium vertical roots, weak effervescence, diffuse segregations of secondary carbonates, no coarse fragments, no mottles

Table 4 Morphological description of Manatokan Soil Series (BD2)

Horizon Depth (cm)	Depth (cm)	Description
Om	0-45	Moderately to strongly decomposed sedge peat, very dark brown (7.5YR2.5/2), von Post decomposition class increases from 5 at the top to 6 at the bottom of the horizon, plentiful fine random roots, non-calcareous, gradual boundary, 40 to 50 cm thick
Oh	45-78	Strongly to almost completely decomposed sedges peat, very dark brown (10YR2/2m), von Post decomposition class increases from 7 at the top to 9 at the bottom of the horizon, non-calcareous, mixed with mineral material at the bottom, 35 to 40 cm thick
Cg	78-120	Dark gray (2.5Y4/1m) wet non-sticky loamy sand, single grain, no roots, no coarse fragments, non-calcareous, no mottles, thin layer of loamy material at the top.

Table 5 Laboratory analyses of Primula Soil Series (BD1)

Horizon	pH		C Total (%)	$CaCO_3$ Equiv. (%)	N Total (%)	C/N	Base Sat. (%)	Exchangeable Cations (meq/100 g)			
	H_2O	$CaCl_2$						Ca	Mg	Na	K
Ah	6.2		1.52	<0.20	0.08	19	62	3.3	0.7	<0.2	0.24
Aej	6.5		0.30	<0.20	<0.02			0.9	0.4	<0.2	0.32
Bm	5.9	5.8	0.12	<0.20	<0.02		84	3.3	1.0	<0.2	0.58
BC	7.2	7.3		<0.20							
Ck	8.4	7.0		5.55							

Horizon	EC (dS/m)	SAR	Available Nutrients (ppm)				Particle Size Distribution (% <2 mm fraction)			Textural Class
			$N\text{-}NO_3$	P	K	S-Sulfate	Sand	Silt	Clay	
Ah			5	54	92	6	86	6	8	Loamy Sand
Aej			<2	46	117	8	84	10	6	Loamy Sand
Bm	0.56	0.2	2	21	211	78	88	4	8	Loamy Sand
BC	0.29	0.1					88	4	8	Loamy Sand
Ck	0.31	0.2					90	2	8	Sand

6 STOP 3: ST. ALBERT RESEARCH STATION

6.1 Location

The site is situated 10 km north of Edmonton and 3 km north of St. Albert on St. Albert Research Station land (53°42'N Lat. and 113°38'W Long).

The area lies within the former basin of Glacial Lake Edmonton, which drained from the region about 12,000 ^{14}C (radiocarbon dated) years ago (Dalton et al. 2020). This event was followed by a potential readvance of a lobe of Laurentide ice across glaciolacustrine sediments in this area. A range of landforms, including a number of eskers, was formed during this readvance (Utting and Atkinson 2019). The Tour will examine Chernozemic soils developed on a glaciolacustrine plain (SARS1 site, Figure 6) and on an esker composed of loamy glaciofluvial sediments (SARS2 site). This esker is a northeast-southwest oriented ridge that follows a meandering pattern of the former meltwater channel (Figure A-8 in Appendix A). The fine-textured glaciolacustrine sediments surrounding the esker are saline at depth and form a very gently undulating plain (Figure 5). The salts originate from marine shale underlying the Quaternary sediments.

Morphological description and results of laboratory analyses of the Ponoka and Malmo soils are presented in Tables 6, 7 and 8 below.

6.2 Land Use

Located just north of St. Albert, the St. Albert Research Station is an 800 acre (324 ha or 5 quarter sections) farm given to the University in 2008 as a gift from the Bocock family. The farm is primarily used for agronomic and environmental research. Funding from the Alberta Government has enabled the construction of new infrastructure on the site, including a field research center complete with a meeting space, machine shop and equipment storage (University of Alberta 2022).

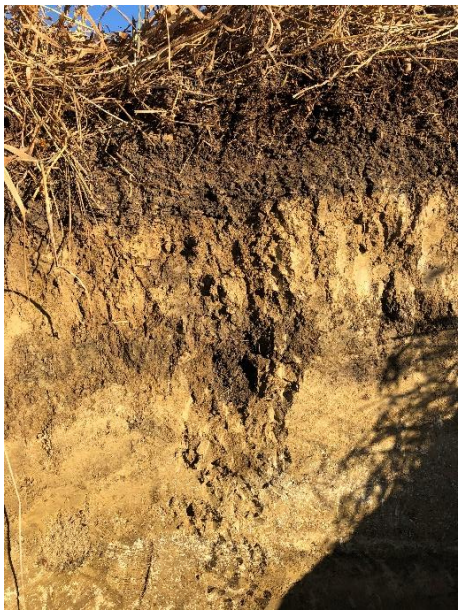
The City of St. Albert celebrates a rich history that dates back over 150 years and is often called Alberta's Finest City. Founded in 1861 by Father Albert Lacombe, St. Albert at the time was the oldest, non-fortified

community in Alberta and once was the largest agricultural settlement west of Winnipeg. Today, St. Albert is a bustling city with over 66,000 residents (City of St. Albert 2022).

Both, SARS1 and SARS2 soil pits are located in cultivated farm fields outside of established research plots.

Figure 5 Gently undulating glaciolacustrine landscape (SARS2)

Figure 6 Ponoka Soil Series profile (SARS1)



6.3 Field Description

SARS1 (Upland Soil Pit on an Esker)

- Soil Classification: Eluviated Black Chernozem, Ponoka Soil Series (POK), cultivated variant
- Elevation: 691 masl
- Location: UTM E326138, N5953142, Zone 12U, Datum WGS84
  NW Sec 28, Twp 54, Range 25, W4M

SARS2 (Upland Soil Pit on Lacustrine Plain)

- Soil Classification: Eluviated Black Chernozem, Malmo Soil Series (MMO), cultivated variant with saline subsoil
- Elevation: 687 masl
- Location: UTM E326304, N5952965, Zone 12U, Datum WGS84
  NW Sec 28, Twp 54, Range 25, W4M

Climate and Ecosite

- Central Parkland Natural Subregion of grassland-boreal transition. The average frost-free period in this area is 102 days and the average annual precipitation is 441 mm (Natural Regions Committee 2006; refer to Appendix C for climate information).
- This locality is situated within SCA 10, known as the Thick Black/Dark Gray-Gray Soil Zone of Central and East-Central Alberta. SCA 10 is characterized by a mix of thick Black Chernozems

under grasslands and Dark Gray Chernozems and Gray Luvisols under native aspen forests. Gleysols and a small proportion of Organic soils occupy depressional areas (Alberta Soil Information Centre 2016; Government of Alberta 2022c).

- Agricultural suitability is subclass 2H for upland soils on the glaciolacustrine plain. Subclass 2H includes land with slight limitations that may restrict the growth of small-grain crops due to insufficient growing degree days. Soils in depressions, that occupy approximately 20 percent of the area, are deemed class 5W soils with very severe limitations due to excess water (Agronomic Interpretations Working Group 1995; Alberta Soil Information Centre 2016). Soils on the esker would have moderate limitations for growth of small-grain crops due to the steepness of slopes and the landscape pattern (subclass 3HT).

Table 6 Morphological description of Ponoka Soil Series, cultivated variant (SARS1)

Horizon	Depth (cm)	Description
Ap	0-18	Very dark brown (10YR2/2m, 10YR4/2d) dry slightly hard loam to silt loam, weak medium subangular blocky macrostructure breaking into moderate to strong granular mesostructure, <1% fine to medium sub-round gravel, few random medium roots, plentiful random fine roots, non-calcareous, abrupt slightly wavy boundary, 18 to 20 cm thick
Bt	18-43	Dark brown (10YR3/3m, 10YR5/3d) moist firm silty clay loam, weak to medium prismatic macrostructure breaking into moderate medium subangular blocky mesostructure, 1% fine to medium subrounded gravel, few fine vertical roots, dark brown (10YR3/3m, 10YR3/4d) clay films on many ped surfaces, non-calcareous, distinct wavy boundary, 23 to 27 cm thick
BCsk	43-55	Dark olive brown (2.5Y3/3m, 2.5Y6/3d) moist firm clay loam, weak medium prismatic macrostructure breaking into weak medium subangular blocky mesostructure, 1% fine subrounded gravel, few fine vertical roots, some of the roots are exped, weakly expressed olive brown (2.5Y4/3m, 2.5Y5/3d) clay films on some ped surfaces, strong effervescence, abrupt wavy boundary, 10 to 17 cm thick
Csk1	55-72	Light olive brown (2.5Y5/3m, 2.5Y6/3d) moist firm silt loam, massive, 2% medium subrounded gravel, few very fine vertical roots, very strong effervescence, distinct very wavy boundary, 17 to 33 cm thick
Csk2	72-110	Olive brown (2.5Y4/3m, 2.5Y6/3d) moist firm silt loam, 2% medium subrounded gravel, very few very fine random roots, strong effervescence, distinct slightly wavy boundary, 17 to 40 cm thick
Csk3	110-140	Olive brown (2.5Y4/4m, 2.5Y6/4d) moist firm silt loam to clay loam, 5% coarse subrounded gravel, very few very fine random roots, strong effervescence

Vegetation

Estimates vary, but current information suggests that only about five percent of the Central Parkland Natural Subregion remains in native vegetation. The area has been intensively cultivated for over a century, and the few remaining contiguous areas of parkland vegetation occur on sites that are unsuitable for agriculture because of topography or soil constraints. Trembling aspen is abundant in the natural stands, with balsam poplar and some white birch occurring on moist lowlands. Plains rough fescue grasslands and meadow areas were interspersed with aspen in the original forest (Natural Regions Committee 2006).

