University Heights Neighbourhood No. 3
Natural Areas Screening Report

Prepared For
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EXECUTIVE SUMMARY

This document summarizes the results and recommendations of a field Natural Areas Screening conducted in 2019 to guide the planning and design of the future University Heights Neighbourhood No. 3 (UH3) on the northeast side of Saskatoon, SK. According to the City of Saskatoon's Official Community Plan (Bylaw No. 8769), all new developments require a natural area screening as part of the development design process. The Study Area for UH3 has undergone several natural area screening studies in the past; previous recommendations included the need for additional research and monitoring of specific areas prior to land development.

One of the overarching goals of the UH3 planning process is to design and build a neighbourhood that balances human use with the natural environment. The intent of this current Natural Areas Screening was to document current vegetation and wildlife communities within the Study Area, determine what potential positive or adverse effects the proposed UH3 may have on areas of interest and natural features within the Study Area, including the flora and fauna communities, and make recommendations for best management practices to achieve the overarching goals of balance for this new development.

The Study Area is 504 hectares. It is bordered by the proposed Saskatoon Freeway corridor to the north, the Northeast Swale to the east, Agra Road to the south, and the South Saskatchewan River valley and South Access Road (formerly Central Avenue North) to the west. Potential Areas of Ecological Interest identified by the City of Saskatoon include:

- the Riverbank Area located on the east bank of the South Saskatchewan River;
- the Riddell Paleontological Site;
- the Small Swale and adjacent native vegetation communities, including the wetland and upland habitat located north of McOrmond Drive North; and,
- grasslands adjacent to the Northeast Swale, including those portions along the north edge of the Northeast Swale.

Key Findings

The key findings from the 2019 Natural Areas Screening for UH3 are summarized as follows:

Habitat Classification

- The Study Area is made up of 13 habitat types:
  - Crop Land
  - Disturbed/Developed
  - Disturbed/Gravel Pit
  - Yard Site Active
  - Yard Site Abandoned/Tame Grassland
  - Hay Crop (Forage)

  - Closed Canopy Deciduous Woodland
  - Open Canopy Deciduous Woodland
  - Tall Shrub Grassland
  - Native Dominant Grassland
  - Native Dominant Grassland / Tame Grassland
  - Tame Grassland
  - Wetland
- The dominant habitat type is Crop Land, which accounts for 42% of the Study Area, followed by Disturbed/Developed at 15%, Native Dominant Grassland/Tame Grassland at 15%, and Tame Grassland at 12%.
- The following habitat types associated with woodlands, grasslands, and wetlands in the Study Area are of the most ecological interest because of the functions they provide (e.g., provision of wildlife habitat, maintenance of vegetation diversity, aesthetic/cultural, and hydrological), coupled with the historical loss of grasslands and wetlands in the Prairies:
  - Closed Canopy Deciduous Woodlands and Open Canopy Deciduous Woodlands account for 3% of the Study Area and are associated with the Riverbank Area, the Riddell Paleontological Site, a strip of Trembling Aspen and Hawthorn along the southern boundary of the Civic Materials Handling Yard, and Trembling Aspen groves associated with the Small Swale.
  - Four types of grassland habitat are found in the Study Area; collectively, they account for 28% of the Study Area. The two grassland habitats of ecological interest are the Native Dominant Grasslands and the Native Dominant Grasslands/Tame Grassland. They make up approximately 2% and 15% of the Study Area, respectfully.
  - Wetlands account for 5% of the Study Area and are mostly associated with a large wetland complex and adjacent isolated wetlands within the Small Swale. Isolated temporary and seasonal wetlands are also scattered throughout the Study Area.

Flora

- Three provincially listed S3 (Vulnerable/Rare to Uncommon) plant species were observed in the Study Area. Plains Rough Fescue and Crowfoot Violet were identified in the uplands adjacent to the Small Swale. A population of American Bugseed was documented in the Riddell Paleontological Site.
- A total of 230 plant species were found in the Study Area during the vegetation surveys. The Small Swale and Adjacent Upland Survey Area had a total of 165 species identified, with two provincially listed species at risk, and 11 weed species governed by the provincial *Weed Control Act*. The Grasslands Adjacent to the Northeast Swale Survey Area had 68 plant species and five provincially listed weed species. A total of 138 plant species were found within the Riverbank Area and the Riddell Paleontological Site Survey Areas, including 11 provincially listed weed species, and one plant species at risk at the Riddell Paleontological Site.

- Rangeland Health Assessments in 2019 confirmed findings from 2014. Key findings from the health assessments are:
    - The native grassland on the slopes and bottom of the Small Swale in LSD 6 and 7-18-37-04 W3M was classified as Healthy and of ecological interest in both 2014 and 2019.
    - The grasslands that were assessed in LSD 13-18-37-04 W3M and LSD 1 and 8-24-37-05 W3M were classified as Unhealthy in both 2014 and 2019. However, both sites included a high number of native species despite the actual ground cover being dominated by Smooth Brome and Kentucky Bluegrass. It was among the moderately to heavily invaded grassland in the uplands of SE 24-37-05-W3M that Plains Rough Fescue (S3) and Crowfoot Violet (S3) were found. Grassland assessments conducted in LSD 12 and 14-18-37-04 W3M found the grassland to be Healthy with Problems in 2019.
    - The grassland in SE 19-37-04 W3M that was assessed as Healthy with Problems in 2014 has been bisected by the recently constructed McOrmond Drive North. The remaining remnant of grassland was not assessed in 2019 because it was deemed to be not ecologically significant given its isolated and disturbed state.
    - A grassland assessment was conducted in a revegetated portion of the upland adjacent to the riverbank where a storm water outfall was installed nine years ago. This area was not assessed in 2014 because it was not within the 2014 Study Area. The grassland received a 'Healthy' score as it was dominated by native species and contained very few introduced or invasive species.
- The Riverbank Area community was the healthiest, most biodiverse, and intact habitat surveyed in the Study Area.

Fauna

- The presence of a Sharp-tailed Grouse lek was confirmed within the Native Dominant Grassland / Tame Grassland of NW 18-37-04 W3M, adjacent to the Northeast Swale; 19 to 22 individual grouse were observed during the three surveys. No other leks (i.e., satellite leks) were documented within the Study Area.
- Boreal Chorus Frogs, Wood Frogs, and Northern Leopard Frogs were detected primarily in association with the semi-permanent and permanent wetlands within the Study Area. Northern Leopard Frogs are currently listed federally as a species of special concern and protected under the *Species at Risk Act*; provincial guidelines recommend a 10 m setback distance for low disturbance activities [1], 200 m setback for medium disturbance activities[2], and 500 m setback distance associated with high disturbance activity types[3] from breeding and overwintering ponds for this species.
- Fifty-six migratory bird species were detected in the Study Area, with a similar species diversity as has been documented in past natural area screening studies and field surveys.

[1] Low disturbance activities include foot traffic, vehicles <1 ton including ATVs, operating oil or gas wells, pipelines

[2] Medium disturbance activities include vehicles >1 ton, plough-in pipelines, operating compressor station or batteries

[3] High disturbance activities include roads, battery or compressor station construction, seismic, drilling rigs, trench-in pipeline, blasting, mines, gravel pit, quarries, rock crushing, asphalt batching, renewable energy projects

- Wildlife, particularly ungulates, are frequently using game trails to move between habitat in the NW 18-37-04 W3M, crossings of Lowe Road, and the habitat in the NW 13-37-05 W3M associated with the Small Swale.
- A short-eared owl was observed in the vicinity of NW 18-37-04 W3M.

Wetlands

- Wetland classification and management recommendations were found to be is similar to previous studies to preserve a number of wetlands.
- Twenty-two wetlands are found within the Study Area: nine temporary wetlands (Class 2), nine seasonal wetlands (Class 3), two large semi-permanent wetlands (Class 4), and two permanent wetlands (Class 5) that were originally human-made.
- Two changes to the classification of the wetlands within the Study Area were made in 2019 from what was previously documented in 2014. Wetland 9055 was re-classified as a Class 5 wetland and five wetlands that were delineated in 2014 as being individual are now connected to make up one large Class 4 wetland complex within the Small Swale, which is bisected by the North Commuter Parkway into two hydrologically connected Class 4 wetlands (Wetland 3027 and 3031).
- Management classifications of the wetlands assessed in 2019 have not changed since 2013 and 2014. Of the 22 wetlands in the Study Area, 10 wetlands are classified as Preserve, two as Manage 1, and two as Manage 2.

Hydrology

- Surface water hydrology of the Study Area is characterized by precipitation runoff, surface flows in the Small and Northeast Swales, and the isolated wetland basins. The surface water drains from the Study Area, through the topographic lows towards the South Saskatchewan River. In the Small Swale a topographic drainage divide occurs near the north boundary of the Study Area, and this coincides with the approximate location of McOrmond Drive. The Northeast Swale drainage is unidirectional, from southwest to northeast, discharging to the South Saskatchewan River.
- The Northeast and Small Swales are separated by a topographic rise that extends between these two hydrologic features. Groundwater elevations measured in piezometers within the wider area of both swales ranges from surface to 10 m depth and within the Study Area are generally 3 to 5 m below ground surface.
- The surface water in the Small Swale occurs on surface because of precipitation inputs and to a lesser degree, groundwater interactions.
- The hydrology of the Northeast Swale is largely influenced by groundwater flow and recharged, while the Small Swale is more dependent on surface water flow and runoff, and less dependent on groundwater recharge to maintain water levels throughout any given year. Therefore, the Small Swale is more susceptible to flood events given high runoff flows, particularly during the spring/summer during high precipitation events, and/or snowmelt events. Conversely, during the late summer/fall when precipitation is lower, or during dry periods, there is potential for wetlands in the Small Swale to become isolated, fully disconnected, and potentially completely dry if natural runoff is intercepted or directed out of the Swale area.

Riddell Paleontological Site

- After the start of this Study it was determined Riddell Paleontological Site requires a paleontological Heritage Resources Impact Assessment (pHRIA). This is not part of this work, but will be addressed under a separate scope of work.

Key Recommendations

Key recommendations generated from the review of information for this Natural Areas Screening are summarized as follows:

- An integrated approach with representatives from various City departments would allow for input by different disciplines and subject matter experts so that design considerations (e.g., greenway, roadways, intersections, infrastructure) can be discussed and vetted from multiple points of view.
- Try to maintain the existing terrain profile within the UH3 area if possible as part of the planning and design of the neighbourhood areas adjacent to the Northeast and Small Swale features. Further, as part of construction, consider limiting the amount of area disturbed at one time (i.e., a phased approach to construction and reclamation is recommended).
- Natural areas were assessed and deemed important to be retained and incorporated into the proposed Ecological Zones (e.g., grasslands within the Small Swale and Northeast Swale).
- The Riverbank Area and the adjacent upland within 150 m from the shoreline of the South Saskatchewan River should be dedicated Municipal Reserve as a natural asset under the provisions of Bylaw No.8769 of the Official Community Plan.
- Recommend monitoring the Sharp-tailed Grouse lek for a 5 to 10 year period to gain additional information as the neighbourhood develops.
- Maintain additional habitat within proximity of the lek in the quarter section NW 18-37-04 W3M.
- Pre-construction nest surveys to be completed prior to construction.
- Suggest preserving large tracts of mature trees near and along the southern border of the Small Swale.
- Incorporate and design breeding bird habitat in the design of open green spaces. Where possible consider incorporating the current and/or historical wetland basins and existing treed habitats identified in the Study as part of a linear connections.
- Northern Leopard Frog are a known inhabitant of the Small Swale and Riddell Paleontological Site. These sites require preservation to maintain breeding and overwintering habitat.
- Consider preserving or creating wetlands where possible during the design phase as part of newly constructed green spaces to provide habitat and dispersal opportunities for various species.
- Wildlife corridor monitoring resulted in the recommendation for two linear connections between the swales. Recommendations were made based on the data gathered. However, additional monitoring would provide better information on movement patterns, and be beneficial to further inform roadway wildlife crossing corridors. At the same time, it helps determine if other mitigation measures are needed to reduce wildlife mortalities.

- Monitor water level data to determine natural fluctuation ranges in surface water in the Swales, and complete groundwater monitoring to observe water level fluctuations and vertical gradients in the vicinity of the Swales.
- Keep water level fluctuations in any potentially influenced wetland within natural ranges.
- Manage stormwater in the Study Area using a variety of techniques including low impact designs (e.g., bioswales, rain gardens) within the development area to provide filtration, attenuate peak flows and promote infiltration.
- Minimize the construction of stormwater structures within the swales. However, where required in proximity to the Small Swale, water management structures should be constructed on previously disturbed ground such as the Civic Material Handling Site.
- To maintain natural water level fluctuations and mitigate potential high flow events or unnatural drying conditions in the Small Swale, implement groundwater and discharge control measures (e.g., interceptor drains, bioswales, rain gardens) to buffer flow alterations and to maintain a bi-direction exchanges with shallow groundwater.
- Greenways are found to be useful borders to natural areas and the continued use of this design is recommended along the borders of the Small Swale and along the length of the north side of the Northeast Swale. The inclusion or placement of pedestrian trails as part of the greenway should be carefully considered when designing the greenway to minimize edge effects (e.g., introduction of invasive/noxious weeds, interruption of wildlife corridors).
- Linear greenspace connectivity to be created to link the Small Swale and Northeast Swale features.
- Lowe Road is required for emergency services access and improved connectivity between existing and future neighbourhoods. It is recommended the road be upgraded to provide the natural hydrologic flow and function of the Northeast Swale. As part of the upgrade the current roadway crossing of the Northeast Swale wetland should be upgraded and replaced with a clear span bridge or open bottom/box culvert network.
- Continued resource management is recommended for the proposed Ecological Zones.

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1 INTRODUCTION

EDI Environmental Dynamics Inc. (EDI), with support from subconsultants Chet Neufeld, Atlheritage Services Corp., and Missinipi Water Solutions, was retained by Saskatoon Land to complete a field, site-specific, natural area screening and compile a report (referred to as the Project) to help guide the planning and design for the future University Heights Neighbourhood No. 3 (UH3). This Project was completed under the guidance of the City of Saskatoon's Official Community Plan, Bylaw No. 8769 (the OCP) (City of Saskatoon 2019). The OCP is referenced in this Project report, as appropriate, to provide context for the methods, findings and/or recommendations presented. Sections of the OCP with particular importance to the Project are as follows:

- Section 1.2 of the OCP refers to providing a policy framework to define, direct, and evaluate development in the City of Saskatoon, ensuring that development takes place in an orderly and rational manner, balancing the environmental, social, and economic needs of the community.
- Section 5.1.2 (j) of the OCP requires that "The development and subdivision of land in new and existing neighbourhoods shall respect the significant natural, archaeological, and environmental features of the area."
- Section 9.2 Conservation of Natural Areas and Archaeological Sites provides the following objectives: "a) To identify and protect important ecosystems and other natural areas and archaeological sites, as part of the land development process; b) To enhance the beauty and enjoyment of the City and Region; and c) To conserve the biodiversity of both plant and animal life for the enjoyment of present and future generations."
- Section 9.2.2 relates to Analysis of Natural Areas. Section 9.2.2 c) states that "As part of the area sector plan or area concept plan design process, a general screening shall be undertaken for important natural areas, features, or archaeological sites. If deemed appropriate, more detailed analysis of natural areas or features shall be undertaken by a qualified consultant, acceptable to both the City of Saskatoon and the developers, with all costs borne by the affected developers."

1.1 PROJECT OBJECTIVES

The UH3 Study Area (the Study Area; Figure 1) has undergone several natural area screening studies (Stantec 2013a, b; Stantec 2015); previous recommendations include the need for additional research and monitoring of specific areas prior to land development. Therefore, the primary objectives for this screening were to:

1) characterize the flora and fauna within the Study Area by completing detailed field surveys to collect data on the current vegetation and wildlife communities; and,

2) provide recommendations and best management practices on specific planning and design features for UH3 based on the data collected during the field surveys, as well as relevant information from previous reports and studies.

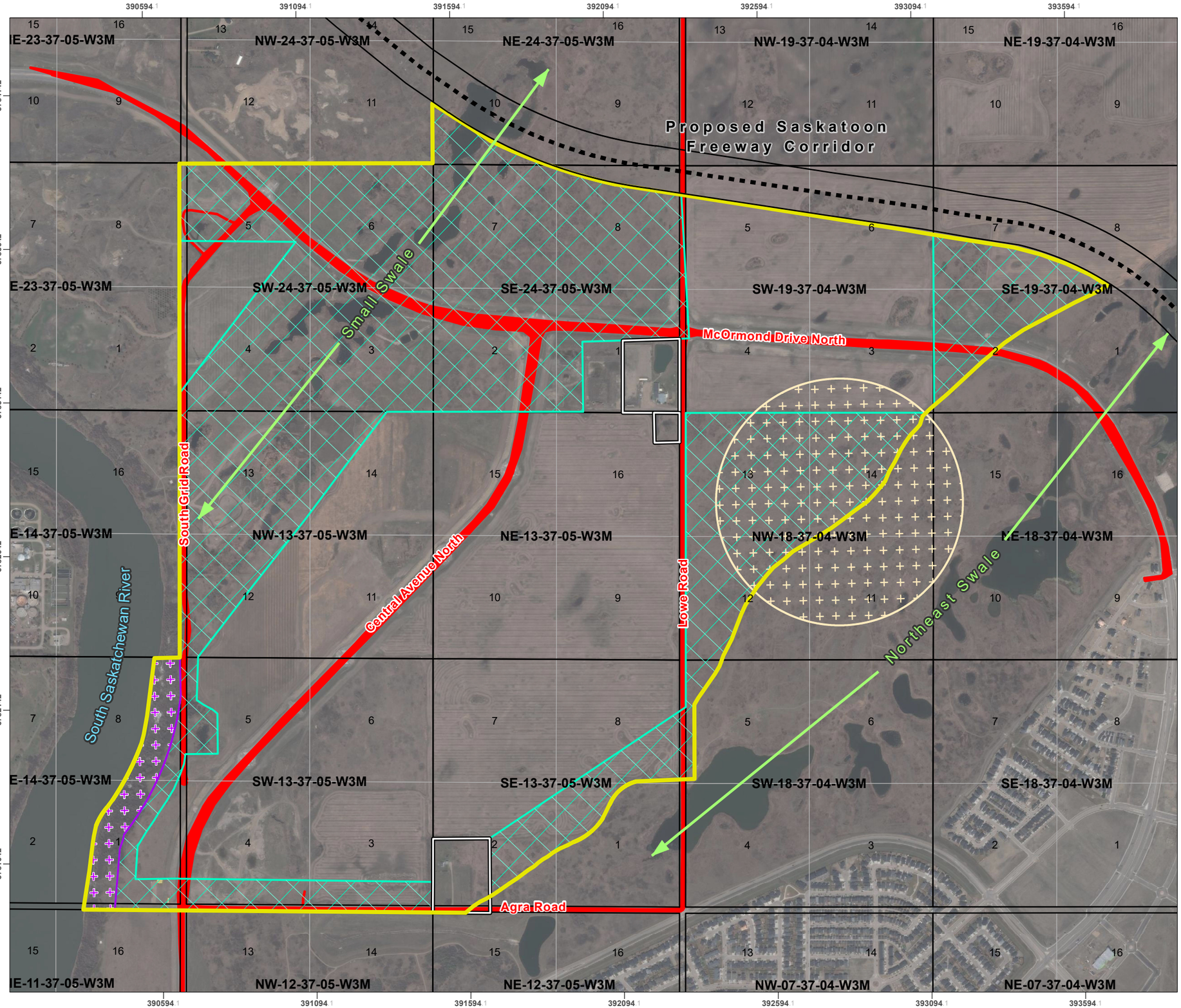
By identifying natural areas in the Study Area, the City of Saskatoon can continue its goal of designing and building a neighbourhood that balances human use with the natural environment, particularly those associated with the Small Swale and Northeast Swale. The City of Saskatoon has already preserved nearly 300 hectares, as outlined in the Northeast Swale Master Plan (MVA 2015) of the Northeast Swale and contributed $500,000 (Saskatoon Land 2017) for swale enhancements and resource management.

This report includes:

- a summary of the methods and results of the detailed field surveys that were completed to document the vegetation and wildlife species, including species at risk, that currently use the available habitat within the Study Area;
- an update on the classification of the habitat (i.e., land cover) types and wetland features since their last assessment;
- recommendations on Site Specific Areas of Interest and Ecological Areas of Interest, referred to as proposed Ecological Zones in this report, regarding retention and preservation of natural areas including habitats adjacent to the Small Swale and Northeast Swale features;
- a discussion related to the hydrological connectivity of wetlands within the Small Swale and Northeast Swale, and how these features could be considered as part of the UH3 design; and,
- recommendations on how roadways and crossings of the swales can be incorporated into the neighbourhood design, based on information collected during the field programs, to reduce the potential effects of UH3 on the vegetation and wildlife communities currently using the available habitat within the swales.

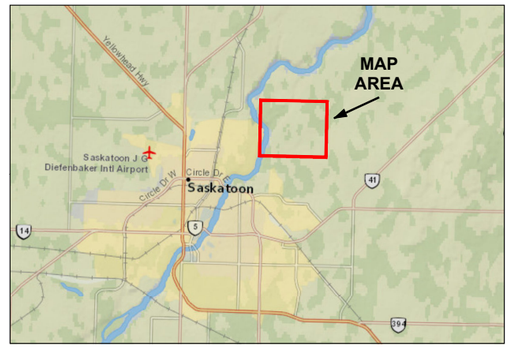
UH3 Natural Area Screening Study Area

CITY OF SASKATOON



Legend

- Future Saskatoon Freeway
- Future Saskatoon Freeway ROW
- Project Boundary
- 92m Riverbank Area
- Lek Lands of Interest
- Potential Areas of Ecological Interest
- Private Lands
- Quarter Section
- Legal Subdivision
- Road



0 100 200 300 400 500
Meters

Map Scale = 1:12,500 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N

N

Data Sources

- Imagery. World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
- Inset map. National Geographic World Map

Disclaimer

EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

Drawn:	Checked:		
YN	JS/CJ/HT	Figure 1	Date: 2021-03-16

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The above points are intended to address the following Section 9.2.2 subsections of the OCP (City of Saskatoon 2019):

- Protection of Natural Areas "d) The conservation or mitigation for loss of important natural areas, features, or archaeological sites shall be considered in the review of area sector plans, area concept plans and subdivision applications, and proposals to include lands within Phasing Sequence I of the Official Community Plan - Phasing Map;
- Integrated Open Space "f) Wherever possible, important natural areas, features, and systems shall be integrated into new development areas and form part of the park and open space system, including the retention of natural corridors and natural ponding areas."

1.2 STUDY AREA

The Study Area is bordered by the proposed Saskatoon Freeway Corridor to the north, the Northeast Swale to the east, Agra Road to the south, and the South Saskatchewan River valley and South Access Road (formerly Central Avenue North) to the west (Figure 1). The Study Area is crossed by the recently constructed McOrmond Drive North and the newly aligned Central Avenue North (North of Fedoruk Drive).

The Study Area is 5.04 square kilometres (km^2), or 504 hectares (ha) in size. The majority of the land is owned by the City of Saskatoon (the City), except for three parcels:

1) a 4 ha parcel owned by the Saskatchewan Wildlife Federation along Lowe Road (RR 3050);
2) a 0.80 ha parcel privately owned along Lowe Road; and,
3) a 4 ha parcel privately owned along Agra Road.

2 APPROACH

The approach taken for the Project included:

- desktop review;
- literature review;
- flora and fauna assessment – including methods and results for the 2019 field programs;
- hydrological review;
- summary of key findings, based on the observations from the 2019 field program; and,
- recommendations – based on the review of previous studies, observations from the 2019 field programs, and industry best management practices.

Details of these components are discussed in the following subsections, and representative photographs are provided in Appendix A.

When developing the field programs for the Project, survey efforts were focused on the following *Potential Areas of Ecological Interest* as identified by Saskatoon Land (Figure 1):

- Riverbank Area located on the east bank of the South Saskatchewan River, specifically 92 m and 150 m offset from the river in SE 14-37-05 W3M (Photos 01 to 05);
- Riddell Palaeontological Site located in SW 13-37-05 W3M;
- Small Swale and adjacent native vegetation communities, particularly the wetland and upland habitat located in S½ 24-37-05 W3M, north of McOrmond Drive North (Photos 06 to 07); and,
- grasslands adjacent to the Northeast Swale, particularly those portions along the north edge of the Northeast Swale within NW 18-37-04 W3M and SE 13-37-05 W3M (Photo 08).

These Areas of Ecological Interest were evaluated to determine what changes, if any, have occurred to the natural area features in the Study Area since baseline conditions were recorded in 2013 and 2014 (Stantec 2013a, b; Stantec 2014). This was completed to identify matters relevant to future development in the Study Area. Based on these findings, recommendations were developed on how to integrate the natural areas into the design of UH3, and which natural areas should be designated as proposed Ecological Zones (see Section 9 for additional details), to comply with the OCP (City of Saskatoon 2019).

3 DESKTOP REVIEW

Prior to initiating the 2019 field programs, a desktop review was completed to provide a high-level overview of the environmental setting for the Study Area. This review was used as a planning tool to develop the field programs and identify potential environmental matters to be considered as part of future UH3 planning and design.

Information sources for the desktop review included past studies, available literature sources, satellite imagery, online databases such as the Hunting, Angling, and Biodiversity in Saskatchewan (HABISask) database (SKCDC 2019), and general knowledge of the Study Area. The collected information provided details on land cover types, vegetation communities, potentially sensitive wildlife habitat, wetlands, locally significant areas, and previously documented occurrences of provincially tracked or federally and provincially listed species within the City limits (e.g., Small Swale, Petursson's Ravine).

The desktop wetland classification consisted of a review of wetland studies conducted by Stantec (2012), historical aerial imagery provided by Saskatoon Land, and Google Earth Pro satellite imagery. These data were used to verify the classifications of the wetlands within the Study Area, identify wetlands that had not been classified, and assess whether the condition (e.g., extent) of wetlands previously classified had changed. This review was used to determine appropriate recommendations and best management practices.

A reconnaissance to ground-truth and confirm current habitat types within the Study Area was conducted over several days in April 2019 to prioritize areas for intensive survey efforts prior to initiating the field programs.

3.1 LITERATURE REVIEW

To better understand the past and present condition of the Study Area, a detailed review of previous studies, relevant legislation, and literature was conducted. These resources provided context on how the landscape within the Study Area has changed over the past decade or more. The literature review identified data gaps and/or recommendations for further study; these data gaps were considered in determining what specific data needed to be collected during the 2019 field programs.

While a complete list of the literature reviewed is included in Section 15 References, the following studies, which pertain to areas located within or adjacent to the Study Area, were reviewed in detail:

- The "Small Swale" Resource Overview (Stantec 2003)
- Northeast Swale Development Guidelines (Stantec 2012)
- North Commuter Parkway – Baseline Terrestrial and Aquatic Field Studies, and Heritage Resource Impact Assessment (Stantec 2013a)
- North Central-North East Natural Area Screening (Stantec 2013b)
- University Heights Neighbourhood 3 - Natural Area Screening and Heritage Resource Impact Assessment (Stantec 2015)

- Meewasin Valley Authority (MVA) Northeast Swale Mitigation Planning (CanNorth 2016)

3.1.1 PREVIOUS DATA GAPS AND AREAS REQUIRING FURTHER STUDIES

The field surveys selected as part of the 2019 field programs were partly based on the data gaps and recommendations identified in Stantec (2015), which recommended that additional flora and fauna studies be completed prior to development within the Study Area. It was also recommended that the presence of federally and provincially listed wildlife and plant species be confirmed, and whether any provincial activity restriction setbacks recommended by the Saskatchewan Ministry of Environment (ENV 2017) would need to be considered as part of future planning and development activities. Specifically, early and late rare plant surveys for uplands and wetlands were recommended because the 2014 field surveys had been conducted outside the recommended survey periods for vegetation (Stantec 2015).

Breeding bird surveys, nocturnal spring amphibian surveys, and amphibian visual surveys were not conducted in 2014 (Stantec 2015). In addition, previous studies completed in the Study Area (e.g., Stantec 2013a,b) did not include surveys for Short-eared Owl (*Asio flammeus*), Common Nighthawk (*Chordeiles minor*), and Sharp-tailed Grouse (*Tympanchus phasianellus*) leks. The requirement for these surveys began in 2017, when the ENV instructed proponents to include these species as part of their wildlife field programs to comply with Species Detection Survey Protocols that are continually being updated.

Previous reports recommended that the hydrological connectivity of the Small Swale wetlands be maintained, and the hydrological function of the wetlands be considered (Stantec 2013). The previous reports recommended a focus on retaining hydrological connectivity in the Small Swale, which is understood in the past work to be less connected to groundwater and maintaining integrity of the system in consideration of stormwater management and development . The completion of a comprehensive hydrological study to better understand the hydrology including groundwater connectivity, surface water hydrology, hydrologic function, and changes over time in the Small Swale was recommended in several reports, but to date has not been completed (Stantec 2013a, b; Stantec 2015). In 2015, a hydrogeology study was completed (Pinter & Associates 2015), to characterize the hydrogeology with a focus on groundwater risks to basement and utility construction. The study design was not focused on connectivity or interactions with the wetlands but did provide details on the groundwater conditions across the Study Area.

3.2 DATABASE SEARCHES AND REVIEW OF SATELLITE IMAGERY

A review of the HABISask database (SKCDC 2019) was used to identify listed plant and wildlife species within the Study Area that have setback requirements as per ENV (2020) and to focus field survey efforts. A review of satellite imagery and a reconnaissance/ground truthing of the area were conducted to confirm land cover and prioritize areas for intensive survey effort.

Eight listed plant species historically observed within the Study Area were identified. Some of the occurrences may not have been identified within the Study Area, although their associated buffer overlaps portions of the Study Area.

- Blueflag (*Iris versicolor* [June 23, 1994]), Menzie's Catchfly (*Silene menziesii* [1938, 1945, 1952, 1971 and 1992]), Rocky Mountain Sedge (*Carex saximontana* [1927, 1932, 1936 and 1937]) and Plains Rough Fescue (*Festuca hallii* [1990, 1993, 1994, 2018]) were found on the east bank of the South Saskatchewan River (SE 14-37-5 W3M).
- Crowfoot Violet (*Viola pedatifida*) was documented in the Northeast Swale in NW 18-37-4 W3M (2012, 2013, 2014, 2015 and 2018).
- Crawe's Sedge (*Carex crawii* [1993]), Few-flowered Aster (*Almutaster pauciflorus* [1965]) and Wood Lily (*Lilium philadelphicum* [2013]) were identified in the Small Swale in SE 24-37-5 W3M. While not rare, the Wood Lily is protected by *The Provincial Emblems and Honours Act* (Government of Saskatchewan 1988).

The HABISask database (SKCDC 2019) identified the following listed wildlife species as historically observed within the Study Area:

- Loggerhead Shrike (*Lanius ludovicianus excubitorides*) was documented in the Small Swale in 2017;
- Northern Leopard Frog (*Lithobates pipiens*) was documented in NE 24-37-05 W3M, SW 24-37-5 W3M, SE 25-37-5 W3M as well as in the Northeast Swale in 2012 and 2013, as well as the Saskatoon Wildlife Federation Trout Pond in 2016;
- Sharp-tailed Grouse lek has been documented near the Northeast Swale in 2016;
- Short-eared Owl was documented in 2010, 2011, and again in 2014 in NW 18-37-4 W3M associated with the Northeast Swale; and,
- Turkey Vulture (*Cathartes aura*) has been documented in NE 24-37-5 W3M in 2013.

4 HABITAT CLASSIFICATION

4.1 METHODS

Habitat types in the Study Area were classified during the 2019 Project field surveys using an adapted version of the ENV's habitat categories as outlined in the Saskatchewan Conservation Data Centre's Species Detection Load Form (ENV 2019a). The habitats were delineated in the field using the Avenza Maps Pro program[4] on a portable tablet and classified into one or a combination of the habitat types shown on Figure 2. Appendix B provides a description of each of the habitat types noted. Although these provincially recognized habitat categories are not the same as the land use types used in the 2015 UH3 Screening (Stantec 2015), they are comparable as shown in Table 1.

4.2 RESULTS

The Study Area is comprised of 13 habitat types covering 504.20 ha (Table 1; Figure 2). Crop Land was the dominant habitat type accounting for 213.02 ha (42.25%) of the Study Area, followed by Disturbed/Developed at 76.22 ha (15.12%), Native Dominant Grassland/Tame Grassland at 75.25 ha (14.92%), and Tame Grassland at 58.82 ha (11.67%). Collectively, the four grassland habitat types listed in Table 1 total 143.07 ha, making up 28.38% of the Study Area.

Table 2 summarizes the area and percent cover of the habitat types in the Study Areas from this Project and the comparable land use types used in the Stantec (2015) UH3 Screening, to allow comparison and indicate trends. The Study Area for the 2019 Study Area differs slightly from the 2015 UH3 Screening because of the 2019 inclusion of the Riverbank Area within SW 14-37-05-W3M.

The increase in the amount of Distrubed/Developed land (9.6% in 2014 to 18.76% in 2019) is a result of the construction of roadways for the North Commuter Parkway Project. Other changes include a decrease in Hayland by 27 ha, a decrease in Native Vegetation by 45 ha, and an increase in Tame Grassland by 46 ha. Loss of Hayland can be partly attributed to the construction of McOrmond Drive North and Central Avenue North, partly by the change from Hayland to Crop Land in LSD 11-37-05 W3M, LSD 14-37-05 W3M and LSD 15-37-05 W3M; and partly because farms were included in the Stantec (2015) Hayland category. The decrease in Native Vegetation is partly caused by the construction of McOrmond Drive North (i.e., in S½ 24-37-5 W3M and SE 19-37-4 W3M) and partly by the reclassification of land that was categorized as Native Grassland in 2014 to the category of Tame Grassland in 2019: grasslands that may have had a higher number of native species than introduced species but had an overall cover dominated by introduced grass species (e.g., Smooth Brome).

[4] Avenza Maps Pro program is an application for mobile devices that allows a user to collect data and add shapefiles to a geospatial PDF.

Habitats Identified in the Study Area

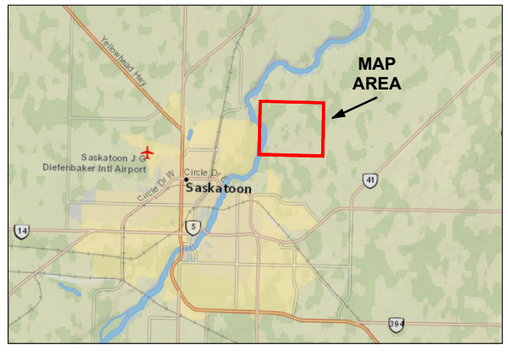
CITY OF SASKATOON

Legend

- Road
- Quarter Section
- Legal Subdivision

Habitat

- Closed Canopy Deciduous Woodland
- Crop Land
- Disturbed/Developed
- Disturbed/Gravel Pit
- Hay Crop (Forage)
- Native Dominant Grassland
- Native Dominant/Tame Grassland
- Open Canopy Deciduous Woodland
- Tall Shrub Grassland
- Tame Grassland
- Wetland
- Yard Site Abandoned/Tame Grassland
- Yard Site Active



0 100 200 300 400 500
Meters

Map Scale = 1:12,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N

N

Data Sources

- Imagery. World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
- Inset map. National Geographic World Map

Disclaimer

EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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Table 1. Habitat types located within the Study Area.

Habitat Type[1]		Land Use Type used in the Stantec (2015) Natural Area Screening	Area (ha)	Percent Cover
1	Crop Land	Cultivated	213.02	42.25%
2	Disturbed/Developed	Developed[2]	76.22	15.12%
3	Disturbed/Gravel Pit	Developed	10.1	2.00%
4	Yard Site Active	Developed	8.27	1.64%
5	Yard Site Abandoned/Tame Grassland	Hayland[3]	0.76	0.15%
6	Hay Crop (Forage)	Hayland	14.52	2.88%
7	Closed Canopy Deciduous Woodland	Native Vegetation[4]	12.13	2.41%
8	Open Canopy Deciduous Woodland	Native Vegetation	2.66	0.53%
9	Tall Shrub Grassland	Native Vegetation (Native Grassland)	0.89	0.18%
10	Native Dominant Grassland	Native Vegetation (Native Grassland)	8.11	1.61%
11	Native Dominant Grassland / Tame Grassland	Native Vegetation (Native Grassland)	75.25	14.92%
12	Tame Grassland	Tame Pasture/ Native Vegetation (Native Grassland)	58.82	11.67%
13	Wetland	Wetland	23.46	4.65%
Total Study Area (ha)			**504.20**	

[1] Habitat types are based on the categories provided by the Saskatchewan Conservation Data Centre's Species Detection Load Form (ENV 2019a).

[2] Developed includes commercial and industrial development and residential, and municipal areas.

[3] Hayland includes farms.

[4] Native vegetation includes native grassland, shrubland, and woodland.

Table 2. Land use in the Study Area in 2014 compared with 2019.

Land Use	2014 Conditions (Stantec 2015)		2019 Conditions (EDI 2020)	
	ha	%	ha	%
Cultivated	235.1	47.3%	213.02	42.25%
Developed	47.6	9.6%	94.59	18.76%
Hayland	41.3	8.3%	15.28	3.03%
Native Vegetation	144.0	28.9%	99.04	19.64%
Tame Grassland	11.6	2.3%	58.82	11.67%
Wetland	18.0	3.6%	23.46	4.65%
Total Study Area(ha)	**497.6**		**504.21**	

The habitat types of most ecological interest in the Study Area are those associated with woodlands, grasslands, and wetlands because of the functions (e.g., provision of wildlife habitat, maintenance of vegetation diversity, aesthetic/cultural, and hydrological) they provide and because of the significant historical loss of grasslands and wetlands in other regions across the Prairies.

Deciduous woodlands account for 14.79 ha (2.93%) of the Study Area. Closed Canopy Deciduous Woodland is the dominant woodland habitat at 12.13 ha; it is primarily within the Riverbank Area and a strip of Trembling Aspen (*Populus tremuloides*) and Hawthorn (*Crataegus chrysocarpa*) that runs along the south boundary of the Civic Material Handling Yard (see Figure 2). Smaller patches are located adjacent to a wetland in legal subdivision (LSD) 06-24-37-05-W3M, at an active yard site in LSD 02-13-37-05-W3M, and at an inactive yard site in LSD 11- 13-37-05-W3M. Open Deciduous Woodland is found in the Riddell Paleontological Site and adjacent to two wetlands in LSD 03-19-37-04-W3M.

Four habitat categories represent the grasslands found in the Study Area. Native Dominant Grassland is limited to the slopes and bottoms of the Small Swale in LSD 07-24-37-5-W3M, making up 8.11 ha (1.61%) of the Study Area. The upland grasslands, which are more susceptible to introduced / invasive species, were mapped as Native Dominant Grassland / Tame Grassland at 75.25 ha (14.92%) and Tame Grassland at 58.82 ha (11.57%), with small patches of Tall Shrub Grassland (0.89ha) found within the other grasslands.

All grasslands are of ecological interest in terms of the potential for providing wildlife habitat; however, in terms of maintaining diversity and integrity of grassland vegetation communities, the habitats of Native Dominant Grassland and Native Dominant Grassland / Tame Grassland are of most interest. Native Dominant Grassland / Tame Grassland is a combination category, hybridizing the ENV habitat types of Native Dominant Grassland and Tame Grassland to better represent the land cover in the Study Area. This was considered appropriate, particularly for the upland grasslands where, despite a relatively high number of native species present, the majority of the vegetation cover is dominated by an introduced species. For example, the upland area surveyed in NW 18-37-4-W3M was dominated by Kentucky Bluegrass (*Poa pratensis*)

and Smooth Brome (*Bromus inermis)* in terms of cover, although the species richness was quite diverse, with 51 of the 66 species being native plants. As such, this upland area was categorized as the combination Native Dominant Grassland/Tame Grassland. This same habitat type was identified in other uplands adjacent to the Small Swale and Northeast Swale (see Figure 2).

The wetlands in the Study Area are primarily associated with the Small Swale, although there are a few additional temporary and seasonal wetlands scattered throughout the landscape. An increase in wetland area is due to the inclusion of three wetlands that were not documented in the Stantec (2015) document and the expansion of wetland area in the old snow dump associated with the Small Swale.- Section 7 provides a detailed description of the wetlands in the Study Area and recommendations for their integration into the UH3 design.

5 FLORA

Most of the Study Area has been assessed as part of previous natural area screening studies that have examined the ecological and habitat value of the flora communities (Stantec 2013a, b; Stantec 2015). As part of these previous studies, vegetation community assessments (Thorpe 2007) and rangeland health assessments (Saskatchewan PCAP Greencover Committee 2008a) were conducted to characterize the native vegetation communities in the Study Area (Stantec 2013a, b; Stantec 2015). The results of these past studies classified the vegetation communities within the Study Area as not yet described (as defined in Thorpe 2007) and the rangeland health as Unhealthy. The classification of "not yet described" is given to a vegetation community that does not resemble the reference community (i.e., the potential natural vegetation community for the site under light grazing disturbance) or any of the vegetation communities that have been described for sites that have been altered by heavy grazing or other disturbances. In this case, the "not yet described" vegetation community was dominated by non-native (introduced) grasses, such as Smooth Brome (*Bromus inermus*). The exception to this were portions of SE 19-37-04 W3M, SW 24-37-5-W3M, and SE 24-37-5-W3M where isolated, remnant native grassland communities persisted. The health of the grasslands in SE 19-37-04 W3M were rated as Healthy with Problems; the grassland on the slopes and within SW 24-37-05 W3M and the northwest corner of SE 24-37-05 W3M were Healthy (Stantec 2013a, b). The completion of the North Commuter Parkway Project in 2018 resulted in a change in land use that directly affected vegetation communities within certain locations the Study Area. For example, the grassland community in SE 19-37-04 W3M has been affected by the construction of McOrmond Drive North, and Central Avenue North has been rerouted through the central portion of the Study Area.

To document the current state of the vegetation communities in the Study Area, EDI focused their flora assessment on the Potential Areas of Ecological Interest identified by the Saskatoon Land (Figure 1):

- The Small Swale and Adjacent Grasslands
    - North of McOrmond Drive North (SE 24-37- 05 W3M and SW 24-37-05 W3M)
    - South of McOrmond Drive North (NW 13-37-05 W3M)
- Adjacent Grasslands North of the Northeast Swale
    - SE 19-37-04 W3M
    - NW 18-37-04 W3M
    - SE 13-37-05 W3M
    - SW 13-37-05 W3M
- Riverbank Area and Adjacent Upland
    - SE 14- 37-05 W3M
- The Riddell Paleontological Site
    - SW 13-37-05 W3M

5.1 METHODS

The flora assessment included vegetation species detection surveys to identify provincially tracked or federally listed species and species listed under the provincial *Weed Control Act* (Government of Saskatchewan 2010) as well as rangeland and riparian health assessments (as per Saskatchewan PCAP Greencover Committee 2008b). As per the ENV Rare Vascular Plant Survey Protocol (ENV 2019b), two survey rounds were conducted, each separated by a minimum of 28 days. The first round of surveys was completed between April 27 and June 14, 2019, to capture early blooming species. The second round of surveys was conducted from August 5 to September 24, 2019, to capture the late blooming species. See Appendix C – Figure C1 for the locations of the Species Detection Survey Transects and the Rangeland Health Assessments.

Particular focus was paid to the grassland adjacent to and within the Small Swale located in the north portion of SW 24-37-05 W3M and the northwest portion of SE 24-37-05 W3M because they were the only grassland parcels rated as Healthy during the Stantec (2015) study. Species detection surveys and rangeland health assessments were not conducted at all Potential Areas of Ecological Interest identified in Figure 1 because of the current land use. Several areas supported non-native habitat (e.g., portions of SE 13-37-05 W3M, SE 24-37-05 W3M) while others (e.g., NW 13 and SW 13-37-05 W3M) have been disturbed by gravel extraction and/or aggregate storage activities.

Species Detection Surveys

The 2019 flora surveys focused on the uplands and wetlands within the Potential Areas of Ecological Interest in the Study Area. A review of satellite imagery and a reconnaissance/ground truthing within the Potential Areas of Ecological Interest were conducted to confirm land cover and prioritize areas for intensive survey effort. The Riverbank Area transect followed the shoreline of the South Saskatchewan River south and then looped north on a well-established hiking trail. The Riddell Paleontological Site was surveyed with north-south parallel linear transects where possible, with deviations made to avoid obstacles. The portion of the Northeast Swale in SE 13-37-05 W3M was surveyed using a transect that followed the inside perimeter of the native habitat within the Study Area, as defined by the boundary of the cultivated field. For areas north of the Small Swale, and the adjacent upland north of the Northeast Swale in LSD 13-37-4 W3M, east-west parallel linear transects were conducted at 20 m intervals (Appendix C – Figure C1). Within NW 18-37-04 W3M, species detection survey efforts focused specifically on the northwest corner of LSD 13-18-37-04 W3M because the vegetation community in this area was different than the grassland in the remainder of the quarter section. This land was historically disturbed by a homestead (Stantec 2015) and agricultural activities, but has been recolonized by native species. The land within LSD 12-18-37-04 W3M and LSD 14-18-37-04 W3M did not undergo a formal species detection survey because the initial field reconnaissance in April revealed that the species present were representative of the grassland community within the boundaries of the Northeast Swale. However, to document the current vegetation species community and determine the health of the grassland communities in other locations within NW 18-37-04 W3M, Rangeland Health Assessments were conducted in July of 2020 (Appendix C – Figure C1).

All transects had a 5-m search width. During the surveys, plant species encountered were recorded and compiled into species lists for their respective areas. Species lacking plant parts required for a positive

identification were identified to genus, if possible. Provincially listed plant species were mapped, photographed, and enumerated. The presence of invasive species listed under the provincial *Weed Control Act* were documented during the surveys.

Rangeland and Riparian Health Assessments

During the second round of surveys in 2019, Rangeland Health Assessments as per the Saskatchewan PCAP Committee (2008a) were conducted to assess the plant community health of the grasslands north of the Small Swale in LSD 7-24-37-05-W3M and LSD 8-24-37-05-W3M; the grasslands northwest of the Northeast Swale in LSD 12-18-37-04-W3M, LSD 13-18-37-04-W3M, and LSD 14-18-37-04-W3M; and the grassland in LSD 1-14-37-05 W3M (Appendix C – Figure C1). Rangeland (range) is land made up of indigenous or introduced vegetation that is managed as a natural ecosystem and is grazed or has the potential to be grazed (Saskatchewan PCAP Greencover Committee 2008a). Range health considers net production, maintenance of soil/site stability, capture and slow release of water, nutrient and energy cycling and functional diversity of plant species. Rangeland includes grassland, pastureland, grazable forestland, shrubland, and riparian areas.

The Rangeland Health Assessment includes two types of assessments, one specific to grasslands and one specific to forest rangeland. Health scores are based on an overall score out of 100 determined by assessing the following five indicators of range health: species composition, community structure, invasive species, soil/site stability, and hydrologic function and soil protection. The first three indicators represent the vegetation status of the land and the last two represent the hydrologic function and soil protection of the site.

Vegetation status is determined by how the species composition and community structure compare to that of the reference community for the ecosite[5] the survey is in, as well as the cover and distribution of invasive/noxious weeds. Hydrologic function and soil protection are determined by the level of soil erosion, bare soil, and amount of litter present. Based on an overall score of 100, grassland range health scores are 60% based on the vegetation status of the land and 40% based on hydrologic function and soil protection; whereas forest health scores are 70% based on vegetation status and 30% based on hydrologic function and soil protection (Saskatchewan PCAP Greencover Committee 2008a). Based on the overall score out of 100, the rangeland is categorized as:

- Healthy (75% - 100%) – resembles the reference community (i.e., full range of native species), has stable soils, and uniform expected amounts of litter;
- Healthy with Problems (50% - 74%) – moderate changes from the reference community (i.e., increase in non-native species, presence of invasive/noxious species), reduction in soil stability, and reduction in the amount and uniformity of litter; and,
- Unhealthy (<50%) – significant changes from the reference community (i.e., dominated by non-native species, presence of invasive/noxious species), reduction in soil stability, and significant reduction in the expected amount and uniformity of litter.

[5] An ecosite is "a kind of land with a specific potential natural community and specific physical site characteristics" (Thorpe 2007). Each ecosite contains different reference communities representing the plant community that develops under ungrazed or lightly grazed conditions within that ecosite (e.g., gravelly ecosite reference community B is Needle-and-thread – June Grass – Pasture Sage) (Thorpe 2007).

A Saskatchewan Riparian Health Assessment (Saskatchewan PCAP Greencover Committee 2008b) was completed for the Small Swale (Appendix C – Figure C1). Riparian areas are transitional areas between a water body and the adjacent upland. Riparian health is the ability of a section or entire lake, slough, wetland, stream, river or a watershed composed of many lakes, wetlands, or rivers to perform key ecological functions (Saskatchewan PCAP Greencover Committee 2008b). Such functions include water filtration (e.g., nutrient filtration, salinity control, trapping of sediments), erosion control, storage of water and energy, groundwater recharge, maintenance of biological diversity, building and maintenance of streambanks, and creating primary productivity.

Riparian Health Assessment Scores are determined by plant community composition (i.e., vegetative cover, invasive species cover, cover of disturbance-caused vegetation, and woody vegetation present), utilization (browsing) of woody vegetation, vegetative and physical human alteration of the riparian area, human-caused bare ground, and degree of artificial modifications of water level (Saskatchewan PCAP Greencover Committee 2008b).

The following riparian health assessment categories are based on the percent value of the overall score and describe the condition of the reach assessed and the ability of it to perform riparian functions:

- Healthy (80% - 100%) – all riparian functions are performed and the reach exhibits a high level of riparian condition;
- Healthy with Problems (60% - 79%) – many riparian functions are still being performed, but some clear signs of stress are apparent; and,
- Unhealthy (<60%) – most riparian functions have been severely impaired or lost (Saskatchewan PCAP Greencover Committee 2008b).

5.2 THE SMALL SWALE AND ADJACENT GRASSLANDS

A species detection survey, one Saskatchewan Riparian Health Assessment, and three Saskatchewan Grassland Range Health Assessments were completed north of McOrmond Drive North in SW 24 37-05 W3M and SE 24 37-05 W3M (Appendix C – Figure C1). This area supports grasslands and the wetland complex associated with the Small Swale. Field surveys focused in this area because native grassland in SE 24-37-5-W3M and SW 24-37-5-W3M were categorized as Healthy in 2014 (Stantec 2015).

Field surveys were not conducted south of McOrmond Drive North in SW -24-37-05 W3M and NW 13-37-05 W3M because these areas have been cultivated or disturbed, as confirmed by air photo analysis (Google Earth Pro 2020) and based on results from Stantec (2015).

5.2.1 RESULTS AND DISCUSSION

North of McOrmond Drive North – SE 24 37-05 W3M and SW 24 37-05 W3M

Rangeland health assessments completed by Stantec (2013b) in the east half of SE 24-37-05 W3M determined that this area was dominated by Smooth Brome and was classified as Unhealthy. In 2019, EDI conducted

rangeland health assessments in LSD 08-24-37-5-W3M, which is categorized as Tame Grassland in Figure 2, and the same Unhealthy classification was determined:

- Grassland Assessment Plot 1 was located within a grassland community dominated by Kentucky Bluegrass (*Poa pratensis)* with 75% coverage, Smooth Brome with 20% coverage, and Sweet Clover (*Melilotus officinalis*) with 5% coverage. No bare ground or signs of erosion were present. This site received a score of Unhealthy (50/100) due to a plant community where the coverage was dominated by introduced species (e.g., Kentucky Bluegrass and Smooth Brome), fewer vegetation layers, and many invasive species (Table 3). Canada Thistle was found sporadically through the assessed area.
- Grassland Assessment Plot 3 was located within a shrub community. Snowberry (*Symphoricarpos albus*) made up 30% of the community, with Kentucky Bluegrass at 58% and Smooth Brome at 10%, dominating the grass layer. Canada Thistle (*Cirsium arvense*) was the most common forb. No bare ground or signs of erosion were present. Similar to Grassland Assessment Plot 1, this site received a score of Unhealthy (50/100) due to a significantly altered plant community, reduced vegetation layers and severe infestation of invasive species (Table 3).

The vegetation community becomes more diverse in LSD 07-24-37-05 W3M, with the habitat transitioning to Native Dominant Grassland/Tame Grassland (Figure 2). Although most of the uplands and slopes associated with the Small Swale feature were moderately to heavily invaded by introduced plant species such as Kentucky Bluegrass and Smooth Brome, many native species persist in isolated pockets scattered throughout the upland, including two provincially listed plant species: Plains Rough Fescue (S3)[6] and Crowfoot Violet (S3) (Figure 3). The Crowfoot Violet population numbered approximately 225 plants (Appendix A – Photo 10).

Native species became prominent and biodiversity increased down the slope of the Small Swale, with the vegetation communities in the bottom of the Small Swale noted as being in the best condition. The habitat for the lower slopes and adjacent areas surrounding the wetlands of the Small Swale in LSD 07-37-05 W3M is categorized as Native Dominant Grassland (Figure 2). An occurrence of Western Red Lily (*Lilium philadelphicum*)[7] was found in this portion of the Small Swale (Figure 3; Appendix A – Photo 11).

[6] S3 - At moderate risk of extinction or extirpation due to a restricted range, relatively few populations, recent and widespread declines, threats, or other factors (SKCDC 2019).

[7] As the provincial floral emblem, the Western Red Lily is protected under the *Provincial Emblems and Honours Act*. As such, it cannot be picked, uprooted, injured, or destroyed (Government of Saskatchewan 1988).

Table 3. Grassland rangeland and riparian health assessment sites completed in the Study Area.

Survey Area	Survey Site	Legal Land Location	Natural Area Type	Position on Land	Dominant Species	Plants in Immediate Area (20 m radius) of Assessment Waypoint	Rangeland Health
Small Swale and Adjacent Grasslands	G1	LSD 8 - 24-37-5-W3M	Grassland	Upland	Kentucky Bluegrass* – 75%; Smooth Brome* – 20%; Sweet Clover (*Melilotus officinalis*)* – 5%.	Blue Lettuce (*Lactuca pulchellum*); Common Yarrow (*Achillea millefolium*); Dock (*Rumex sp.*); Low Prairie Rose (*Rosa arkansana*); Many-flowered Aster (*Symphyotrichum ericoides*); Pasture Sage (*Artemisia frigida*); Prairie Sage (*Artemisia ludoviciana*); Silverleaf Psoralia (*Pediomellum argophyllum*); Wavyleaf thistle (*Cirsium undulatum*).	Unhealthy (50/100)
	G2	LSD 7-24-37-5-W3M	Grassland	Lowland	Northern Wheatgrass (*Elymus lanceolatus ssp. lanceolatus*) – 28%; Needle and Thread Grass (*Hesperostipa comata ssp. comata*) – 20%; Sedge sp. (*Carex* sp.) – 20%); Northern Bedstraw (*Galium boreale*) – 20%; Western Wheatgrass (*Pascopyrum smithii*) – 10%; Clubmoss sp. (*Lycopodium sp.*) – 2%	Blue Grama (*Bouteloua gracilis*); Golden-bean (*Thermopsis rhombifolia*); Kentucky Bluegrass*; Pasture Sage; Sand Grass (*Calamovilfa longifolia*); Saskatoon (*Amelanchier alnifolia*); Smooth Brome*; Wolf Willow (*Elaeagnus commutata*).	Healthy (90/100)
	G3	LSD 8 - 24-37-5-W3M	Shrubland/Grassland	Upland	Kentucky Bluegrass* – 58%; Snowberry – 30%; Smooth Brome* – 10%; Canada Thistle* – 1%; Goldenrod sp. (*Solidago sp.*) – 1%.	Northern Bedstraw, Prairie Sage, Low Prairie Rose, Wolf Willow, Thorny Buffaloberry (*Sheperdia argentea*).	Unhealthy (50/100)
	R1	LSD 7-24-37-5-W3M	Marsh	Bottom of Small Swale	Sedges – 85%; Perennial Sow Thistle (*Sonchus arvensis*)* – 10%; Wild Licorice (*Glycyrrhiza lepidota*) – 2%; Smooth Brome* – 1%; Quack Grass* – 1%; Kentucky Bluegrass* – 1%.	Baltic rush (*Juncus balticus*); Bebb's Willow (*Salix bebbiana*); Common Cattail (*Typha latifolia*); Foxtail Barley (*Hordeum jubatum*); Goldenrod sp.; Goosefoot sp.(*Chenopodium sp.*); Reed Canary Grass (*Phalaris arundinacea*); Thorny Buffaloberry; Three-square Bulrush (*Schoenoplectus pungens*); Rayless Aster (*Symphyotrichum ciliatum*); Wild Mint (*Mentha arvensis*); Wolf Willow.	Healthy with Problems (42/57)

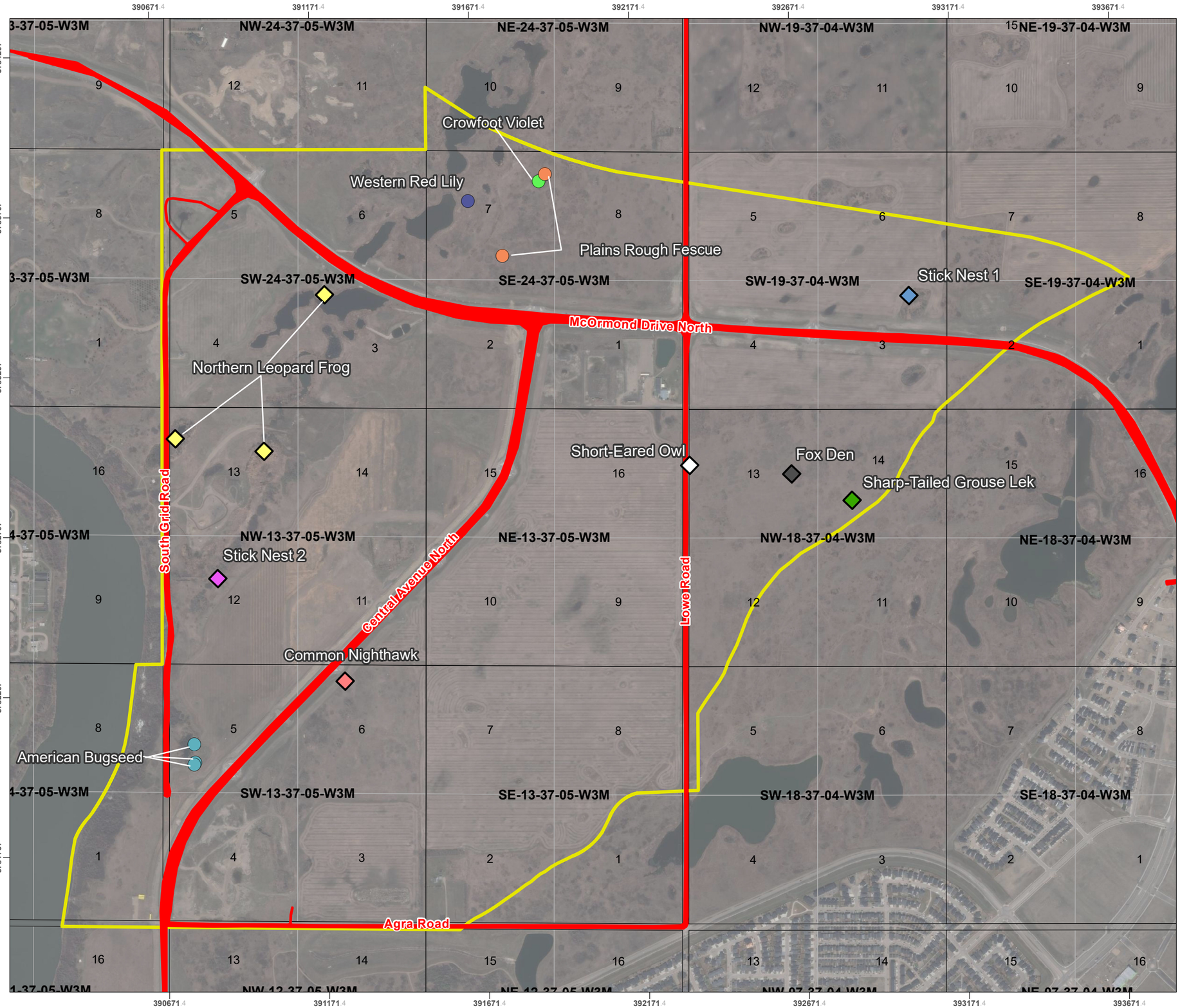
Survey Area	Survey Site	Legal Land Location	Natural Area Type	Position on Land	Dominant Species	Plants in Immediate Area (20 m radius) of Assessment Waypoint	Rangeland Health
Grasslands Adjacent to the Northeast Swale	G4	LSD 13 - 18-37-5-W3M	Grassland	Upland	Smooth Brome* – 83%; Crested Wheatgrass* – 10%; Snowberry – 5%; Hairy Golden Aster (*Heterotheca villosa*) – 2%; Common Yarrow – <1%; Slender Milkvetch (*Astragalus flexuosus*) – <1%; Low Goldenrod (*Solidago missouriensis*) – <1%.	Blue Lettuce; Cicer Milk-vetch (*Astragalus cicer*)*; Cut-leaved Anemone (*Anemone multifida*); Canada Thistle; Leafy Spurge (*Euphorbia esula*)*; Low Prairie Rose; Many-flowered Aster; Narrow-leaved Puccoon (*Lithospermum incisum*); Nodding Thistle (*Carduus nutans*) *; Northern Bedstraw; Pasture Sage; Prairie Crocus (*Anemone patens*); Prairie Sage; White Cinquefoil (*Potentilla arguta*); Wolf Willow.	Unhealthy (47/100)
	G5	LSD 13 - 18-37-5-W3M	Grassland	Upland	Kentucky Bluegrass* – 40%; Smooth Brome* – 40%; Snowberry – 15%; Crested Wheatgrass* – 2% Wolf Willow – 2%; Leafy Spurge*- 1%; Hairy Golden Aster – 1%;	Awned Wheatgrass (*Elymus trachycaulus*); Blue Lettuce; Broomweed (*Gutierrezia sarothrae*); Canada Thistle*; Cut-leaved Anemone; Low Prairie Rose; Needle and thread grass; Northern Bedstraw; Northern Wheatgrass; Pasture Sage; Prairie Coneflower; Prairie Crocus; Prairie Sage.	Healthy with Problems (50/100)
	G6	LSD 14 - 18-37-5-W3M	Grassland	Upland	Kentucky Bluegrass* – 50%; Snowberry – 25%; Smooth Brome* – 7%; Needle and Thread grass - 5%; Crested Wheatgrass – 5% Wolf Willow – 4%;Northern Wheatgrass – 2%; Hairy Golden Aster– 1%; Low Prairie Rose – 1%.	Awned Wheatgrass; Blue Lettuce; Broomweed; Common Yarrow; Cut-leaved Anemone; Gailardia; Harebell (*Campanula rotundifolia*); Prairie Coneflower; Northern Bedstraw; Prairie Crocus; Prairie Sage; Silverleaf Psoralia (*Pediomellum argophyllum*); Wavy-leaved Thistle (*Cirsium undulatum*).	Healthy with Problems (54/100)

Survey Area	Survey Site	Legal Land Location	Natural Area Type	Position on Land	Dominant Species	Plants in Immediate Area (20 m radius) of Assessment Waypoint	Rangeland Health
	G7	LSD 12 - 18-37-5-W3M	Grassland	Upland	Kentucky Bluegrass* – 50%; Snowberry – 20%; Smooth Brome* - 20%; Crested Wheatgrass* – 5%; smooth brome, Wolf Willow – 2%; * - 1%; Hairy Golden Aster – 1%; Wavy-leaved thistle – 1%; Low Goldenrod (*Solidago missouriensis*) – <1%; Slender Milk-vetch (Astragalus flexuosus) <1%;	Blue Lettuce; Canada Thistle*; Common Yarrow; Golden Bean; Low Prairie Rose; Needle and Thread grass; Northern bedstraw; Northern Wheatgrass; Pasture Sage; Prairie Sage.	Healthy with Problems (54/100)
Riverbank Area and Adjacent Upland	G8	LSD 1 - 14-37-5-W3M	Grassland	Slope and Upland	Green Needlegrass (*Nassella viridula*) – 50%; Western Wheatgrass – 40%; Northern Wheatgrass – 10%; Smooth Brome* – <1%; Crested Wheatgrass* – <1%.	Low Prairie Rose, Pasture Sage, Western Snowberry, Beautiful Sunflower (*Helianthus laetiflorus*), Hairy Golden Aster, Canada Thistle*, Absinthe*.	Healthy (76/100)
	F1	LSD 1 - 14-37-5-W3M	Forest	Slope	Largeleaf Avens (*Geum macrophyllum*); Highbush Cranberry (*Viburnum opulus var. americanum*); Trembling Aspen; Balsam Poplar (*Populus balsamifera*); Green Ash (*Fraxinus pennsylvanica*).	Red Osier Dogwood (*Cornus canadensis*); Canada Thistle*; Common Dandelion (*Taraxacum officinale*)*; Manitoba Maple (*Acer negundo*); Strawberry (*Fragaria sp.*); Northern Bedstraw; Cream coloured Vetchling (*Lathyrus ochroleucus*); Purple Oatgrass (*Schizachne purpurascens*).	Healthy (80/100)

* Denotes introduced species.

Provincially Listed Wildlife and Plant Species Observed in the Study Area During the 2019 Field Surveys

CITY OF SASKATOON



Legend

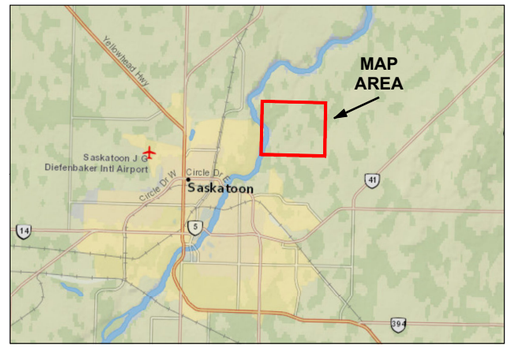
- Road
- Project Boundary
- QSec
- LSD

Provincially Listed Plants

- American Bugseed
- Crowfoot Violet
- Plains Rough Fescue
- Western Red Lily

Wildlife Observations 20200729

- Common Nighthawk
- Occupied Stick Nest-Great Horned Owl
- Occupied Stick Nest-Swainson's Hawk
- Fox Den
- Northern Leopard Frog
- Sharp-Tailed Grouse Lek
- Short-Eared Owl



0 100 200 300 400 500
Meters

Map Scale = 1:12,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N

N

Data Sources

- Imagery World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
- Inset map. National Geographic World Map

Disclaimer

EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

Drawn: YN	Checked: CJ/HT	Figure 3	Date: 2021-03-16

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Path: L:\PROJECTS\2019\19S0049_COS_UH3\Mapping\Report\19S0049_Fig3_Wildlife_Vegetation_202007.mxd

- Rangeland health assessments completed by Stantec (2015) classified the grassland on the slopes and within the Small Swale located in LSD 07-24-37-05 W3M as Healthy and resembling the moist-mixed grassland ecosite reference community of Needle-and-Thread Grass – June grass – Pasture Sage. In 2019, the rangeland health assessment completed by EDI at Grassland Assessment Plot 2 confirmed the Healthy status and ecosite reference community classification (Table 3) observed in 2014; Grassland Assessment Plot 2 was located on an intact native grassland remnant in LSD 07-24-37-05, just bordering LSD 06-24-37-05 W3M. The vegetation was comprised of a diverse community with dominant species including Needle and Thread Grass (*Hesperostipa comata ssp. comata*) with 20% coverage, Northern Wheatgrass (*Agropyron dasystachyum*) with 28% coverage, Western Wheatgrass (*Pascopyrum smithii*) with 10% coverage, Sedges (*Carex* spp.) with 20% coverage, and a variety of forbs making up over 30% of the community. No bare ground or signs of erosion were present. The Healthy (90/100) score was brought down by sporadic occurrences (<1% coverage) of Smooth Brome and Kentucky Bluegrass (Table 3).

Rangeland health assessments completed by Stantec (2015) also classified the grasslands in the northern portions of LSD 05 and 06 24-37-05 W3M as Healthy and resembling the moist-mixed grassland ecosite reference community of Needle-and-Thread Grass – June grass – Pasture Sage. Since the Stantec study, the grasslands within LSD 05 and the western portion of LSD 06 were disturbed by earthworks during the construction of McOrmond Drive North and are categorized as Disturbed/Developed in Figure 2. The remaining grassland in the eastern portion of LSD 06 -24-37-05 W3M is categorized as Native Dominant Grassland/Tame Grassland instead of Native Dominant Grassland because of an increased prevalence of introduced species.

In 2019, EDI also conducted a riparian health assessment in a representative portion of the wetland complex in LSD 07-24-37-05 W3M (Appendix C – Figure C1):

- Riparian Assessment Transect 1 was located in the wet meadow zone of Wetland 3027. The vegetation community was predominantly made up of Sedge species; however, Perennial Sow Thistle (*Sonchus arvensis*) was dominant on the outer edges of the wetland. Wetland communities in the Small Swale tended to be healthier within or closer to the water's edge, because fewer invasive species grow in saturated soil or standing water. The wetland vegetation community scored Healthy with Problems (42/57) due to the presence of invasive species, along with poor tree and shrub establishment, and disturbance of the riparian area by cattle. Based on our understanding of the past land use of this area, long-term moderate to heavy grazing has likely simplified the plant community (Table 3).

In terms of the biodiversity and ecological importance of the vegetation communities surveyed, SE 24-37-05 W3M and SW 24-37-05 W3M are particularly valuable given their high species richness and the presence of provincially listed plant species. Overall, 165 plant species were documented north of McOrmond Drive North during the species detection survey, of which 103 species were native (Appendix D – Table D1) and two were provincially listed species at risk (Plains Rough Fescue and Crowfoot Violet). A rare plant survey is only able to confirm the presence of a species, not the absence of a species. As such, it is important to note that although the following provincially listed plant species were not detected by EDI in 2019, there is potential for their occurrence given recent observations near the Study Area:

- Few-flowered Aster (*Almutaster pauciflorus*) (S3) was previously documented in adjacent habitat types (SKCDC 2019).
- Marsh Felwort (*Lomatogonium rotatum*) (S3) was found near the Study Area in NW 24-37-5 W3M, on September 7, 2019, as part of a Meewasin survey effort.

A total of 11 weed species listed under the provincial *Weed Control Act* were identified in the surveyed area (Appendix D – Table D2).

South of McOrmond Drive North – SW 24-37-05 W3M and NW 13-37-05 W3M

The majority of the land cover south of McOrmond Drive North in SW 24-37-05 W3M and NW 13-37-05 W3M includes a mosaic of previously disturbed lands (e.g., cropland, tame grasslands, and developed land for municipal material storage associated with the Civic Material Handling Yard) along with remnant wetland communities and patches of native upland as shown in Figure 2. As a result, native grassland has been reduced, only occurring in NW 13-37-05 W3M along the margins of the wetland complexes and the remnant treed habitat comprised of Trembling Aspen and Hawthorn immediately south of the Civic Material Handling Yard. The vegetation communities are largely classified as Unhealthy as a result of past disturbance and have been heavily encroached by invasive and introduced grass species such as Smooth Brome and Kentucky Bluegrass, which form the dominant ground cover. Similarly, many of vegetation communities associated with the wetland complex in the portion of the Small Swale south of McOrmond Drive North are unhealthy due to the extent of cultivation that extended into or through the wetlands when conditions were dry, as they were from 2002 to 2006, based on historical satellite imagery (Google Earth Pro 2020).

5.2.2 RECOMMENDATIONS

North of McOrmond Drive North – SE 24 37-05 W3M and SW 24 37-05 W3M

The native grassland within the lowlands of the Small Swale feature is considered healthy and the uplands support populations of Prairie Fescue and Crowfoot Violet, both provincially tracked plant species. Although the uplands are moderately to heavily invaded by introduced grasses, species richness of native species is high.

It is recommended that the native grassland within and adjacent to the Small Swale in LSD 06- 24-37-05 W3M and LSD 07-24-37-05 W3M be included as part of the proposed Ecological Zone with a set-back distance of at least 100 m from the Prairie Fescue and Crowfoot Violet populations. This 100-m setback distance represents a compromise between the development of UH3 and Environment Canada's Activity Set-back Distance Guidelines for Prairie Plant Species at Risk (Henderson 2011), which recommends a 300-m setback distance for Class 3 activities[8]. The Most roadside edge effects on plant species resulting from construction and repeated traffic are greatest within the first 30 to 50 m, but salinity, nitrogen and hydrological effects can extend 100 to 200 m, and invasive species can occur up to 1 km from roads (Forman and Alexander 1998; Forman et al. 2003). As such, the recommended 100 m setback distance minimizes most roadside edge effects

[8] Class 3 activities - cause acute and chronic disturbances (i.e., buildings and permanent structure, paved roadways, improved recreational trail or parking lot - gravel or paved, spraying of pesticides or release of biological control agents, and seeding of non-native crops or forages) (Henderson 2011).

and salinity, nitrogen, and hydrological effects. To minimize the introduction of weed species, it is recommended that weed management practices be applied within a 1,000 m of Project development. Several areas within SE 24 37-05 W3M and SW 24 37-05 W3M currently support grasslands with introduced species. As such, it is recommended that range management and weed management practices be included to control the further proliferation of these introduced/invasive species.

South of McOrmond Drive North – NW 13-37-5-W3M

It is recommended that the treed area, comprised of Trembling Aspen and Hawthorn, located south of the Civic Materials Handling Yard (adjacent to Wetland 3031) be left intact to provide a natural travel corridor for wildlife and to maintain connectivity with the vegetation communities within the Small Swale feature. Preservation of the Hawthorn shrubs is also important because it provides potential nesting habitat for Loggerhead Shrike, which has been previously documented in the Study Area (SKCDC 2019). Secondly, these mature trees will provide green infrastructure and aesthetic value for future urban development.

This is expected to allow compliance with Section 9.2 of the OCP (City of Saskatoon 2019), related to Conservation of Natural Areas and Archaeological Sites and Section 9.3 of the OCP, related to Urban Forestry (City of Saskatoon 2019).

5.3 GRASSLANDS ADJACENT TO THE NORTHEAST SWALE

Species Detection Surveys and Rangeland Health Assessments were conducted in the native grassland within the northwest portion of LSD 13-18-37-04 W3M, as well as within the remnant vegetation communities in the LSD 02-13-37-05 W3M (Appendix C – Figure C1). In 2014, both areas were found to support a relatively diverse native species complement but had been invaded by introduced grass species resulting in a rangeland health assessment classification of Unhealthy (Stantec 2015). Rangeland Health Assessments were conducted in July of 2020 within LSD 12-18-37-04 W3M, LSD 14-18-37-04 W3M, and the southeast portion of LSD 13-18-37-04 W3M, to document the current vegetation species communities and determine the grassland's health (Appendix C – Figure C1).

Formal vegetation surveys were not conducted in SW 13-37-05 W3M or SE 19-37-04 W3M in 2019 because of the limited extent of native vegetation communities that persist and high levels of disturbance, including past cultivation and gravel extraction/storage activities in SW 13-37-05 W3M and the North Commuter Parkway project (e.g., construction of the McOrmond Drive North expansion and associated forebays and other infrastructure). A review of 2017 satellite imagery (Google Earth Pro 2020) and ground-truthing in the spring of 2019 confirmed the limited size of native vegetation communities, and the extent of isolation/fragmentation in this portion of the Study Area.

5.3.1 RESULTS AND DISCUSSION

NW 18-37-04 W3M

A Species Detection Surveys and Rangeland Health Assessment were completed within the northwest corner of NW 18-37-04 W3M (i.e., LSD 13) (Appendix C – Figure C1), portions of which have been disturbed by agricultural activities. Typically, introduced grasses, such as Smooth Brome, Kentucky Bluegrass, and Crested Wheatgrass (*Agropyron cristatum*), are some of the first plants to establish in disturbed areas. High proportions of Smooth Brome were noted in LSD 13-18-37-04 W3M and along the Lowe Road ditch, and Crested Wheatgrass was prevalent in the southern portion of the LSD. The dominance of introduced grass species was reflected in the rangeland health assessment:

- Grassland Assessment Plot 4 was located in LSD 13-18-37-04 W3M and received a score of Unhealthy (47/100). Smooth Brome with 83% coverage and Crested Wheatgrass at 10% coverage were the dominant grasses, with Snowberry comprising 5% coverage, and the remaining cover made up of different forb species. No provincially listed plant species at risk were found within the surveyed area. Although the vegetative cover was dominated by introduced species, the number of native species (i.e., species richness) was relatively high. For instance, 51 of the 66 plant species documented during the species detection survey were native, including eight native grass species (Appendix D – Table D3). Even though the plants were mostly native and no bare ground or signs of erosion were present, the dominance of Smooth Brome resulted in the Unhealthy Score: the Vegetations Status only received 7/60 because the plant community did not resemble the reference community due to the dominance of Smooth Brome (7/40[9]); the vegetation layers did not resemble the reference community (0/10); and the cover and distribution of invasive/noxious species (i.e., smooth brome) was high (0/10). Of the introduced species identified, five were weed species listed by the provincial *Weed Control Act* (Appendix D – Table D4). It is anticipated that previous management techniques in this portion of NW 18-37-04 W3M have effectively reduced the proliferation of introduced species (particularly Smooth Brome) and allowed opportunities for native plant species to re-establish within previously disturbed areas.