Table 7 Morphological description of Malmo Soil Series, cultivated variant, saline subsoil (SARS2)

Horizon	Depth (cm)	Description
Ap	0-18	Black (10YR2/1m) moist friable clay loam, moderate medium granular structure, no coarse fragments, non-calcareous, few fine random roots, abrupt slightly wavy boundary, 18 to 20 cm thick
Bt	18-37	Dark olive brown (2.5Y3/3m) moist firm silty clay, weak medium subangular blocky structure, no coarse fragments, non-calcareous, no roots, distinct slightly wavy boundary
Ck	37-65	Very dark grayish brown (10YR3/2m) wet sticky silty clay, massive, strong effervescence, white diffuse segregations of secondary carbonates, no coarse fragments, no roots, distinct slightly wavy boundary
Cskgj	65-100	Very dark grayish brown (2.5Y3/2m) wet sticky silty clay, massive, moderate effervescence, white segregations of salt crystals, many medium distinct gley mottles, no coarse fragments, no roots

Parent Materials

The SARS1 soil pit is located on a glaciofluvial esker composed of loamy sediments with minor amounts of coarse fragments. Fine stratification can be observed in the Ck horizon of the soil. The glaciolacustrine plain surrounding the esker is formed on saline fine-textured sediments of Glacial Lake Edmonton (SARS2 soil pit). The glaciolacustrine parent material is stone-free, and surface stones are absent.

Landform

The meandering esker (SARS1 site) extends in a northeast-southwest across the area (Figure A-8 in Appendix A). The ridge features slope class 5 (10-15%). The landform at the SARS2 site is classified as undulating with a low relief topography (slope class 2) and a limiting slope of two percent. Slope length ranges from 30 to 100 m (Soil Classification Working Group 1998; Government of Alberta 2022c). A series of arcuate, ice marginal moraines and associated landforms are found about 2 km north of the Tour stop, marking the limits of the former extent of the former Glacial Lake Edmonton. The Chernozemic SARS1 soil pit occurs on an upper slope position with a seven percent slope and a northwestern exposure. The SARS2 site is located in a low slope position on a one percent slope of southeastern exposure.

Drainage

Chernozemic soils found on the esker slopes are well drained (SARS1 site). Chernozemic soils on the glaciolacustrine plain are moderately-well to imperfectly drained due to the fine texture of the parent material (SARS2 site). Soils in depressions are occupied by poorly drained soils.

Table 8 Laboratory analyses of Ponoka Soil Series, cultivated variant (SARS1)

Horizon	pH		C Total (%)	N Total (%)	$CaCO_3$ Equiv. (%)	Base Sat. (%)	CEC	Exchangeable Cations (meq/100 g)			
	H_2O	$CaCl_2$						Ca	Mg	Na	K
Ap	6.0	6.2	6.2	0.64	0.33	96	37	25.1	6.7	<0.2	3.18
Bt	8.0	7.5	1.25	0.12	<0.20	99	24	19.4	6.7	<0.2	2.64
BCsk	7.7	7.7			3.64						
Csk1	6.4	7.9			3.96						
Csk2	7.3	8.1			2.30						
Csk3	7.7	7.7			4.08						

Horizon	EC (dS/m)	SAR	Soluble Cations (mg/kg)				Soluble Anions (mg/kg)		Available Nutrients (ppm)				Particle Size Distribution (% <2 mm fraction)		
			Ca	Mg	Na	K	Cl	SO_4	N	P	K	S	Sand	Silt	Clay
Ap	1.36	<0.1	103	29.3	3	76	14	100	80	100	1090	42	28	46	26
Bt	0.98	0.2	62.3	18.1	5	47	26	108	9	46	960	57	17	47	36
BCk	4.03	1.0	409	162	72	44	117	1320					25	45	30
Cca	6.21	2.0	412	256	151	9	283	1330					27	71	2
Ck1	7.05	2.2	491	366	213	<6	352	1560					20	56	24
Ck2	8.36	1.4	581	413	139	6	399	1250					23	51	26

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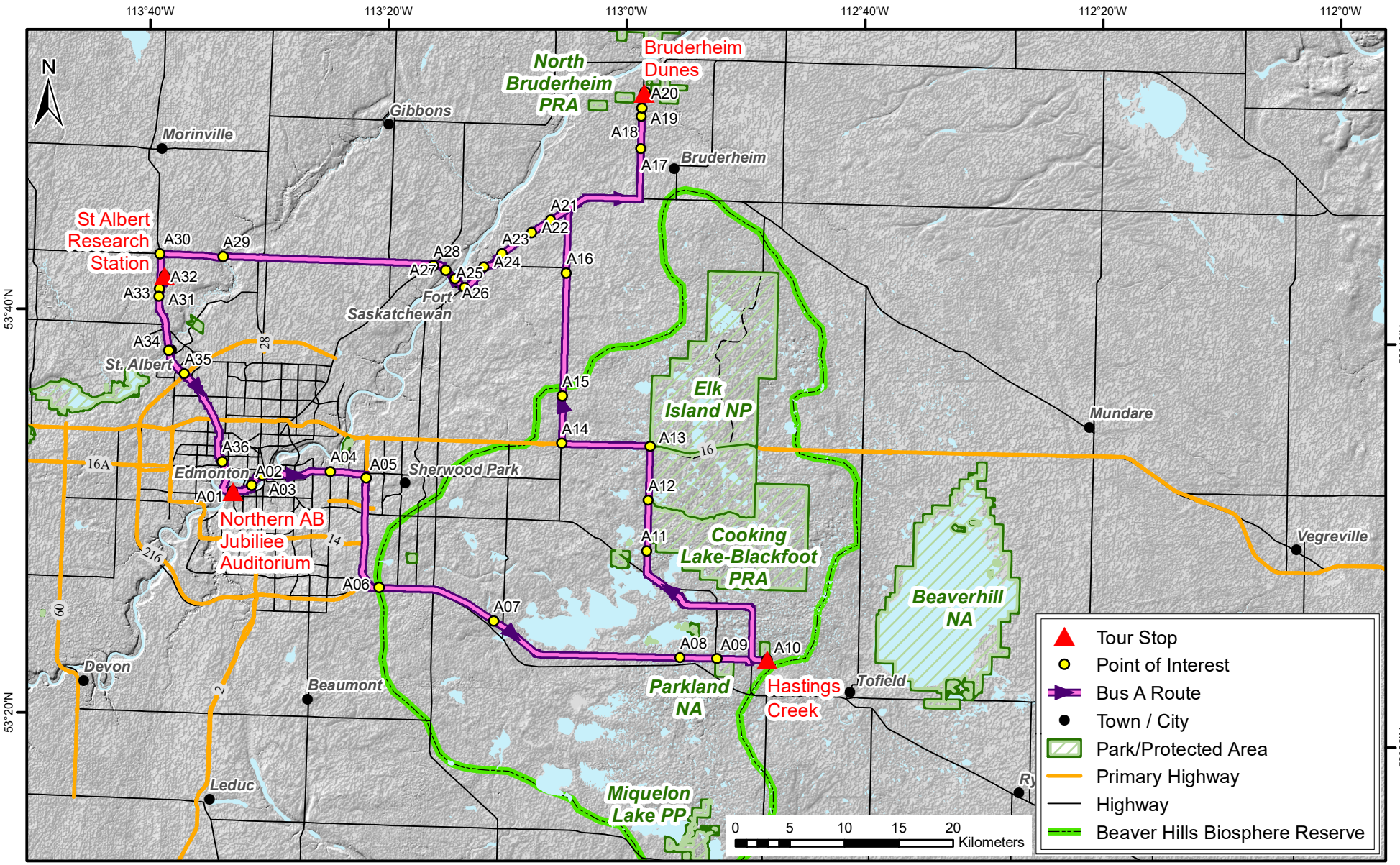
Appendix A Tour Maps

- Figure A-1. Mid-Conference Tour Overview
- Figure A-2. Mid-Conference Tour Natural Subregions
- Figure A-3. Mid-Conference Tour Bedrock Geology
- Figure A-4. Mid-Conference Tour Surficial Geology
- Figure A-5. Mid-Conference Tour Land Systems
- Figure A-6. Hastings Creek Site Topography
- Figure A-7. Bruderheim Dunes Site Topography
- Figure A-8. St. Albert Research Station Topography