Based on incidental observations collected as part of the spring 2019 surveys, and the three Rangeland Health Assessments that were conducted in July of 2020, the remaining portions of the quarter section (i.e., the southeast corner of LSD 13, LSD 12, and LSD 14-37-04 W3M adjacent to the ecological boundary of the Northeast Swale) were comprised of grasslands that have not been physically disturbed (i.e., previously cultivated) and supported healthier plant communities than that found in the northwest corner of LSD 13-18-37-04 W3M. Although native plants, particularly forbs, were dominant in terms of overall species present at all three assessed sites, the overall cover was dominated by introduced grass species (e.g., Kentucky Blue Grass, Smooth Brome) with patches of snowberry distributed throughout the quarter section at approximately 20% coverage. Patches of Leafy Spurge were distributed throughout the southeast corner of LSD 13-18-37-04 W3M. Although a few patches of Leafy Spurge were present within LSD 12-18-37-04 W3M, the presence

[9] 7/40: "Compared to the reference community the plant community shows significant alterations due to disturbances. Disturbance impact is heavy to very heavy. Plants are mostly native. Some tall, non-native plants may be present…. Example 2. Kentucky blue grass plant community".

of Leafy Spurge was relatively isolated within the fenced boundary of LSD 13-18-37-04 W3M. Intermittent patches of Canada Thistle were present throughout LSD 13-18-37-04 W3M and to a lesser extent in LSD 12-18-37-04 W3M. Although Canada Thistle was also present in LSD 14-18-37-04 W3M, its abundance and distribution were lower. No bare ground or erosion was evident at the sites. The overall health score for all three sites was reduced by the dominance of introduced grass species, as well as the more prominent cover and distribution of invasive species:

- Grassland Assessment Plot 5 was located in the southeast corner of LSD 13-18-37-04 W3M and received a score of Healthy with Problems (50/100). Kentucky Bluegrass and Smooth Brome were the dominant species, with each comprising about 40% of the overall cover. Several native grass species were found; however, they were less common. Approximately 15% of the area was covered by Snowberry. The forb layer provided the highest number of species present with native plants dominating, such as Blue Lettuce, Hairy Golden Aster, and Prairie Sage. Leafy Spurge was documented throughout LSD 13-18-37-04 W3M, as well as several patches of Canada Thistle.
- Grassland Assessment Plot 6 was located in LSD 14-18-37-04 W3M and received a score of Healthy with Problems (54/100). Kentucky Blue Grass was the dominant grass species, with an overall cover of 50%. Secondary grass species included Smooth Brome, Crested Wheatgrass, Needle and Thread Grass, Northern Wheatgrass, and Smooth Brome. Snowberry was prominent on the site, covering approximately 25% of the area. The diverse forb layer was predominantly native species with Hairy Golden Aster, Low Goldenrod, and Blue Lettuce being the most common.
- Grassland Assessment Plot 7 was located in LSD 12-18-37-04 W3M and received a score Healthy with Problems (54/100). The vegetation community within LSD 12-18-37-04-W3M was very similar to LSD 14-18-37-04 W3M; however, it had a higher coverage of Smooth Brome, particularly along the western edge of the grassland. Canada Thistle was present in several patches. Hairy Golden Aster, Wavy-leaved thistle, Low Goldenrod, and Slender Milk-vetch were the dominant forb species.

SE 13-37-05 W3M

The native grassland portion of the SE 13-37-05 W3M, specifically LSD 02-13-37-05 W3M that was surveyed, is adjacent to the boundary of the Northeast Swale and the southern boundary of the Study Area. This community was similar to that found in NW 18-37-04 W3M. This area exhibits more topographic relief than NW 18-37-04 W3M, including some rocky knolls that supported small, but intact, native grassland communities, including Needle and Thread Grass. Outside these pockets of native grassland, most of this portion of the SE 13-37-05 W3M was dominated by Kentucky Blue Grass and Smooth Brome. Nuisance and noxious weeds included Nodding Thistle (*Carduus nutans*), Canada Thistle, Perennial Sow-thistle, Common Tansy (*Tanacetum vulgare*), and Common Dandelion (*Taraxacum officinale*).

Shrub encroachment is also disturbing the state of the native grasslands in this portion of the Study Area. Shrubs are not naturally prominent in grasslands due to natural disturbances such as burning and grazing. Shrub encroachment changes the vegetative structure and plant community, thereby transitioning the natural grassland to shrubland and thus changes the flora and fauna species that it supports. This grassland was classified as Unhealthy in 2014 (Stantec 2015). Although a formal Rangeland Health Assessment was not

conducted in this area during the 2019 surveys, the health of the vegetation community was deemed to be Unhealthy as it was comparable to the grassland habitat found in NE 18-37-04-W3M.

5.3.2 RECOMMENDATIONS

NW 18-37-04 W3M

It is recommended that the grasslands in NW 18-37-04 W3M, particularly LSD 14-18-37-04 W3M, be conserved to the extent practical for ecological benefits, and undergo range management to reduce the proliferation of introduced and invasive species. Section 6 elaborates on the ecological benefits. Subject to detailed design, two options to conserve this portion of grassland include:

- integrate as much of the grassland in LSD 14-18-37-04 W3M into the proposed Ecological Zone as part of the Northeast Swale boundary; and,
- consider bordering the proposed Ecological Zone in NW-18-37-04 with a core park or a school yard similar to Silver Spring Elementary School or St. Joseph High School.

Upland native grasslands are at greater risk of development than those found in "unserviceable land" associated with the slopes of the Northeast Swale. These remnant habitats can facilitate movement of wildlife and plants through the maintenance of connectivity corridors and habitat island refugia; the larger and more well-connected these areas are, the more resilient they will be to invasive species and disease, allowing for the maintenance of native plant biodiversity. Additional benefits of preserving this grassland habitat are provided in Section 6.1.3 as they relate to wildlife species.

SE 13-37-05 W3M

It is recommended that a greenway along the northwest edge of the Northeast Swale boundary (discussed in further detail in Section 10.1) extend into SE 13-37-05 W3M. Although Smooth Brome and Kentucky Bluegrass tend to dominate the vegetative cover in this area, the number of native grass, forb and shrub species is relatively diverse. As part of the greenway, it is likely that maintaining a portion of this grassland for use as a Greenway will provide connectivity with the grassland and shrub habitats that are currently part of the Northeast Swale.

This is expected to allow compliance with Section 9.2.2(f) related to Integrated Open Space (City of Saskatoon 2019).

5.4 RIVERBANK AREA AND ADJACENT UPLAND

According to the OCP (City of Saskatoon 2019), the Riverbank Area is defined as "Land within the corporate limits of the City of Saskatoon being within ninety-two (92) metres of the shoreline of the South Saskatchewan River or on any part of the slope leading down to said shoreline where the gradient is in excess of twenty (20) percent, plus 10 metres, whichever extends the greatest distance measured horizontally from the shoreline." The University Heights Sector plan identified the Riverbank Area in SE 14-37-05 W3M as 150 m from the

shoreline. During the 2019 field surveys, EDI assessed the accuracy of the 150 m Riverbank Area according to the definition in the OCP.

A Species Detection Survey was completed for the Riverbank Area and two Saskatchewan Rangeland Health Assessments were conducted within 92 m and 150 m from the shoreline of the South Saskatchewan River within SE 14-37-5-W3M (Appendix C – Figure C1). A forest Rangeland Health Assessment was conducted in a representative portion of the Riverbank Area in LSD 01-14-37-5-W3M.

A grassland Rangeland Health Assessment was conducted on a site that was disturbed in 2010/2011 to construct a stormwater outfall near the river shoreline. This site was revegetated with native grass species by the MVA in 2011.

5.4.1 RESULTS AND DISCUSSION

The 2019 field surveys verified that the width of the Riverbank Area was within 92 m of the river in the north and extends to a width of 125 m in the south, confirming agreement with the OCP's definition of the Riverbank Area.

The Riverbank Area is comprised largely of an intact and diverse riparian forest with a deciduous-dominated tree canopy, an understory of shrubs and forbs, and small patches of grassland on portions of the drier upper slopes. Along the river's edge, a community of aquatic plants dominated, in an area that supported a number of natural seeps. Of the 138 plant species identified within the Riverbank Area and the Riddell Paleontological Site, 65 species were not found anywhere else in the Study Area, likely due to the microhabitat of the riparian forest and terrain features (Appendix D – Table D5). A total of 11 weed species listed by the provincial *Weed Control Act* were identified in the surveyed area (Appendix D – Table D6).

- Forest Assessment Plot 1 – The vegetation community received a score in 2019 of Healthy (80/100). Dominant species were Trembling Aspen, Balsam Poplar (*Populus balsamifera*), Green Ash (*Fraxinus pennsylvanica*), Largeleaf Avens (*Geum macrophyllum*), and Highbush Cranberry (*Viburnum opulus var. americanum*). The health score was lowered by erosion noted at informal hiking trails, a thinner than normal surface organic layer, and the presence of invasive species. The invasive species made up <5% coverage and consisted of European Buckthorn (*Rhamnus cathartica*), Canada Thistle, Absinthe (*Artemisia absintha*), Common Dandelion, Perennial Sow Thistle, and Sweet Clover.

The previously disturbed area at Grassland Assessment Plot 8 that was reseeded in 2011 now supports a relatively diverse native grassland habitat as reflected in the grassland rangeland health assessment conducted at this site:

- Grassland Assessment Plot 8 – The vegetation community at this location in 2019 received a score of Healthy (76/100). The dominant species at the site were Green Needlegrass (50%), Western Wheatgrass (40%), and Northern Wheatgrass (10%). The proportion of introduced species in the plot, including Smooth Brome, Crested Wheatgrass, Canada Thistle, and Absinthe was low, with a combined cover of <1%. The score was lowered because the plant community only moderately resembled the reference plant community where only tall grasses were present, the lack of forbs or ground cover, and by the presence

of invasive species. The biodiversity of the plant community is expected to increase and include forbs as the site matures and propagules disperse from nearby native sites into this revegetated area.

5.4.2 RECOMMENDATIONS

Overall, the Riverbank Area provides one of the healthiest, most intact, and biodiverse habitats within the Study Area. As such, it is recommended that subject to detailed design, the Riverbank Area and the adjacent upland within 150 m from the shoreline be dedicated to Municipal Reserve as a Natural Area or Natural Asset under the provisions outlined in Bylaw No.8769 of the OCP (2019). This is expected to allow compliance with Section 9.1 of the OCP, related to Riverbank Stewardship, and Section 9.3 related to Urban Forestry.

5.5 THE RIDDELL PALEONTOLOGICAL SITE

A species detection survey was conducted at the Riddell Paleontological Site in LSD 05-13-37-05 W3M, an upland site that has been identified as an important paleontological site (as described in further detail in Section 9.3). The area is comprised of four different habitat types due to its variable topography and soil types: a grassland community, a wetland community, an open deciduous woodland, and steep eroded sandy slopes associated with a small coulee complex that extends northwest towards the South Saskatchewan River valley.

5.5.1 RESULTS AND DISCUSSION

The grassland community is on the unexcavated areas within the boundaries of the site and includes a mix of native and introduced species, although it is dominated by Smooth Brome and Wolf Willow.

The site includes two wetlands, both with a management class type of Preserve: Wetland 3001 (Class 3 – seasonal) and Wetland 3002 (Class 2 – temporary)[10]. The wetland community in Wetland 3001 was dominated by Common Cattail (*Typha latifolia*) and Sandbar Willow (*Salix interior*), with Trembling Aspen found at the toe of the slopes.

The temporary wetland (Wetland 3001) was dominated by Willows. A small stand of Cottonwood trees (*Populus deltoides*) and patches of Hawthorn and Saskatoon were found on the toe of the slope. The steep and eroded slopes along the inactive gravel pit, which experience active slumping, provides a unique habitat found in the Study Area. It is on these sandy slopes where a population of 42 provincially listed S3 (Vulnerable/Rare to uncommon)[11] American Bugseed (S3) were found (Appendix A – Photo 9). The sandy microsite habitat, on which American Bugseed is dependant, is only found at this site within the Study Area.

Although a formal rangeland health assessment was not conducted in the Riddell Paleontological Site, the vegetation communities were deemed to be Healthy with Problems due to the mix of native and introduced species that modified the vegetation community from that of its reference community. Illegally dumped

[10] See Section 7 for an explanation of wetland classes.

[11] S3 - At moderate risk of extinction or extirpation due to a restricted range, relatively few populations, recent and widespread declines, threats, or other factors (SKCDC 2019).

household items (e.g., mattresses) were found on the east side of the site, in an area where introduced and invasive species were more dominant.

The Riddell Paleontological Site forms an extension of the Riverbank Area plant community. While adjacent to the former Central Avenue North roadway, the Riddell Paleontological Site and the adjacent Riverbank Area share commonalities including common vegetation communities, geography, hydrological features and likely share a genetic exchange between the two areas.

5.5.2 RECOMMENDATIONS

Given the Riddell Paleontological Site's paleontological importance, its proximity to the Riverbank Area, its current composition of native vegetation communities, topographic relief, and hydrological features, it is recommended that:

- the Riddell Paleontological Site be included as part of a proposed Ecological Zone, subject to detailed design, dedicated as Municipal Reserve, Natural Area or Natural Asset; and,
- the integrity of the site is not disturbed, but left in its current condition. For example, the eroded slopes of the coulee complex should remain undisturbed to provide a suitable ecological niche for American Bugseed to persist in the Study Area.

These recommendations are expected to allow compliance with Section 9.2 of the OCP, related to Conservation of Natural Areas and Archaeological Sites.

6 FAUNA

The fauna assessment focused on detection of species at risk and important/sensitive wildlife features, such as raptor nests and Sharp-tailed Grouse leks, within the Study Area that need to be considered during the planning and development of UH3. The assessment methods were based on science and current accepted protocols outlined by ENV and Alberta Environment and Parks (Government of Alberta 2013), and included the following:

- Sharp-tailed Grouse lek survey;
- raptor nest survey;
- breeding bird survey;
- Common Nighthawk survey;
- Short-eared Owl survey;
- amphibian (auditory and visual) survey; and,
- wildlife corridor (i.e., remote camera) surveys.

The following sub-sections discuss the methods and results of each survey. Survey points for each survey are shown in Appendix C – Figures C2 – C6, and wildlife observations recorded during these surveys are shown in Figure 3.

6.1 SHARP-TAILED GROUSE LEK SURVEY

The presence of a Sharp-tailed Grouse lek within the Study Area in LSD 14-18-37-04 W3M has been documented by MVA for the past decade and noted by the ENV in the HABISask database (SKCDC 2019). The purpose of the 2019 Sharp-tailed Grouse lek survey was to assess the status of this lek and determine the presence of Sharp-tailed Grouse at other potential locations (i.e., satellite leks) within the Study Area.

6.1.1 METHODS

Three rounds of Sharp-tailed Grouse lek surveys were completed in accordance with the Alberta Environment and Sustainable Resource Development's (ESRD) Sensitive Species Inventory Guidelines (Government of Alberta 2013) on April 3 – 4, April 12 and April 25, 2019. Currently, ENV does not have their own published survey protocols for Sharp-tailed Grouse and raptor nest surveys. As such, they have adopted the ESRD survey protocol developed by AEP (Government of Alberta 2013). The 2019 surveys were conducted in areas of suitable habitat within the Study Area during the active lekking period (i.e., late March to early May).

Prior to the first round of surveys, 15 survey points (plus the known lek, which is the 16th survey point) were chosen based on suitable habitat identified using satellite imagery from the past five years (Google Earth Pro 2020). During round one, all 15 of these points were surveyed and their habitat suitability assessed. After the first round, 10 of the points were eliminated, and not resurveyed in subsequent rounds, due to poor habitat suitability at the survey point locations. The second and third rounds of surveys included five survey points (i.e., Survey Points 1, 6, 7, 8 and 13) with suitable Sharp-tailed Grouse habitat. In addition, a temporary blind

was constructed in the late afternoon on April 24, 2019, approximately 40 m north of the lek, to allow the surveyors to obtain an accurate count of males and females.

Surveys were completed in the early morning hours when lek activity is at its peak, beginning an hour before sunrise and ending three hours after sunrise. Point locations were surveyed during favorable weather conditions (i.e., no precipitation and winds under 20 km/hour). At each point, the observer scanned the landscape with binoculars, while listening for signs of Sharp-tailed Grouse for six minutes. Where grouse were observed, a GPS location of the observation was collected, along with the total number of grouse, presence of a lek or individuals displaying mating behavior, habitat type, and landscape features.

6.1.2 RESULTS AND DISCUSSION

During the 2019 field surveys, the Sharp-tailed Grouse lek was confirmed at the previously recorded location within LSD 14-18-37-04 W3M and found to be actively used by both male and female grouse. The number of individual grouse observed on the lek varied from 19 to 22 (Table 4). During round one and two, as well as the afternoon visit of round three (April 24) to set-up the temporary blind, the grouse flushed (i.e., birds were startled into flight upon approach) before sex composition could be determined.

Table 4. Number of Sharp-tailed Grouse observed at the lek in LSD 14-18-38-04 W3M during the 2019 field surveys.

Round	Date	Task	# Adult Birds (Observed on Lek)	Comments
1	April 3	Lek Survey	20	Grouse flushed – sex composition not determined
2	April 12	Lek Survey	20	Grouse flushed – sex composition not determined
3	April 24	Temporary Blind Set-up	22	Grouse flushed – sex composition not determined
3	April 25	Lek Survey	19	16 males and 3 females observed from temporary blind.

Sharp-tailed Grouse were identified at two of the remaining 14 survey points (Survey Points 6 and 13 Appendix C – Figure C2) (Table 5). Two Sharp-tailed Grouse were observed at Survey Point 6 in rounds two and three, while an individual grouse was observed at Survey Point 13. While Sharp-tailed Grouse were observed at these two other survey points, there was no indication that additional leks were located within the Study Area.

Table 5. Sharp-tailed Grouse survey results observed within the UH3 Study Area in 2019.

Sharp-tailed Grouse Survey Point	Zone	Easting	Northing	Dominant Habitat	Round 1 Observations (April 3 and April 4)	Round 2 Observations (April 12)	Round 3 Observations (April 25)	Description
1	13U	390625	5781861	Tame Grassland	0	0	0	No observations
2	13U	390815	5782430	Tame Grassland	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
3	13U	390712	5783016	Hay Crop (Forage)	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
4	13U	391036	5783497	Hay Crop (Forage)	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
5	13U	391722	5783210	Tame Grassland	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
6	13U	391388	5782741	Yard Site Abandoned/Tame Grassland	0	2	2	Two adults
7	13U	391401	5782138	Tame Grassland	0	0	0	No observations
8	13U	392825	5782765	Native Dominant Grassland	20	20	19 (16 males 3 females)	Confirmed active lek (average 20 adults)
9	13U	392519	5782880	Native Dominant Grassland	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
10	13U	392422	5782351	Native Dominant Grassland	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
11	13U	393446	5783358	Native Dominant Grassland	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
12	13U	393241	5783589	Native Dominant Grassland	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
13	13U	392003	5783828	Native Dominant Grassland/ Tame Grassland	1	0	0	1 adult
14	13U	391250	5783754	Native Dominant Grassland/ Tame Grassland	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability
15	13U	391689	5781474	Tame Grassland	0	NA	NA	Not surveyed R2/R3 due to poor habitat suitability

Based on survey data received from the MVA (Grilz 2019), Table 6 provides a summary of the number of males using the lek recorded over the past four years:

Table 6. Number of adult male Sharp-tailed Grouse observed on the lek in LSD 14-18-38-04 W3M, 2016 to 2019.

Year	# Adult Male Birds (Observed on Lek)
2016	38[12]
2017	34
2018	22
2019	24

Sharp-tailed Grouse are native grassland specialists (Barber and Pepper 1971) and require a combination of habitat types to fulfill their life requisites (Alberta Conservation Association 2010). Grasslands provide habitat for foraging, resting places, and leks. Shrublands provide suitable nesting habitat and protective cover for young, as well as a source of food, particularly Western Snowberry. Treed habitat provides day-roosting sites and lookout perches, additional foraging opportunities, as well as protective cover during the winter, both from the branches, but also the accumulated snow to burrow in (Nature Saskatchewan 2002).

Breeding habitats are typically dominated by relatively dense herbaceous cover and some shrubs, although the dominant vegetation species may vary (Conkin 2018). Nesting occurs in close proximity to the lek location, and nests are usually located in relatively thick cover (Pepper 1972), often with vegetation at least 30 cm high with dense foliage (Connelly et al. 1998). Further, Nicholson (2019) indicated that 75% of Sharp-tailed Grouse typically nest within 1.6 km of a lek. Once the young leave the nest, the broods disperse to habitats with diverse cover types that offer a range of food sources such as forbs and insects. In winter, Sharp-tailed Grouse rely on a variety of habitat types for protective cover and a source of food (Schmidt 1992; Alberta Conservation Association 2010), including riparian areas, deciduous hardwood shrub draws and forest (both deciduous and open coniferous).

The areal extent of the lek in NW 18-37-04 W3M is approximately 20 m by 40 m, although birds were observed incidentally using adjacent native habitat types for shelter or refuge during other wildlife and vegetation surveys. The number of birds using the lek consistently throughout the survey period (i.e., the month of April) indicates that this lek would be classified as relatively healthy. However, it is unclear to what extent, if any, the recent activities in the vicinity of the Study Area have affected the number of males and female Sharp-tailed Grouse attending the lek or if the effects are due to natural causes. The success of the lek co-existing in an urban setting would depend on a number of factors, including habitat quantity and quality in the vicinity of the lek (e.g., setback distance); the capacity of the remaining habitat to meet all the life-requisites of the birds; the connectivity of habitat in the Study Area with other habitat types; the level of human disturbance; and environmental conditions such as weather. This species tends to be more tolerant to disturbance than other grouse species (Conkin 2018; Nicholson 2019), whereby birds that are flushed from the lek by a passing disturbance or potential predator, typically return promptly to the lek (Nature Saskatchewan 2002). However,

[12] Construction for the North Commuter Parkway project began in late 2015.

repeated disturbance to the birds on a lek may disrupt breeding activities and result in abandonment of the lek (Alberta Conservation Association 2010; Nicholson 2019). Therefore, continued monitoring of the population of the lek is important and recommended; tracking the number of birds over time, and comparing results to population trends at other leks, is expected to provide additional insight on whether the birds are directly affected by urban expansion and activities or natural causes.

Several of the biggest threats to long-term sustainability of upland game bird populations include habitat loss, fragmentation and degradation (Aldridge et al. 2004; Norton et al. 2010; Environment Canada 2013a; North American Bird Conservation Initiative 2016). With respect to populations, upland game bird numbers have been highly variable through time (Conkin 2018). This is largely related to their vulnerability to inclement environmental conditions and their high reproductive capacity that allows populations to rebound quickly after they have experienced significant declines. Annual variation in upland game bird populations is largely driven by weather severity (Pepper 1972; Flanders-Wanner 2004) and how weather influences survival and reproduction in a variety of different ways.

There is potential for the lek to remain viable if surrounded by urban development. The development plan should consider the setback distance, habitat retention, and minimal human disturbance to encourage a healthy viable lek. However, as noted in Tables 5 and 6, the observed population size of Sharp-tailed Grouse on this lek appears to be declining from numbers previously identified by the MVA. If the lek is surrounded by urban development and associated anthropogenic activities, it is anticipated that the direct effects on the birds (e.g., habitat loss, disturbance) would likely increase. Depending on the development plan (e.g., setback distance, habitat retention, allowed human disturbance), adjacent activities could lead to a further decline in the number of Sharp-tailed Grouse using the lek and the associated habitats that are currently providing all the life requisites with the possibility of abandonment of the lek. While Red Fox, Coyotes and other predators currently use the Study Area, it is expected that an increasing presence of humans and domestic canines, especially in the vicinity of the lek, would increase the stresses on the birds. While Sharp-tailed Grouse rely primarily on native habitats, they may use non-native habitats (e.g., cropland) to supplement their resource needs for additional forage opportunities or for protective cover. Without the availability of native habitat, this species would likely have difficulty persisting (Pepper 1982; Grossman and Stavne 2005). However, setting aside native habitat may continue to provide the life requisites for this species. Given that native grassland habitat has been particularly vulnerable to loss and degradation over the last century, and while the majority of native habitat loss occurred decades ago, it is important to retain the remaining native habitat as much as possible to fulfill the life requisites of this species. Setting aside grassland habitat surrounding the lek, with appropriate connectivity, is anticipated to be beneficial for the Sharp-tailed Grouse on a year-round basis.

At a local perspective, while the distribution of Sharp-tailed Grouse is uneven throughout the Saskatoon region, of the estimated 141 known leks, the majority tend to be located in larger, contiguous pasture habitats west of Saskatoon around Pike Lake, Donavon, Asquith and Goose Lake (Nature Saskatchewan 2002). Leks no longer exist in many areas around Saskatoon due to the conversion of natural habitat to cultivated lands and urban expansion, including acreage developments. Of the 12 leks that were once active south of Saskatoon, by 1998 only three remained (Nature Saskatchewan 2002). The nearest lek to the Study Area is located in SW 30-37-04 W3M, approximately 1.0 km north of the Study Area where no data were collected.

The recommendations provided as part of the discussion sections of this report are based on the currently available data for the studied lek and those that will be collected as part of future monitoring programs.

Given the importance of quality habitat in the long-term sustainability of upland game bird populations, it is imperative to engage those responsible for managing the land base (Conkin 2018). This is addressed further in the following recommendation section.

The potential for the lek to remain viable, if it were completely surrounded by urban development, would be directly related to disturbance levels, habitat connectivity, the resiliency of the Sharp-tailed Grouse, and the implementation of recommendations discussed in the following paragraphs. If sufficient habitat and spatial boundaries are retained surrounding the lek that would provide suitable breeding habitat (i.e., use of the lek), foraging habitat for the young and adult birds, and protective cover provided by short shrub and treed communities, it is possible that the use of the lek may continue. However, this is dependent on the actual disturbance levels from the development (i.e., level of stress placed on the Sharp-tailed Grouse) and the response by the birds. No information on the results of comparable interactions with leks being surrounded by urban development was found; however, in other jurisdictions where leks have been affected by the expansion of urban areas, the leks have not survived (Nicholson 2019). However, the proposed recommendations and mitigation measures are designed to limit the adverse effects on the habitat providing all the life requisites, including the lek, and limit human disturbance, to increase the potential for the population of Sharp-tailed Grouse to remain viable as the UH3 proceeds.

6.1.3 RECOMMENDATIONS

The following recommendations are intended to protect the integrity and longevity of the lek located within LSD 14-18-37-04 W3M and the surrounding habitat, with consideration of how the Sharp-tailed Grouse could co-exist in an urban setting These are aimed at better understanding the population of the lek, combined with retaining habitat for the life requisites for Sharp-tailed Grouse, maintaining habitat connectivity to adjacent areas, and precluding human disturbance (e.g., hiking, dog walking) within NE 18-37-04 W3M as much as possible. Collectively, these recommendations are expected to increase the potential for the lek to remain viable.

- **Annual long-term monitoring** – Continued monitoring of the lek is recommended over the next five to ten years. As evidenced by the MVA records, the lek appears to remain viable in its current state, with the current levels of disturbance, and the surrounding habitat.
- **Grassland habitat in NW 18-37-04 W3M** – It is recommended that the grassland in proximity to the lek be defined as a Municipal Reserve, Natural Area or Natural Asset to augment the life requisites for this species. This could be combined with a school site similar to Silver Spring Elementary School or St. Joseph High School. Setting aside as much habitat as feasible in the NW 18-37-04 W3M in the Study Area would allow retention of habitat required for year-round use by the Sharp-tailed Grouse using this lek.

- **Create a buffer around the lek** – To reduce the level of disturbance from urban or human activities, it is recommended that a 200 m setback distance be used for low disturbance activities[13] (and 400 m setback be used for medium[14] and high[15] disturbance activities from an active Sharp-tailed Grouse lek in accordance with the Saskatchewan Activity Restriction Guidelines for Sensitive Species (ENV 2017) during the spring breeding period. The limit of the guidelines vary according to the disturbance category (e.g., low, medium, high) of the proposed activity. Activities associated with construction and development of UH3 are categorized as high; as such, the recommended setback distance from an active Sharp-tailed Grouse lek is 400 m (ENV 2017) during the breeding season.
- **Signage** – Further, the land manager could consider installing appropriate signage to indicate no entrance between March 15 and July 15, combined with fencing off a portion of the NW 18-37-4 W3M to exclude or limit pedestrians from entering the grassland area where the lek is located. Use of signs and fencing has been used on various Ducks Unlimited Canada projects to control access to certain wetland or upland waterfowl nesting habitat sites.
- **Establish a visual barrier along the edge of the setback** – It is recommended that one or more mixed-species shelterbelts comprised of short and tall shrubs be planted in appropriate locations within the 200 m buffer to provide a visual barrier for the lek from noise, light, and other sensory disturbances associated with any activities related to the construction and development of future residential lots. A qualified biologist should be consulted as part of the planning of the shelterbelts within this buffer area so that the correct habitat and protective barrier are designed accordingly. As per discussions with Vern Doell, Senior Ecological Protection Specialist – ENV, Saskatoon (Doell 2019), it is anticipated that by planting the shelterbelts early in the planning process, by the time lands adjacent to the lek are developed, the planted vegetation species will have become well established to provide an effective barrier/buffer to help mitigate disturbances to Sharp-tailed Grouse using the lek. This barrier could be an effective mitigation measure to reduce the potential for adverse effects resulting from activities associated with the construction and subsequent use of the residential development, and would provide habitat that would fulfill, in part, the life requisites for Sharp-tailed Grouse throughout the year. Several studies (e.g., Foreman et al. 2002; Patten et al. 2006) focussing on grassland birds provide support for the concept that some area-sensitive grassland species could benefit from some type of screening and/or buffer from human disturbances, particularly noise, especially in a context where the extent of their core habitat is limited. Further, the lek is located within a slight depression and is therefore not directly visually apparent from beyond the ridge line approximately 200 m to the north. This provides a natural topographic barrier so that activities associated with the residential development may not be as readily apparent to birds using the lek. With habitat retention, the natural topographic barrier, and the implementation of a multi-species shelterbelt, it may be possible to design the residential development with appropriate biological/environmental considerations. These considerations should include an appropriate setback distance from the lek developed in consultation with ENV in context with the availability and quality of adjacent suitable habitat.

[13] Low disturbance activities include foot traffic, vehicles <1 ton including ATVs, operating oil or gas wells, pipelines.

[14] Medium disturbance activities include vehicles >1 ton, plough-in pipelines, operating compressor station or batteries.

[15] High disturbance activities include roads, battery or compressor station construction, seismic, drilling rigs, trench-in pipeline, blasting, mines, gravel pit, quarries, rock crushing, asphalt batching, renewable energy projects.

Cumulatively, the mitigation could increase the potential for the lek to remain viable. This is expected to comply with Section 9.2.2(d) of the OCP, related to Protection of Natural Areas (City of Saskatoon 2019).

6.2 RAPTOR NEST SURVEY

6.2.1 METHODS

Raptor stick nest surveys were completed in 2019 following the prairie raptors survey protocol in Alberta ESRD's Sensitive Species Inventory Guidelines (Government of Alberta 2013). The surveys were completed during the recommended raptor breeding season during daylight hours on April 3 and 4, April 25, June 11 and June 20, 2019. The April surveys were completed prior to the tree canopy leaf-out to facilitate the detection of all raptor stick nests within the Study Area. Once a nest was identified, the location was recorded using a GPS, and the nest size, occupancy, and habitat type were documented. Incidental observations of raptor species and/or stick nests were also recorded during other field surveys throughout the spring and summer. The June surveys were completed to verify the occupancy of the identified stick nests from the April surveys.

6.2.2 RESULTS AND DISCUSSION

Eight potential raptor stick nests were identified during the April 2019 surveys (Table 7), including nests found incidentally during other wildlife and vegetation surveys throughout the nesting season (Appendix C – Figure C3). Two of these nests were confirmed to be occupied by raptor species including Swainson's Hawk (*Buteo swainsoni*) and Great Horned Owl (*Bubo virginianus*), while the remaining six nests were unoccupied in the 2019 breeding season (Appendix A – Photos 27 – 33). It was not possible to confirm the type of birds that built the unoccupied nests.

Table 7. Raptor stick nests observed during the University Heights Neighbourhood No. 3 2019 field surveys.

Nest Number	Raptor Species	Zone	Easting	Northing	Occupied (Y/N)	Photo
1	Great Horned Owl	13	393029	5783403	Y	Photo 27
2	Swainson's Hawk	13	390850	5782565	Y	Photo 28
3	Not Occupied	13	392194	5783857	N	Photo 29
4	Not Occupied	13	393124	5783589	N	Photo 30
5	Not Occupied	13	391111	5782902	N	Photo 31
6	Not Occupied	13	391464	5782177	N	Photo 32
7	Not Occupied	13	391225	5782047	N	Photo 33
8	Not Occupied	13	391470	5781529	N	No Photo

6.2.3 RECOMMENDATIONS

Raptors such as Swainson's Hawk and Great Horned Owl are common species within the Saskatoon region and do not have species-specific provincial activity restriction setbacks associated with their nests (ENV 2017); however, the federal *Migratory Birds Conservation Act* (MBCA) prohibits the destruction of any migratory bird nest (Government of Canada 1994), which would include Swainson's Hawk. Nest status and species occupancy of stick nests can vary between breeding seasons and these results may vary in subsequent years. According to the MBCA Regulations, migratory birds may not be killed, captured or taken, and nests may not be damaged, destroyed, removed or disturbed without a permit (Government of Canada 1994).

To comply with the MBCA, it is recommended that if construction associated with the UH3 neighbourhood (e.g., clearing, stripping, grading) is scheduled to occur during the spring breeding and nesting period for migratory birds, prior to activities commencing, pre-construction nest surveys should be completed by a qualified biologist to document the occupancy of raptor nests within the Study Area. If an occupied nest of a raptor species is documented within the Study Area, the applicable no-disturbance setback (i.e., activity restriction buffer) based on the type of species identified will be implemented following discussions between the biologist and the appropriate City personnel. Construction activities would subsequently be allowed to resume once a qualified biologist confirmed the nest was no longer occupied.

Given the propensity of raptors to nest in well established treed bluffs, it is recommended that preservation of tracts of native habitat that support stands of mature trees be considered as part of the detailed design process as much as feasible. Inclusion of these habitat types as part of a Municipal Reserve and/or proposed Ecological Zones will provide potential nesting opportunities for raptors within the UH3 neighbourhood. This is expected to comply with Section 9.2.2(d) of the OCP, related to Protection of Natural Areas, and Section 5.1, related to Neighbourhood Design and Development (i.e., in an efficient and environmentally sensitive way).

6.3 BREEDING BIRD SURVEYS

6.3.1 METHODS

Breeding bird surveys (BBS) were completed within the Study Area to determine bird species occupancy, richness, and relative abundance during the breeding season (i.e., late May to late June). The BBS consisted of point-count surveys (15 survey points), completed in accordance with the Saskatchewan Species Detection Survey Protocols – Grassland Birds Surveys (ENV 2014a). As mentioned in Section 4.2 (Table 1) and shown in Figure 2, the Study Area is comprised of a total of 13 habitats. The BBS survey focused on the six primary habitat types that included Crop Land; Tame Grassland; Native Dominant Grassland; Wetland; Hay Crop (Forage); and Deciduous Woodland (open and closed canopy). The 15 BBS survey points were located within the following primary habitat types alone or in combination:

- BBS Survey Point 1 – Native Dominant Grassland/Tame Grassland
- BBS Survey Point 2 – Native Dominant Grassland
- BBS Survey Point 3 – Tame Grassland and Crop Land

- BBS Survey Point 4 – Tame Grassland
- BBS Survey Point 5 – Native Dominant Grassland/Tame Grassland and Crop Land
- BBS Survey Point 6 – Native Dominant Grassland/Tame Grassland
- BBS Survey Point 7 – Native Dominant Grassland/Tame Grassland
- BBS Survey Point 8 – Native Dominant Grassland/Tame Grassland and Crop Land
- BBS Survey Point 9 – Native Dominant Grassland/Tame Grassland
- BBS Survey Point 10 –Tame Grassland and Deciduous Woodland
- BBS Survey Point 11 – Deciduous Woodland
- BBS Survey Point 12 – Tame Grassland and Crop Land
- BBS Survey Point 13 – Tame Grassland and Crop Land
- BBS Survey Point 14 – Native Dominant Grassland and Deciduous Woodland
- BBS Survey Point 15 – Hay Crop (Forage) and Crop Land

Two rounds of BBS were conducted on May 30 and June 10, 2019, respectively. Each round included fifteen, 100-m radius survey points spaced approximately 800 m apart to avoid double-counting individual birds (Appendix C – Figure C4). The location of each survey point was pre-selected to spatially cover the representative habitat of the six primary habitat types within the Study Area.

Surveys were completed between sunrise and four hours after sunrise under appropriate weather conditions (i.e., wind speeds under 20 km per hour, temperatures above 0°C, precipitation no greater than very light drizzle). At each survey point location, observers completed a five-minute point-count survey from the survey point, during which all birds detected by sight or sound were recorded, including their distance and direction from the observer.

6.3.2 RESULTS AND DISCUSSION

A total of 56 bird species were observed during the 2019 breeding bird survey (Appendix C – Figure C4). The highest number of species were documented at Survey Point 2 (22 species), located in the Small Swale north of McOrmond Drive North in Native Dominant Grassland habitat adjacent to wetland habitat, and Survey Point 10, located in Tame Grassland habitat adjacent to Closed Canopy Deciduous Woodland habitat associated with the South Saskatchewan River Valley (Figure 4; Appendix C – Figure C4). The fewest number of bird species was documented at Survey Point 3 (8 species), located adjacent to Lowe Road, north of McOrmond Drive North in Crop Land and Tame Grassland habitat (Figure 4; Appendix C – Figure C4).

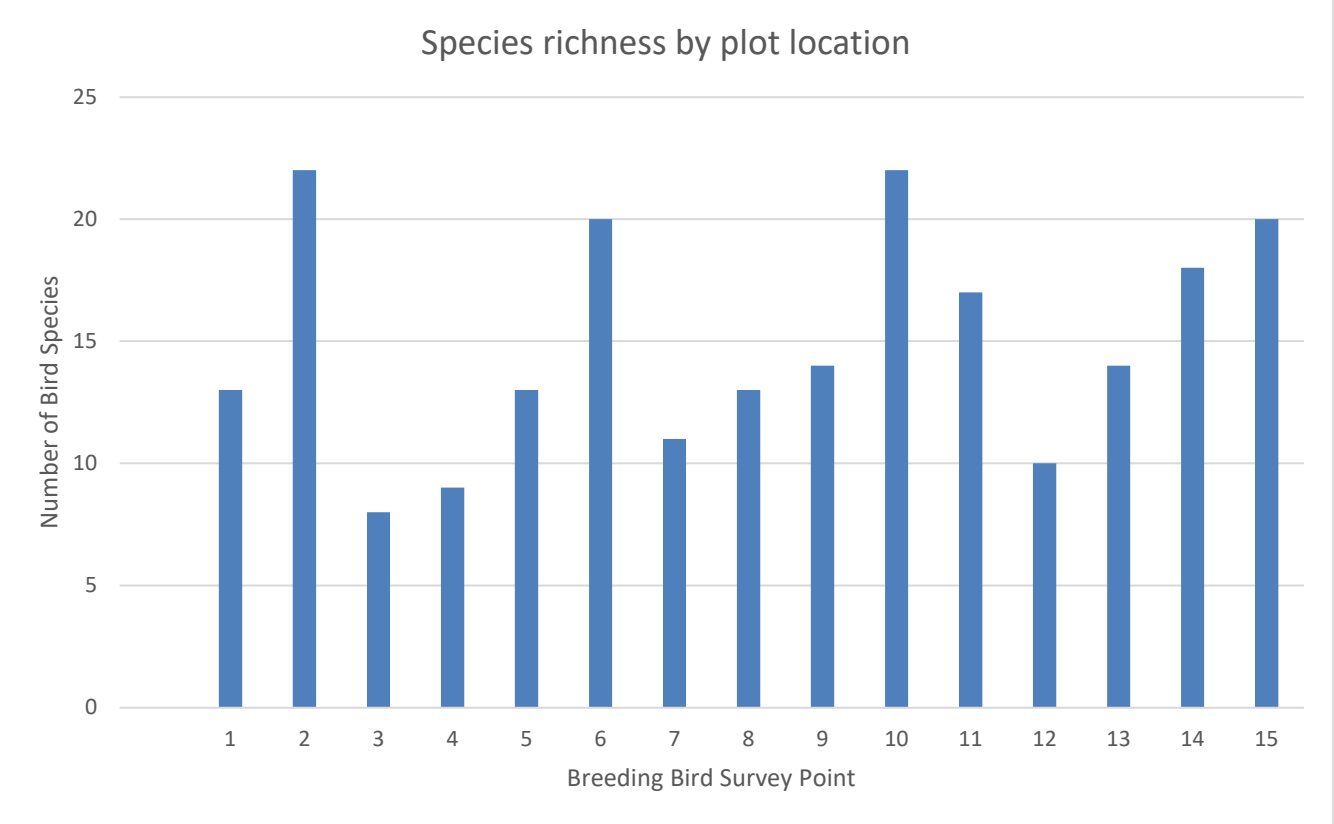

Figure 4. Breeding bird survey species richness by survey point in the University Heights Neighbourhood No. 3 Study Area.

In terms of abundance, 541 individual birds were observed during the BBS. The abundance of individual birds observed at each plot is shown in Figure 5. The highest number of individuals were detected at the following locations:

- Survey Point 14 (63 individuals) – comprised of a mixture of Native Dominant Grassland and Deciduous Woodland habitats;
- Survey Point 2 (57 individuals) – comprised of Native Dominant Grassland habitat; and,
- Survey Point 8 (50 individuals) – comprised of a mosaic of Native Dominant Grassland/Tame Grassland and Crop Land habitats.

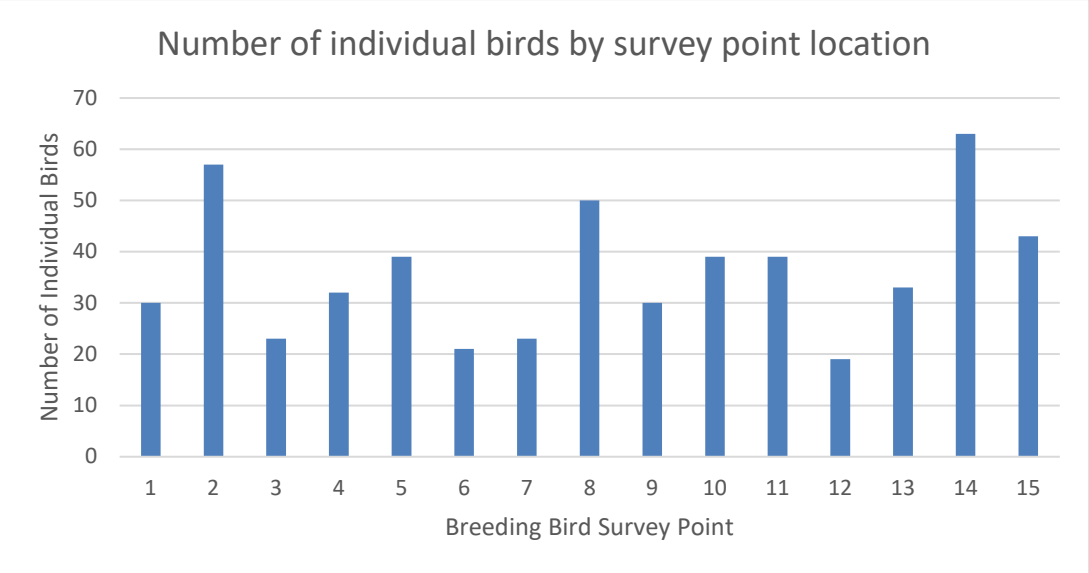

Figure 5. Breeding bird survey number of individuals by survey point location in the University Heights Neighbourhood No. 3 Study Area.

The most common species identified during the 2019 surveys (i.e., bird species with the highest number of individual observations) included the Clay-colored Sparrow (*Spizella pallida*) [70 individuals], Red-winged Blackbird (*Agelaius phoeniceus*) [60 individuals] and Western Meadowlark (*Sturnella neglecta*) [39 individuals]. Figure 6 provides a summary of the total number of each species documented at the survey points within the Study Area. Barn swallows (*Hirundo rustica*), which are a wildlife SOMC listed as Threatened under the *Species at Risk Act (SARA)* (Government of Canada 2002), were observed at Survey Point 2 and 7 with a combined total of three individuals observed between the two plots. This species typically prefers to nest on a variety of man-made structures with a vertical face and overhang (e.g., barns, houses, garages and sheds) (COSEWIC 2011). Potential nesting sites for barn swallows are located at the Wildlife Federation buildings in 01-24-37-05 W3M, the active yard site in 02-13-37-05 W3M and the abandoned yard site in 11-13-37-05 W3M; however no nests were observed in these locations during the 2019 field surveys.

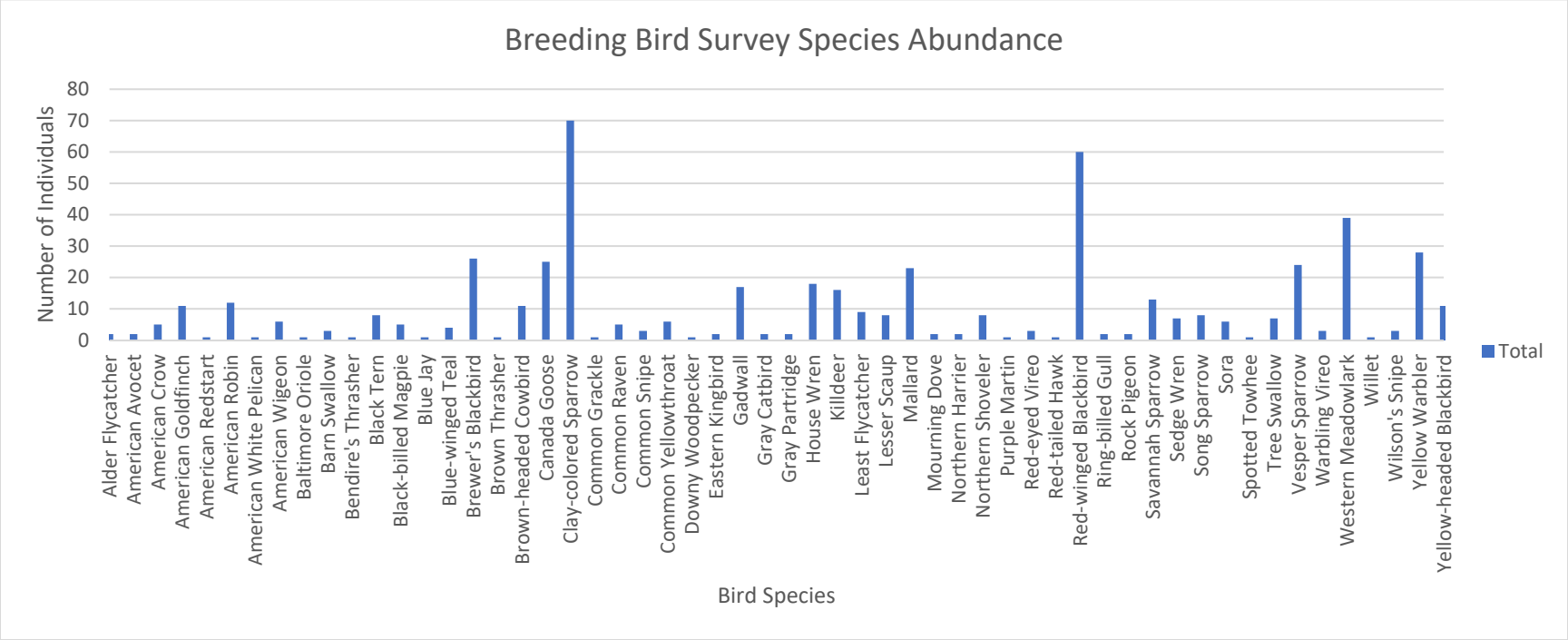

Figure 6. Breeding bird survey species abundance in the Study Area.

The number of birds documented at each habitat type varied within the Study Area. Wetland habitats had the highest number of individual birds observed (125 birds), followed by Tame Grassland at 115 birds, Native Dominant Grassland at 111 birds, and Deciduous Woodland at 97 birds (Figure 7). In comparison, disturbed habitats such as Cropland had only 72 individual birds, while Disturbed/Developed lands had only 15 birds (Figure 7). The fact that wetland habitats, which tend to support a more heterogeneous vegetation community, had a higher number of individuals compared to Deciduous Woodland, is likely due to the characteristics of the bird species that use these habitats. For example, wetland bird species are often flocked or have greater densities during the breeding period (e.g., Red-winged Blackbird) while woodland bird species tend to be more solitary (e.g., House Wren).

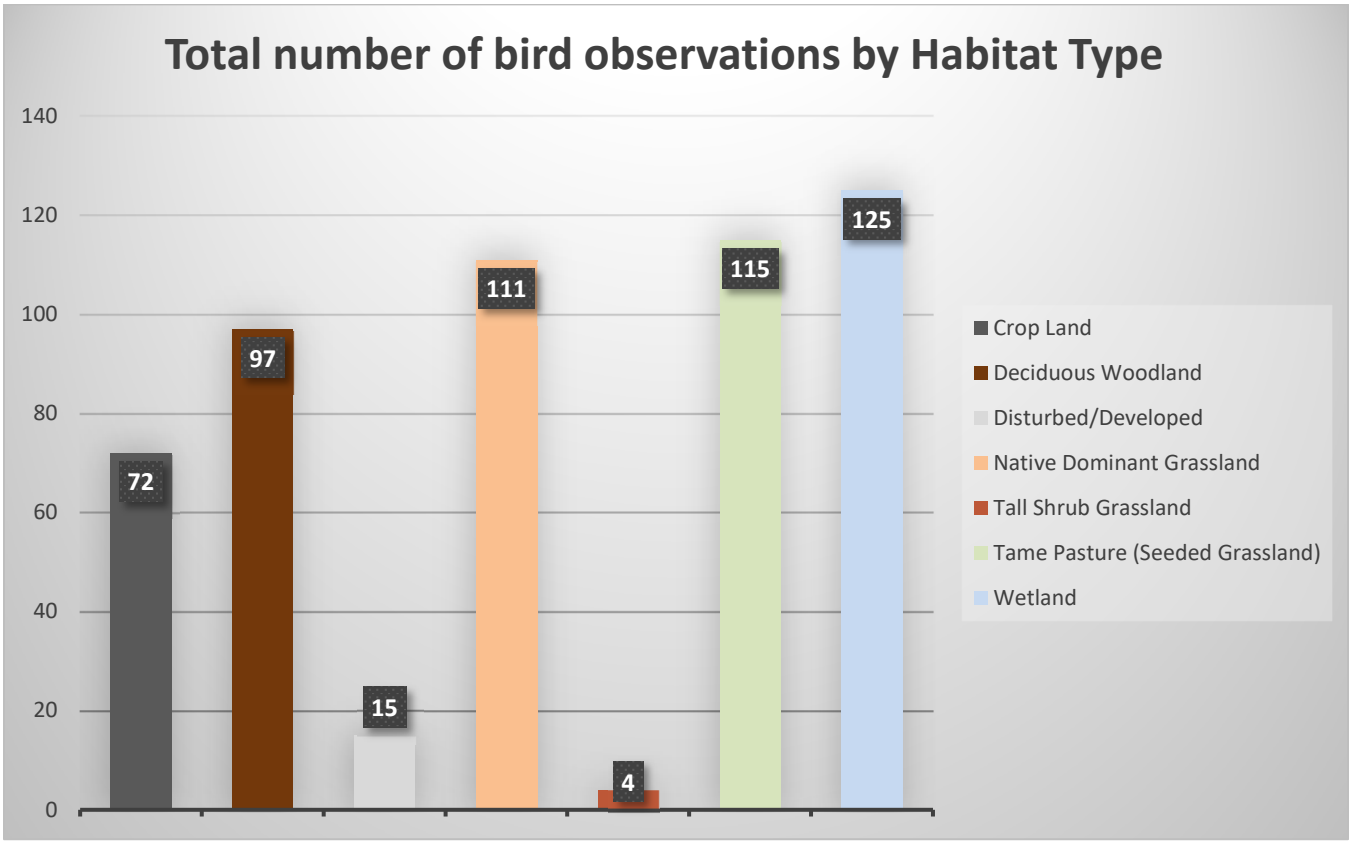

Figure 7. Breeding bird survey total number of observations by Habitat Type in the University Heights Neighbourhood No. 3 Study Area.

In terms of species richness within each habitat type (i.e., the number of different species within an ecological community or habitat type), Deciduous Woodland habitat contained the highest number of bird species at 34, followed by Native Dominant Grassland at 33, Crop Land at 26 with Wetland and Tame Grassland at 23 different species (Figure 8). While it is expected that the habitat types with more heterogeneous vegetation communities such as Deciduous Woodlands, Native Dominant Grasslands and Tame Grassland tend to be more diverse and offer a wider range of nesting/breeding, foraging, and protective cover opportunities for migratory birds, Crop Land in the Study Area also supported a relatively high number of different species.

Based on the data recorded and species observed, this was likely due to the use of adjacent habitat types (i.e., birds were recorded flying to and from adjacent grassland and wetland habitats).

None of the previous studies completed relative to the Study Area to date looked at species richness by habitat type either because of study design (MVA 2009; Stantec 2013a,b) or a detailed field component was not included as part of the scope of work (e.g., Stantec 2015).

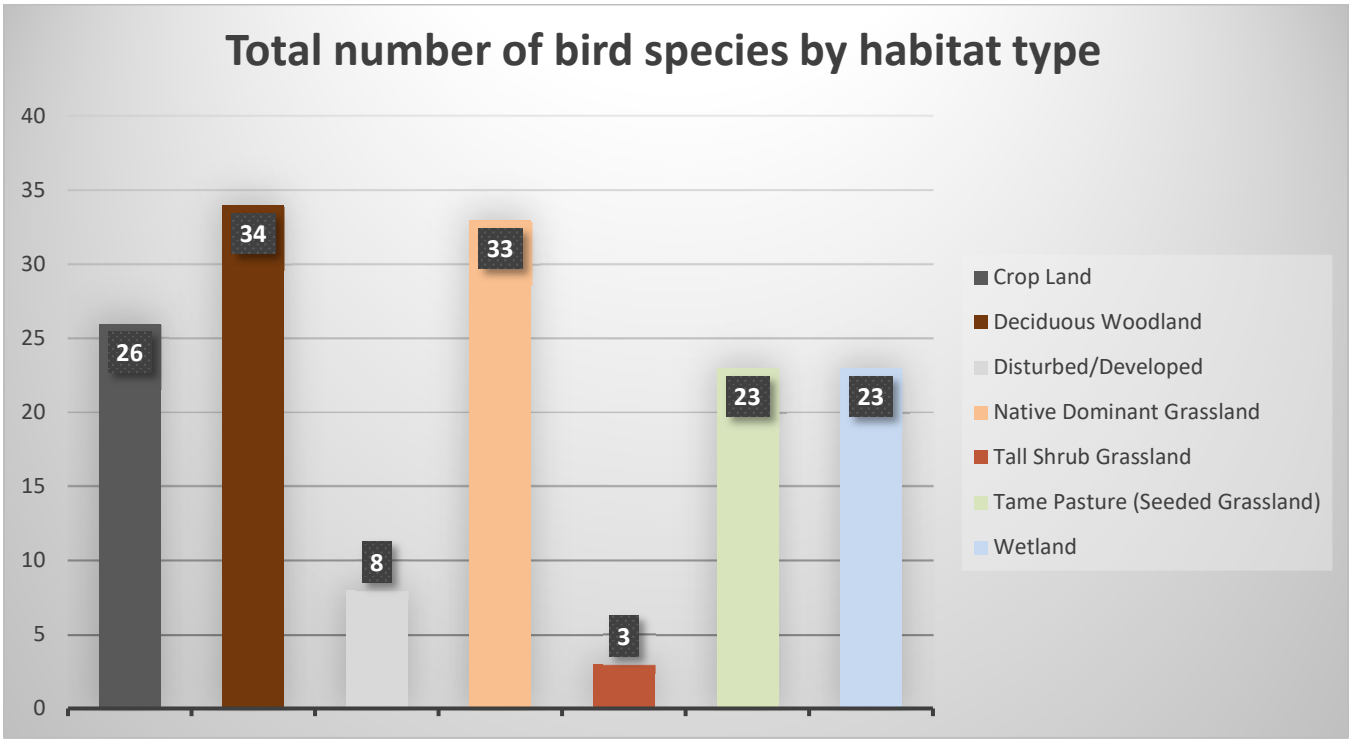

Figure 8. Species richness by habitat type within the Study Area.

6.3.3 RECOMMENDATIONS

Based on the results from the breeding bird surveys, native habitat types, particularly Deciduous Woodlands and Native Dominant Grassland tend to support a greater number of different migratory bird species. As such, it is recommended that preservation of tracts of native habitat be considered as part of the detailed design process to the extent practical. Inclusion of these habitat types as part of a Municipal Reserve and/or proposed Ecological Zones is expected to provide continued breeding, nesting and foraging opportunities for migratory birds within the UH3 neighbourhood. This is expected to comply with Section 5.1 of the OCP related to Neighbourhood Design and Development (i.e., in an efficient and environmentally sensitive way), Section 9.2.2(d) related to Protection of Natural Areas, and Section 9.5.2(d) related to Least Disturbance to wetlands (City of Saskatoon 2019).

6.4 COMMON NIGHTHAWK SURVEYS

6.4.1 METHODS

Two rounds of Common Nighthawk (*Chordeiles minor*) surveys were completed in areas of suitable habitat within the Study Area to identify this species, which is currently listed federally as a species of special concern (COSEWIC 2018) and is included on the *SARA* (Government of Canada 2002). The surveys consisted of point-counts with call playback during the active breeding period (i.e., late May to late June) for Common Nighthawks and were completed in accordance with the Saskatchewan Common Nighthawk Species Detection Survey Protocol (ENV 2015a).

The Common Nighthawk surveys were completed from one hour before sunset to 30 minutes after sunset on May 23 and June 11, 2019. Each survey round included nine survey points spaced approximately 800 m apart within the Study Area in suitable habitat (Appendix C – Figure C5). At each survey point location, the observer completed a three-minute passive count, followed by a three-minute call playback survey, while scanning the landscape and listening for signs of Common Nighthawks.

6.4.2 RESULTS AND DISCUSSION

One Common Nighthawk was heard calling at one of the nine survey points in SW 13-37-05 W3M (13U 391242 5782236) at Survey Point 6 (Figure 3 and Appendix C – Figure C5). This survey point was located in a mixture of Tame Grassland and Tall Shrub Grassland habitats. No other Common Nighthawks were observed or heard incidentally during the 2019 surveys.

Breeding habitat for Common Nighthawks tends to be varied, but generally consists of open areas for foraging in flight and bare ground for nesting (COSEWIC 2018). In the prairies, this species tends to occur more in grassland habitat than cropland, particularly in areas with short grass and low density of shrubs (McLachlan 2007; Ng 2009). Nest sites typically include forest clearings, open areas in grassland, gravel pits, rocky outcrops, and road or rail sides (Brigham et al. 2011). Urban (i.e., residential and commercial) environments comprise a relatively small portion of their Canadian range; in these areas, nighthawks have been documented to nest almost exclusively on roofs covered with pea gravel that have a source of shade, such as a parapet (Marzilli 1989).

6.4.3 RECOMMENDATIONS

While this species has been previously documented in the Saskatoon area (Delanoy 2001; Jensen Ecosystem Services 2009; SKCDC 2019) and during the 2019 surveys, Common Nighthawk appears to be relatively uncommon given the low numbers recorded. Given the uncommon occurrence of this species, there are no species-specific recommendations associated with the planning and development of UH3.

6.5 SHORT-EARED OWL SURVEYS

6.5.1 METHODS

In 2019, Short-eared Owl surveys were completed in areas of suitable habitat (i.e., Native Dominant Grassland, Native Dominant Grassland/Tame Grassland and/or Hay Crop [Forage]) within the Study Area to identify this species, which is currently listed federally as a species of special concern (COSEWIC 2008) and is included in the *SARA* (Government of Canada 2002). Suitable habitat and survey timing for Short-eared Owls overlaps somewhat with that of the Common Nighthawk; as such, Short-eared Owl and Common Nighthawk were surveyed from the same survey points (Appendix C – Figure C5). Three rounds of Short-eared Owl surveys were completed , two of which were completed in conjunction with the Common Nighthawk surveys. Short-eared Owl surveys consisted of point-count surveys during the active breeding period (i.e., May to June).

The point-count surveys were completed during the evenings of May 9, May 23 and June 11, 2019 in accordance with the Saskatchewan Species Detection Survey Protocols – Short-eared Owl Surveys (ENV 2015b). The Short-eared Owl surveys included nine survey points within the Study Area, spaced approximately 800 m apart. Each evening, the Short-eared Owl surveys started one hour before sunset and ended 30 minutes after sunset. At each survey point location, the observer completed a three-minute passive count while scanning the landscape with binoculars and listening for Short-eared Owl calls.

6.5.2 RESULTS AND DISCUSSION

One Short-eared Owl was observed at one of the nine survey points in NW 18-37-04 W3M (13U 392332 5782887) at Survey Point 3 (Appendix C – Figure C4). This point was located in Native Dominant Grassland habitat. No other Short-eared Owls were observed or heard incidentally during the 2019 surveys.

Short-eared Owls generally nest in open habitats including grasslands, bogs, marshes, old pastures, abandoned fields and row crops near agricultural activities such as haying, mowing, and livestock grazing (COSEWIC 2008). This species is generally not prone to extensive human disturbance (COSEWIC 2008) although they are particularly sensitive to human disturbance during the laying or incubation stages (Leasure and Holt 1991). Habitat conversion/degradation has been implicated in population declines of this species across the prairie provinces (e.g., Smith 1996); extensive losses in native grasslands throughout the central portions of the range have likely had a significant negative impact on Short-eared Owl abundance and population viability (COSEWIC 2008).

While this species has been previously documented in the Saskatoon area (Delanoy 2001; SKCDC 2019) and during the 2019 surveys, Short-eared Owl appears to be relatively uncommon based on the low numbers documented. Although relatively uncommon, Short-eared Owls have been observed previously in proximity to the Northeast Swale (SKCDC 2019) and more recently along Lowe Road in 2019.

6.5.3 RECOMMENDATIONS

The proposed Ecological Zone in NW-18-37-04 W3M and shelterbelt buffer will help support the life requisites of the Short-eared Owl. Consider using plant material that will augment this species and conserving land within NW-18-37-04 W3M to support this species.

6.6 AMPHIBIAN AUDITORY AND VISUAL SURVEYS

6.6.1 METHODS

Three rounds of nocturnal amphibian auditory surveys were completed in 2019 within the Study Area. While all identified amphibian species were documented, the surveys were designed to focus on Northern Leopard Frogs (*Lithobates pipiens*), which are currently listed federally as a species of special concern (COSEWIC 2009) and is included on the *SARA* (Government of Canada 2002). The auditory surveys were completed primarily using Wildlife Acoustics SM4 bio-acoustic monitors deployed at wetlands providing suitable breeding habitat for Northern Leopard Frogs (i.e., permanent and semi-permanent waterbodies with emergent vegetation). According to the Saskatchewan Amphibian Auditory Survey Protocol (ENV 2014b), digital recording devices are considered an acceptable alternative to observers present when conducting amphibian auditory surveys.

Eleven wetlands were surveyed on April 24, May 9 and May 22, 2019. Bio-acoustic monitors were deployed at 10 of the survey points, while one location (Survey Point 4 on Wetland 3) was surveyed in person due to high human presence (Appendix C – Figure C6). The bio-acoustic monitors were programmed to take a five-minute recording every hour from 9:00 pm to 3:00 am, resulting in 35 minutes of audio data per survey night at each location. The Saskatchewan Amphibian Auditory Survey Protocol (ENV 2014b) states that the optimal time of day to survey for amphibians is 30 minutes after sunset to 1:00 AM; as such, the 11:00 PM recording was analysed for each location. If the 11:00 PM recording was of poor quality, the 10:00 PM or 12:00 AM recording was analysed instead. The recordings were analyzed and interpreted by biologists with expertise in identifying amphibians by call.

In addition to the auditory surveys, three rounds of amphibian visual surveys were also completed within the Study Area in 2019. While all identified amphibian species would be documented, the surveys were designed to focus on wetlands that would provide potential over-wintering habitat. The same eleven wetland locations used for the amphibian auditory surveys were used for the amphibian visual surveys. These wetlands were surveyed on September 4 and 5, 2019, and October 2, 2019, in accordance with the Saskatchewan Species Detection Survey Protocols – Amphibian Visual Surveys (ENV 2014c). The surveys were conducted by slowly walking the shorelines and adjacent emergent vegetation of the wetlands within the Study Area and counting any adults or young of the year.

6.6.2 RESULTS AND DISCUSSION

During the auditory amphibian surveys, three amphibian species were identified at 7 of the 11 wetlands surveyed (Table 8), including Boreal Chorus Frog (*Pseudacris maculata*), Wood Frog (*Lithobates sylvaticus*) and

Northern Leopard Frog. Boreal Chorus Frogs were identified at four wetlands, Wood Frogs at six wetlands and Northern Leopard Frog at three wetlands.

During the visual amphibian surveys, Northern Leopard Frogs were observed at Wetland 9055, associated with the wetland complex in the Small Swale area south of McOrmond Drive North (Figure 3 and Appendix C – Figure C6 [Survey Point 6]). Five were observed on September 4, 2019; four were observed on September 19, 2019; and one individual was observed on October 2, 1019 (Appendix A – Photos 45 – 46). No other amphibian species were observed at any of the other wetlands in the three rounds of visual surveys. However, Northern Leopard Frogs were also observed incidentally along the South Saskatchewan River bank on August 5, 2019 at 13U 390615 5782422 during the riverbank vegetation assessment.

Northern Leopard Frogs typically use three habitat types over the course of their lifecycle: deeper, well oxygenated waterbodies for overwintering; seasonal and semi-permanent wetlands and marshes for breeding in the spring; and upland grasslands for use during the summer (Environment Canada 2013b). Although wide-spread declines in populations were noted in the early 1970s, this species is now relatively widespread and considered locally common to abundant across its range (COSEWIC 2009). Northern Leopard Frogs have been previously identified in the Study Area, particularly associated with the Northeast Swale and Small Swale (Jonker and Gallop 2000; Stantec 2013a,b; SKCDC 2019), although sightings have been sporadic. Overwintering by this species has not been confirmed in any of the wetlands in the Study Area, as species presence was not documented immediately prior to the onset of winter conditions, but larger, more permanent (i.e., deeper) wetland basins typically provide overwintering habitat for this species.

Table 8. Amphibian auditory survey results during the 2019 field surveys in the Study Area.

Survey Point Number	Wetland number	Zone	Easting	Northing	Amphibian Species Detected	Photo
1	3027	13	391630	5783902	None	Photo 34
2	3027	13	391603	5783749	Wood Frog	Photo 35
3	3027	13	391780	5783857	None	Photo 36
4	3	13	392238	5783191	None	Photo 37
5	3031	13	391203	5783445	Boreal Chorus Frog	Photo 38
	3031				Northern Leopard Frog	Photo 39
6	9055	13	390727	5783005	Boreal Chorus Frog	Photo 40
	9055				Wood Frog	
	9055				Northern Leopard Frog	
7	3001	13	390721	5782057	Wood Frog	
8	South Saskatchewan River	13	390568	5782100	None	Photo 41
9	3031	13	391003	5782960	Boreal Chorus Frog	Photo 42
	3031				Wood Frog	
	3031				Northern Leopard Frog	
10	3031	13	391102	5783215	Boreal Chorus Frog	Photo 43
	3031				Wood Frog	
11	Northeast Swale	13	392307	5781845	Wood Frog	Photo 44

6.6.3 RECOMMENDATIONS

Given the presence of suitable habitat for this species in the Study Area, it is recommended that wetlands assigned a management class of Preserve within and adjacent to the Small Swale and the Riddell Paleontological Site be left intact due to the presence of Northern Leopard Frogs in these areas. Wetlands associated with the Small Swale, in particular, provide all three habitat requirements for this species for its different life requisites. Accordingly, these wetlands have been recommended for inclusion as part of a proposed Ecological Zone for the Small Swale.

It is also recommended that the design of UH3 include linear parks or other green spaces that contain wetland features (either preserve existing features or create wetlands), which could provide habitat and dispersal opportunities for this species (i.e., allowing access between the Northeast and Small Swales as well as to the South Saskatchewan River valley depending on the design of the neighbourhood). Because this species is particularly susceptible to anthropogenic changes to habitat (i.e., habitat loss, fragmentation, and degradation), and existing riparian areas and wetlands are known to facilitate dispersal and provide corridors for movement between habitats (COSEWIC 2009), preservation of existing natural habitat or creation of new wetland and upland habitat as part of the neighbourhood design would be beneficial.

This is expected to comply with Section 5.1 of the OCP related to Neighbourhood Design and Development (i.e., in an efficient and environmentally sensitive way), Section 9.2.2(d) related to Protection of Natural Areas, and Section 9.5.2(d) related to Least Disturbance to wetlands.

6.7 WILDLIFE CORRIDORS

6.7.1 METHODS

As part of field program, existing game trails and other potential wildlife travel corridors within or through the Study Area were evaluated in 2019 to determine the connectivity of habitats and how wildlife species (in particular medium to large mammals) move around, through and within the Study Area. To better understand how wildlife use the various habitats within the Study Area and identify potential wildlife corridors, the use of existing game trails and movement patterns or behaviours of wildlife species within the Study Area were examined.

Locations of existing game trails were mapped in the field using a combination of GPS units and aerial imagery. Once the potential corridors were identified, remote cameras (RCs) were installed at 14 locations throughout the Study Area to capture images of habitat use and movement by wildlife and to verify the use of the existing game trails and habitat types (Table 9 and Appendix C – Figure C7).

In conjunction with Saskatoon Land, EDI biologists met with representatives from the MVA to discuss collaborative approaches to collecting and sharing data from RCs that had been deployed by both parties, as relevant to the Study Area. Following the initial discussion, MVA agreed to collaborate with EDI and place four cameras within the Study Area. The data collected from these four cameras would be shared with EDI to augment the information collected on wildlife use as it pertains to the Study Area.

EDI used the five Boly SG 2060 RCs deployed at 10 locations, while MVA used four Moultrie S50i deployed at four locations, both of which use Passive Infrared (PIR) motion sensors[16]. The cameras were set to take one photo per detection, with a zero second time delay between detections to document all passing wildlife.

As noted in Table 9, cameras, and subsequently, the captured images, from both EDI and the MVA were used in the survey. On June 5, 2019, EDI deployed four cameras at camera survey points RC01, RC02, RC03, and RC04. On June 5, 2019, EDI biologists also conducted a wildlife crossing assessment of Lowe Road within the Study Area and identified four locations where well used game trails crossed the roadway (Appendix C – Figure C8). These crossings were marked with flagging tape and on June 7, 2019, MVA staff deployed their four cameras at these locations.

On July 12, 2019, EDI deployed a fifth camera at RC09 in NW 18-37-04 W3M to capture wildlife use within the northwest portion of this Native Dominant Grassland habitat. As part of a rotation to cover as much of the Study Area as possible, EDI moved four of the EDI cameras on July 25, 2019 to survey different locations within the Study Area at RC05, RC06, RC07, and RC08. A sixth camera was installed in SE 24-37-05 W3M at RC10 (as recommended to Saskatoon Land by EDI) to monitor wildlife use associated with the Small Swale north of McOrmond Drive North that was not already covered by the other RC locations.

The MVA cameras were deployed for 151 days and the EDI cameras were deployed for an average of 37 days at each of the 10 locations. The MVA retrieved their cameras on November 5, 2019, and EDI retrieved their cameras on August 29, 2019. The MVA's cameras surveyed the same location for the duration of the deployment. EDI re-positioned their cameras to new locations after approximately 30 days of monitoring to increase RC survey coverage with the number of cameras available.

The City of Saskatoon Transportation Division closed Lowe Road during the study on July 11, 2019, which restricted traffic from using Lowe Road. Given the relatively short period of time that the road was closed while the cameras were still operational, it is not possible to determine whether this closure had an affect on wildlife movement patterns or frequency of use across Lowe Road.

The EDI cameras were checked on a bi-monthly basis to replace the memory cards and batteries and download the photos. Each digital photo included a date and time stamp as well as the UTM coordinates. Once the survey was completed, the photos from each location were filtered to eliminate any blank photos (i.e., photos with no wildlife, caused by false triggering) and analysed to determine wildlife species, date and time. The data were then entered into an Excel file based on a wildlife event. A wildlife event was defined as a single photo by one passing animal or a series of photos of a single animal or group of animals triggering the camera multiple times. Photos were analysed to determine the number of animals per event, by counting the number of animals within one photo or number of animals in a series of photos.

[16] PIR sensors are electronic sensors that measure infrared light radiating from objects in its field of view (FOV). They work by measuring the amount of ambient or background heat in the FOV, and when an object of a different temperature passes through, or there is an abrupt temperature change in the FOV, the sensor converts this change to a change in the sensor's output voltage, which triggers the camera (Wikipedia 2019)

Table 9. Remote camera survey locations for the 2019 field surveys in the Study Area.

Remote Camera (RC) Survey Point Name	Zone	Easting	Northing	Camera Owner	Photo	Deployment Start Date	Deployment End Date	Camera Functioning Days
1	13U	391105	5781881	EDI	Photo 47	June 5, 2019	July 25, 2019	48
2	13U	391711	5781681	EDI	Photo 48	June 5, 2019	July 25, 2019	51
3	13U	391491	5782475	EDI	Photo 49	June 5, 2019	July 25, 2019	40
4	13U	390841	5782555	EDI	Photo 50	June 5, 2019	July 25, 2019	30
5	13U	391592	5783193	EDI	Photo 51	July 25, 2019	August 29, 2019	28
6	13U	391001	5782825	EDI	Photo 52	July 25, 2019	August 29, 2019	25
7	13U	390745	5782080	EDI	Photo 53	July 25, 2019	September 16, 2019	29
8	13U	392788	5783040	EDI	Photo 54	July 25, 2019	August 29, 2019	35
9	13U	391603	5783772	EDI	Photo 55	July 12, 2019	August 29, 2019	48
10	13U	392064	5782404	EDI	Photo 56	July 25, 2019	August 29, 2019	35
11	13U	392293	5781914	MVA	Photo 57	June 7, 2019	November 05, 2019	151
12	13U	392316	5782070	MVA	Photo 58	June 7, 2019	November 05, 2019	151
33	13U	392324	5782434	MVA	Photo 59	June 7, 2019	November 05, 2019	151
14	13U	392314	5783008	MVA	Photo 60	June 7, 2019	November 05, 2019	151

6.7.2 RESULTS AND DISCUSSION

The results of the RC photo analysis are summarized in Table 10 and representative photos are provided in Appendix A (Photos 61 – 82). The number of events per survey point ranged from 13 (RC 5) to 391 (RC 12). The average number of events per day, per survey point ranged from 0.15 (RC01) to 3.47 (RC04). The total number of individual wildlife at each survey point ranged from 15 (RC 5) to 720 (RC12). The average number of individual wildlife per day at each survey point ranged from 0.14 (RC 11) to 4.74 (RC12).

Table 10. Wildlife detection at remote camera survey locations in the Study Area.

Remote Camera (RC) Survey Point Name	Camera Functioning Days	Number of Events Per Survey Point	Average Number of Events Per Day	Total Number of Individuals	Average Number of Individuals Per Day
1	48	55	1.15	68	1.42
2	51	110	2.16	127	2.49
3	40	65	1.63	73	1.83
4	30	104	3.47	125	4.17
5	28	13	0.46	15	0.54
6	25	34	1.36	47	1.88
7	29	50	1.72	65	2.24
8	35	30	0.86	49	1.4
9	48	62	1.29	78	1.63
10	35	83	2.37	105	3.00
11	152	23	0.15	22	0.14
12	152	391	2.57	720	4.74
13	152	37	0.24	59	0.39
14	152	137	0.90	120	0.79

In terms of species diversity, the following 20 confirmed wildlife species were detected in the Study Area during the remote camera survey (Appendix E – Table E1):

- American Badger (*Taxidea taxus*);
- American Beaver (*Castor canadendis*);
- American Crow (*Corvus brachyrhynchos*);
- Black-billed Magpie (*Pica hudsonia*);
- Coyote (*Canis latrans*);
- Eastern Kingbird (*Tyrannus tyrannus*);
- Franklins Gull (*Leucophaeus pipixcan*);
- Gray Partridge (*Perdix perdix*);
- House Sparrow (*Passer domesticus*);
- Mallard (*Anas platyrhynchos*);
- Moose (*Alces alces*);

- Mule Deer (*Odocoileus hemionus*);
- North American Porcupine (*Erethizon dorsatum*);
- Northern Harrier (*Circus hudsonius*);
- Raccoon (*Procyon lotor*);
- Snowshoe Hare (*Lepus americanus*);
- Tree Swallow (*Tachycineta bicolor*);
- Western Kingbird (*Tyrannus verticalis*);
- White-tailed Deer (*Odocoileus virginianus)*; and,
- White-tailed Jackrabbit(*Lepus townsendii*).