NOTES



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Projection: UTM 12N NAD83

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Figure A-1: Mid-Conference Tour Overview

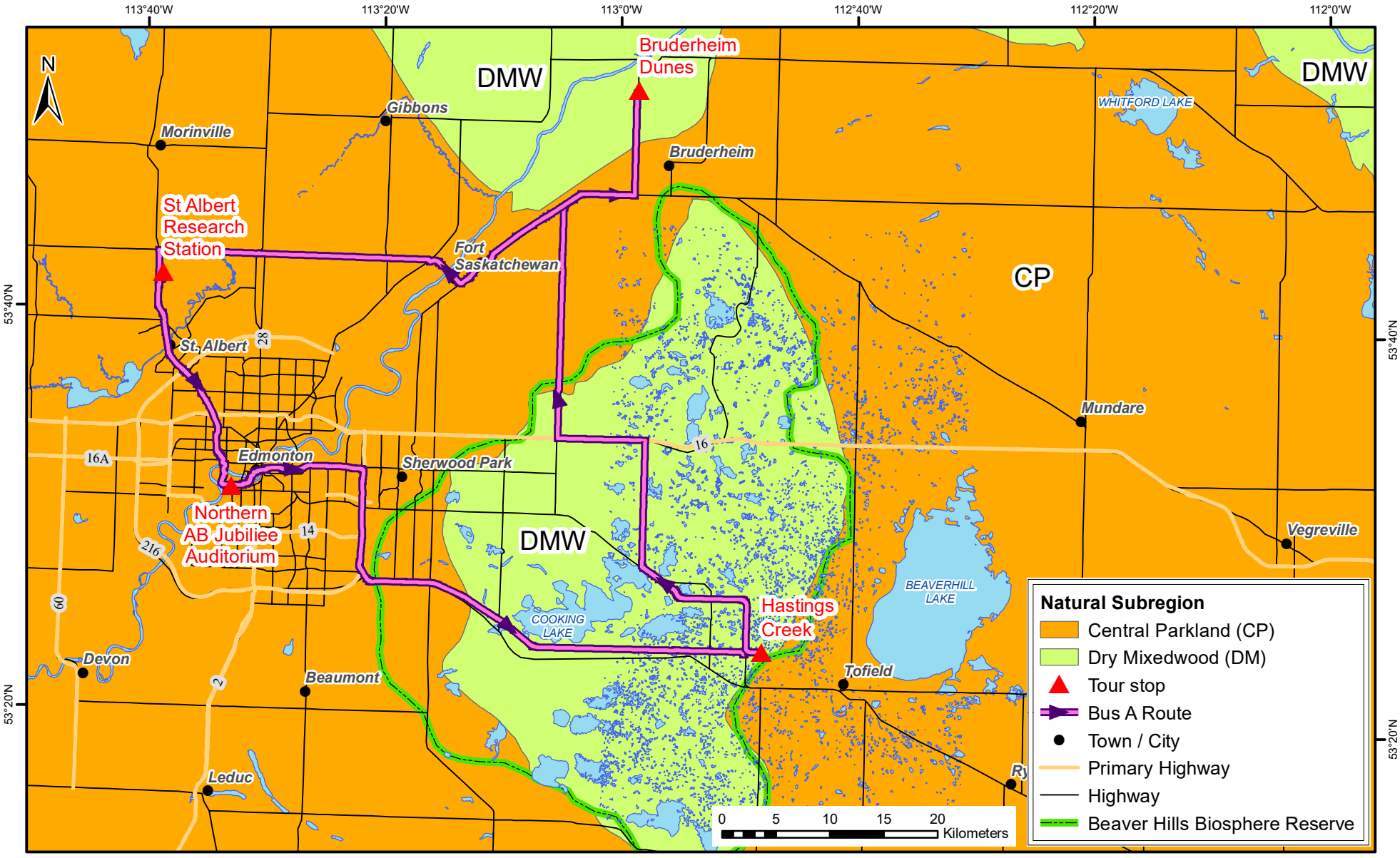

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Figure A-2: Mid-Conference Tour Natural Subregions

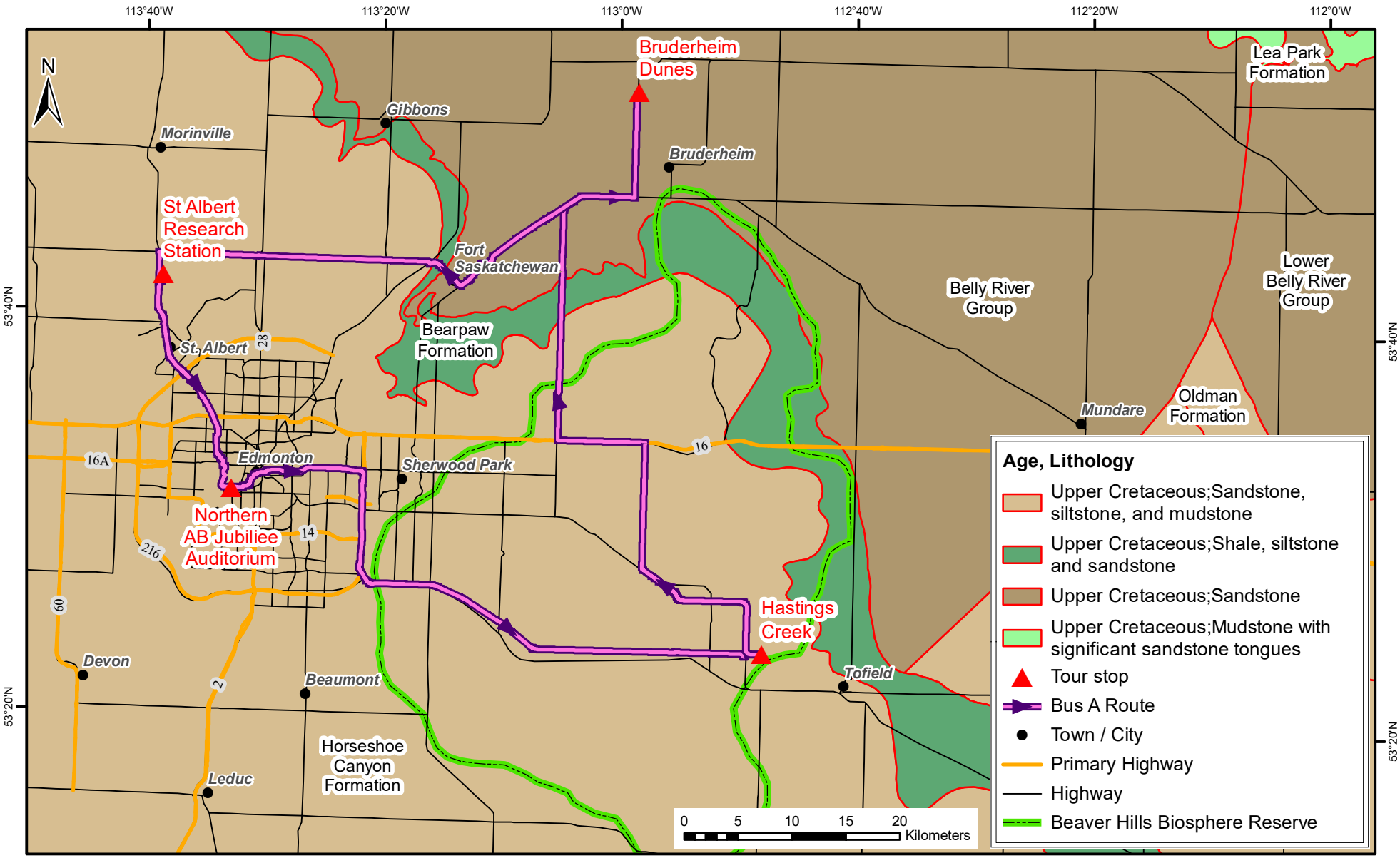

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Figure A-3: Mid-Conference Tour Bedrock Geology