Mule Deer were the most abundant species at 801 detections, followed by White-Tailed Deer at 667, Coyote at 70, unknown deer species at 64 and White-tailed Jackrabbit at 60. Of the 801 Mule Deer detected, the RC Survey Point 2 accounted for 633. The majority of these detections appeared to be of the same doe/fawn groups traveling back and forth along the game trail past the camera over the 151-day deployment period.

White-tailed Deer presence was consistent at 9 of the 14 camera locations, with 31 to 122 detections. Five of the cameras (RC 3, RC5, RC 9, RC 11 and RC 13) captured much lower White-tailed Deer presence at 0 to 13 detections. Three MVA cameras (RC 12, RC 13 and RC 14) positioned along Lowe Road, detected more Mule Deer than White-tailed Deer, whereas the majority of the other camera locations detected more White-tailed Deer than Mule Deer. These data suggest that Mule Deer tend to occupy or pass through the grassland habitats in the eastern portion of the Study Area (e.g., Section 18-37-04 W3M) associated with the Northeast Swale, while the majority of the White-tailed Deer occupy the woodland habitats associated with the Small Swale, as well as the central portion of the Study Area in Crop Land habitat. White-tailed Deer are widespread in a variety of habitats but prefer forests bordering agricultural fields or natural meadows, whereas Mule Deer prefer open areas with cover in which to feed (Bowers et al. 2004).

The RC Survey Point 9 (Appendix C – Figure C7), located at the north end of NW 18-37-04 W3M, captured a high number of Coyote images accounting for 68% (40 of 59) of all Coyote detections. There were at least two adult Coyotes identified at this location, as well as juveniles, which would suggest that there is likely a den in the vicinity.

The RC Survey Point 3 (Appendix C – Figure C7) captured numerous images of White-tailed Jackrabbit activity accounting for 94% (51 of 54) of all White-tailed Jackrabbit detections. During the photo analysis, this species was observed entering and exiting a burrow within the camera's field of view, approximately 2 m from the base of the tree where the camera was positioned, which attributed to the high number of detections.

With respect to the Lowe Road closure, it is not possible to determine if the reduction in vehicle traffic on this roadway influenced wildlife movement patterns across Lowe Road. The remote camera program started on June 2019 and the road closure began in July 2019, which did not leave sufficient time to gather sufficient baseline data on wildlife use and movement patterns to determine if there were any changes beyond baseline conditions. Further, the objective and design of the remote camera study was to determine general habitat use and preferences, with less emphasis on specific species behaviour.

Cameras are typically used to determine species use at a particular site; as such, the number of individuals recorded by the cameras at each survey location provides an indication of general activity and not a population estimate. For example, as the antlers of male deer (bucks) grow, they begin to develop unique features or characteristics that allow the identification of individuals. Identifying the same individuals on multiple camera locations can provide an indication of habitat use and movement by deer throughout the Study Area.

During the photo-interpretation analysis, 33 different (recognizable) White-tailed and Mule Deer bucks were identified within the Study Area. Seventeen of these bucks were detected at several different survey locations and it was possible to track how and where these individuals were moving through the Study Area. Based on their presence at different camera locations, the deer appeared to be moving in a west to east direction between the Small Swale and Northeast Swale or vise versa. The remaining 16 bucks were detected at single camera locations, and therefore, it was not possible to track movement patterns for each buck. Of these 16, six were detected several times at a single camera location, which may indicate the camera was positioned within their core home range. The remote camera survey results are provided in Appendix F.

6.7.3 RECOMMENDATIONS

The retention of natural habitat types within the Study Area to the extent practical is recommended, as they provide cover, foraging opportunities and travel corridors for a diverse assemblage of wildlife species.

To further understand wildlife movement and how animals of different species are using the habitat types within the Study Areas, it is recommended that monitoring using remote cameras be continued. The use of the cameras as part of the 2019 survey recorded habitat use and movement patterns over a relatively short period of time between the summer and fall periods. While this provided insight on habitat use, it does not consider how habitat use and movement patterns may change throughout the year or over the course of one or more years. During the summer and early fall period, many animals particularly deer, tend to stay within small home ranges, whereas in the fall and winter periods, individuals extend their movement patterns over a larger area in search of food, protective cover or mating opportunities. A study conducted in southern Saskatchewan looked at deer migration and dispersal patterns and observed that the majority of excursion movements outside core home ranges occurred from late fall to early spring (Skelton 2010).

Additional or continued monitoring using RCs over the course of a year or more would provide additional information on what wildlife species are using specific habitat types within the Study Area, how they move through the Study Area, how movement patterns may differ over each of the four seasons and provide data on the species success. If monitoring continues in 2021 or 2022, this information would further support recommendations related to potential wildlife corridors and how linear parks, proposed Ecological Zones, or other linkages could be designed as part of the neighbourhood design plan. Additional monitoring would provide better information on wildlife movement patterns, and be beneficial to further inform roadway wildlife crossing corridors. At the same time, it will help determine whether other mitigation measures are needed to reduce wildlife mortalities (as described further in Section 11).

This is expected to comply with Section 5.1 of the OCP related to Neighbourhood Design and Development (i.e., in an efficient and environmentally sensitive way), Section 9.2.2(d) related to Protection of Natural Areas, and Section 9.5.2(d) related to Least Disturbance to wetlands (City of Saskatoon 2019).

7 WETLANDS

According to the City of Saskatoon Wetland Policy (City of Saskatoon 2013a), wetlands are defined as "lands having water at, near or above the land surface or land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, aquatic vegetation and various kinds of biological activity which are adapted to a wet environment. Wetlands can hold water temporarily or permanently, with water levels fluctuating over the course of a single year and over many years with climactic cycles." A wetland complex is defined as "a combination of individual wetlands and surrounding riparian areas that have complementary functions and have greater significance when viewed together compared to individual significance."

According to the Bond et al. (1992), wetland function is defined as "the capabilities of wetland environments to provide goods and services including basic life-support systems, which may directly or indirectly provide benefits to society".

7.1 METHODS

The wetlands in the Study Area were initially assessed in the fall of 2014 by Stantec (2015), including those wetlands in the Small Swale in SW 24–37-05 W3M (Stantec 2013b). As part of this assessment, wetlands were classified using the Stewart and Kantrud (1971) classification system and functional assessments were also conducted in 2014 on select wetlands using the Minnesota Routine Assessment Method (MnRAM) (Minnesota Board of Water and Soils Resources 2010a). Only wetlands of Class 2 or higher were inventoried.

In 2019, EDI completed a wetland survey and, using the previously collected data, each wetland (Class 2 to Class 5) located within the Study Area was revisited to document current conditions. The same methods (e.g., Stewart and Kantrud [1971] and Minnesota Board of Water and Soils Resources [2010a]) were used to verify/update the wetland boundaries, classifications and functional assessment of each wetland from previous conditions.

The Stewart and Kantrud (1971) method classify wetland basins based on certain species of plants that occupy the following distinct vegetational zones:

- Low prairie zone (Class 1 - Ephemeral) – Ephemeral ponds occur in small swales and contain species such as Kentucky Blue Grass. Surface water is only maintained for a brief period in early spring prior to the bottom ice seal melt.
- Wet meadow zone (Class 2 - Temporary) – In freshwater temporary ponds, the central wet meadow zone is the deepest part of the wetland area and is usually dominated by Western Wheatgrass and Foxtail Barley. Class 2 wetlands experience rapid water loss from ground seepage and surface water is maintained only for brief periods after spring snow melt and occasionally after periods of heavy rain.
- Shallow marsh zone (Class 3 - Seasonal) – Seasonal ponds are wetlands with a shallow marsh zone dominating the deepest part of the wetland area. These ponds are frequently surrounded by a ring of willows (*Salix* spp.) with a wet centre containing sedges (*Carex* spp.). Surface water in Class 3 wetlands is

maintained for extended periods in the spring and summer but typically dry out in late summer to early fall.

- Deep marsh zone (Class 4 - Semi permanent) – In semi-permanent ponds and lakes, the deep marsh zone dominates the deepest part of the wetland area. Common Cattail and Bulrushes (*Scirpus* spp.) are typical emergent species. Surface water in Class 4 wetlands is typically maintained throughout the spring and summer and often into the fall and winter periods.
- Permanent open water zone (Class 5 - Permanent) – The permanent open water zone dominates the deepest part of the wetland area and is devoid of emergent vegetation. Surface water of Class 5 wetlands is maintained throughout the year with relatively stable water levels.
- Intermittent Alkali zone (Class 6) – The intermittent alkali zone dominates the deepest part of the wetland area and is devoid of emergent vegetation. Alkali wetlands are characterized by a pH above 7 and a high concentration of salts. The dominant plants are generally salt tolerant. Surface water of Class 6 wetlands is typically shallow and highly saline that alternates with exposed bare salt flats.
- Fen/Alkaline bog (Class 7) – The fen zone dominates the deepest part of the wetland area. Peripheral wet meadow and low prairie zones are often present. Fen ponds often have floating mats of emergent vegetation, including sedges, grasses, and other herbaceous plants. Surface water in this class is usually absent; however, bottom soils are typically saturated by ground water seepage.

These zones are closely related to differences in water permanency influenced by the permeability of the bottom soils, and classifications can change overtime and season due to variation in yearly climatic conditions (Stewart and Kantrud 1971).

The MnRAM assesses function of wetlands and was designed to consider both functions and values when assessing wetlands and ultimately to determine land use decisions (Minnesota Board of Water and Soils Resources 2010a). The MnRAM database evaluates 12 function/value characteristics for each wetland (Minnesota Board of Water and Soils Resources 2010b). These include characteristics that relate to vegetation composition, hydraulic regime, water quality, shoreline protection, habitat for fish, amphibian, and wildlife species, as well as anthropomorphic value attributes such as aesthetic, educational, cultural and various land uses. Wetlands that contain a species of management concern are automatically classified as Preserve wetlands. Once wetlands have been assessed they are assigned to one of the following four management classifications: Preserve, Manage 1, Manage 2, or Low (Minnesota Board of Water Resources 2019). These data can then be used as a framework for planning, and to make land use and wetland management decisions.

7.2 RESULTS

A total of 22 wetlands were identified within the Study Area (Figure 9). See Table 11 for a description of each wetland, including an explanation of any changes that have occurred since the last assessment in 2014 (Stantec 2015).

Since 2014, the construction of McOrmond Drive has directly affected Wetlands 3031, 7147, and 7151. Wetland 3031, as delineated by Stantec (2015), was bisected by McOrmond Drive North; and the southern portion of Wetland 7151 was reduced. The southern tip of Wetland 7147 has been modified as part of the McOrmond Drive North infrastructure, including a small catch basin. Two additional wetlands (7152 and

9754) that were assessed by Stantec (2015) were filled in for the construction of McOrmond Drive North and Central Avenue North and are not included as part of this screening.

Based on the results of the 2019 field program, the classification of most of the wetlands that were not directly affected by the North Commuter Parkway Project remained unchanged since 2014 (Stantec 2015). However, Wetland 9055 was re-classified because review of historical imagery revealed that the centre of the wetland is a dug-out and it has held water consistently for almost 20 years (Google Earth Pro 2020). Five wetlands in the Small Swale that were delineated by Stantec (2015) as being individual basins are now connected (i.e., expansion of the wet meadow and shallow marsh vegetation zones) to make up one large Class 4 wetland complex (Table 11). The complex is bisected by the North Commuter Parkway into the following two wetlands, which are connected hydrologically by culverts (see Figure 9):

- Wetland 3027 (Combined Stantec [2015] Wetlands 3027, 3029, 9572, and the portion of 3031 that is now located north of McOrmond Drive North); and,
- Wetland 3031 (Combined Stantec [2015] Wetland 3034 and the portion of 3031 that is now located south of McOrmond Drive North).

Wetlands 3001 and 3002, associated with the Riddell Paleontological Site are unique in the Study Area, as they are not natural prairie potholes or part of either of the swale features. Wetland 3001 is a seasonal wetland that formed at the bottom of the previously excavated (inactive gravel pit) area on the southern portion of the site. Wetland 3002 is a temporary wetland in the northern portion of the site, dominated by willows and appears to be part of an extension of a riverbank coulee complex and its deciduous forest. The groundwater that feeds both these wetlands continues to the riverbank where it seeps out of the slope. The area and size of these wetlands in the current wetland assessment have been reduced slightly compared to the information provided by Stantec (2015) with the removal of the upland areas and slopes of the site that were likely included previously as part of the air photo interpretation.

Table 11. Wetlands and management classifications located within the University Heights Neighbourhood No. 3 Study Area.

2019 Wetland No. (EDI)	Legal Land Location (W3M)	2019				2014 (Stantec 2015)				Cause of Change in Area between 2014 and 2019
		Size (ha)	Wetland Class [1]	Management Class [2]	Photo (App. A)	Wetland No.	Size (ha)	Wetland Class	Management Class	
1	SW 19-37-04	0.16	3	Manage 2	Photo 12	-	-	-	-	New identification
2	SW 19-37-04	0.21	2	Manage 2	Photo 13	-	-	-	-	New identification
3	SE 24-37-05	0.67	5	Null[5]	Photo 14	-	-	-	-	New identification.
3001	SW 13-37-05	0.23	3	Preserve	Photo 15	3001	0.48	3	Preserve	Wetland re-mapped based on field observations to exclude slopes and upland.
3002	SW 13-37-05	0.04	2	Preserve	No Photo	3002	0.28	2	Preserve	Wetland re-mapped based on field observations to exclude slopes and upland.
3027	E-24-37-05	8.533	4	Preserve	Photo 16 - 18	3027	4.6	4	Preserve	Wetlands re-mapped as one wetland.
						3029	4.19	4	Preserve	
						9572	5.95	3	Preserve	
3028	SW-24-37-05	0.2	3	Preserve	No Photo	3028	0.2	3	Preserve	-
3031	SW-24-37-05	11.74[3]	4	Preserve	Photo 19 - 21	3031	7.29	3	Preserve[4]	Wetlands re-mapped as one wetland.
						3034	1.53	3	Manage 1	
7147	SW 19-37-04	0.51	3	Preserve	No Photo	7147	0.51	3	Preserve	-
7150	SW 19-37-04	0.11	3	Manage 1	No Photo	7150	0.5	3	Manage 1	Wetland re-mapped to exclude the area containing a Trembling Aspen bluff.

2019 Wetland No. (EDI)	Legal Land Location (W3M)	2019				2014 (Stantec 2015)				Cause of Change in Area between 2014 and 2019
		Size (ha)	Wetland Class [1]	Management Class [2]	Photo (App. A)	Wetland No.	Size (ha)	Wetland Class	Management Class	
7151	SW 19-37-04	0.12	2	Manage 2	Photo 22	7151	1.52	2	Manage 2	Southern portion of wetland was filled for the construction of McOrmond Drive North; Northern portion of wetland re-mapped to exclude the area containing a Trembling Aspen bluff.
7158	SE 13-37-35-05	0.36	2	Null	No Photo	7158	0.36	2	Null	-
7167	SE 13-37-35-05	0.12	2	Null	No Photo	7167	0.12	2	Null	-
7171	NE 13-37-35-05	0.06	2	Null	No Photo	7171	0.06	2	Null	-
7175	NE 13-37-35-05	0.05	2	Null	No Photo	7175	0.05	2	Null	-
7178	NE 13-37-35-05	0.13	3	Manage 1	No Photo	7178	0.13	3	Manage 1	-
7184	NE 13-37-35-05	0.1	2	Null	No Photo	7184	0.1	2	Null	-
7189	NW 13-37-35-05	0.28	3	Manage 2	No Photo	7189	0.28	3	Manage 2	-
9050	SW 24-37-05	0.28	3	Preserve	Photo 23	9050	1.25	3	Preserve	Wetland re-mapped to exclude area containing Trembling Aspen bluff.
9051	SW 24-37-05	0.05	3	Preserve	Photo 24	9051	0.05	3	Preserve	-
9055	NW 13-37-35-05	0.24	5	Preserve[3]	Photo 25	9055	0.24	3	Preserve[4]	Reclassified as a Class 5 (permanent wetland) because it is a dug-out.
9755	SE 19-37-04	0.02	2	Preserve	No Photo	9755	0.02	2	Preserve	-

[1] Based on Stewart and Kantrud 1971.

[2] Based on Minnesota Board of Water and Soil Resources 2010a,b,c.

[3] The 2019 area for Wetland 3027 only includes the extent of the wetland that is located within the Study Area.

[4] Wetland received Management Class of Preserve based on existence of Species at Risk amphibian habitat despite lower scores in other functions.

[5] A functional assessment was not conducted on Wetland 3 because it is on private land.

Preserve – Maintain wetland and existing functions, values and wildlife habitat. Active management may be required to protect unique features. Strict avoidance standards should be applied, and conservation easements may be appropriate.

Manage 1 – Maintain wetland without degrading existing functions, values and wildlife habitat.

Manage 2 – Maintain wetland footprint. Improve wetland biological and plant community diversity/integrity or enhance other functions if possible.

Null – No functional assessment conducted due to low quality habitat.

Wetlands Identified Within the Study Area

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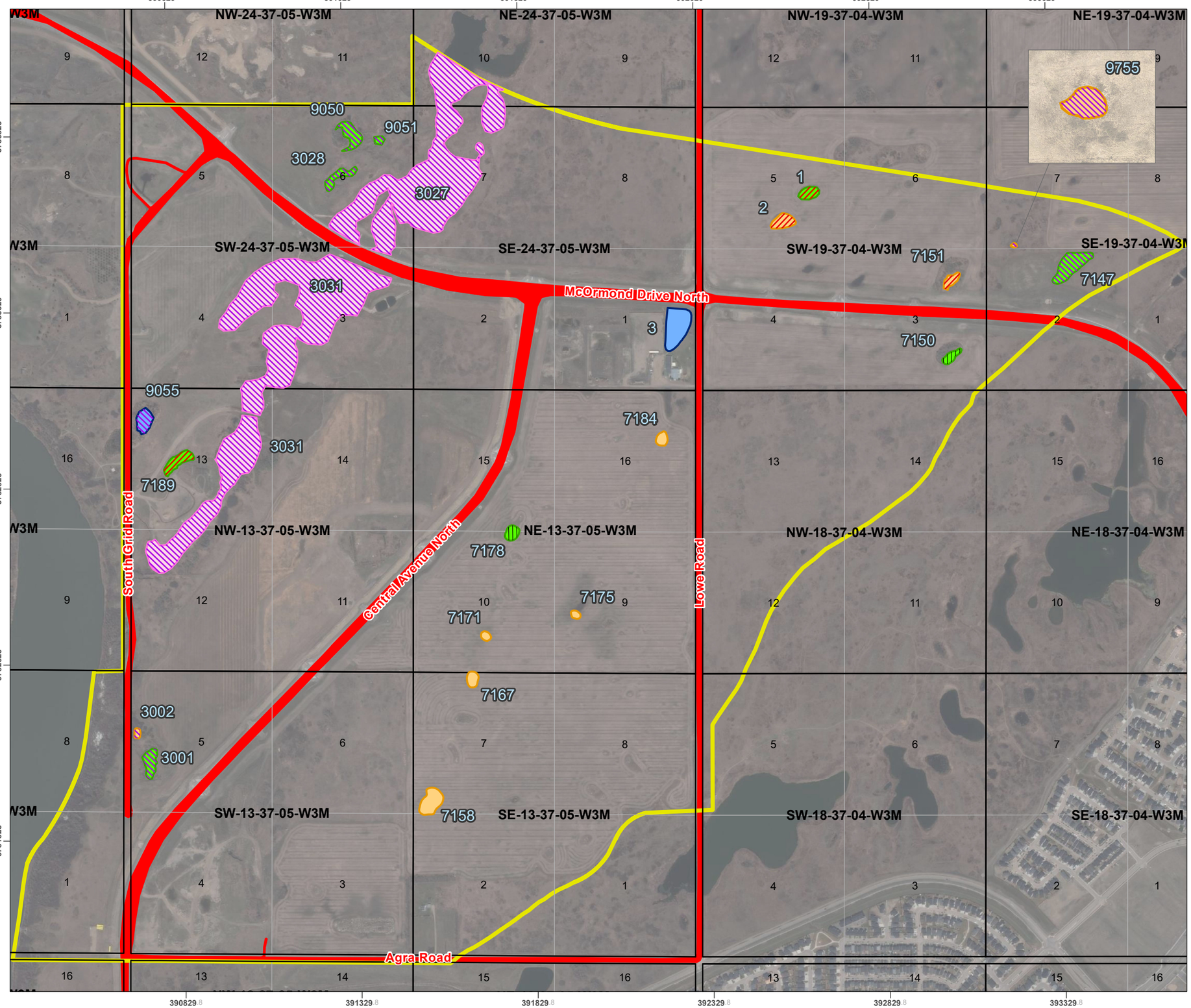


Legend

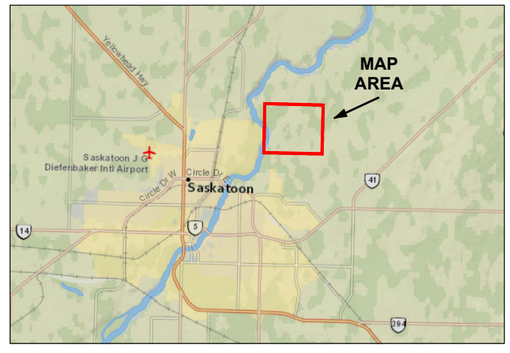
Management Classifications

- Manage 1
- Manage 2
- Preserve

Wetland Classifications

- Class 2 (Temporary)
- Class 3 (Seasonal)
- Class 4 (Semi-permanent)
- Class 5 (Permanent)

- Project Boundary
- Road
- Quarter Section
- Legal Subdivision



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Meters

N

Map Scale = 1:11,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N

Data Sources

- Imagery. World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
- Inset map. National Geographic World Map

Disclaimer

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Three new wetlands were identified during the 2019 surveys. A Class 2 (Temporary) wetland and a Class 3 (Seasonal) wetland were located in SW 19-37-04 W3M (Wetlands 1 and 2 on Figure 9); both wetlands were adjacent to Trembling Aspen bluffs and neither wetland held standing water at the time of the survey. The Saskatchewan Wildlife Federation Trout pond in SE 24-37-05 W3M was added as a Class 5 (Permanent) wetland (Wetland 3 on Figure 9) because it fits the City's definition of a wetland and was identified as possible habitat for Northern Leopard Frogs. Functional assessments were conducted for Wetlands 1 and 2, but not for Wetland 3 because it is on private land.

During the 2019 wetland surveys, based on the MnRAM functional assessments criteria, it was noted that the characteristics and classification of the wetlands in the Study Area had not changed since the 2013 and 2014 Stantec surveys. As such, no further updates to the MnRAM functional assessment were required. Ten wetlands were classified as Preserve, two wetlands as Manage 1, and three wetlands as Manage 2 (Table 11). The remaining six wetlands were not assessed because their functional score was predicted to be Low because they have been tilled through. The exception to this was Wetland 3 which is on private land owned by the Saskatchewan Wildlife Federation.

Other than Wetland 7189, which is located within the Civic Material Handling Yard, all wetlands associated with the Small Swale (i.e., Wetlands 3027, 3031, 3028, 9050, 9051, 9055) are classified as Preserve , including the wetlands south of McOrmond Drive North that have cultivated and developed adjacent upland habitat. Despite the lower scores in other functions assessed, Wetland 3031 was given a Management Class of Preserve because of the presence of Northern Leopard Frog, a species of management concern. Wetland 9055 was given a Management Class of Preserve because of the potential for the wetland to provide suitable amphibian breeding and overwintering habitat. Although the Northern Leopard Frog was not observed at Wetland 9055 in 2013 or 2014 (Stantec 2015), it was observed during the 2019 surveys. During the 2019 field surveys, Northern Leopard Frogs were also observed within the Small Swale north of McOrmond Drive North at Wetland 3027.

7.3 RECOMMENDATIONS

According to Section 9.5.2 (c) of the Official Community Plan (OCP) Bylaw 8769 (City of Saskatoon 2019), the City of Saskatoon will favour the conservation of existing significant wetland resources over the restoration of drained wetlands or the creation of new wetlands during it their review of Sector Plans and Concept Plans; and, as per Section 9.5.2(b), development in the City should:

(i) avoid impacts to wetlands with particular consideration given to significant wetland resources;

(ii) minimize impacts to wetlands where avoidance cannot be fully achieved; and,

(iii) undertake compensatory mitigation for any impacts to wetlands that occur as a result of development.

The following recommendations for the wetlands identified in Section 7.2 are expected to comply with the polices on Wetland Conservation and Management set out in Section 9.5.2., as well as Section 5.1 related to

Neighbourhood Design and Development (i.e., in an efficient and environmentally sensitive way) and Section 9.2.2(d) related to Protection of Natural Areas.

Incorporation of Wetlands into the UH3 Neighbourhood Design

Following the OCP and the management strategy associated with Preserve wetlands (Table 12), it is recommended that the two Preserve wetlands located within the Riddell Paleontological Site (Wetlands 3001 and 3002) and the six Preserve wetlands associated with the Small Swale (Wetlands 3027, 3028, 3031, 9050, 9051, and 9055) be protected as part of a proposed Ecological Zone that includes a 30 m setback buffer (see Section 9). The remaining wetland associated with the Small Swale, Wetland 7189 (Manage 2), is located within the disturbed area of the Civic Material Handling Yard and was not considered to provide enough value to be integrated into the Ecological Zone but could instead be incorporated into a stormwater management system, otherwise it will need to be compensated for as set forth in a Wetland Mitigation Plan developed as part of the Area Concept Plan (see below).

It is recommended that development be designed to reduce the disturbance and/or alteration of Wetlands 1 (Manage 2), 2 (Mange 2), 7150 (Manage 1), and 7151 (Manage 2) by incorporating them into UH3 as Natural Areas or Natural Assets. By retaining them as wetlands as part of the neighbourhood design will take advantage of the aesthetic value of the Trembling Aspen trees and other vegetation that surround the wetlands and maintain wildlife habitat; as noted in Section 6.2.2, an occupied Great-horned Owl stick nest was observed at Wetland 7151 (Appendix A – Photo 27).

The two remaining Preserve wetlands (Wetlands 7147 and Wetlands 9755), located in SE 19-37-04 W3M, should be considered for incorporation into a stormwater management system, retaining as much of the natural vegetation as possible. It is also recommended that Wetland 7178 (seasonal, Manage 1) and the five temporary wetlands (Wetlands 7158, 7167, 7171, 7175, and 7184) in E -13-37-05 W3M be incorporated into a stormwater system, if neighbourhood design allows. As evident in Figure 10, these two sets of wetlands are part of the current natural drainage system. If incorporating into stormwater management is not possible, these wetlands should be compensated for as described in a Wetland Mitigation Plan.

It is anticipated that all retained wetlands, including those left as natural areas and those designed for storm water management purposes, will be monitored by the City of Saskatoon with the goal of maintaining or enhancing water quality and function.

Table 12. Recommended wetland management standards for management classes.

Management Classification	Management Strategy	Stormwater treatment	Buffer
Preserve	Maintain wetland and existing functions, values and wildlife habitat. Active management may be required to protect unique features. Strict avoidance standards should be applied and conservation easements may be appropriate.	Avoid conveyed flows where prudent and feasible. Upstream sediment and nutrient pre-treatment is required to maintain background loading rates. Maintain existing hydrology and divert increased flows. Avoid concentrating flows.	≥15 m for water quality and ≥30 m for wildlife habitat.

Management Classification	Management Strategy	Stormwater treatment	Buffer
Manage 1	Maintain wetland without degrading existing functions, values and wildlife habitat.	Pre-treat conveyed flows to maintain background loading rates.	10-15 m
Manage 2	Maintain wetland footprint. Improve wetland biological and plant community diversity/integrity or enhance other functions if possible.	Pre-treat all conveyed discharges to remove all heavy particles and maximize removal of fine grained sediment prior to discharging to the wetland.	7.5-10 m
Low	Allow for relaxed sequencing and replacement plan flexibility. Consider for restoration/enhancement.	Pre-treat all conveyed flows to remove all medium grained and larger sediments.	7.5 m

Minnesota Board of Water and Soil Resources (2010 a,b,c)

Development of a Wetland Mitigation Plan

It is understood that the City requires a Wetland Mitigation Plan be included as part of any Area Concept Plan or Area Concept Plan Amendment that has the potential to impact wetlands identified as Preserve, Manage 1, or Manage 2. It may also be required for any other development proposal that requires City approval. As such, it is anticipated that a Wetland Mitigation Plan will likely be needed to address any effects to the following wetlands that are not included as part of the proposed Ecological Zone:

- Wetland 1 (Manage 2);
- Wetland 2 (Manage 2);
- Wetland 7150 (Manage 1);
- Wetland 7151 (Manage 2);
- Wetland 7178 (Manage 1);
- Wetland 7189 (Manage 2);
- Wetland 7147 (Preserve); and,
- Wetland 9755 (Preserve).

The Wetland Mitigation Plan may also need to include any wetlands that may be adversely affected by construction of various neighbourhood components, particularly Wetlands 3027 and 3031, if stormwater management forebays are constructed in the Small Swale area.

As outlined in Section 3.2(d) of the City's Wetland Policy, a Wetland Mitigation Plan requires:

- an account of anticipated impacts to all wetlands in the Concept Plan area identified as Preserve, Manage 1 and Manage 2 according to the functional assessment categories as identified by the City's Wetland Inventory, with a focus on any wetland resources identified as significant;
- an explanation of all measures, which must be consistent with the Wetland Development Guidelines, that will be taken to mitigate for impacts as part of the proposed development;
- if applicable, an explanation of any impacts for which mitigation is not proposed;

- for all retained wetlands, an explanation of how development will interface with wetlands and their associated riparian areas and how successful establishment of vegetation communities will be ensured;
- a description of measures to be taken to ensure that impacts on wetlands are minimized while development is underway;
- a monitoring strategy to ensure the measures outlined in the Wetland Mitigation Plan are implemented; and,
- a proposed allocation of wetlands, associated riparian areas and buffers into categories of Dedicated Lands. The allocation will be subject to the review and approval of the City.

Stormwater Management Integration - Wetland Development Guidelines

Design of wetlands as part of the storm water management system in the UH3 development should abide by the City's Wetland Policy and also follow the Wetland Design Guidelines (City of Saskatoon 2014). These guidelines provide best management practices and a set of basic guidelines to aid in the understanding, siting, and design requirements for stormwater management constructed wetlands.

As per Section 3.3 of the City's Wetland Policy, Wetland Development Guidelines are required to be established to provide guidance for:

- general establishment and management procedures for constructed and preserved wetlands;
- buffer widths;
- erosion and sediment control measures;
- pre-treatment, treatment and conveyance to maintain acceptable water quality and quantity levels, including maintenance reduction measures where wetlands are integrated into the storm water system;
- maintenance of hydrologic function;
- protection of wetland resources during development;
- a management regime for initial establishment of wetland and riparian plant communities;
- harvest and reuse of wetland and riparian soils where wetlands are modified or lost to development;
- types of vegetation to be planted and timelines for establishment recognizing that native plants should be used if possible; and,
- low impact development techniques.

8 HYDROLOGY

The hydrology of the Study Area includes the wetlands (as discussed in Section 7), surface water, groundwater, and the connectivity between them. The hydrologic connectivity is defined as the interaction of surface water and groundwater as it varies across the landscape and over time. The connectivity is dynamic and driven by the flow regimes across the Study Area, inputs from precipitation, groundwater recharge, and outflows into adjacent wetlands and watercourses (e.g., South Saskatchewan River).

For the purpose of this report, the key components related to the hydrology of the Study Area include the portion of the Small Swale situated within the Study Area boundary and the Northeast Swale, which borders the east side of the Study Area. The objective of the hydrology component of this report is to assess the hydrological connectivity in the Swales using available information from previous reports, available data, and supported by field observations from EDI. The objective is to better understand the hydrology in the Swales, including groundwater connectivity, surface water hydrology, hydrologic function, and changes over time in the Small Swale.

Previous reports have emphasized maintaining the connectivity in the Swales (Stantec 2013). As such, the assessment of the hydrologic connectivity will consider potential impacts to the Swales from land-use changes associated with roadways and storm water retention with forebays for pre-treatment, and will focus on retention of hydrological connectivity in the Small Swale and maintaining integrity of the system in consideration of stormwater management. These considerations, and observations of current conditions, such as the roadways, are used to recommend best management practices for adjacent neighbourhood developments.

8.1 CURRENT SETTING

The topography of the Study Area is comprised of undulating and gently rolling terrain, with the Small and Northeast Swales being the predominant landforms (depressions). The elevation across the Study Area ranges from 493 m to 511 m, generally decreasing from higher elevations along the east and southeast portions of the site, towards the South Saskatchewan River, with a topographic high between the Swales (maximum elevation 503 m). Along the east side of the Study Area, the South Saskatchewan River has eroded the surficial sediments and the elevation drops sharply to approximately 470 m. The topography of the area is dominated by lacustrine clays and silts, underlain by till. Across the Study Area, erosional processes across have resulted in a depositional terrace marked by the Small and Northeast Swales, representing erosional channel scars (Clifton 2013).

Surface water hydrology associated with the Study Area is characterized by precipitation runoff, surface flows in the Small and Northeast Swales, and the isolated wetland basins, which also function as recharge and hydrologic storage features. The surface water drains from the Study Area, through the topographic lows towards the South Saskatchewan River. The Northeast Swale drainage is unidirectional, from southwest to northeast, flowing to the South Saskatchewan River. In the Small Swale, a topographic drainage divide occurs near the north boundary of the Study Area, which coincides with the approximate location of McOrmond

Drive North. The construction of McOrmond Drive North bisected the Small Swale, but as the alignment of the roadway follows the natural topographic divide in the Study Area, the natural drainage paths within the Small Swale were preserved with the majority of the drainage in the Small Swale flowing south (Figure 10) such that drainage patterns function normally.

The Small Swale is comprised of a series of semi-permanent and seasonal wetland features located near the South Saskatchewan River that are connected hydrologically via surficial and subsurface conduits, and groundwater pathways. As mentioned previously, the Small Swale is a channel scar that drains to the southwest and northeast, separated by a drainage divide, with the larger portion of the Small Swale draining to the south (Figure 10). The gross drainage area to the outflow from the southern waterbody of the Small Swale is approximately 2.08 km^2. This area flows to the southwest to the South Saskatchewan River where the gross drainage area increases to 2.53 km^2 at the river edge. An estimate of annual unit runoff from the Small Swale at the outflow from the southern waterbody of the Small Swale is approximately 24,960 m^3 based on an estimate of 12 dam^3/km^2 for the Saskatoon area (Agriculture and Agri-Food Canada 2013).

The Northeast Swale is a larger, more prominent channel scar situated in an eroded till plain, which drains northeast towards the South Saskatchewan River (Stantec 2002, 2015). The Northeast Swale is dominated by a large semi-permanent wetland, with several smaller temporary and seasonal wetlands. The gross drainage area of the Northeast Swale in the Study Area approximately 63.8 km^2. An estimate of annual unit runoff from the Northeast Swale is approximately 765,600 m^3 based on an estimate of 12 dam^3/km^2 for the Saskatoon area (Agriculture and Agri-Food Canada 2013).

The climate of the Study Area is continental, with hot summers, cold winters, and annual average precipitation of 316.5 mm/yr (MDH 2011). Less than 27% of the precipitation falls as snow annually, and therefore recharge is primarily from precipitation during the summer months, when precipitation levels are highest (May through July). Regional recharge to the groundwater at the Study Area occurs as vertical precipitation driven groundwater flow through the till, and lateral groundwater flow from the Strawberry Hills in the east (MDH 2011, Clifton 2013). Local recharge to groundwater occurs at topographic highs along the east of the site, and infiltration of precipitation and surface water including wetlands, and is dominated by depression focused recharge. Recharge to the main aquifer is estimated to range between 1 to 10 mm/year, varying regionally.

8.2 HYDROGEOLOGY

The main groundwater aquifer underlying the Study Area is the Forestry Farm Aquifer (FFA), a hydrostratigraphic unit within the Floral Formation (MDH 2011, Pinter & Associates 2015, WSA 2020). The hydrostratigraphic unit is a geological formation with similar hydrologic properties that is used to both define the aquifer unit based on stratigraphy and groundwater properties and understand the groundwater flow regime, including connectivity. The hydrostratigraphy of the aquifer is generally gravel, sand, and silt, and may be discontinuously confined by the till layer. The FFA is a water bearing gravel/sand/silt unit that underlies the Study Area; it is regionally expansive, and not limited to the Study Area. Regional groundwater flow is east to west across the Study Area, with lateral flow moving through the FFA towards the South Saskatchewan River. The erosion of the South Saskatchewan River has exposed the FFA along the riverbanks, and seepage indicates that groundwater discharges along this face as springs (Clifton 2013, Pinter & Associates 2015).

Drainage Patterns Within the Study Area

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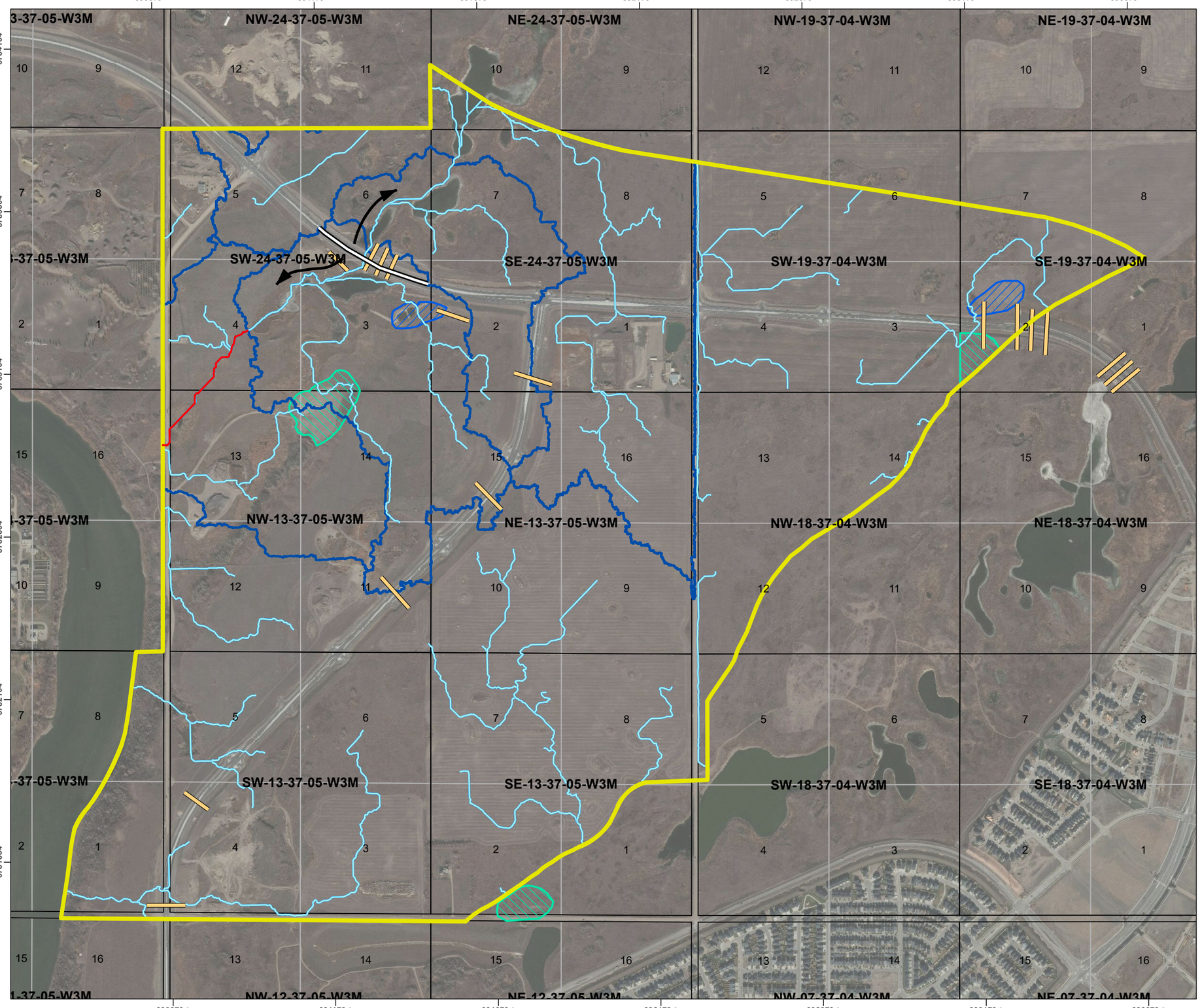
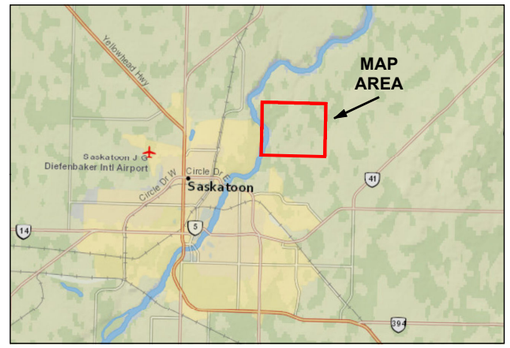


Legend

- South Swale Outflow
- Topographic Divide
- Culvert
- Project Boundary
- Delineated Flow Path
- Small Swale Incremental Drainage Area
- Existing Forebay/Catchment Basin
- Proposed Forebay
- Quarter Section
- Legal Subdivision



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Meters

Map Scale = 1:12,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N

N

Data Sources

- Imagery. World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
- Inset map. National Geographic World Map

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To understand the hydrologic connectivity in the Study Area, including the groundwater recharge and discharge, storage capacity, and flow characteristics, an understanding of the regional hydrologic processes is bridged with the local hydrostratigraphic data to form a conceptual site model. The conceptual site model is used to understand the local flow regimes, including the magnitude of groundwater fluctuations, surface and subsurface controls on the hydrologic connectivity and relative variability across the Study Area. This information is then used to inform the recommendations on potential hydrologic responses to changes in the Study Area. Regional fluctuations in the groundwater elevations are monitored in the Water Security Agency (WSA) observation well (WSA Saskatoon), installed in 1967 (NW 16-08-37-04 W3). In this observation well, used to monitor water levels in the FFA, groundwater levels show a correlation with precipitation trends, with an approximate lag of several months to a year relative to the five-year precipitation average. From its installation until 2005 (nearly 40 years), the range of the annual water fluctuations in the observation well was approximately 1 m, decreasing an average of 0.15 m over the dry period. During the period where the water fluctuations were less than 1 m, the water table elevation was below the base of the confining till layer, and the aquifer was not fully saturated, allowing the water table to fluctuate freely in unconfined conditions[17]. After 2005, following a period of higher-than-normal precipitation, the water table in the FFA rose to the base of the confining till layer, approximately 501 metres above sea level (masl); and as the aquifer received more recharge from the precipitation, it became fully saturated and pressurized. This is reflected in the water levels in the observation well rising, due to the pressure, to approximately 505 masl, which is above the base of the till and indicates groundwater in the observation well has an upward vertical gradient (WSA 2020).

The shallow groundwater is widespread across the area in which the FFA occurs and is variable in depth, depending on surface topography, gradients, surficial material, seasonal trends and regional groundwater fluctuations. The Northeast and Small Swales are separated by a topographic rise that extend between these two hydrologic features. Well and borehole records for the Study Area and surrounding areas provide information on the water levels in the area, and the lithology encountered locally (Clifton 2013, Pinter & Associates 2015, WSA 2020). Water levels across the entire Study Area are reported between 2.5 to 10 m below ground surface in the drill logs. Within the area of the Small Swale, groundwater elevations measured in piezometers were generally reported between 3 to 5 m below ground surface (Clifton 2013). Pinter & Associates (2015) discusses the suitability for construction, foundations, piles, and with respect to slope stability, put emphasis on drainage to control groundwater levels, and controlling water into the Swales. It is understood that further work will be completed as part of the detailed design done by Saskatoon Water.

Generally, trends across the Study Area show unconfined or discontinuously confined conditions east of the Northeast Swale.

In the Northeast Swale, the overlying till unit is thin to absent resulting therefore the aquifer is unconfined, and the FFA is exposed in the swale (Clifton 2013). Piezometers installed in the Northeast Swale show that the swale water level represents the groundwater elevation in the FFA and groundwater levels are at or within 1 m of ground surface (Clifton 2013). Groundwater connectivity in the Northeast Swale is an important component of the surface hydrology as the wetlands receives recharge from the groundwater, as well as

[17] An unconfined aquifer is defined as one that is not under pressure and that may be because the water bearing unit is not fully saturated, or the aquifer is not bound by a confining layer and therefore, the water is not under pressure.

wetlands recharge the aquifer during periods of high surface water. and In the Small Swale, near the north end of the Study Area, a discontinuous till confining layer was observed in borehole logs. At the south end of the Small Swale, drill logs indicate thick units of clay, and confined conditions with an upward vertical gradient where groundwater was encountered. Inland from the South Saskatchewan River, gravel extraction indicates spatially variable stratigraphy and variable thickness of the confining till in the area surrounding the Small Swale. A downward gradient, which represents surface water recharging groundwater, was reported in piezometers in the vicinity of the Small Swale; however, the gradient is expected to vary seasonally, with an upward gradient expected during wet seasons (Pinter & Associates 2015).

The surface water in the Small Swale occurs on surface because of precipitation inputs and to a lesser degree, groundwater interactions. The groundwater interactions in the Small Swale influence surface water to a lesser degree relative to the Northeast Swale due to the physical isolation where the confining layer is present across the Small Swale. In the Northeast Swale, a confining unit was not observed in the borehole logs, and therefore the surface water is not physically isolated from the groundwater. Therefore, surface water in Northeast Swale is seasonally an expression of the water table.

8.3 SURFACE HYDROLOGY

Historical observations of the surface hydrology and imagery of the Study Area provide valuable data on the hydrologic function of the Swales, as well as an improved understanding of the seasonal and interannual variability, especially in the Small Swale. The hydrograph of the groundwater observation well (WSA Saskatoon) shows there has been an increase in groundwater levels regionally up to 5 m between 2005 and 2015, with water levels then gradually decreasing from 2015 through 2020 (WSA 2020). In the Small and Northeast Swales, trends in the groundwater levels measured in the piezometers follow the regional groundwater trends, but locally are of smaller magnitude. Between 1985 and 2013, groundwater levels in site piezometers have increased up to 3 m (Clifton 2013). Within the Swales, piezometers monitored in February 2013 and April 2015 showed a decrease in groundwater levels of 0.1 m in the Northeast Swale, and at least 0.5 m in the Small Swale, reflecting the declining trend in the regional groundwater levels. The magnitude of change in the Swales with time reflects the stronger connection with groundwater in the Northeast Swale, where the groundwater levels remained near surface.

Reports suggest that during historical dry periods the Small Swale had been previously cultivated and used for agricultural purposes and homesteading (Stantec 2003, 2013). Other historical aerial imagery, as well as field observations in May 2020, indicate that when water is readily available it is likely that local depressions within the Small Swale are functionally connected and would appear as a single waterbody. In the Swales, prior to 2005, corresponding to the period when regional groundwater levels were relatively stable with annual fluctuations of approximately 1 m, historical imagery shows that changes in surface water extents were limited (Clifton 2013). Between 2005 and 2013, the historical imagery shows that the footprint of the wetland and pond areas in both Swales increased, corresponding to the increase in the regional groundwater levels and increases in precipitation in the past decade. Due to the increased precipitation, wetlands in the Small Swale have been reported as being deeper and maintaining water for longer periods due to the higher inundation levels (Stantec 2013)

Historical aerial images of the Small Swale and the wetland assessment indicate that at most times there is at least some water stored within local depressions, but dry episodes and reduced surface expression correspond with periods of reduced precipitation and decreased groundwater levels. Based on review of historical satellite imagery, during dry years, either as a result of decreased precipitation, reduced recharge or groundwater level declines, there is a potential for those same local depressions and seasonal wetlands in the Small Swale to become disconnected at surface.

Hydrological connectivity in the Swales is dependent on a combination of precipitation, surficial runoff and groundwater recharge. Groundwater recharge occurs through infiltration of surface water into the subsurface, and this infiltration capacity has the effect of moderating flooding and spikes in flow during periods of high runoff and surface inputs. Conversely, groundwater discharge to surface water can sustain surface water flow and maintain surface water features during dry periods. The Northeast Swale is characterized by semi-permanent wetlands. The confining layer was not observed in the borehole logs in the Northeast Swale, and the absence of a confining unit indicates surface water exchanges with groundwaters is not limited by the stratigraphy, and therefore is hydraulically connected to the FFA. In the Northeast Swale, water levels in the piezometers, based on the 2013 to 2015 data, suggest the water table has remained relatively stable relative the regional groundwater fluctuations, supporting the previous finding that the Northeast Swale maintains a strong connection with groundwater. In the Small Swale, the connectivity between wetlands is dependent on the volume of surficial runoff and, to a lesser degree, groundwater recharge to maintain water levels throughout any given year. The aquifer is discontinuously confined through the Small Swale, and the water level in the piezometers reflects more of the regional groundwater fluctuations than surface conditions.

A discontinuous confining layer occurs throughout the extent of the Small Swale, which limits infiltration capacity and groundwater recharge, where the confining layer reduces water transmission. Therefore, the Small Swale is susceptible to flood events if runoff is concentrated into the swale. The likelihood of flooding is greater in the spring/summer during high precipitation events, and/or snowmelt events. In the later part of the summer/fall when precipitation is lower, or during dry periods, the Small Swale is more dependent on surface water runoff because groundwater inputs are limited by the confining layer. Therefore, there is potential for wetlands in the Small Swale to become isolated, fully disconnected, and potentially completely dry if natural runoff is intercepted or directed out of the Swale area

The construction of McOrmond Drive North has bisected the Small Swale, with connectivity maintained within the Small Swale through cross-drainage culverts. The placement of McOrmond Drive North augmented the local drainage patterns to the wetlands in the southern drainages of the Small Swale. Prior to construction of McOrmond Drive, a portion of the drainage to the Small Swale naturally contributed directly to the most upstream wetland (Wetland 3027) in the Small Swale on the northern side of the drainage divide. With McOrmond Drive North in place, this drainage pattern is influenced by the culvert and drainage features associated with McOrmond Drive North, which redirects some runoff to the southern side of the drainage divide, ultimately draining into the forebays near the Small Swale. The upstream wetland will still receive water from natural drainage from adjacent areas, although at a reduced rate. Due to the drying potential in the wetlands in the Small Swale, connectivity may be disrupted should water levels drop below the invert of the cross-drainage structure during dry years or if upstream flow is diverted out of the wetland complex.

8.4 POTENTIAL EFFECTS FROM NEIGHBOURHOOD DEVELOPMENT

With respect to both swales, development of UH3 has the potential to affect water quantity and quality. Qualitatively speaking, development near the Small Swale may change runoff volumes and timings to the Small Swale. The discontinuous nature of the confining till layer through the Small Swale reduces capacity for storage and groundwater recharge and discharge in areas where the confining layer is present. Existing data are not sufficient to quantitatively estimate the potential changes to the Small Swale. While it is recognized that wetlands in the Small Swale have dried up (seasonally) under natural conditions, the development of the UH3 neighbourhood may have the potential to increase the frequency or duration of the drying periods if surface water runoff is diverted away from the Swale. Conversely, should the development of the UH3 neighbourhood increase flow volumes through wetlands in the Small Swale as a result of storm events, there may be a potential for geomorphological changes such as erosion and sediment mobilization, and shifting of flow pathways at the wetland outlets and along the downstream flow path. In addition, should water from the upstream catchment be diverted around the first receiving wetlands, there would be a potential break in connectivity downstream.

Changes to the magnitude and timing of water level fluctuations of wetlands in the Small Swale are expected with the UH3 neighbourhood as local infiltration rates will be changed with paved and hard packed surfaces influencing the response to both surface water and groundwater systems. It is expected that all stormwater from impermeable surfaces will be diverted to the Small and Northeast Swales through infrastructure thus reducing infiltration to groundwater. Qualitatively speaking, water levels in the Small and Northeast Swales will see faster responses to storm events than would occur prior to development. The precipitation contributing to these storm events will typically occur in the spring/summer period. Groundwater recharge will likely have low flow rates to the Small and Northeast Swales over a longer period of time relative to the much more rapid shedding of water through stormwater infrastructure. It may be possible that outflows and evaporation losses from the wetlands in the Small Swale may result in a lower water elevation in the wetlands than prior to development of the UH3 neighbourhood. This may particularly be the case in drier years, when water levels in the Small Swale may be lower later in the season (compared to current patterns in water level fluctuations) on account of reduced inflows from runoff from the UH3 neighbourhood.

Aquifer vulnerability is a property of a groundwater system that considers the sensitivity of an aquifer to human and/or natural impacts. The upper FFA has been ranked as having predominantly high vulnerability due to the proximity of the aquifer units to surface (MDH 2011). At the local scale, the aquifer vulnerability is variable, and may be influenced by surface features and development which impact the flow, the groundwater recharge, and potential contaminant pathways. In the Northeast Swale, the aquifer is unconfined and maintains a stronger connection to the surface water and therefore, aquifer vulnerability is higher relative compared to the Small Swale. The groundwater flow across the Study Area is from east to west, therefore development in the Study Area will not contribute to the vulnerability in the Northeast Swale. However, construction of impervious surfaces, road crossings and stormwater retention features, and the nature of the materials transported on roadways are factors for consideration in aquifer if traffic is projected to move across higher vulnerability areas regardless of groundwater flow directions. Runoff from impervious surfaces and

stormwater collection have the potential to contain contaminants; however, retention ponds typically have mitigating effects on contaminant transport due to aquatic vegetation and flow dynamics (Stantec 2002).

8.5 RECOMMENDATIONS

Development of the UH3 should incorporate planning and design elements to achieve the objectives through the following recommendations:

- Protect the water quality of wetlands within the Small Swale and Northeast Swales through continued water monitoring. Water quality monitoring recommendations include pH, conductivity, , and turbidity, and analytical sampling could include total suspended solids, salinity, and nutrients (e.g., nitrogen and phosphorus).
- Monitor water level data to determine natural fluctuation ranges in surface water in the Swales, and complete groundwater monitoring to observe water level fluctuations in the vicinity of the Swales.
- Keep water level fluctuations in any potentially influenced wetland within natural ranges.
- Manage stormwater in the Study Area using a variety of techniques including low impact designs (e.g., bioswales, rain gardens) within the development area to provide filtration, attenuate peak flows and promote infiltration.
- Manage stormwater within the development to reduce erosion and/or sedimentation of natural stream beds associated with the swales.
- Complete stormwater modeling for the Study Area for the purpose of sizing of forebays and to include the potential impacts on water levels of downstream wetlands.
- Determine whether development of UH3 will reduce water level contributions to any wetlands that reside outside of either swale. This will require assessment of the local drainage area to these wetland areas in consideration of the proposed development footprint.
- Institute erosion control measures either through flow management or infrastructure design considerations (storage ponds, erosion control to reduce velocities). Loss of sediment through erosion will ultimately result in increased sediment loads at the forebays and will increase the frequency of forebay maintenance.
- Given the relatively small drainage area of the Small Swale, drainage patterns should be maintained such that upstream wetlands continue to receive their current proportion of drainage area prior to development (Figure 10).
- To mitigate potential drying conditions in the Small Swale, implement groundwater and discharge control measures (e.g., interceptor drains as described by Pinter & Associates (2015) to allow return flow to the Small Swale to provide a continuous source of water.
- Culverts should be designed and built to withstand projected high flow events to minimize the potential disruption to connectivity between the wetlands.
- A design flood event should be considered when determining the setback for any development that may be compromised by high flood waters. The City may need to consider flood events with recommendation from the WSA for design criteria.

- Any stormwater management structures (e.g., forebays) immediately upstream of a receiving waterbody should be constructed with sufficient setback (i.e., construct buildings outside known flood margins or high water mark, design to 1:500 flood event), in terms of ground distance as well as invert elevation, that the receiving waterbody cannot backflow into the management structure. Any flow paths from management structures should be constructed with suitable channel protection to manage erosion into receiving wetlands.
- Minimize the construction of stormwater structures within the swales. Where required in proximity to the Small Swale, water management structures should be constructed on previously disturbed ground such as the Civic Material Handling Site. Any such structure should be considered in context of any potential geotechnical or hydrogeological conditions in the area.
- Determine if groundwater discharge to any constructed stormwater management structure will have a detrimental impact on the structures function and mitigate any such influence during design and construction.
- Manage stormwater within the Study Area in consideration of maintaining the natural fluctuation of water levels in wetlands influenced by the development (e.g., direct stormwater to isolated wetlands that could be included as part of a linear park or greenspace feature).
- Incorporate erosion protection measures in any stream alignment (i.e., last point of release from the wetlands in the Small Swale that drain into the South Saskatchewan River), which may prevent channel degradation and subsequent bank failures such as near the river where the terrain steepens.
- Incorporate sediment removal maintenance as required to prevent channel aggradation (i.e., sediment deposition into the channel), which may influence flood levels above normal water level response in any receiving wetland.

9 INTEGRATION OF PROPOSED ECOLOGICAL ZONES

The 2019 field surveys were focused on documenting the current conditions within several natural areas, referred to as Areas of Ecological Interest, within the Study Area (see Section 2). Based on the results of the 2019 field program and the desktop review, the establishment of defined areas, referred to as proposed Ecological Zones, are recommended to remain intact and undeveloped by future residential neighbourhoods.

The following subsections provide an overview of the proposed Ecological Zones that are recommended to be conserved based on the flora and fauna communities and the topographical and hydrological characteristics that comprise these areas. These proposed Ecological Zones also consider other recommendations made throughout this report pertaining to species-specific habitat requirements. The locations of the proposed Ecological Zones are illustrated in Figure 11.

9.1 SMALL SWALE AND ADJACENT NATIVE HABITAT COMMUNITIES

The suggested boundaries of the Small Swale should include the existing wetland and grassland habitats on both the north and south sides of McOrmond Drive North in NW 13-37-05 W3M and S½ 24-37-05 W3M. It is recognized that portions of this land base have been disturbed as a result of the operations of the Civic Material Handling Yard in NW 13-37-05 W3M, as well as historical gravel extraction and agricultural practices in S½ 24-37-05 W3M. As such, the suggested boundaries exclude these disturbance areas and include the existing wetland and grassland (including tame and modified portions). This delineation is intended to maintain the hydrological and habitat connectivity of the Small Swale feature as much as possible, while conserving one of the healthier native grassland communities documented in the Study Area. Further, disturbed areas that are not recommended to be part of the proposed Ecological Zone could be included as part of a Municipal Reserve with a greenway buffer along the outer boundary.

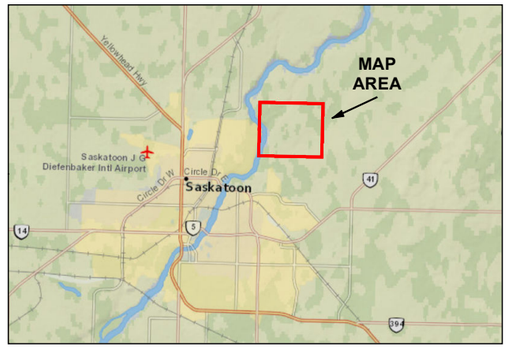
The grassland and wetland habitats delineated for preservation support Plains Rough Fescue and Crowfoot Violet, two provincially listed plant species, as well as a Northern Leopard Frogs. Maintaining these habitats is expected to provide nesting and breeding habitat for raptors and songbirds (as mentioned in Sections 6.2.3 and 6.3.3), as well as conserving eight wetlands with a management class of Preserve that provide suitable habitat for amphibian species (see Recommendations in Section 6.6.3). Further, this area currently provides natural travel corridors to facilitate wildlife movement to and from the South Saskatchewan River valley (as mentioned in the Recommendations in Section 6.7.3).

Recommended Ecological Zones and Linear Design Features within the Study Area

CITY OF SASKATOON

Legend

- Proposed Linear Park Alignment
- Proposed Greenway
- Proposed Roadway Alignment
- Riverbank Area
- Recommended Municipal Reserve
- Existing Forebay/Catchment Basin
- Proposed Forebay
- Proposed Ecological Zone
- Project Boundary
- Quarter Section
- Legal Subdivision



0 100 200 300 400 500
Meters

Map Scale = 1:12,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N

N

Data Sources

- Imagery. World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
- Inset map. National Geographic World Map

Disclaimer

EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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9.2 GRASSLANDS IN NW 18-37-04 W3M ADJACENT TO THE NORTHEAST SWALE

It is recommended that the existing boundary of the Northeast Swale be extended to include an adjacent portion of the grassland in NW 18-37-04 W3M. This delineation is intended to maintain additional grassland habitat as part of the Northeast Swale feature to the extent practical, that is expected to benefit a number of wildlife species by fulfilling their life requisites. Wildlife that may benefit include Short-eared Owl (see Section 6.5.3), Sharp-tailed Grouse that have a lek located nearby (see Section 6.1.3), and ungulates that use this area as part of natural travel corridors (see Section 6.7.3). In addition, the suggested boundary for the proposed Ecological Zone in NW 18-37-04 W3M includes a 200-m radial setback from the Sharp-tail Grouse lek centre point as well as a recommended visual treed barrier 200 m – 400 m from the lek to address the Saskatchewan Activity Restriction Guidelines for Sensitive Species (ENV 2017), as described in detail in Section 6.1.3.

According to the Northeast Swale Development Guidelines: "Some disturbed lands along the north boundary fall within the Swale boundary and some relatively good native prairie areas fall outside the boundary. Prior to residential development, there may be some opportunity to further refine this boundary to include the small portions of native prairie and exclude the more disturbed sites" (Stantec 2012). Based on the results of the 2019 survey, the proposed Ecological Zone will provide a north boundary for the Northeast Swale that represents a balance between protecting the ecological character of the Northeast Swale and developing the adjacent lands. This recommendation also relates to the objectives outlined in Section 9.2 OCP (City of Saskatoon 2019) related to the Conservation of Natural Areas to protect this local ecosystem, enhance the beauty of this area for local residents, and conserve the flora and fauna this area supports.

9.3 RIDDELL PALEONTOLOGICAL SITE

Information on the Riddell Paleontological Site is limited to Dr. Skwara-Woolf's (Department of Geological Sciences, University of Saskatchewan) permit report based on paleontological exploration and collection at the Riddell Site in 1976 (Woolf 1977) and a Field Report that was later prepared by Dr. John Storer (previous curator at the Royal Saskatchewan Museum) (Storer, John. n.d.). Based on discussions with Mr. Ryan McKellar, Curator of Invertebrate Paleontology at the Royal Saskatchewan Museum (McKellar 2019), the paleontological exploration and collection work completed at the Riddell Site was done before the creation and implementation of *The Heritage Property Act* (Government of Saskatchewan 1980). Therefore, the requirements for fieldwork, permits and reporting were not yet fixed in their current form.

During the paleontological exploration program at the Riddell Paleontological Site in 1976, vertebrate fossils, ocherous wood and shells were found. In addition, 19 taxa of large mammals (three of which are extinct) from the late Pleistocene epoch (Late Rancholabrean Age) were discovered in a stratified and cross-bedded sand deposit known as the Riddell Member (Woolf 1981). Unfortunately, due to the vagueness of past reports, there is no definitive information on what remains of the site; however, to be conservative, we assumed that intact components of the Riddell Paleontological Site likely exist. Dr. Storer's Field Report recommended that the site be marked with a sign and considered as a future candidate for designation as Provincial Heritage Property.

Based on the response from the Heritage Conservation Branch (HCB), it was determined that a paleontological Heritage Resources Impact Assessment (pHRIA) is required to attempt to determine the status, size and location of the site (e.g., the exact LSD location) and level of disturbance (HCB File No. 19-678). A pHRIA will be completed under a separate contract in 2020. This will be completed to determine the extent of the Riddell Site, the exact location, and to further evaluate its overall significance and if areas are still 'in-tact' to avoid.

Although several past HRIAs have been completed in the Study Area, to confirm if there are any outstanding archaeological requirements Atlheritage contacted the HCB. The HCB determined that areas of remnant native grassland in LSDs 2 and 7 in Section 19-37-4 W3M required further assessment by the HCB. The HRIA was completed on these areas, and no artifacts or archaeological features (e.g., stone circles, stone cairns, cellar depressions) or the remains of historic trails (e.g., Moose Woods-Batoche Trial) were discovered. Subsequently, a HRIA was completed on October 25, 2019, and the HRIA Permit Report submitted to HCB for review. The HRIA Permit Report was approved by HCB and heritage clearance granted on December 6, 2019. No further mitigation measures are required.

It is anticipated that site-specific recommendations will be provided once the pHRIA has been completed. However, given the unique historical significance of the site, combined with the flora and fauna communities that this site supports, it is recommended that the Riddell Paleontological Site be preserved and protected as part of a proposed Ecological Zone or subject to detailed design. This recommendation also relates to the objectives outlined in Section 9.2 of the OCP (City of Saskatoon 2019) related to the Conservation of Natural Areas and Archaeological Sites to protect this unique site for its historical and aesthetic value as well as to conserve the flora and fauna this area supports.

Further, connectivity to the Riverbank Area should be retained to maintain habitat connectivity with the South Saskatchewan River valley. Given the unique topography of this site, with the eroded slopes of the coulee complex, wetlands and occurrence of a provincially listed plant species, the integrity of the site should be protected in its current state. It is also recommended that the UH3 design include this site as a destination and extension of the current urban trail systems, with appropriate controls. The Riddell Paleontological Site already acts as a trail head to active, informal riverbank trails. An interpretive trail could be placed on the upland adjacent to the site on the north, west, or south sides. Interpretive signs posted along the trail could provide the paleontological history of the site and ecological information pertaining to the different habitats and the species at risk that are known to occur on the site (e.g., American Bugseed and Northern Leopard Frog). Additional information related to the recommended best management practices for the integration with development around the Riddell Paleontological Site is provided in Appendix G.

10 DESIGN FEATURES

Specific design features are recommended for consideration as part of the UH3 design. These include a greenway, exclusion fencing to separate domestic animals from the natural areas, multi-use trails connected to existing trail networks (e.g., MVA trails, residential trails), and pathway and neighbourhood lighting. Additionally, consideration was given to potential linkages between the Northeast and Small Swale features that could be designed into the overall layout of the UH3 Neighbourhood. Most of these design features are intended to be incorporated adjacent to the Northeast and Small Swale features but could also be considered for other aspects of the UH3 design, such as within dedicated municipal reserve.

10.1 GREENWAY

EDI recommends that a design, similar to the Aspen Ridge Greenway (Stantec 2012), be used for the north edge of the Northeast Swale. It is proposed that the greenway extend southwest from McOrmond Drive North in SW 19-37-04 W3M, through NW 18-37-04 W3M, W3M, southwest through SE 13-3-05 W3M and along Agra Road in the SW 13-37-05 W3M to connect with Central Avenue North (Figure 11). A greenway is also recommended along both sides of the Small Swale in SW 24-37-05 W3M and NW 13-37-05 W3M, as illustrated in Figure 11. In both cases, the greenway could connect with McOrmond Drive North and Central Avenue North multi-use trails, as well as any future constructed river valley / urban trails. The inclusion or placement of pedestrian trails as part of the greenway should be carefully considered when designing the greenway so as to minimize edge effects (e.g., introduction of invasive/noxious weeds, interruption of wildlife corridors) from such development. While pedestrian trails are mentioned as part of the greenway recommendation, these may not be suitable at all locations. It is anticipated that the final decision on where to incorporate pedestrian trails be left up to Saskatoon Land, in consultation with appropriate design staff and biologists alike.

To better understand how the Aspen Ridge Greenway design was implemented following the construction of the Aspen Ridge neighbourhood, a tour was completed on October 17, 2019. Once it was ascertained what the greenway was comprised of and how it was constructed, a literature review was conducted to determine whether there were other buffer designs considered in other jurisdictions that could be an alternative to a greenway.

The current Aspen Ridge Greenway design (Figure 12) is based on a concept that incorporates a setback and buffer zone (Carolinian Canada Guide 2003). A 'setback' is defined as the distance from a rear lot edge of a developed area to a natural heritage feature to separate two different land uses. The 'buffer zone' is defined as an area within the setback that is necessary for the protection of natural heritage features and their ecological function, where its purpose is to minimize potential adverse effects on these features and their functions and maximize the long-term viability of native species and natural systems (Carolinian Canada Guide 2003).

The objective of the greenway design is to provide a multi-use buffer between a natural area (e.g., the Northeast Swale) and the adjacent urban development area, to provide a conduit for infrastructure (e.g., sanitary, power, and telecommunication lines), stormwater management (i.e., ditches to facilitate rainwater to

collect and flow towards holding reservoirs), as well as a conduit (e.g., paved trails) for recreation and commuting (Stantec 2002). Collectively, the three zones that have been established (the Ecological Buffer, Trail Zone, and Transition Zone) create a 'soft-edge effect' that functions to buffer the natural area from potential disturbance from the adjacent residential and/or commercial development area (e.g., inhibit encroachment of weed species from residential lots, provides a border that is more aesthetically pleasing than a hardscape median or edge).

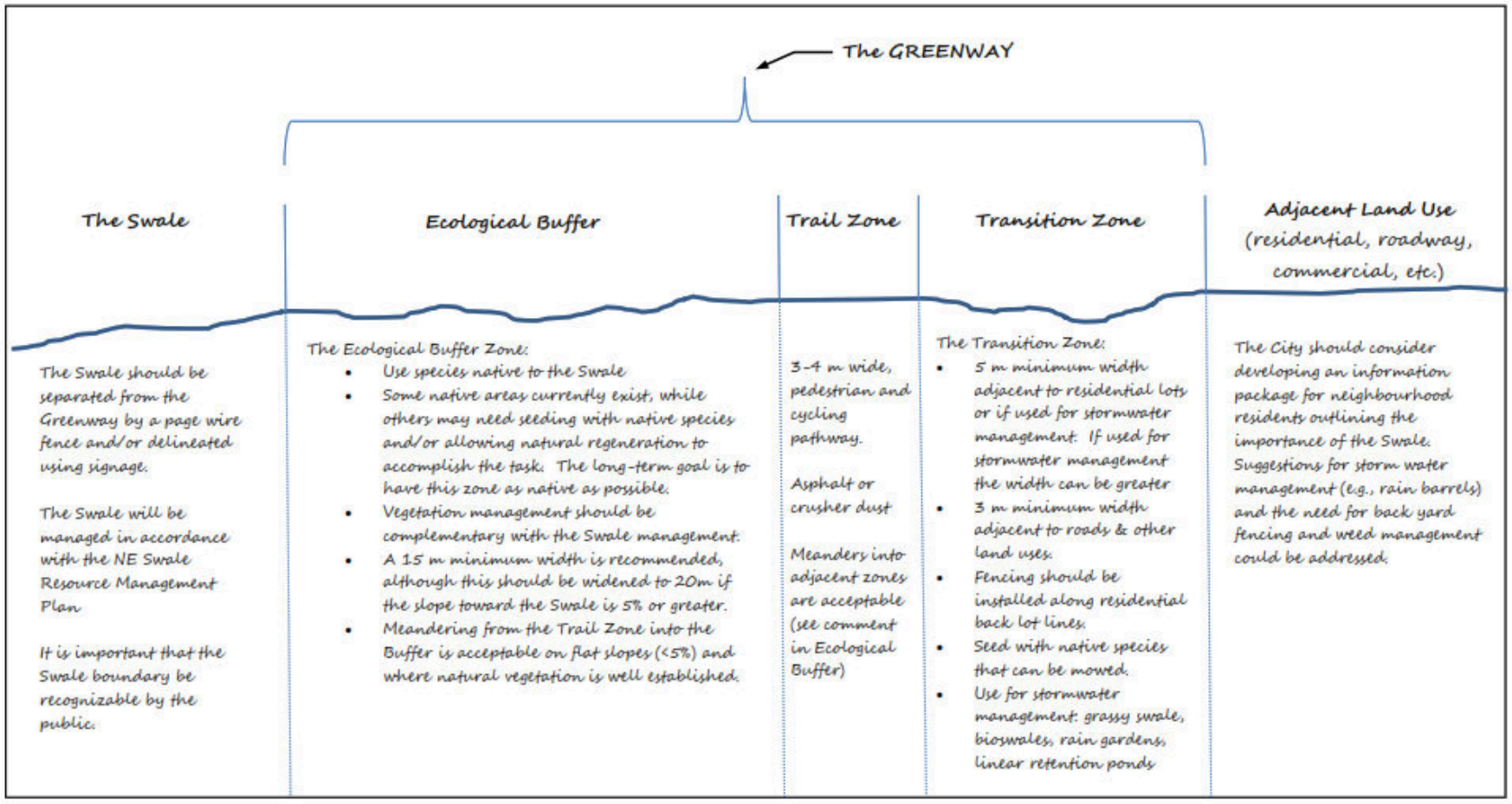

Figure 12. Current greenway design (Source: Northeast Swale Development Guidelines, Stantec 2012).

Based on the literature review, the conclusion is that natural buffers are effective and often required for the protection of natural heritage features and ecological function by providing protection from adverse or undesirable effects (Beacon 2012; Stantec 2013b; WSP 2018). The design of the buffer will depend on the natural habitats currently present and what the adjacent land uses and/or developments are or might be, along with other intrinsic factors such as topography, soil type, and hydrology (Beacon 2012; Stantec 2013).

If there is a need to incorporate a stormwater and sanitary piping system as part of the proposed greenway design that is similar to that which was used in the Aspen Greenway, this may require a wider work area so that the pipe trenches can be excavated. This would likely increase the amount of ground disturbance (i.e., disturbance footprint) that eventually needs to be reclaimed, preferably with native grasses, forbs, and shrubs as much as feasible. The design of the UH3 Greenway should strive for a balance between disturbing as little of the native vegetation as possible associated with the Northeast and Small Swale areas and the area required for the greenway, to reduce the amount of disturbed area that needs to be reclaimed. However, it is anticipated that the actual components included as part of the greenway will be subject to detailed design of the neighbourhood.

The overall function of a buffer is to insulate a natural area feature from the adjacent land uses (usually land use changes) so that the natural area can continue to provide the same, or a comparable range, of ecological goods and services, as it did prior to the change in land use (Beacon 2012). According to North-South Environmental Inc. (2009) and Beacon (2012), buffers can function in the following ways:

- help mitigate sediments and pollutants;
- provide a visual barrier (i.e., screen) against human activities that result in noise, light or other sensory disturbances;
- provide a barrier that reduces access into a natural area feature such as related to predation by dogs and cats or human intrusion;
- provide an area for wildlife to carry out part of their life cycle such as waterfowl nesting next to a wetland;
- provide a vegetated zone to help provide water quality controls for overland flows before reaching the feature such as active, exposed construction areas next to a feature;
- provide a vegetated zone to help control overland flow so as to reduce possible problems such as erosion on valley slopes;
- serve as a habitat transition zone;
- provide for wildlife movement; and,
- contribute to the protection of the given area (e.g., limiting the spread of invasive species).

To be effective, buffers should be permanently vegetated and provide a measure of protection against the impacts from adjacent land uses (Beacon 2012). Further, while buffer widths tend to be based on factors related to topography, sensitivity of features, and magnitude of adverse effects from adjacent land use, a recommended buffer width from a natural area feature should be a minimum of 24 m, as per the Northeast Swale Development Guidelines (Stantec2012).



Photos 1, 2, and 3. Looking southwest and northeast onto the existing Aspen Ridge Greenway (October 17, 2019). Note the lighted, paved path that allows for pedestrian traffic as well as the adjacent landscaped ditch that facilitates stormwater drainage.

10.2 EXCLUSION FENCES

Exclusion fences (e.g., aluminum fencing, chain link fencing) could be included as part of the greenway design or Swale Management Plan along the property line of the residential lots to preclude domestic pets (cats and dogs) from accessing the Northeast and Small Swales. Buffers that are designed to exclude pets have been proven to be effective if the buffer design includes other measures such as fences (Metsers et al. 2010). Further, fences that are at least 1.5 to 1.8 m in height are more likely to preclude larger wildlife (e.g., deer) from gaining access to residential yards that back onto the natural area features (City of Edmonton 2010). The actual style and type of fence would depend on the design requirements for the development planned adjacent to the Northeast and Small Swales and the intended role that the fence is to serve.

While decorative/aesthetically pleasing styles (e.g., heavy duty steel profusion welded fencing) may be more appealing to residential and commercial lot owners, this style will be more effective at keeping large mammals out of adjacent lots and less effective at keeping pets (e.g., cats) from wandering into nearby natural areas. Conversely, chain link fences may be less decorative and appealing to lot owners but would provide a more effective barrier as an exclusion mechanism for keeping pets in and wildlife out. The fence design and placement should consider the purpose of the fence, the wildlife species found in the adjacent natural areas, site specific features including topography (slope) and habitat types. Additional information and potential options for consideration can be found in guidance documents related to wildlife friendly fences and wildlife exclusion (Government of Saskatchewan 2016; Huijser et al. 2015).

Photos 4 and 5. Examples of different types of exclusion fencing (e.g., chain link and steel/wrought iron fence panels).

10.3 MULTI-USE TRAILS

An additional recommendation for the UH3 greenway designs would be the inclusion of appropriately routed and designed paved pedestrian trails or crusher dust trails, similar to what is currently in place at the Aspen Ridge Greenway feature and MVA multi-use trails. Ideally, the trails could connect to the existing MVA trail networks and be routed appropriately to consider and protect environmentally sensitive features that may be within the proposed greenway alignment.