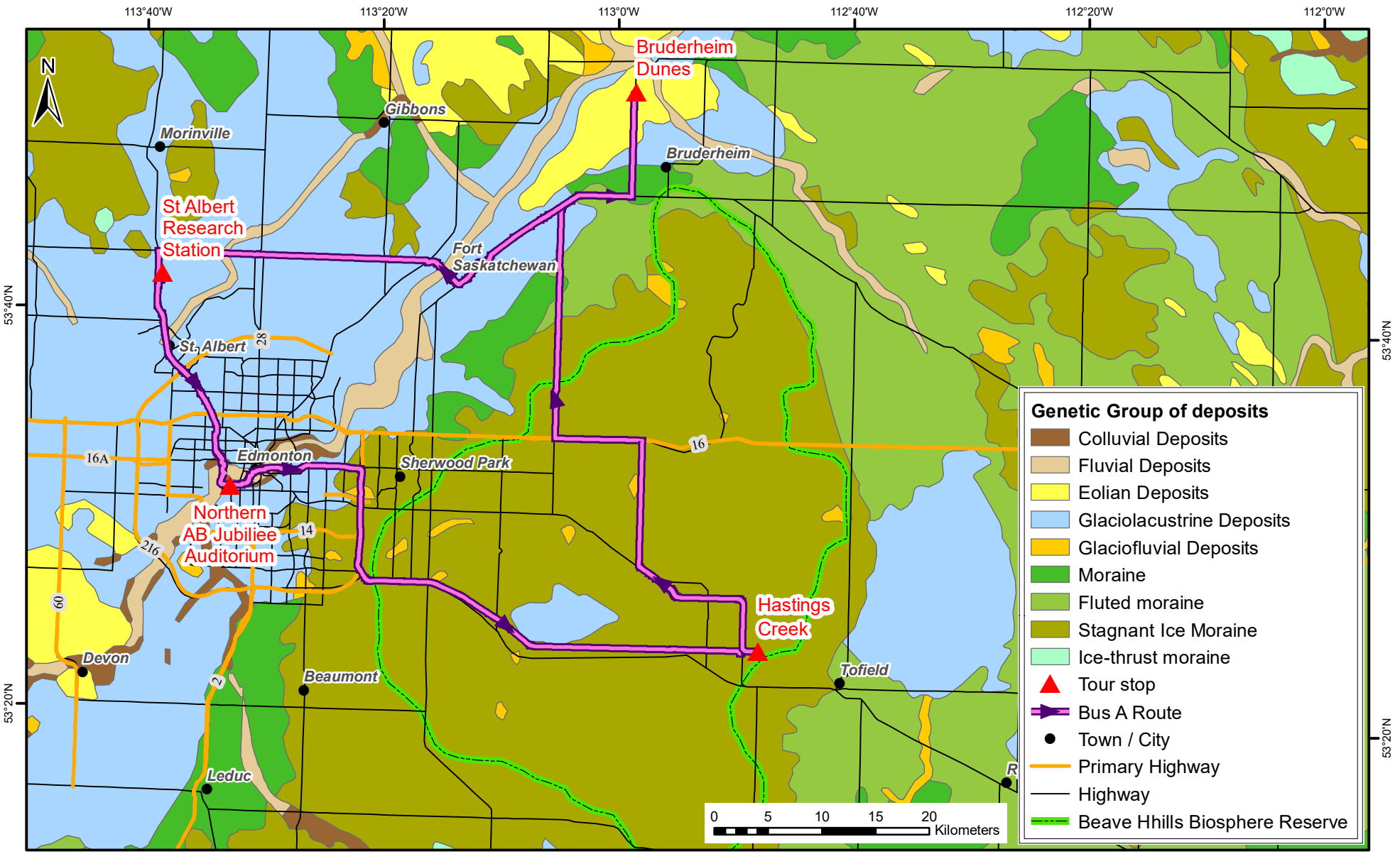

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Figure A-4: Mid-Conference Tour Surficial Geology

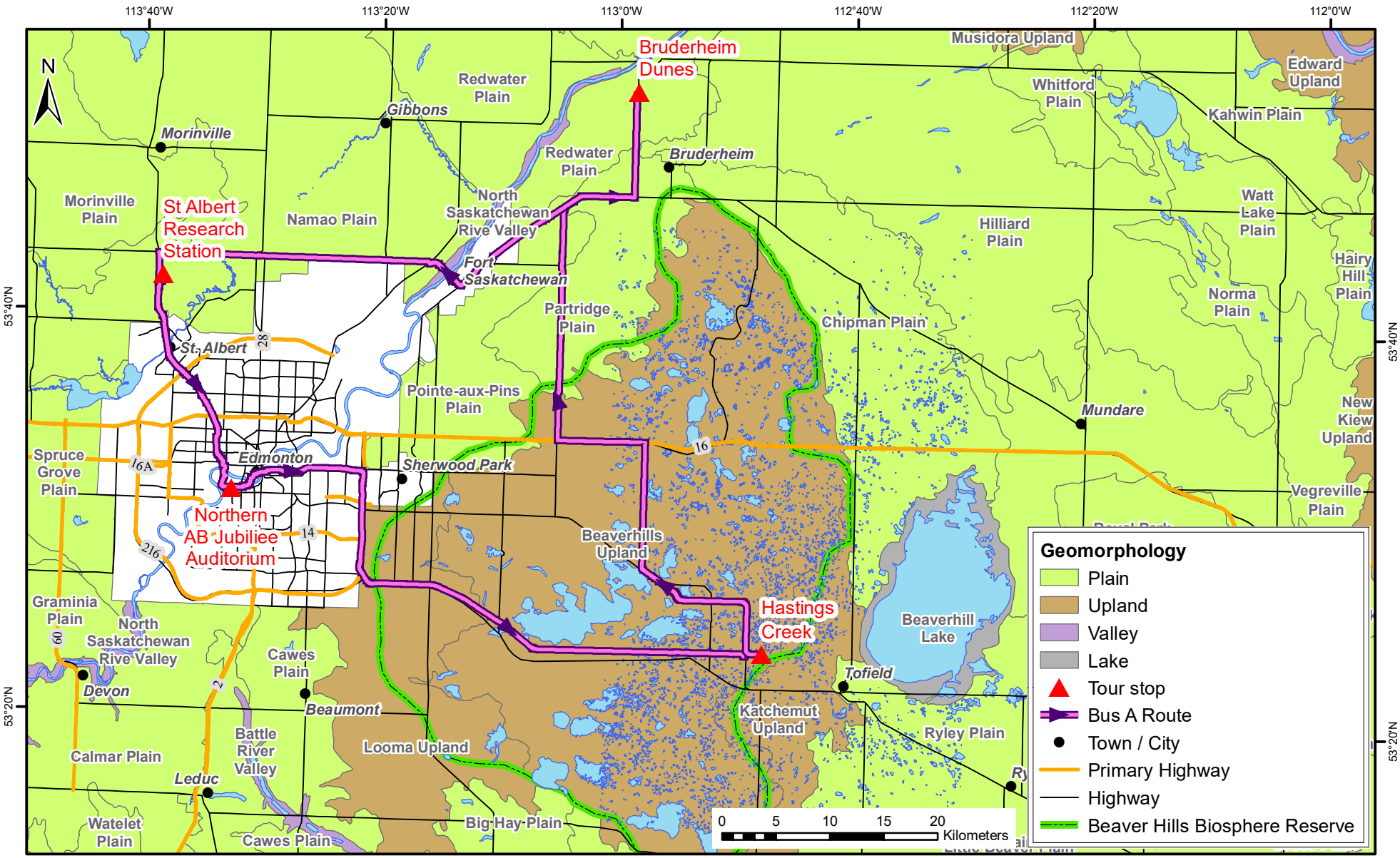

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Figure A-5: Mid-Conference Tour Land Systems