Based on the findings of the tour of the Aspen Ridge Greenway and a literature review, EDI recommends that a similar design would be suitable for the north edge of the Northeast Swale, along both sides of the Small Swale and the interior disturbed area. Consideration for routing of a greenway should consider the location of any site-specific terrain features or vegetation communities so that these can be avoided (i.e., routed around) for protection of these features. Further, interpretive points of interest could be incorporated into the landscaping component for the design of the trail network as part of the greenway.

10.4 LIGHTING

With respect to lighting, the use of outdoor lighting that minimizes the potential adverse effects from light pollution in an urban setting is recommended. Lighting along trails associated with either the greenways or other linear park features should be designed to meet standards provided by the International Dark-Sky Association. Light pollution can include glare, skyglow, light trespass, and clutter associated with outdoor lighting features and design in urban areas (IDSA 2020). With respect to adverse effects on wildlife, artificial lights can disrupt nocturnal activity patterns, migration behaviours, and can lead to mortality events as wildlife are either distracted by or drawn to lighted areas or where predators are able to access areas previously not illuminated (IDSA 2020).

Lighting options should consider light colour, fixture design, and placement. Blue light emissions tend to brighten the night sky more than any other color of light because it has a significantly larger geographic reach than lighting consisting of less blue. Further, these lights create potential road safety problems for motorists and pedestrians alike. Therefore, it is important to minimize the amount of this colour of light that is emitted.

Recommended light sources should include use of low-pressure sodium (LPS) and/or light emitting diode (LED) fixtures that have a color temperature of no more than 3000 Kelvins (IDSA 2020). Further, full cut-off lighting (i.e., fixtures that project their light in a downward direction) and/or that are fully shielded to reduce glare and light trespass should be incorporated. Lighting should also be provided in the appropriate placement and spacing so that fixtures are placed at only the areas that need to be illuminated. Other considerations could include the use of solar lighting and timers to limit the time period that certain areas are illuminated, as feasible from a public safety perspective.

10.5 LINEAR CONNECTIONS BETWEEN THE NORTHEAST SWALE AND SMALL SWALE

One of the objectives of the field program was to identify wildlife travel corridors within or through the Study Area. This objective was completed by setting up remote cameras at existing game trails to determine the connectivity of habitats and how wildlife species (in particular medium to large mammals) move around, through and within the Study Area (as described in Section 6.7). The intent in identifying wildlife travel corridors was not only to better understand wildlife movement in and around the Study Area, but also to use this information to determine possible linear connections between the Northeast Swale and Small Swale features. These linear connections could then be designed as linear parks or other connected green spaces that could be used as corridors through a residential neighbourhood for both wildlife and pedestrians alike.

Based on existing topographical features, natural vegetation communities, and the wildlife use data collected as part of the wildlife corridor survey, two potential linear connections are recommended (Figure 11). These two connections have the opportunity to include current and/or historical wetland basins that could be designed into permanent wetland features as a way to link the swales via a green corridor that can aid in supporting habitat for a number of wildlife species as well as aesthetic appeal to local users.

Based on the photo interpretation from the remote camera survey, it was determined that these two potential linear connections had some of the highest use by ungulates within the Study Area and the direction and orientation of the potential linear connections align with the general movement patterns and trends that were detected.

11 ROADWAYS REVIEW

Part of the planning for UH3 includes consideration for incorporating existing and future roadway infrastructure into the design of the surrounding development. Existing roadways include the extension to Central Avenue North, McOrmond Drive North, Lowe Road, Agra Road, and the South Grid Road (formerly Central Avenue North). Further, it is understood that, based on the University Heights Sector plan (City of Saskatoon 2013b), the northwestern portion of the Study Area is anticipated to be developed as a business and industrial district (i.e., the University Heights Business Park). Considerations need to include how roadways will be designed to allow sufficient access to adequately service the needs of residential and commercial/industrial users as well as for emergency support vehicles.

The following provides a discussion related to several specific roadways, including those which will provide connectivity to the University Heights Business Park, the existing Lowe Road crossing of the Northeast Swale, as well as the portion of the newly constructed McOrmond Drive North that crosses the Small Swale.

11.1 CONNECTIVITY WITH THE UNIVERSITY HEIGHTS BUSINESS PARK

The University Heights Business Park currently proposed for development in the northwestern corner of the Study Area will need to be connected to other roadways within the Study Area. Typical commuter and commercial traffic needs to be considered as part of the design of any roadway into the business park, which may entail multiple points of access into and out of the development area. Another key consideration is a design that allows for adequate response times for emergency service and support vehicles. The natural alignment of the Small Swale limits the number of potential options for locations of a roadway.

In previous studies, two infrastructure crossings were proposed through the small swale (S1 and S5; see Figure A.6 in Stantec 2015). After review of the vegetation communities and wildlife species documented in these areas, EDI's recommendation would be to avoid using either of these locations (S1 and S5), and instead use the existing South Grid Access Road (the former Central Avenue North) and extend the southern portion of the roadway through the northwestern portion of SW 13-37-05 W3M (i.e., around the northern edge of the Riddell Paleontological Site in LSD 05-13-37-05 W3M and south of the Small Swale) to connect with Central Avenue North. This would avoid any habitat fragmentation through the Small Swale at NW 13-37-05 W3M. An additional study will be completed at the Riddell Paleontological Site and the outcome of that study will help inform this recommendation as to where the proposed roadway should be located. However, if an additional roadway is required to facilitate access into and out of the University Heights Business Park (i.e., to facilitate emergency services), it is suggested that an alternative crossing option be considered through the current Civic Materials Handling Yard from LSD 14 to 13 in NW 13-37-05 W3M. While this would mean crossing the southern portion of the Small Swale, this option avoids most of the wetland complexes and treed habitats associated with the southern portion of the Small Swale and uses areas that have been previously disturbed from aggregate material storage as well as adjacent agricultural activities.

11.2 UPGRADED CROSSING OF LOWE ROAD AT THE NORTHEAST SWALE

The existing Lowe Road crossing through the Northeast Swale consists of a grid road with an aggregate/fill material sub-base and graveled surface. There are no defined road shoulders or other separate means for pedestrian or bike routes. In its current state, the Lowe Road crossing acts as a barrier to natural hydrologic flow and function, as well as wildlife use of (or travel through) the wetland complex and associated riparian habitat of the Northeast Swale (i.e., the current road does not allow the natural wetland and riparian habitat to function as one habitat unit, as it is bisected into two discrete habitat units). The existing culverts that are in place do not appear to be functional and require replacement to function properly. Small mammals and amphibian species are unable to safely cross under the roadway; therefore, the default crossing is over the road surface.

Photos 6 and 7. Looking north on the Lowe Road crossing of the Northeast Swale wetland, west and east sides of the roadway.

If the road is to remain, the assumption is the road will be upgraded to meet standard traffic safety requirements for people and vehicular movement, including proper response times for emergency services. EDI recommends that the design of the Lowe Road crossing at the Northeast Swale wetland include the complete removal of the existing crossing infrastructure to be replaced with a clear span bridge (Photo 8). This option has fewer adverse effects on the wetland habitat during installation and provides better connectivity (City of Edmonton 2010), both from a hydrological perspective but also for wildlife.

While a clear span bridge is preferred for providing connectivity, alternatively a series of appropriately sized, open-bottom arch-style corrugated steel or pre-cast box culverts could also be considered (Photos 9 and 10). If the latter is used, these should be arranged in a series of chambers (i.e., multi-cells or culverts) across the entire width of the Northeast Swale wetland and include the wetland margin. The open-bottom design creates a smaller in-water footprint, maintains the existing soil surface (i.e., allows for a natural bottom) and associated ecological function (City of Edmonton 2010), which facilitates more efficient movement for aquatic and/or semi-aquatic wildlife species. This type of crossing has been used successfully in several jurisdictions to accommodate coyote-sized animals and smaller animals, including amphibians and waterfowl (Clevenger and Huijser 2011, Ministry of Transport 2015; Credit Valley Conservation 2017). This design would allow greater

connection between the two portions of the wetland complex and allow animals to move freely back and forth (City of Edmonton 2010; Credit Valley Conservation 2017).

Photos 8, 9, and 10. Examples of structures recommended of the Lowe Road crossing at the Northeast Swale wetland (clear span bridge, pre-cast box culverts, open-bottom arch-style corrugated steel culverts).

Either crossing design should be modified to include ledges or narrow walkways (up to 2 m wide) or natural floors to facilitate wildlife movement. To further promote the use of the culverts as a crossing mechanism for small to medium sized animals, it is recommended that native shrubs and other vegetation species be planted along the margin of the riparian habitat on either side of the culvert entrances to provide cover that may encourage species to use these as crossings, while maintaining clear line-of-sight through the culvert. These design considerations have been used effectively across regions of North America (Clevenger and Huijser 2011), as well as in Colorado (Barnum 2003), California (Spencer et al. 2010), Edmonton, Alberta (City of Edmonton 2010), and southern Ontario (Credit Valley Conservation 2017).

It is understood that removal of the existing Lowe Road crossing will have a short-term adverse effect on the Northeast Swale wetland. Mitigation measures to reduce the impacts on the wetland include timing the construction to take place during low flow water conditions and the installation of silt fence and turbidity curtains. The latter mitigation measure is expected to reduce the likelihood of sediment transport from construction activities to address potential water quality and turbidity issues.

Based on EDI's review of the photos captured by the remote cameras installed along Lowe Road, a considerable amount of travel by ungulate species occurs on numerous game trails, portions of which cross Lowe Road. However, wildlife crossing structures, such as landscape bridges or overpasses, are not being recommended at this location due to the high cost of installation and the habitat crossed. This recommendation is consistent with those made previously by Stantec (2002) and CanNorth (2016). Given the lack of protective tree and shrub cover on both sides of Lowe Road, it is expected that larger wildlife species would be reluctant to use a crossing structure of this type (Clevenger and Huijser 2011; CanNorth 2016). Exclusion fencing along both sides of Lowe Road is not recommended, as the ungulates and other wildlife species that frequently use the habitats on either side of Lowe Road need to be allowed access across the roadway and not prevented from moving to and from the habitats associated with the Northeast Swale. Further, lower traffic speeds on roadways that cross or are located adjacent to natural areas are also recommended as these have been effective at reducing wildlife-vehicle collisions (Clevenger and Huijser 2011, CanNorth 2016).

11.3 RECOMMENDATIONS TO REDUCE WILDLIFE COLLISIONS ALONG THE NORTH COMMUTER PARKWAY

It is recognized that infrastructure associated with urban developments can have direct and indirect effects on wildlife, and it is well documented that roadways adjacent to natural areas can result in direct mortality, specifically wildlife-vehicle collisions (Clevenger and Huijser 2011; Ministry of Transport 2015; CanNorth 2016). Wildlife mortality along the primary roadways in the Study Area, specifically Central Avenue North and the North Commuter Parkway, has been documented in the Chief Mistawasis Bridge Traffic Impact Assessment Committee Report May 2020. Between the period of October 1, 2018 to October 31, 2019, a total of 18 wildlife mortalities (14 deer, 5 rabbits, and 1 raccoon) as a result of collisions with vehicles were reported (City of Saskatoon 2020). These statistics were reported for the portions of the Study Area that include:

- Central Avenue North - from McOrmond Drive North to Agra Road (5 wildlife mortalities);
- McOrmond Drive North - from the Northeast Swale to Central Avenue North (2 wildlife mortalities); and,
- McOrmond Drive North - from Central Avenue North to the Chief Mistawasis Bridge[18] (11 wildlife mortalities).

Mitigation measures to reduce vehicular collisions with wildlife recommended and/or implemented in other jurisdictions, according to recent literature sources (Stantec 2002, City of Edmonton 2010, Ministry of Transport 2015; CanNorth 2016; Credit Valley Conservation 2017), include:

- crossing structures (e.g., overpasses/landscape bridges, underpasses/culverts) incorporated into the road design;

[18] Note: while the majority of this stretch of McOrmond Drive North is located within the Study Area, the northwestern portion that includes the Chief Mistawasis Bridge is outside of the Study Area.

- diversion structures (e.g., diversion poles, fencing) designed to divert, exclude or guide animals away from roadways or high traffic areas;
- detection systems (e.g., system of digital warning signs and lights) to alert motorists that wildlife have been detected within a defined area of the roadway so that motorists are able to modify their driving (i.e., reduce their speed) to potentially avoid a collision; and,
- administrative controls (e.g., signage and speed reduction zones) where motorists are notified that they are passing through a known area where wildlife commonly occur and instructed reduce their speed to potentially avoid a collision (e.g., reduced speed zones).

Based on the previously listed mitigation measures, the results of the EDI 2019 field program, and habitat types within the Study Area, recommendations for reducing vehicular collisions with small to medium sized mammal species and large sized species (e.g., ungulates) crossing natural areas within the Study Area include the following:

- Consider creating linear parks based on the wildlife corridors as identified in the Study Area that would be designed to connect the Small Swale and Northeast Swale features and could provide a wildlife travel corridor from one area to another (i.e., by directing wildlife movement through these linear connections). Where these linear connections cross Central Avenue North and Lowe Road, other mitigation measures could be implemented such as the use of appropriate signage to inform local road users of these potential wildlife crossing corridors and reduced speed zones (e.g., 50 kph). Further, installation of automated warning systems at these linear connections that cross Central Avenue North and Lowe Road (or other major arteries designed within UH3) could be established to alert motorists that large sized wildlife (e.g., ungulates) have been detected within the crossing area of the roadway.

Consider installing fencing as part of these linear connections crossing features, or at other high wildlife use areas, to help keep large mammals off roadways. However, the fences must be designed so that they do not trap wildlife on the roadway (i.e., causing wildlife to use crossing sites that could result in increased collision interactions). If fences are considered to prevent wildlife from accessing certain roadways, they should meet the current City of Saskatoon guidelines for height and be designed to target specific species (e.g., chain link to exclude medium and large sized wildlife). Fences should not be installed for extensive lengths, which may lead to a funneling effect. If fencing is extensive, escape routes, such as one-way gates or jump-outs, should be considered to make sure wildlife is not trapped on the road (City of Edmonton 2010). Further, the design of any continuous fencing feature should also take into consideration principles based on Crime Prevention Through Environmental Design as they create roadway tunnels and entrapment zones for residents.

- Consider installing medium-sized culverts to provide connectivity for amphibians and small to medium sized mammals underneath roadways. An open-bottom design that maintains the use of the existing soil surface (i.e., allows for a natural bottom) is preferred, and native vegetation should be planted on either end of the culverts to provide protective cover that may encourage species to use these as crossings (i.e., avoid the use of excessive rip rap or gravelled surfaces that are not as conducive for use by amphibians or small mammals). If large diameter culverts are used, the crossing design should be modified to include ledges or narrow walkways (up to 2 m wide) to promote use by small to medium sized animals. Currently, a number of small diameter culverts have been installed under Central Avenue North and the McOrmond Drive North (Figure 10). Several of these appear to have been designed primarily to convey runoff water from the roadside ditches and not as a means to provide connectivity and a safe crossing mechanism for wildlife. They are either heavily armored with rip rap and/or are caged with steel bars to prevent access (Photos 11 and 12); neither design facilitates suitable movement corridors for wildlife. Conversely, other culverts along the McOrmond Drive North consist of a natural bottom (soil), are not heavily armoured with rip rap and appear to have been used by wildlife based on the presence of tracks at the culvert ends (Photos 13 and 14).

Photos 11 and 12. Existing culverts installed along Central Avenue North that do not appear conducive for providing adequate access for wildlife.

Photos 13 and 14. Existing culverts installed along McOrmond Drive that appear to be more conducive to providing access for wildlife.

12 SUMMARY OF RECOMMENDATIONS

Based on the review of recent literature, the results of the EDI 2019 field program, and discussions with personnel from various City departments, recommendations and best management practices presented throughout this report are provided in summary below.

The following recommendations should be considered for future planning and design of UH3:

General Recommendations

- Consider an integrated approach with representatives from various City departments to provide input on the design and development of neighbourhood features (e.g., greenway, bioswales, roadways, intersections, infrastructure) at the commencement of the planning phase.
- EDI reviewed previous reports (Stantec 2002, 2013, 2013a,b, 2015) and agree that the recommendations from these reports for the Northeast Swale are applicable to the Small Swale.
- If reasonable, maintain the existing terrain profile within the UH3 area as much as possible as part of the planning and design of the neighbourhood areas particularly adjacent to the Northeast and Small Swale features.
- As part of construction, limit the amount of area disturbed at one time (i.e., consider a phased approach to construction and reclamation).
- Incorporate appropriate, functional buffers or setbacks between natural areas and adjacent proposed development areas. Buffers and setbacks have been considered as part of the suggested retention of grassland in NW 18-37-04 W3M (Section 6.1.3, 9.2) and the establishment of proposed Ecological Zones, outlined in Section 9.
- Continue to consult with appropriate regulatory authorities (e.g., ENV) regarding the management of Sharp-tailed Grouse, listed wildlife (e.g., Northern Leopard Frog) and listed plant species within the Study Area. For example, further collaboration with ENV regarding the mixed-species shelterbelt of short and tall shrubs at the buffer boundary at the Sharp-tailed Grouse lek in NW 18-37-04 W3M (Section 6.1.3) would be beneficial to acquire additional input on the design and establishment of this mitigation measure.
- Create linkages between the Northeast and Small Swale features where possible using linear connections or other corridors that will allow unrestricted access and movement for people and wildlife, see Figure 11 (Section 10.9).
- Use the existing South Grid Road infrastructure as much as possible for access in and out of the northwest portion of the Study Area. See Figure 11 for the proposed connection to Central Avenue North at the south end (Section 11.1).
- It is recommended that the current Lowe Road crossing of the wetland in the Northeast Swale be upgraded and replaced with a clear span bridge or open bottom/box culvert network to provide better connectivity for wildlife and wetland function (Section 11.2).
- Use approved, certified, native seed mixes in combination with native vegetation plantings (e.g., forb plugs, shrubs) for reseeding, replanting, and erosion and sediment control.

- Weed management plans should be developed and incorporated as part of any proposed Ecological Zones, natural areas and parks established with UH3. While a number of introduced species have been documented in many areas of the Northeast and Small Swale features, development adjacent to these features should consider management techniques to limit the spread of these introduced species. Management techniques could be done in collaboration with MVA, which is currently managing invasive species in the Northeast Swale.
- While wetlands that exist in the Swales may be suitable for use in stormwater management, it is recommended that forebays be constructed independently of the wetlands and in previously disturbed portions of the Swales, where possible (e.g., the disturbed location of the Civic Materials Handling Yard site in LSD 06-13-37-05 W3M). Design of these forebays should consider mechanisms to reduce the potential for sediment transport into the Swales wetlands.
- Recommend using bioswales, rain gardens or other bioretention facilities as part of forebay and roadway designs, where possible throughout the neighbourhood.
- As part of stormwater management initiatives, reduce the amount of hard/impervious surfaces used in the neighbourhood design, as much as feasible.
- Construct greenways along the boundaries of the Small Swale and northwest side of the Northeast Swale as well as the boundary of the disturbed lands surrounding the Civic Material Handling site.

Flora (Section 5; Section 9)

- The Small Swale and Adjacent Grasslands (Section 5.2.2; Section 9.1)
    - Include the native prairie within and adjacent to the Small Swale in 06- 24-37-05 W3M and LSD 07-24-37-05 W3M into the proposed Ecological Zone (Figure 11).
    - Provide a setback of 100 m from Prairie Fescue and Crowfoot violet. This 100-m setback distance represents a compromise between the development of UH3 and other planned developments for this particular area (e.g., a future interchange at the Central Avenue and Saskatoon Freeway intersection) and the 300-m setback distance recommended by Environment Canada's Activity Set-back Distance Guidelines for Prairie Plant Species at Risk (Henderson 2011).
    - Retain the bluff of Trembling Aspen and Hawthorn located south of the Civic Materials Handling Yard in NW 13-37-5-W3M
    - The suggested boundaries of the Small Swale should include the existing wetland and grassland habitats on both the north and south side of McOrmond Drive North in NW 13-37-05 W3M and S½ 24-37-05 W3M (Figure 11). The exception to this includes the areas previously disturbed from the operations of the Civic Material Handling Yard in NW 13-37-05 W3M, as well as historical gravel extraction and agricultural practices in S½ 24-37-05 W3M (Section 9.1)
- Grasslands Adjacent to the Northeast Swale in NW 18-37-04-W3M and SE 13-37-05 W3M (Section 5.3.2, Section 9.2).
    - Set aside the land proposed ecological zone as shown in Figure 11 and include as part of the Northeast Swale boundary or define it as a Natural Area or Natural Asset. This area provides a natural buffer to adjacent native habitat as well as opportunities for genetic exchange and wildlife movement. Upland grasslands are at greater risk than those found on slopes and within the

lowlands of the Swale. Considering the historical loss of native prairie in Saskatchewan, conservation of this remnant grassland is important and provides an opportunity for residents to benefit from its aesthetic and cultural value.

  - Consider the portion adjacent to the proposed Ecological Zone as a Natural Area or Natural Asset.

- Riverbank Area and Adjacent Upland – SE 14-37-5-W3M (Section 5.4.2)
  - The Riverbank Area and the adjacent upland within the 92 m to 150 m from the shoreline should be left intact and dedicated as Municipal Reserve, Natural Area or Natural Asset under the provisions of the OCP (2019).
- Riddell Paleontological Site – LSD 05-13-37-05 W3M (Section 5.5.2; Section 9.3)
  - The Riddell Palaeontological Site should be included as part of the proposed Ecological Zone dedicated as Municipal Reserve, Natural Area or Natural Asset. The integrity of the site should be left in its current state to support vulnerable plant communities.
  - The extension of the river trail network should include this site as a destination and extension of the current urban trail systems. Further, interpretive signs could be posted along the trail that provide the paleontological history of the site and ecological information pertaining to the different habitats and the species at risk that are known to occur on the site.

Fauna (Section 6; Section 9)

- Sharp-tail Grouse Lek (Section 6.1.3)
  - Annual long-term monitoring is recommended over the next five to ten years
  - Retain existing grassland habitat in proximity to the lek in NW 18-37-04 W3M with a 200m buffer from the centre point of the lek, as shown in Figure 11.
  - Create and establish a visual barrier at the edge of the 200m setback for the lek. This vegetated shelterbelt should be planted early in the development phase to allow time for sufficient growth so that a visual/noise barrier will be in place ahead of development.
  - If annual monitoring shows a decline or abandonment of the lek a re-assessment of the development plan should be reviewed.
- Raptors (Section 6.2.3)
  - Pre-construction nest surveys should be completed prior to construction activities (e.g., clearing, stripping, grading) associated with the neighbourhood development. If an occupied nest of a raptor species is observed within the Study Area, the applicable no-disturbance setback (i.e., activity restriction buffer) based on the type of species identified will be implemented following discussions with the appropriate City personnel. Construction activities would be allowed to resume once the nest is no longer occupied, as confirmed by a qualified biologist.
  - Preservation of tracts of mature trees should be considered as part of the detailed design process as much as feasible. Inclusion of these habitat types as part of linear parks, pocket parks, and/or proposed Ecological Zones is expected to provide potential nesting opportunities for raptors.

- Breeding Birds (Section 6.3.3)
    - The design of UH3 should include native habitat types, particularly Native Dominant Grassland and Deciduous Woodlands, as part of linear parks, pocket parks, and proposed Ecological Zones to maintain breeding, nesting and foraging opportunities for migratory birds within the Study Area.
- Northern Leopard Frog (Section 6.6.3)
    - Wetlands assigned a management class of Preserve along the Small Swale feature and Riddell Paleontological Site should be included as part of the proposed Ecological Zone to maintain breeding and overwintering habitat for Northern Leopard Frogs that have been documented in these areas.
    - Linear parks or other green spaces that include wetland features (either preserve existing features or create wetlands) are recommended to be included in the design of UH3 to provide habitat and dispersal opportunities for this species. These parks would allow access between the Northeast and Small Swales as well as to the South Saskatchewan River valley, depending on the design of the UH3.
- Wildlife Corridors and Linear Connections (Section 6.7.3, Section 10.5)
    - Additional monitoring using remote cameras should be continued to gather information on what wildlife species are using specific habitat types within the Study Area, how they move through the Study Area, and how movement patterns may differ over each of the four seasons.

Two potential linear connections between the Small Swale and the Northeast Swale through the Study Area as linear park corridors are recommended (Figure 11), which provide linkages to the Northeast and Small Swale features. These consider current and/or historical wetland basins as well as existing treed habitats that could be incorporated as part of a linear park. These two corridors were also selected because of the high use patterns by wildlife species within the Study Area (i.e., the direction and orientation of the proposed linear park corridors align with the general movement patterns and trends that were detected).

Wetlands (Section 7)

- As per the Management Strategy associated with Preserve wetlands (Table 12), it is recommended that the two Preserve wetlands located within the Riddell Paleontological Site (3001, 3002) and the six Preserve wetlands associated with the Small Swale (3027, 3028, 3031, 9050, 9051, 9055) be protected as part of a proposed Ecological Zone. A buffer of 30 m should be maintained around Preserve wetlands as per best management practices for this management class (Minnesota Board of Water and Soils Resources 2010a, b).
- Wetlands 7150 (Manage 1) and 7151 (Manage 2) have the potential to be incorporated into UH3 as pocket parks to take advantage of the aesthetic value of the Trembling Aspen trees that surround the wetlands and maintain wildlife habitat; as noted in Section 6.2.2, an occupied Great-horned Owl stick nest was observed at Wetland 7151.
- Provide a wetland mitigation plan for the following wetlands that are not included as part of the proposed Ecological Zone: Wetlands 7150 (Manage 1), 7151 (Manage 2), 7178 (Manage 1), 7189 (Manage 2), 7147 (Preserve), and 9755 (Preserve). A Wetland Mitigation Plan will also be needed for any wetlands within the

proposed Ecological Zone that may be affected by development. This would include Wetlands 3027 and 3031 if they are used for stormwater management.

Hydrology (Section 8)

- Water Quality
  - Protect the water quality of wetlands within the Small Swale and Northeast Swales through continued water monitoring.
- Surface Hydrology and Groundwater
  - Monitor water level data to determine natural fluctuation ranges in surface water in the Swales, and complete groundwater monitoring to observe water level fluctuations and vertical gradients in the vicinity of the Swales.
  - Keep water level fluctuations in any potentially influenced wetland within natural ranges.
  - Determine whether development of UH3 will reduce water level contributions to any wetlands that reside outside of either swale. This will require assessment of the local drainage area to these wetland areas in consideration of the proposed development footprint.
  - Given the relatively small drainage area of the Small Swale, drainage patterns should be maintained such that upstream wetlands continue to receive their current proportion of drainage area prior to development.
  - To mitigate potential drying conditions in the Small Swale, groundwater, and discharge control measures would allow return flow to the Small Swale to provide a continuous source of water.
  - If possible, water management structures should be constructed on previously disturbed ground such as the Civic Material Handling Site near the Small Swale. Any such structure should be considered in the context of any potential geotechnical or hydrogeological conditions in the area.
  - Determine if groundwater discharge to any constructed stormwater management structure will have a detrimental impact on the structures function and mitigate any such influence during design and construction.
- Stormwater
  - Manage stormwater in the Study Area using a variety of techniques including low impact designs (e.g., bioswales, rain gardens) within the development area to provide filtration, attenuate peak flows and promote infiltration.
  - Minimize the construction of stormwater structures within the swales.
  - Manage stormwater within the development to reduce erosion and/or sedimentation of natural stream beds associated with the swales.
  - Complete stormwater modeling for the Study Area for the purpose of sizing of forebays and to include the potential impacts on water levels of downstream wetlands.
  - Any stormwater management structures (e.g., forebays) immediately upstream of a receiving waterbody should be constructed with sufficient setback (i.e., construct buildings outside known flood margins or high water mark, design to 1:500 flood event), in terms of ground distance as well as invert elevation, that the receiving waterbody cannot backflow into the management

structure. Any flow paths from management structures should be constructed with suitable channel protection to manage erosion into receiving wetlands.

- Manage stormwater within the Study Area in consideration of maintaining the natural fluctuation of water levels in wetlands influenced by the development (e.g., direct stormwater to isolated wetlands that could be included as part of a linear park or greenspace feature).

- Erosion Control
  - Institute erosion control measures either through flow management or infrastructure design considerations (storage ponds, erosion control to reduce velocities).
  - Incorporate erosion protection measures in any stream alignment (i.e., last point of release from the wetlands in the Small Swale that drain into the South Saskatchewan River), which may prevent channel degradation and subsequent bank failures such as near the river where the terrain steepens.
  - Incorporate sediment removal maintenance as required to prevent channel aggradation (i.e., sediment deposition into the channel), which may influence flood levels above normal water level response in any receiving wetland.
- High Flow Events
  - Culverts should be designed and built to withstand projected high flow events to minimize the potential disruption to connectivity between the wetlands.
  - A design flood event should be considered when determining the setback for any development that may be compromised by high flood waters. The City may need to consider flood events with recommendation from the WSA for design criteria.

Specific Design Features (Section 10)

- Greenways (Section 10.1)
  - EDI recommends that a design, similar to the Aspen Ridge Greenway (Stantec 2012), be used for the north edge of the Northeast Swale and along both sides of the Small Swale (Figure 11). In both cases, the Greenway could connect with the existing McOrmond Drive North and Central Avenue, as well as the South Connector Road (formerly Central Avenue North).
  - The design of the UH3 Greenway should strive for a balance between disturbing as little of the native vegetation as possible associated with the Northeast and Small Swale areas and the area required for the greenway, to reduce the amount of disturbed area that needs to be reclaimed.
  - The inclusion or placement of pedestrian trails as part of the greenway should be carefully considered during the design process to minimize edge effects associated with such development.
- Exclusion Fencing (Section 10.2)
  - Fences (e.g., heavy duty steel profusion welded fencing) should be included to deter domestic pets and limit pedestrians from accessing natural areas, and conversely, preclude wildlife from using residential lots.
  - Fences that are at least 1.5 to 1.8 m in height are more likely to preclude larger wildlife from gaining access to residential yards that back onto the natural area features.

  - The style and type of fence would depend on the detailed design for the UH3 neighbourhood planned adjacent to the Northeast and Small Swales and the intended role the fence is to serve.
  - The fence design and placement should consider the purpose of the fence, the wildlife species found in the adjacent natural areas, and site-specific features, including topography (slope) and habitat types.
- Multi-use Trails (Section 10.3)
  - Paved or crusher dust multi-use trails could be incorporated as part of the greenway design. The trails could connect to existing urban trail networks and be routed appropriately to consider and protect environmentally sensitive features that may be within the Greenway alignment.
  - Interpretive points of interest could be incorporated into the design of the trail network as part of the greenway.
- Pathway Lighting (Section 10.4)
  - The use of outdoor lighting that minimizes the potential adverse effects from light pollution in an urban setting should be incorporated as part of the greenway design.
  - Lighting should be designed to meet standards provided by the International Dark-Sky Association.
  - Lighting options should consider light colour, fixture design, and placement, including the use of fixtures that give off blue light emissions, use of low-pressure sodium (LPS) and/or light emitting diode (LED) fixtures that have a color temperature of no more than 3000 Kelvin, and full cut-off lighting that projects light in a downward direction and/or that are fully shielded to reduce glare and light trespass.
  - Other considerations could include the use of solar lighting and timers to limit the time period that certain areas are illuminated, as feasible from a public safety perspective.
- Linear Connections Between the Northeast Swale and Small Swale (Section 10.5)

Roadways (Section 11)

- Connectivity with the University Heights Business Park (Section 11.1)
  - Use the existing South Grid Access Road (the former Central Avenue North) and extend the southern portion of the roadway through the northwestern portion of SW 13-37-05 W3M. Between the north edge of the Riddell Paleontological Site in LSD 05-13-37-05 W3M and south of the Small Swale across mostly crop land. This provides access from the north and south.
  - If an additional roadway is required, an alternative crossing option would be through the current Civic Materials Handling Yard in NW 13-37-05 W3M. This option consists of previously disturbed areas from aggregate material storage and agricultural activities, and avoids the majority of the wetland complexes and treed habitats associated with the southern portion of the Small Swale.
- Upgrade Crossing of Lowe Road at the Northeast Swale (Section 11.2) to include a clear span bridge or open bottom arch style corrugated steel or pre-cast box culverts.
- Recommendations to Reduce Wildlife Collisions along McOrmond Drive North (Section 11.3)

- Avoid routing collector or industrial roads through proposed Ecological Zones and/or natural assets to reduce the potential for collisions with wildlife.
- Where linear parks or known animal crossings occur along Central Avenue North and Lowe Road, other mitigation measures such as the use of appropriate signage to inform local road users of these potential wildlife crossing corridors. Further, installation of automated warning systems at these linear parks or known animal crossings could be established to alert motorists that large wildlife (e.g., ungulates) have been detected within the crossing area of the roadway.
- Install fencing as part of these linear park crossing features, or at other high wildlife use areas, to help keep large mammals off roadways. Fences must be designed so that they do not trap wildlife on the roadway (i.e., causing wildlife to use crossing sites that could result in increased collision interactions).
- If large diameter culverts are used, the crossing design should be modified to include ledges or narrow walkways (up to 2 m wide) to promote use by small to medium sized animals.

13 FUTURE MONITORING PROGRAM

It is understood that development of UH3 may not commence for several years. As such, over that time period, the flora and fauna found within the Study Area are expected to change as urban activities from the surrounding areas of the City continue. This time period provides the City with an opportunity to further understand and monitor these changes to the flora and fauna found in the Study Area. As such, EDI suggests the following monitoring program to characterize and assess the quality of the environment within the Study Area. The intent of the monitoring program is to determine if these habitat types are affected, and if so, what changes are apparent based on collection of data over a period of time (i.e., prior to development, during development, and several years once the development has been completed). This monitoring program includes an adaptive management approach to collect data to determine if additional mitigation is required for compliance with the OCP (City of Saskatoon 2019), and to inform decision-making by the City regarding environmental quality of the UH3 Neighbourhood, and other future developments.

Flora

- Establish permanent sampling plots (PSPs) that would be sampled in the spring and late summer periods. At each plot rangeland health and riparian (depending on the habitat type sampled) health assessments to document parameters such as species richness, abundance and evenness of species (i.e., Shannon's Diversity index), and percent cover. Plots would be established in representative habitat types such as forest, wetlands, grassland (Healthy), grassland (Healthy with Problems), and grassland (reclaimed or rejuvenating). It is recommended that the PSPs be sampled every two years, starting in 2021 and continue for four years after development has been completed.
- Include annual monitoring for invasive species in representative areas, including the proposed Ecological Zones, and implementing a weed management plan that would be revised based on annual monitoring results.

Fauna

- Complete breeding bird surveys at the vegetation PSPs annually to document species presence/absence to determine species composition with the Study Area and detect potential trends in habitat use and abundance over time, as development proceeds. It is recommended that the breeding bird surveys be completed every year (annually), starting in 2021 and continue for four years after development has been completed.
- Recommend monitoring the Sharp-tailed Grouse lek for a 5-to-10-year period to gain additional information as the neighbourhood develops.

If additional information is required to further understand wildlife movement and identify wildlife corridors that would be used to identify roadways with low probability of wildlife encounters (at crossing locations), EDI recommends installation of remote wildlife cameras at known wildlife use areas and have these cameras operational over all four seasons. As wildlife movement varies seasonally, it is recommended that sampling over an entire year would provide further insight on how and where wildlife are moving within the Study Area.

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APPENDIX A. PHOTOGRAPHS

Photo 1. Looking south at the riverbank habitat in SE 14-37-05 from the top of the South Saskatchewan River valley; April 25, 2019.

Photo 2. Looking south at the riverbank habitat in SE 14-37-05 from the bottom of the South Saskatchewan River valley; April 25, 2019.

Photo 3. Looking north at the upland habitat adjacent to the Riverbank Area in SE 14-37-05; June 21, 2019.

Photo 4. Looking north at the riverbank habitat in SE 14-37-05 from the mid-slope of the South Saskatchewan River valley; June 21, 2019.

Photo 5. Looking south at the riverbank habitat in SE 14-37-05 from the mid-slope of the South Saskatchewan River valley; June 21, 2019.

Photo 6. Looking south at the grassland habitat on the east side of the Small Swale in SE 24-37-05 W3M; April 24, 2019.

Photo 7. Looking south at the grassland habitat on the east side of the Small Swale in SE 24-37-05 W3M; September 6, 2019.

Photo 8. Looking south at the grassland habitat on the west side of the Northeast Swale in NW 18-37-04 W3M; September 6, 2019.

Photo 9. American Bugseed (*Corispermum americanum*) observed in SW 15-37-05 W3M; August 5, 2019.

Photo 10. Crowfoot Violet (*Viola pedatifida*) population observed in SE 24-37-05 W3M; September 9, 2019. (Inset photo for example purposes).

Photo 11. Approximate location of Western Red Lily (*Lilium philadelphicum*) observed in SE 24-37-05 W3M. (Inset photo for example purposes).

Photo 12. Looking east at Wetland No. 01 in SW 19-37-04 W3M; October 2, 2019.

Photo 13. Looking west at Wetland No. 02 in SW 19-37-04 W3M; October 2, 2019.

Photo 14. Looking north at Wetland No. 03 in SE 24-37-05 W3M; October 2, 2019.

Photo 15. Looking north at Wetland No. 3001 in SW 13-37-05 W3M; September 4, 2019.

Photo 16. Looking north at Wetland No. 3027 in NE 24-37-05 W3M; September 4, 2019.

Photo 17. Looking south at Wetland No. 3027 in SE 24-37-05 W3M; September 4, 2019.

Photo 18. Looking northwest at Wetland No. 3027 in SE 24-37-05 W3M; September 4, 2019.

Photo 19. Looking south at Wetland No. 3031 in SW 24-37-05 W3M; October 2, 2019.

Photo 20. Looking northeast at Wetland No. 3031 in NW 13-37-05 W3M; September 6, 2019.

Photo 21. Looking west at Wetland No. 3031 in NW 13-37-05 W3M; September 6, 2019.

Photo 22. Looking north at Wetland No. 7151 in SW 19-37-04 W3M; April 23, 2019.

Photo 23. Looking west at Wetland No. 9050 in SW 24-37-05 W3M; October 2, 2019.

Photo 24. Looking north at Wetland No. 9051 in SW 24-37-05 W3M; October 2, 2019.

Photo 25. Looking north at Wetland No. 9055 in NW 13-37-05 W3M; September 4, 2019.

Photo 26. Looking east at the Sharp-tailed Grouse lek in NW 18-37-04 W3M; April 4, 2019.

Photo 27. Looking east at raptor stick nest No. 01 (Great Horned Owl) in SW 19-37-04 W3M; April 23, 2019.

Photo 28. Looking north at raptor stick nest No. 02 (Swainson's Hawk) in NW 13-37-05 W3M; April 25, 2019.

Photo 29. Looking north at unoccupied nest No. 01 in SE 24-37-05 W3M; April 23, 2019.