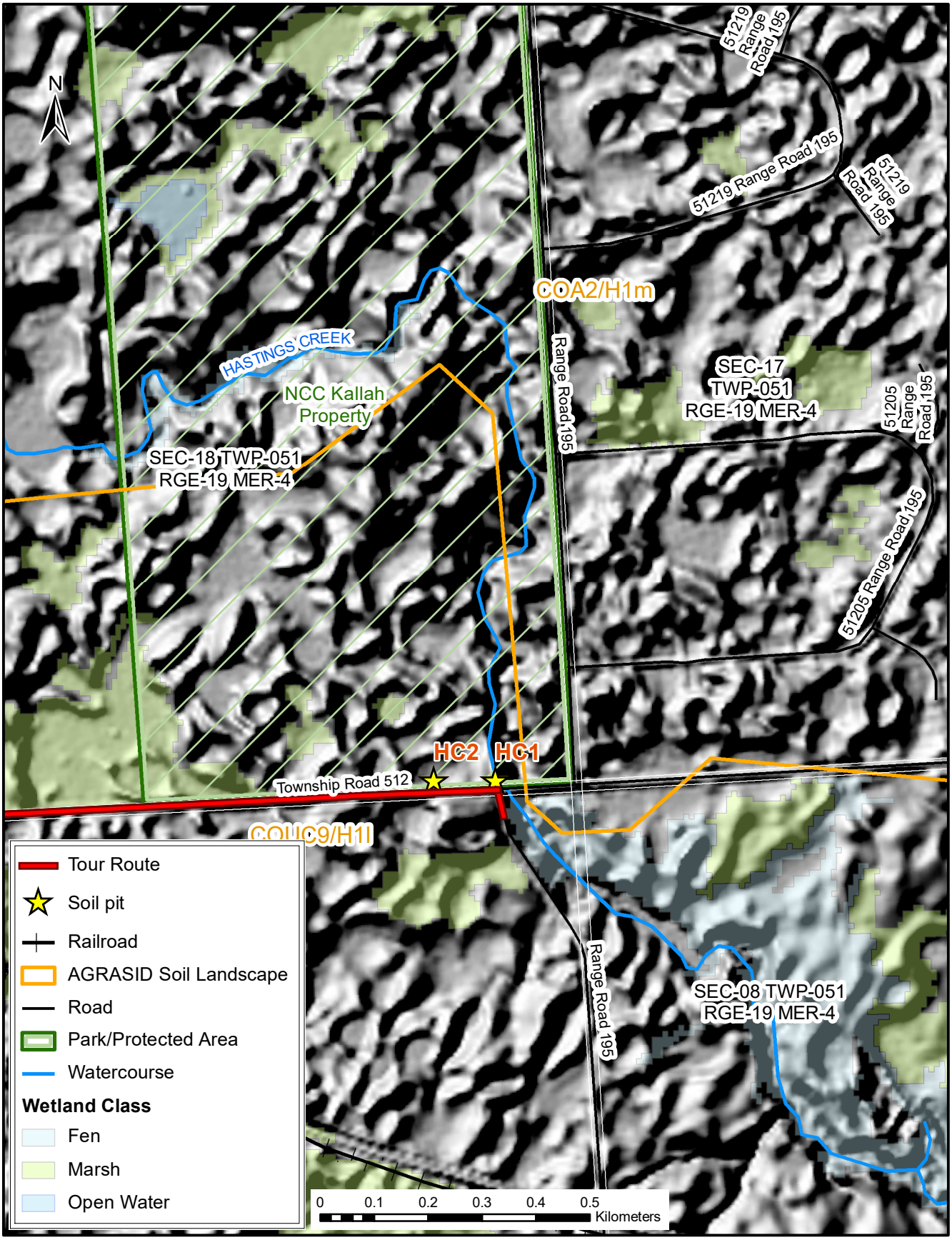

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Figure A-6: Mid-Conference Tour Hastings Creek Site

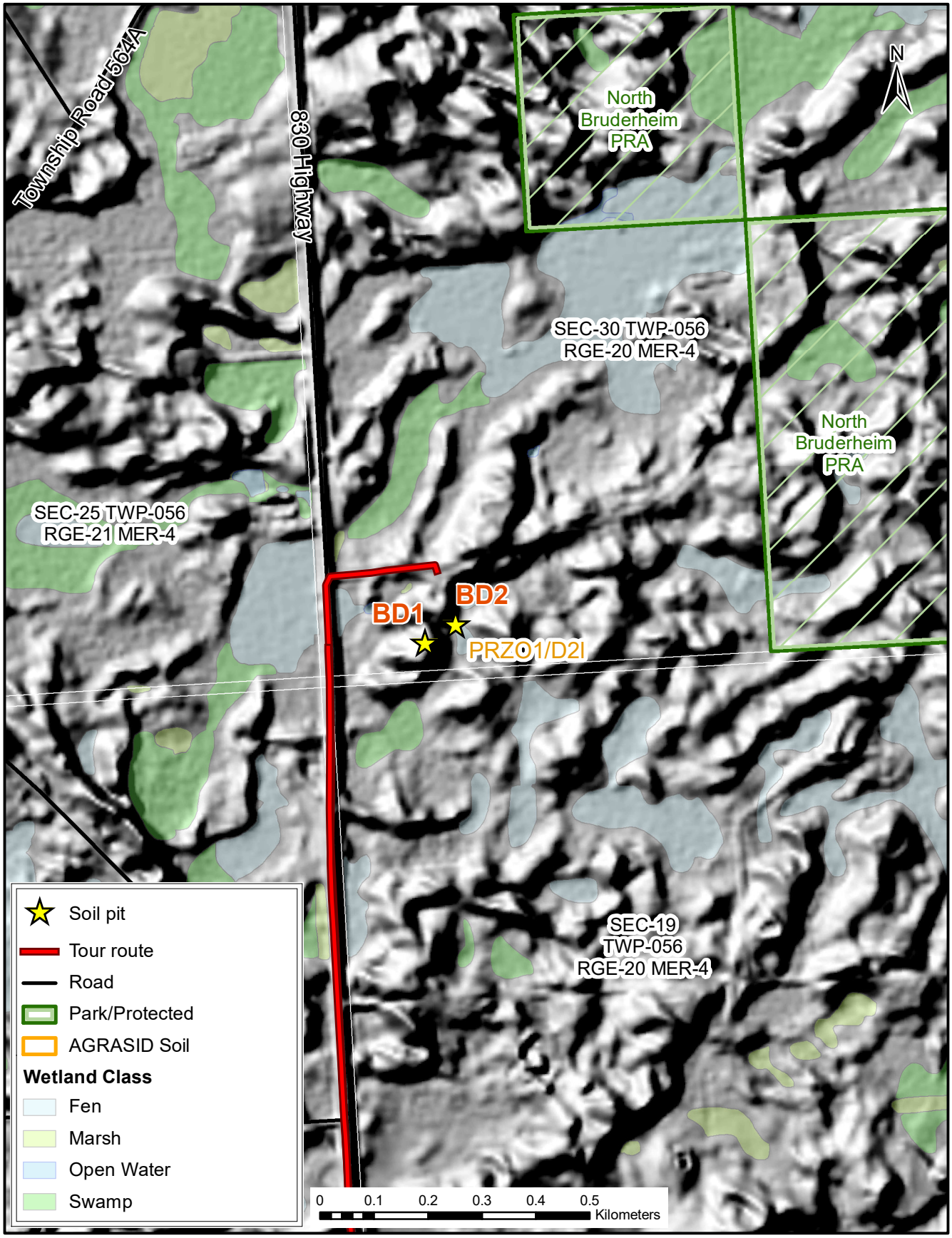

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Figure A-7: Mid-Conference Tour Bruderheim Dunes Site

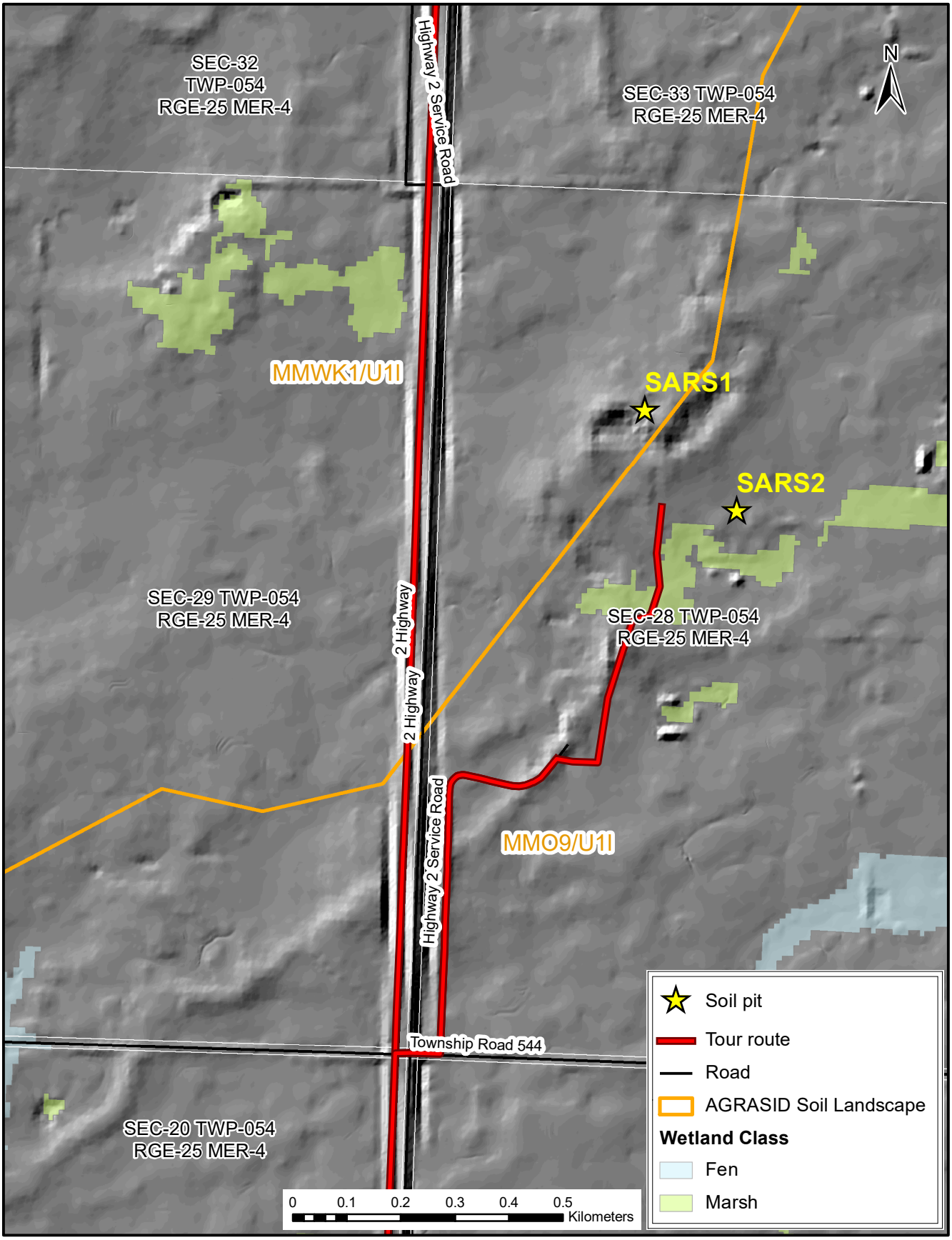

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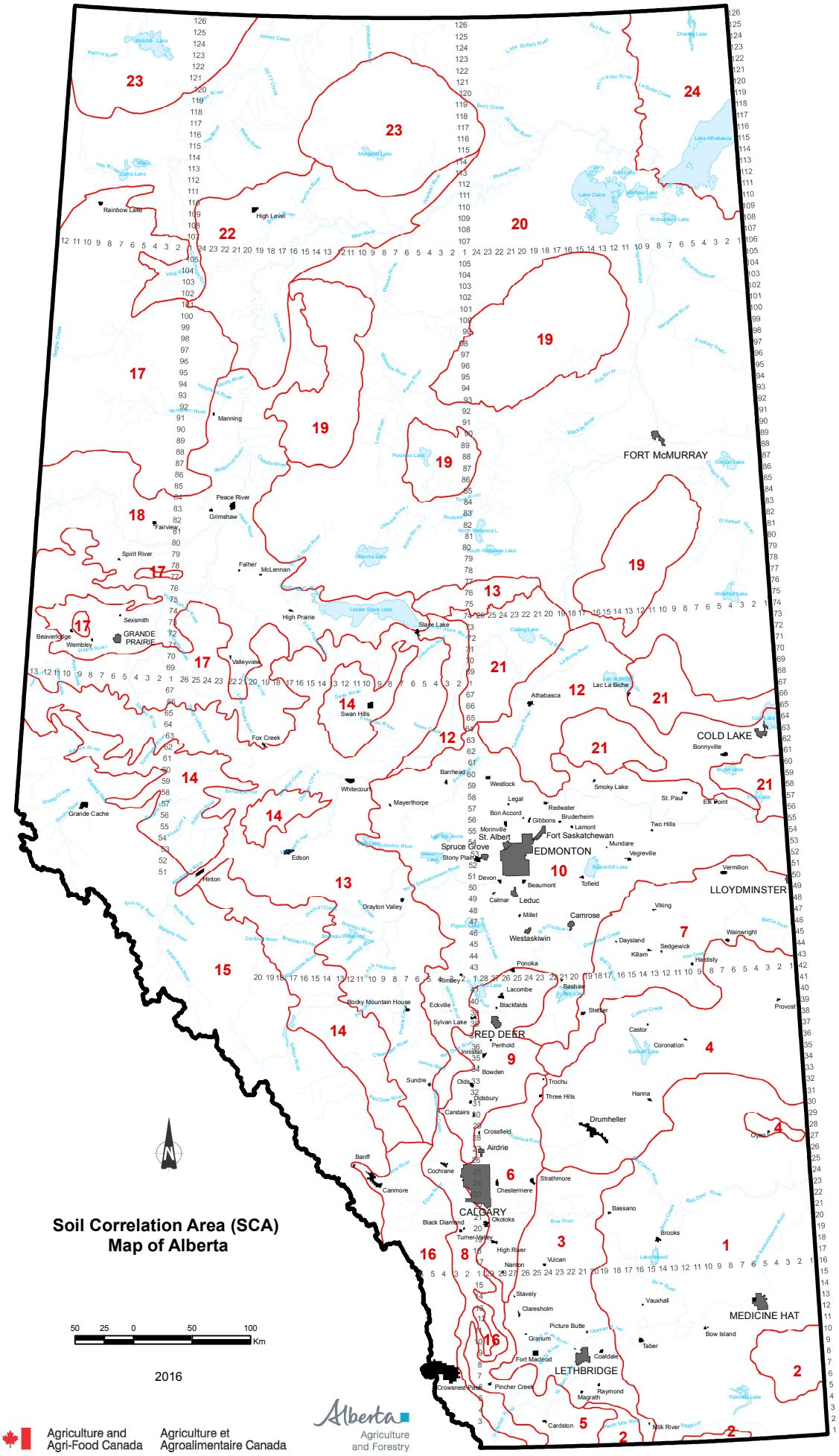
Figure A-8: Mid-Conference Tour St Albert Reseach Station

Appendix B Alberta Soil Correlation Areas

- Soil Correlation Area (SCA) Map of Alberta
- List of Soil Correlation Areas (SCA) of Alberta

NOTES



Soil Correlation Area (SCA) Map of Alberta

2016

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Alberta Agriculture and Forestry

List of Soil Correlation Areas (SCA) of Alberta

Soil Correlation Area number	Soil Correlation Area name	Agroclimate (agriculture suitability class and subclass)
SCA 1	Brown Soil Zone of South-Eastern Alberta	3A
SCA 2	Dark Brown Highlands of Southern Alberta	2AH, 2H
SCA 3	Dark Brown Soil Zone of South-Western Alberta	2A
SCA 4	Dark Brown Soil Zone of East-Central Alberta	2AH
SCA 5	Thin Black Soil Zone of South-Western Alberta	2AH, 3H
SCA 6	Thin Black Soil Zone of South-Central Alberta	2AH, 3H
SCA 7	Thin Black Soil Zone of East-Central Alberta	2H
SCA 8	Thick Black Soil Zone of South-Western Alberta	4H
SCA 9	Thick Black Soil Zone of Southwest-Central Alberta	3H
SCA 10	Thick Black/Dark Gray-Gray Soil Zone of Central and East-Central Alberta	2H, 3H
SCA 12	Dark Gray-Gray Soil Zone of Northeast-Central Alberta	3H
SCA 13	The Lower Foothill Area of West-Central Alberta	4H
SCA 14	The Upper Foothill Area of West-Central Alberta	5H
SCA 15	The Montane, Subalpine and Alpine Areas of West-Central Alberta	6H, 7H
SCA 16	The Montane and Subalpine Areas of South-Western Alberta	6H, 7H
SCA 17	The Central Mixedwood and Lower Foothill Areas of North-Western Alberta	4H, 5H
SCA 18	Dark Gray and Black Soil Zone of the South Peace Area	2H, 3H
SCA 19	The Boreal Highland Areas of Northern Alberta	5H
SCA 20	The Central Mixedwood Area of Central and Northern Alberta	4H
SCA 21	The Central Mixedwood Area of East-Central Alberta	4H
SCA 22	Gray and Dark Gray Soil Zone of the North Peace Area	3H, 4H
SCA 23	The Sub-Arctic Areas of Northern Alberta	6H, 7H
SCA 24	Canadian Shield	6H

Note: the SCA 11, that existed in the original 1993 SCA map, was joined with the SCA 10 in 1996 as the distinction between the two SCA's was difficult to implement (Alberta Soil Information Centre 2016)

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As defined in the publication - Land Suitability Rating System for Agricultural Crops:1. Spring-seeded small grains (Agronomic Interpretations Working Group 1995).

Appendix C Overview of Natural Regions and Subregions on Tour route

- Introduction
- Parkland Natural Region: Central Parkland Natural Subregion
- Boreal Forest Natural Region: Dry Mixedwood Natural Subregion

INTRODUCTION

This discussion is abstracted from the publication *Natural Regions and Subregions of Alberta* (Natural Regions Committee 2006).

The Province of Alberta includes some of the most diverse terrain in North America. Mountains, foothills and plains temper regional climates, the intensity of solar radiation decreases markedly from the 49th to the 60th parallel, and regional landscapes transform solar and climatic influences to produce an intricate ecological complex. Plant communities and soil patterns provide, in part, the evidence for delineating the climatic and physiographic patterns which control vegetation and soil distribution. Both the plant communities and soils develop in response to *abiotic factors*, and *biotic factors*. The relative influence of each factor at any place in the landscape is determined by the interaction of atmospheric and landscape attributes – climate, topography, parent materials and biotic elements – all acting over time, as described by Major (1951) and Jenny (1941) for vegetation and soils, respectively. These attributes can be delineated and represented as abstract ecological map units and may be described at various scales.

In Alberta, *Natural Regions* and *Natural Subregions* constitute the broadest levels of ecologically-based landscape classification. They have supplied the provincial ecological context within which resource management activities have been planned and implemented since the 1970s.

Natural Regions are the largest mapped ecological units in Alberta's classification system. They are defined geographically based on landscape patterns, notably vegetation, soils and physiographic features. The combined influence of climate, topography and geology is reflected by the distribution of these features. There are six Natural Regions in Alberta; the one-day Tour will pass through two of them (Parkland and Boreal Natural Regions).

Natural Subregions are subdivisions of a Natural Region, generally characterized by vegetation, climate, elevation, and latitudinal physiographic differences within a given Region. For example, the Rocky Mountain Natural Region is divided into three Natural Subregions:

1. The cold, wet and treeless Alpine Natural Subregion at the highest elevations;
2. The somewhat more moderate climate of the forested Subalpine Natural Subregion at middle elevations in the Rocky Mountains;
3. The warmer, drier, forest–grassland complexes of the Montane Natural Subregion in the valleys and along the lower slopes and foothills of the Front Ranges.

Natural Subregions are distinguished climatically based on precipitation quantities and distribution and on seasonal temperature variations. Figures C-1 and C-2 summarize these trends for the two subregions traversed by the Tour.

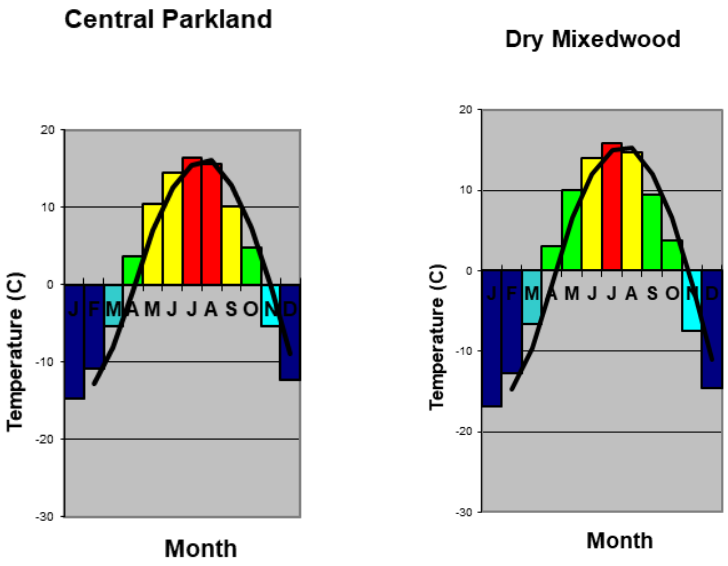

Figure C-1. Comparison of mean monthly temperature trends for two Natural Subregions. (*Red = >15°C, Yellow = 10 to 15°C, Green = 0 to 10°C, Light Blue = -10 to 0°C, Dark Blue = -20 to -10°C, Purple = -30 to -20°C. Time (X) axis is January to December. Temperature (Y) axis is °C, horizontal lines show increments of 10°C*).

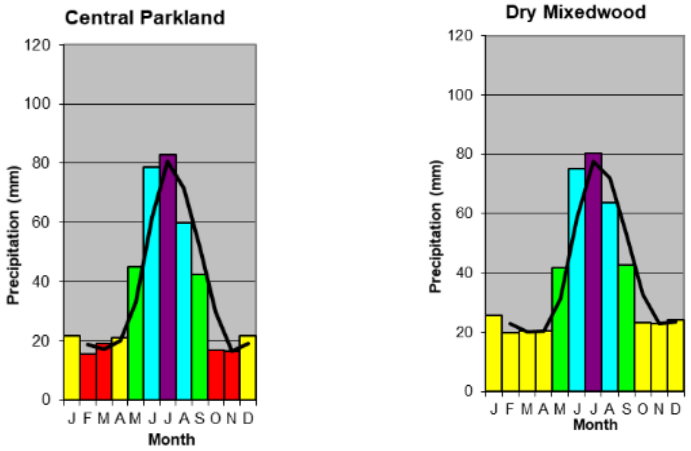

Figure C-2. Comparison of mean monthly precipitation trends for two Natural Subregions. (*Red = <20 mm, Yellow = 20 to 40 mm, Green = 41 to 60 mm, Light Blue = 61 to 80 mm, Purple = >80 mm. Time (X) axis is January to December. Precipitation (Y) axis is mm of precipitation, horizontal lines are increments of 20 mm).*

PARKLAND NATURAL REGION: CENTRAL PARKLAND NATURAL SUBREGION

Theme

The Central Parkland Natural Subregion occupies a broad intensively cultivated and heavily populated fertile crescent in central Alberta. It lies between the cold, snowy northern forests and the warm dry southern prairies, sharing the climatic and vegetation characteristics of both.

Key Features

- Mostly cultivated with scattered remnant prairies and aspen groves on hummocky till or eolian materials
- Temperature, precipitation and growing season characteristics are intermediate between the dry, warm grasslands to the south and the cooler, moister boreal forests to the west and north
- Black Chernozems, some Dark Gray Chernozems, significant occurrences of Solonetzic soils

General Description

The Central Parkland Natural Subregion includes over 50,000 km^2, much of it under cultivation. It includes all or parts of Alberta's three largest cities, and arches north from Calgary through Edmonton and east to the Alberta-Saskatchewan border. It meets the Dry Mixedwood Natural Subregion to the west and north and Foothills Fescue, Foothills Parkland, and Northern Fescue Natural Subregions to the south. Elevations range from 500 masl near the Alberta-Saskatchewan border to 1,250 masl near Calgary. Undulating till plains and hummocky uplands are the dominant landforms; lacustrine and fluvial deposits are locally common in the northern and eastern parts of the Natural Subregion, and there are some significant eolian deposits. Almost all of the area is cultivated, but a mosaic of aspen and prairie vegetation occupies remnant native parkland areas. In the southern and eastern parts of the Natural Subregion, plains rough fescue prairie is the dominant vegetation, with clumps of aspen present but restricted to moist sites. In the northern and western parts, aspen forest is dominant and grasslands are restricted to drier areas. Black Chernozems usually occur under grasslands, and Dark Gray Chernozems and Luvisols usually occur under aspen forests.

Vegetation and soil gradients as influenced by moisture and vegetation are shown in Figure C-3. Mean annual precipitation is 441 mm; mean annual temperature is 2.3°C. The average frost-free period is over 100 days; the Edmonton area has a frost free period of about 120 days. Sixty to 70 percent of the precipitation falls between May and October, mostly from convective storms in June and July. July and August are the warmest months (Figures C-1 and C-2).

The Central Parkland Natural Subregion is highly productive for annual crops because summer precipitation is adequate, the growing season is sufficiently warm and long, and soils are suitable. Estimates vary, but current information suggests that only about five percent of the Central Parkland Natural Subregion remains in native vegetation. The area has been intensively cultivated for over a century, and the few remaining contiguous areas of parkland vegetation occur on sites that are unsuitable for agriculture because of topography or soil constraints. Much of the native vegetation occurring on extensive till plains within the Natural Subregion was replaced by croplands before it could be surveyed and catalogued. Consequently, the delineation of Central Parkland Natural Subregion boundaries depends heavily on soil maps.

Land Uses

The Central Parkland Natural Subregion is the most densely populated region in Alberta; Edmonton, Red Deer and Calgary all lie wholly or partly within it. This is the most productive agricultural region in Alberta.

Cropland covers about 80 percent of the plains and about 65 percent of hummocky uplands; the remaining area is grazing land. Wheat, barley and canola are the dominant crops in the central and eastern portions with some specialty crops such as pulses and flax. At higher elevations in the southwestern part of the subregion, a shorter frost-free period limits crop production to cool-season barley and forages. Conventional petroleum exploration and development activities occur throughout; heavy oil, strip coal mining and gravel extraction activities occur locally.

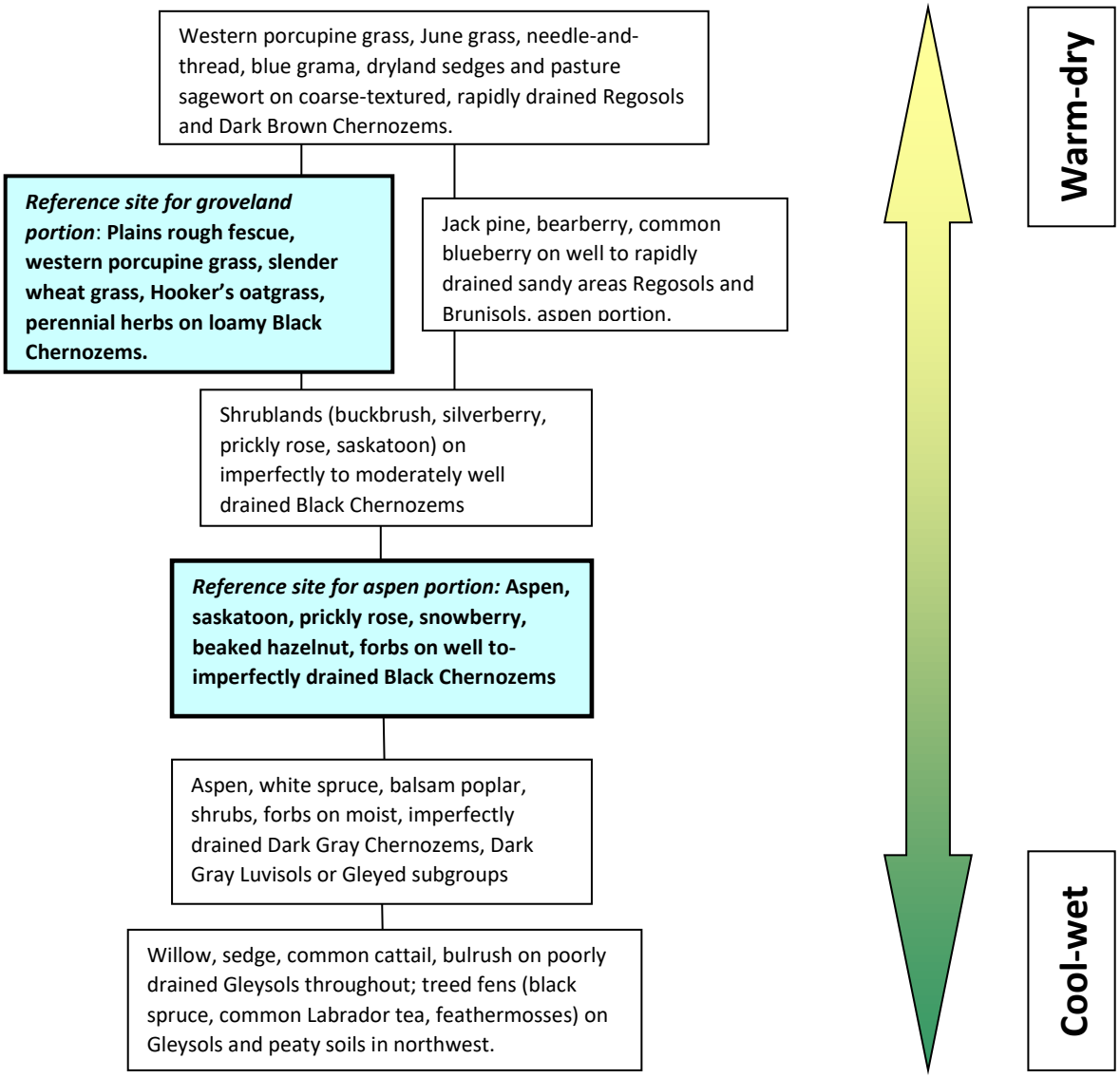

Figure C-3. Common ecosystems arranged along environmental gradient, Central Parkland Natural Subregion. Reference sites (typical of moderately well drained, moderately moist soils) are in blue shaded boxes in boldface type.

BOREAL FOREST NATURAL REGION: DRY MIXEDWOOD NATURAL SUBREGION

Theme

Undulating plains, aspen-dominated forests, and fens define the Dry Mixedwood Natural Subregion, the warmest boreal Natural Subregion.

Key Features

- Warmer summers, and milder winters than other Subregions in the Boreal Natural Region
- Aspen stands with scattered white spruce interspersed with fens; cultivated areas on suitable soils throughout
- Two climatically distinct areas within this Natural Subregion (Peace River and southern)
- Luvisols and Dark Gray Luvisols on uplands; Gleysols and Organic soils in wetlands

General Description

The Dry Mixedwood Natural Subregion is the second largest Natural Subregion in Alberta and is mapped as three separate units. The largest, most northerly unit parallels the Peace River in northwestern Alberta from Grande Prairie to Fort Vermilion. The second unit (through which the soil Tour passes) lies to the south and occupies a crescent-shaped area in central Alberta between the Central Parkland and the Central Mixedwood Natural Subregions; the Lower Foothills Natural Subregion borders the Dry Mixedwood Natural Subregion in the extreme south. The third and smallest unit is associated with morainal uplands in the Cooking Lake area immediately east of Edmonton. Elevations range from 200 masl along the Peace River in the extreme northeast part of the Natural Subregion to 1,225 masl west of Sundre and adjacent to the Lower Foothills Natural Subregion.

Level to gently undulating glacial till or lacustrine plains are the dominant terrain type; hummocky uplands are significant in the two southern mapped units. Gray Luvisols are the dominant soils on uplands; Gleysols and Organic soils are dominant in wetlands. Aspen forests with mixed understories of rose, low-bush cranberry, beaked hazel and Canada buffaloberry are typical on uplands; treed, shrubby or sedge-dominated fens occupy about 15 percent of the Natural Subregion. Jack pine stands occur on dry well to rapidly drained glaciofluvial and eolian parent materials.

Vegetation and soil gradients as influenced by moisture and vegetation are shown in Figure C-4. Mean annual precipitation is 461 mm; mean annual temperature is 1.1°C. The frost-free period averages between 95 and 100 days. Sixty to 70 percent of the precipitation falls between May and October, mostly from convective storms in June and July. July and August are the warmest months (Figures C-1 and C-2).

Land Uses

Slightly over 50 percent of both the Peace River and central Alberta portions of the Dry Mixedwood Natural Subregion have been cultivated. The central Alberta portion has 40 to 70 percent of the cultivated area in barley and forage crops.

Significant aspen harvesting occurs throughout the Natural Subregion for pulp and paper production, along with incidental conifer production. Oil and gas activity is also a major land use with heavy oil in the Cold Lake and Peace River areas and conventional oil and gas production in the west. Hunting and fishing are popular activities throughout the area.

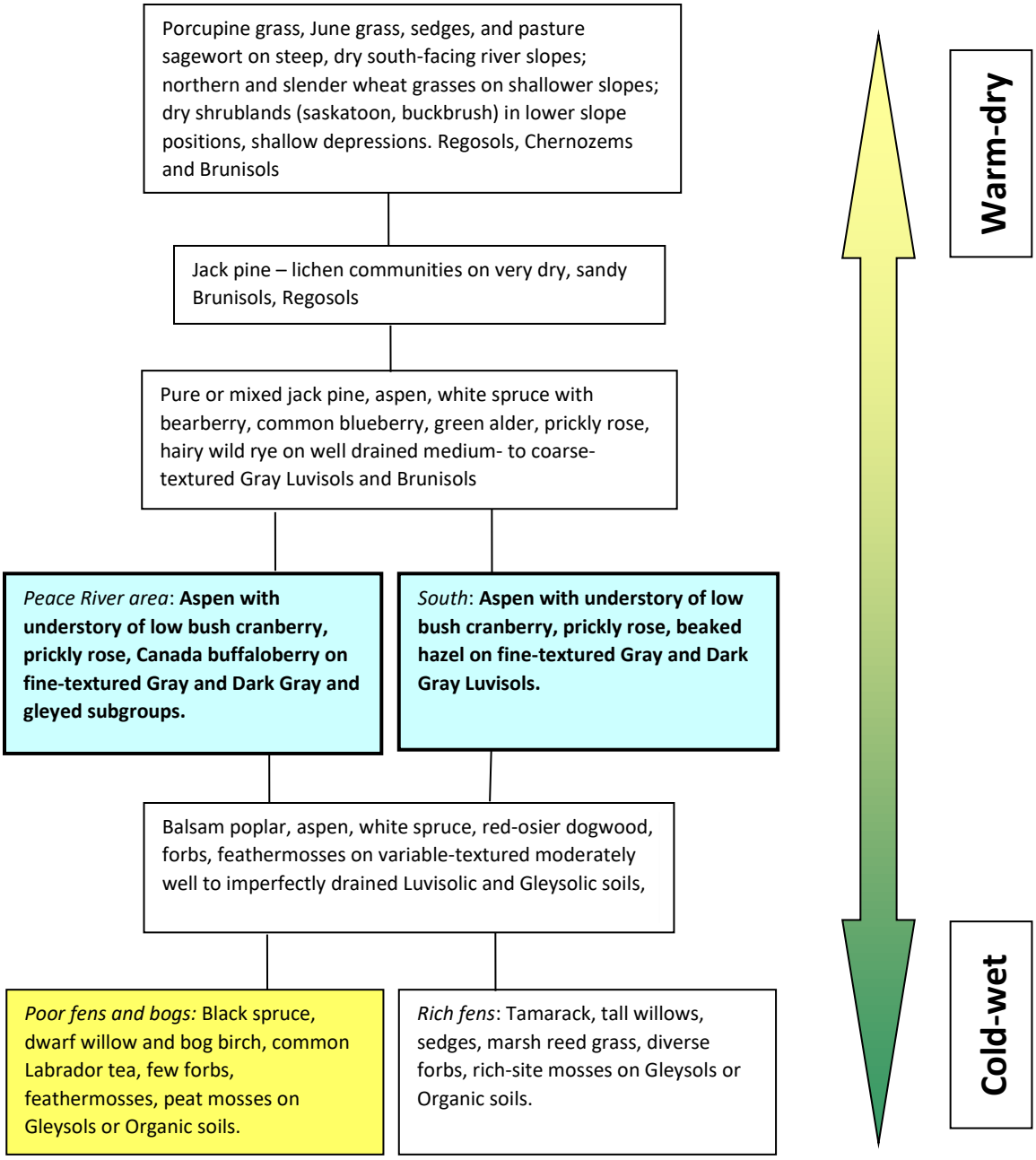

Figure C-4. Common ecosystems arranged along environmental gradient, Dry Mixedwood Natural Subregion. Reference sites (typical of moderately well drained, moderately moist soils) are in blue shaded boxes in boldface type. Nutrient poor sites are indicated by yellow shaded boxes.

REFERENCES

Jenny, H. 1941. Factors of Soil Formation: A System of Quantitative Pedology. Dover Publications. New York, New York. 281 pp.

Major, J. 1951. A Functional, Factorial Approach to Plant Ecology. Ecology 32:392-412

Natural Regions Committee. 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta. Pub. No. T/852.