Photo 30. Looking east at unoccupied nest No. 02 in SW 19-37-04 W3M; April 25, 2019.

Photo 31. Looking southwest at unoccupied nest No. 03 in NW 13-37-05 W3M; June 20, 2019.

Photo 32. Looking northeast at unoccupied nest No. 04 in SW 13-37-05 W3M; April 4, 2019.

Photo 33. Looking northeast at unoccupied nest No. 05 in SW 13-37-05 W3M; June 11, 2019.

Photo 34. Looking northwest at Amphibian Auditory Survey Point No. 01 in NE 24-37-05 W3M; May 22, 2019.

Photo 35. Looking south at Amphibian Auditory Survey Point No. 02 in SE 24-37-05 W3M; May 22, 2019.

Photo 36. Looking west at Amphibian Auditory Survey Point No. 03 in SE 24-37-05 W3M; May 22, 2019.

Photo 37. Looking north at Amphibian Auditory Survey Point No. 04 in SE 24-37-05 W3M; May 22, 2019.

Photo 38. Looking north at Amphibian Auditory Survey Point No. 05 in SW 24-37-05 W3M; May 23, 2019.

Photo 39. Looking east at Amphibian Auditory Survey Point No. 06 in NW 13-37-05 W3M; May 22, 2019.

Photo 40. Looking south at Amphibian Auditory Survey Point No. 07 in SW 13-37-05 W3M; May 22, 2019.

Photo 41. Looking south at Amphibian Auditory Survey Point No. 08 in SE 14-37-05 W3M; May 9, 2019.

Photo 42. Looking east at Amphibian Auditory Survey Point No. 09 in NW 13-37-05 W3M; May 9, 2019.

Photo 43. Looking south at Amphibian Auditory Survey Point No. 10 in NW 13-37-05 W3M; May 23, 2019.

Photo 44. Looking south at Amphibian Auditory Survey Point No. 11 in SW 18-37-04 W3M; May 22, 2019.

Photo 45. Northern Leopard Frog observed at Amphibian Visual Survey Point No. 6 in NW 13-37-05 W3M; September 4, 2019.

Photo 46. Northern Leopard Frog observed at Amphibian Visual Survey Point No. 6 in NW 13-37-05 W3M; October 2, 2019.

Photo 47. Looking south at Remote Camera Survey Point No. 01 in SW 13-37-05 W3M; June 20, 2019.

Photo 48. Looking east at Remote Camera Survey Point No. 02 in SE 13-37-05 W3M; June 5, 2019.

Photo 49. Looking east at Remote Camera Survey Point No. 03 in NE 13-37-05 W3M; June 5, 2019.

Photo 50. Remote Camera Survey Point No 03 camera image of an American Badger; June 26, 2019.

Photo 51. Remote Camera Survey Point No 03 camera image of a porcupine; July 19, 2019.

Photo 52. Looking southeast at Remote Camera Survey Point No. 04 in NW 13-37-05 W3M; June 5, 2019.

Photo 53. Remote Camera Survey Point No 04 camera image of a beaver; June 6, 2019.

Photo 54. Looking east at Remote Camera Survey Point No. 05 in SE 24-37-05 W3M; July 25, 2019.

Photo 55. Remote Camera Survey Point No 05 camera image of a Black-billed Magpie; August 14, 2019.

Photo 56. Remote Camera Survey Point No 05 camera image of a Western Kingbird; August 14, 2019.

Photo 57. Looking southwest at Remote Camera Survey Point No. 06 in NW 13-37-05 W3M; July 25, 2019.

Photo 58. Looking east at Remote Camera Survey Point No. 07 in SW 13-37-05 W3M; July 25, 2019.

Photo 59. Remote Camera Survey Point No 07 camera image of a Snowshoe Hare; July 27, 2019.

Photo 60. Remote Camera Survey Point No 07 camera image of an Eastern Kingbird; August 10, 2019.

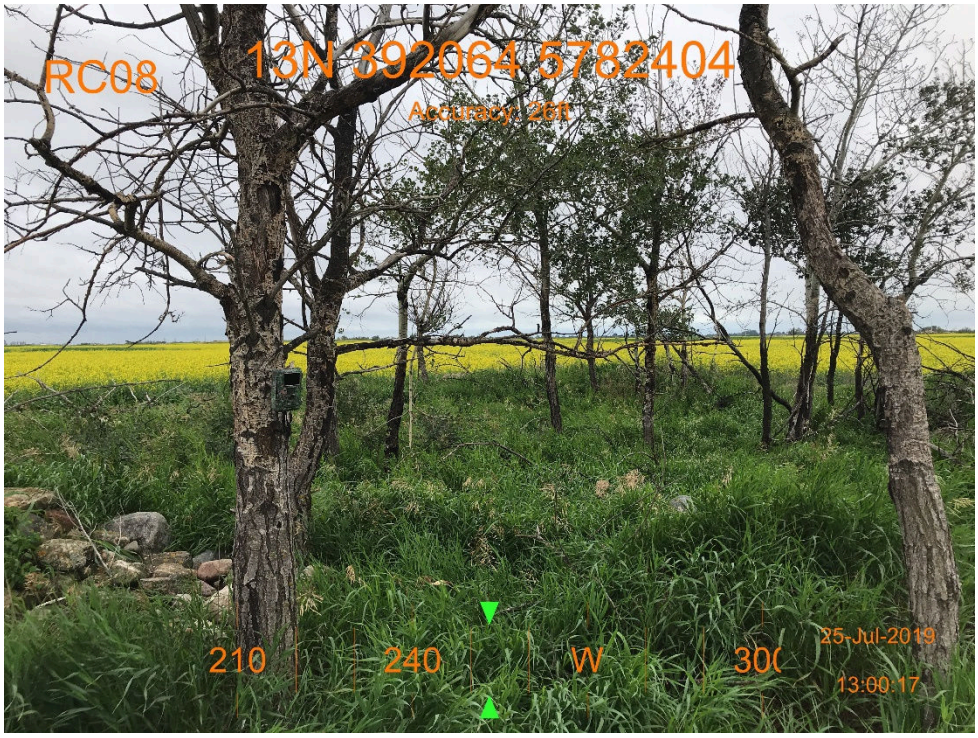


Photo 61. Looking southwest at Remote Camera Survey Point No. 08 in NE 13-37-05 W3M; July 25, 2019.

Photo 62. Remote Camera Survey Point No 08 camera image of a Gray Partridge; August 26, 2019.

Photo 63. Looking southwest at Remote Camera Survey Point No. 09 in NW 18-37-04 W3M; July 12, 2019.

Photo 64. Looking east at Remote Camera Survey Point No. 10 in SE 24-37-05 W3M; July 25, 2019.

Photo 65. Remote Camera Survey Point No 11 camera image of an American Crow; July 10, 2019.

Photo 66. Remote Camera Survey Point No 11 camera image of a Northern Harrier August 29, 2019.

Photo 67. Remote Camera Survey Point No 12 camera image of a Tree Swallow; June 20, 2019.

Photo 68. Remote Camera Survey Point No 14 camera image of a House Sparrow; June 20, 2019.

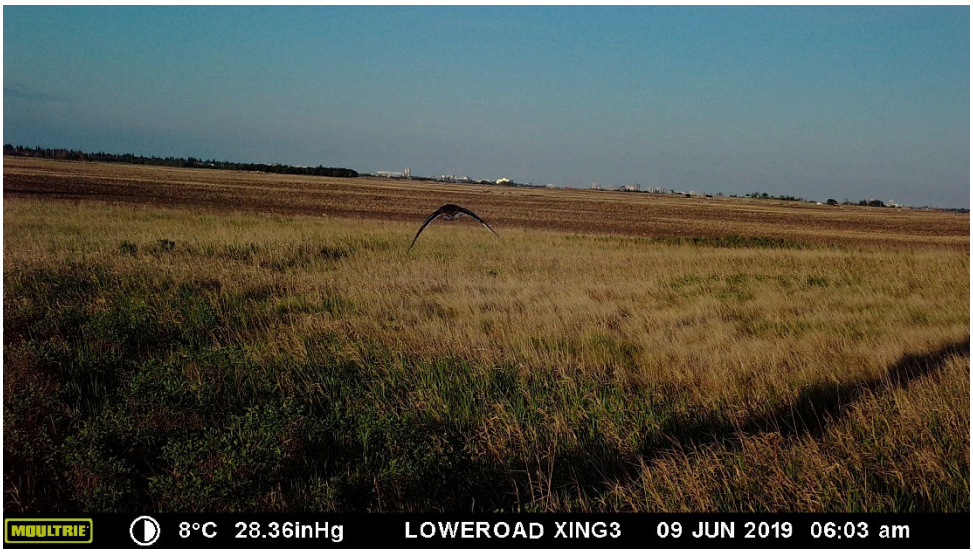


Photo 69. Remote Camera Survey Point No 14 camera image of a Mallard; June 9, 2019.

Photo 70. Looking south at Remote Camera Survey Point No. MVA01 in SE 13-37-05 W3M; June 5, 2019.

Photo 71. Looking south at Remote Camera Survey Point No. MVA02 in SW 18-37-04 W3M; June 5, 2019.

Photo 72. Looking south at Remote Camera Survey Point No. MVA03 in NW 18-37-04 W3M; June 5, 2019.

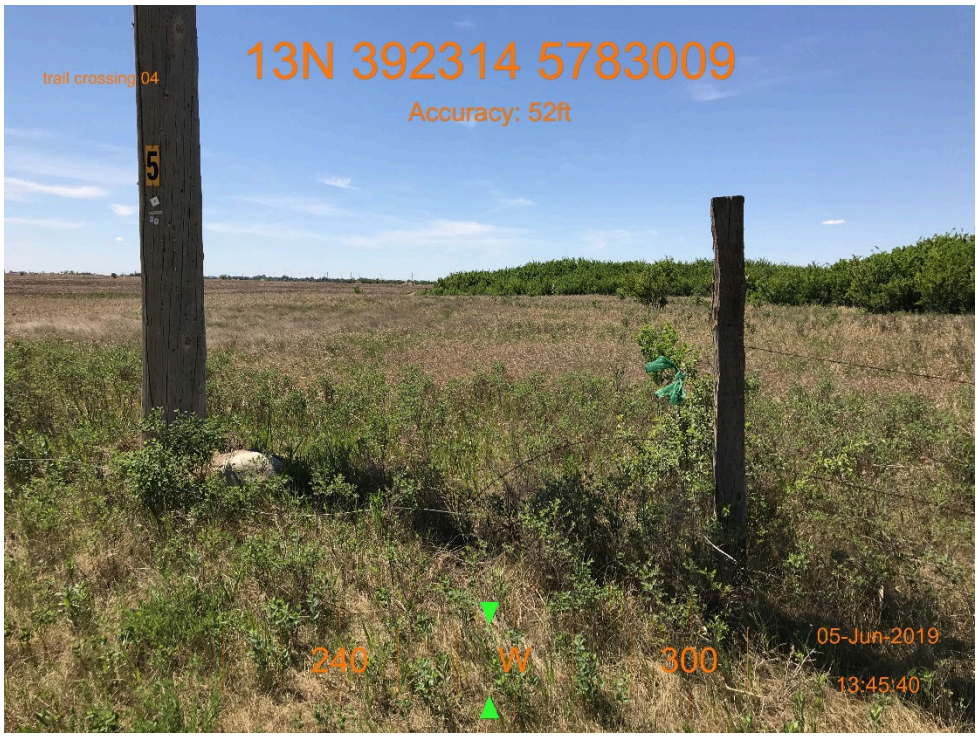


Photo 73. Looking south at Remote Camera Survey Point No. MVA04 in NE 13-37-05 W3M; June 5, 2019.

Photo 74. White-tailed doe and fawn at Remote Camera Survey Point No. 01 on June 13, 2019.

Photo 75. White-tailed fawn at Remote Camera Survey Point No.2 on July 1, 2019.

Photo 76. White-tailed buck at Remote Camera Survey Point No.2 on July 8, 2019.

Photo 77. White-tailed Jackrabbit at Remote Camera Survey Point No. 03 on July 17, 2019.

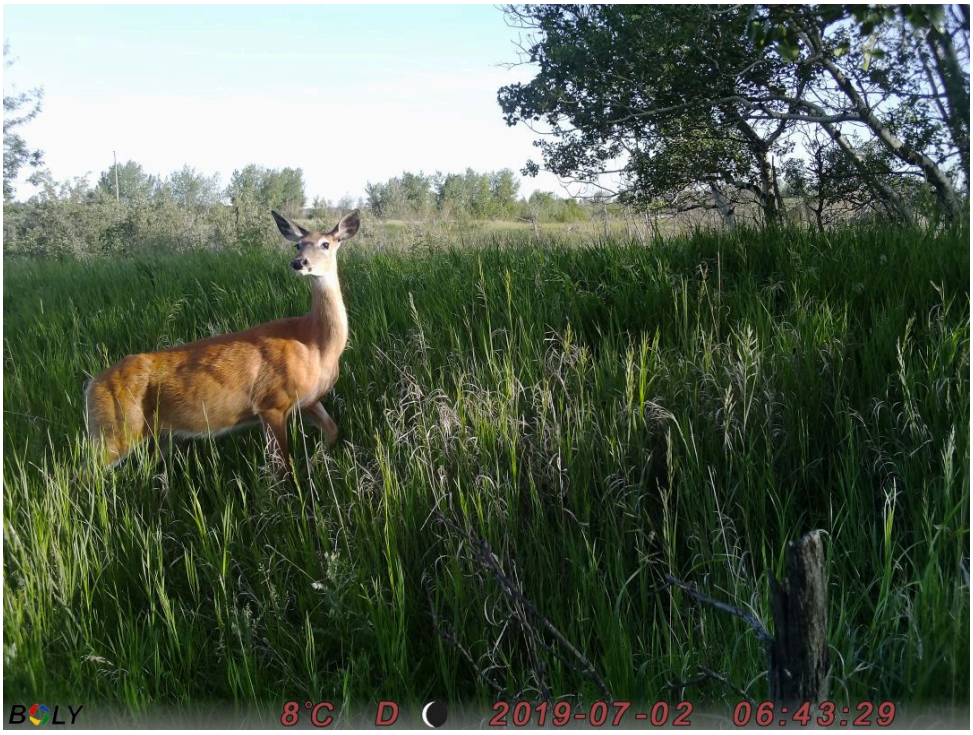


Photo 78. White-tailed doe at Remote Camera Survey Point No. 04 on July 2, 2019.

Photo 79. White-tailed buck at Remote Camera Survey Point No. 05 on July 27, 2019.

Photo 80. White-tailed buck at Remote Camera Survey Point No. 06 on August 3, 2019.

Photo 81. Raccoon at Remote Camera Survey Point No. 06 on August 20, 2019.

Photo 82. White-tailed buck at Remote Camera Survey Point No. 07 on August 13, 2019.

Photo 83. Coyote at Remote Camera Survey Point No. 07 on August 13, 2019.

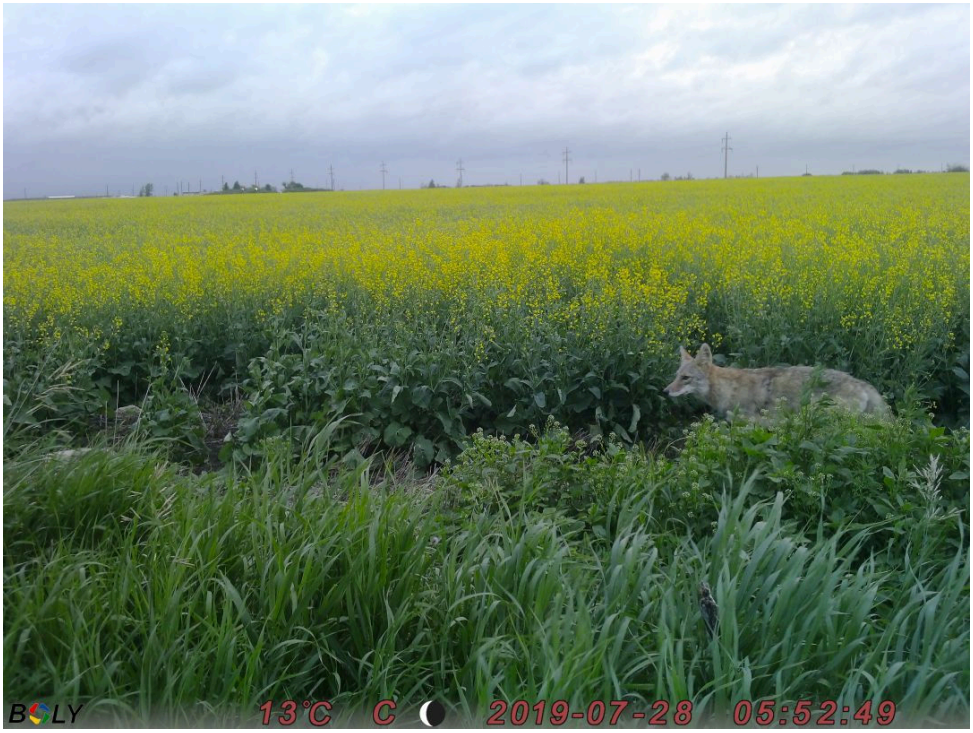


Photo 84. Coyote at Remote Camera Survey Point No. 08 on July 28, 2019.

Photo 85. White-tailed buck at Remote Camera Survey Point No. 08 on August 19, 2019.

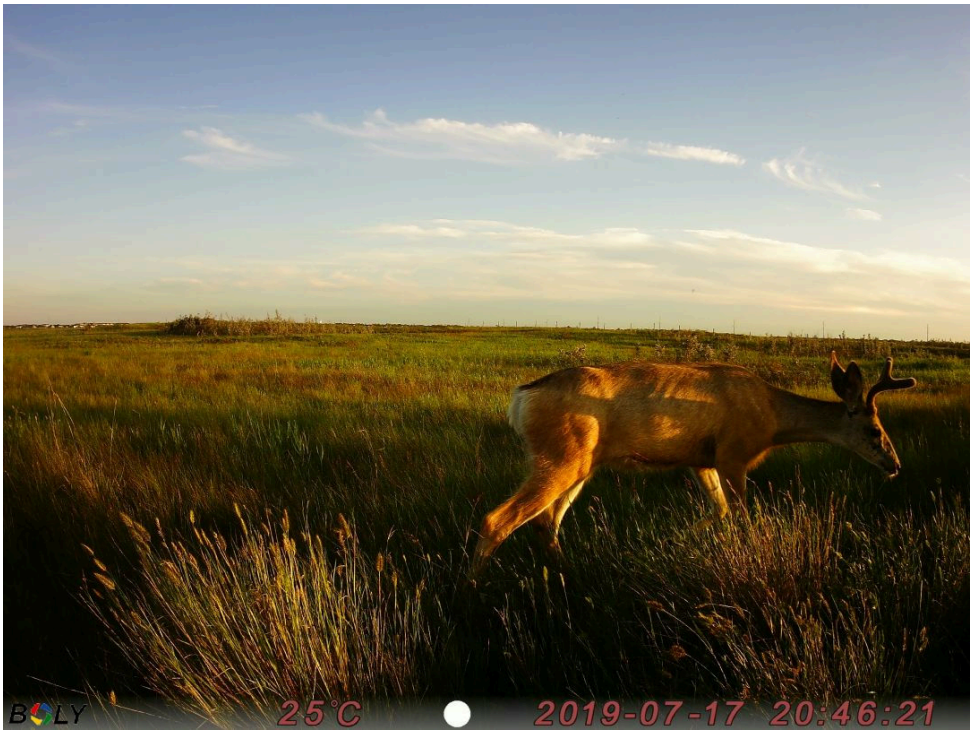


Photo 86. Mule Deer buck at Remote Camera Survey Point No. 09 on July 17, 2019.

Photo 87. Coyote at Remote Camera Survey Point No. 09 on July 28, 2019.

Photo 88. White-tailed doe and fawn at Remote Camera Survey Point No. 10 on July 30, 2019.

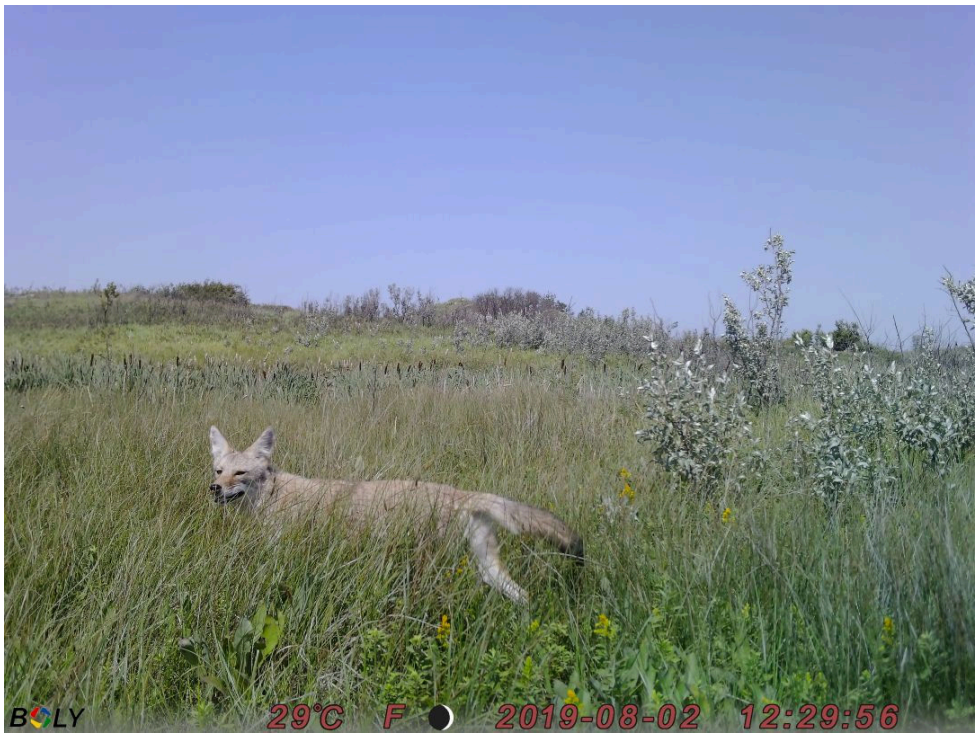


Photo 89. Coyote at Remote Camera Survey Point No. 10 on August 2, 2019.

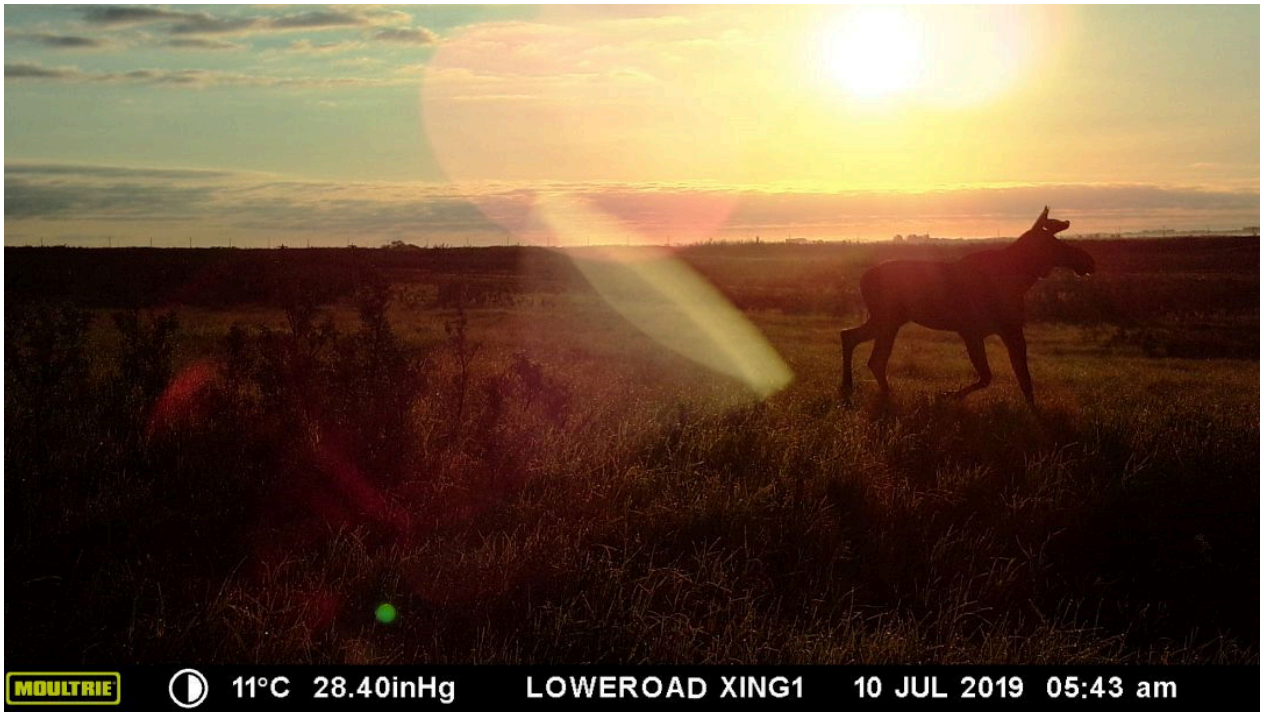


Photo 90. Moose at MVA Remote Camera Survey Point No. 02 on July 10, 2019.

Photo 91. Mule Deer at MVA Remote Camera Survey Point No. 02 on September 16, 2019.

Photo 92. Franklin's Gulls flying past MVA Remote Camera Survey Point No. 03 on August 4, 2019.

Photo 93. White-tailed buck at MVA Remote Camera Survey Point No. 03 on November 2, 2019.

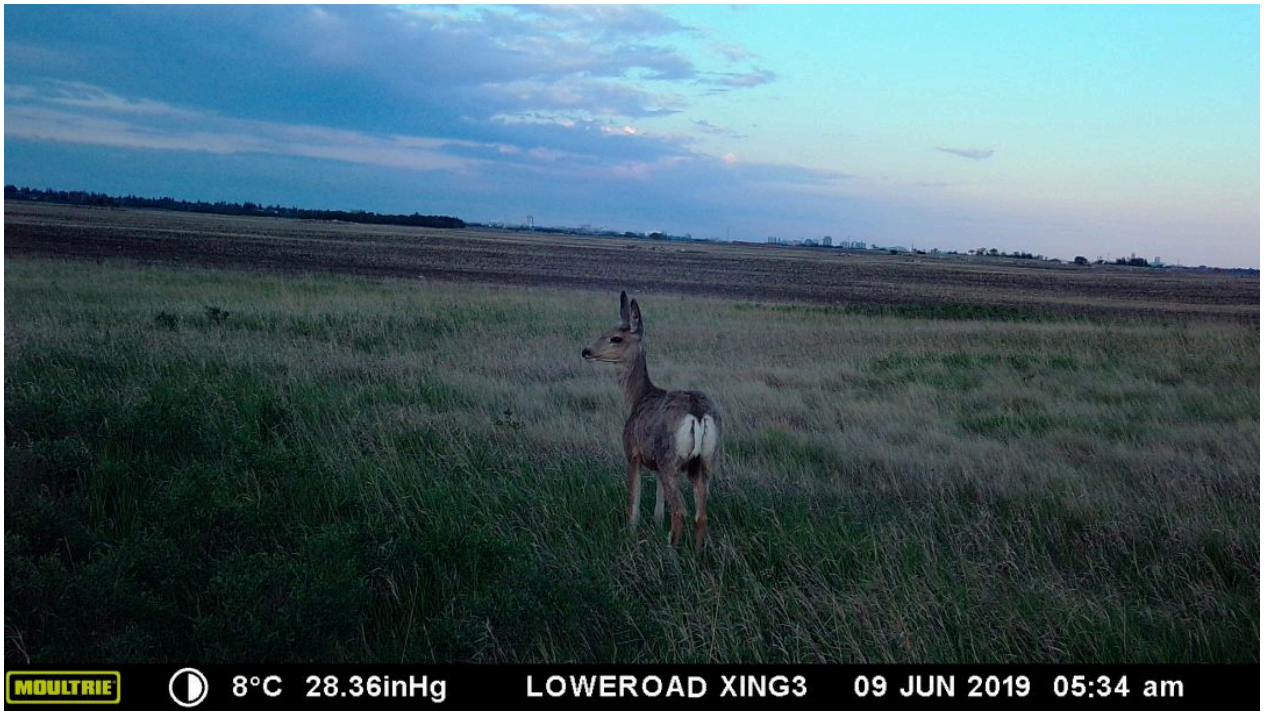


Photo 94. Mule Deer at MVA Remote Camera Survey Point No. 04 on June 9, 2019.

Photo 95. Mule Deer at MVA Remote Camera Survey Point No. 04 on October 13, 2019.

APPENDIX B. HABITAT TYPE DEFINITIONS

Crop Land - Land that is cultivated and/or seeded annually to produce grains, seeds or legumes.

Disturbed/Developed - Land disturbed by construction activities either permanently or temporary.

Disturbed/Gravel Pit - Gravel pit.

Yard Site Active - Active residence.

Yard Site Abandoned/Tame Grassland - Abandoned residence with idle introduced grass species.

Hay Crop (Forage) - Land that is cut/mowed annually to produce livestock forage.

Closed Canopy Deciduous Woodland - Dense deciduous tree cover with a thick overstory.

Open Canopy Deciduous Woodland - Sparse deciduous tree cover with an open overstory.

Tall Shrub Grassland - Grassland habitat dominated by Tall shrub (e.g., wolf willow) cover.

Native Dominant Grassland - Land dominated by native grass, forb and shrub species that has not been cultivated, or historically broken land that has re-vegetated naturally with native species.

Native Dominant Grassland / Tame Grassland - Land that contains a relatively even mix or patchwork of native (grass, forb and shrub) and introduced (tame) grass species.

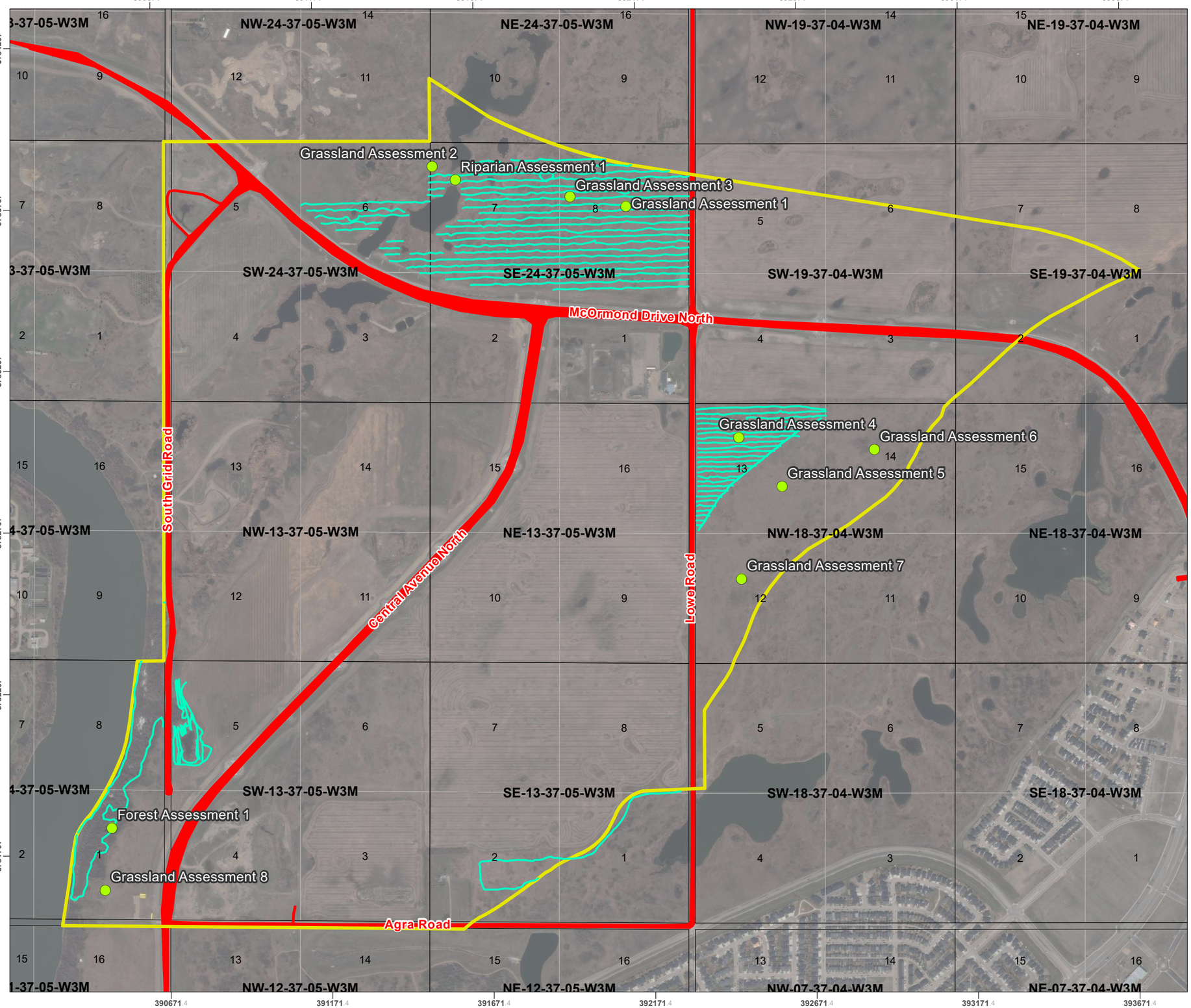
Tame Grassland - Land that has a higher number of introduced species than native species because of encroachment or direct seeding.

Wetland - Land that is saturated with water for a long enough period to promote wetland or aquatic process as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to a wet environment.

APPENDIX C. VEGETATION AND WILDLIFE SURVEY LOCATIONS

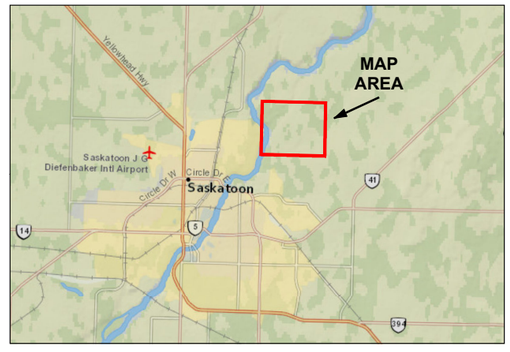
Vegetation Survey Transects and Health Assessments Plots Completed in the Study Area

CITY OF SASKATOON



Legend

- Vegetation Assessment Location
- Vegetation Transect
- Project Boundary
- Road
- QSec
- LSD



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Map Projection: NAD 1983 UTM Zone 13N

N

Data Sources

- Imagery World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
- Inset map. National Geographic World Map

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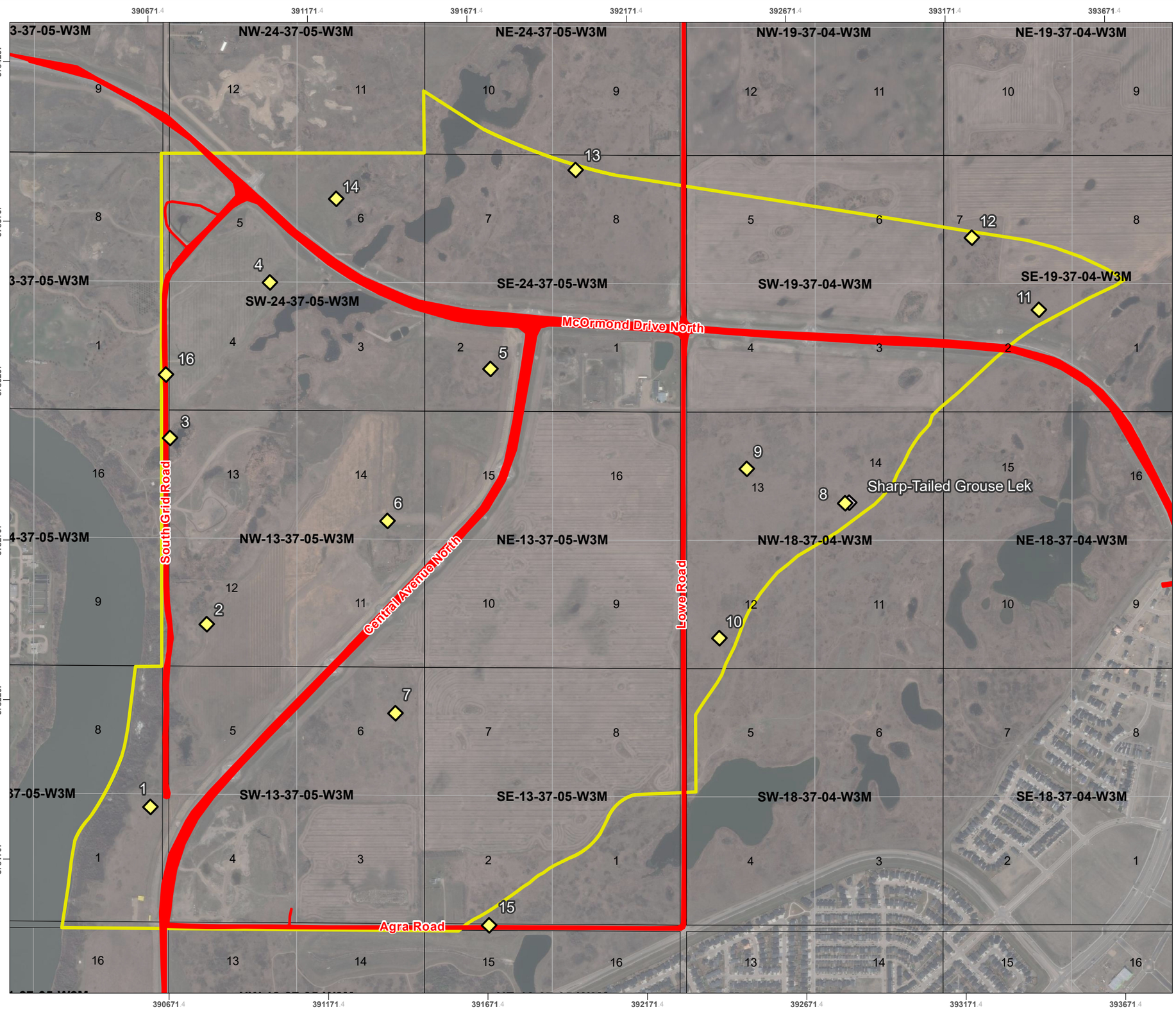
Drawn: YN	Checked: CJ/HT	Appendix C Figure C1	Date: 2021-03-16

EDI ENVIRONMENTAL DYNAMICS INC.

Path: L:\PROJECTS\20\19\19S0049_COS_UH3\Mapping\Report\19S0049_AppxC_FigC1_Veg_Transects_202007.mxd

Sharp-tailed Grouse Survey Points Completed in the Study Area

CITY OF SASKATOON

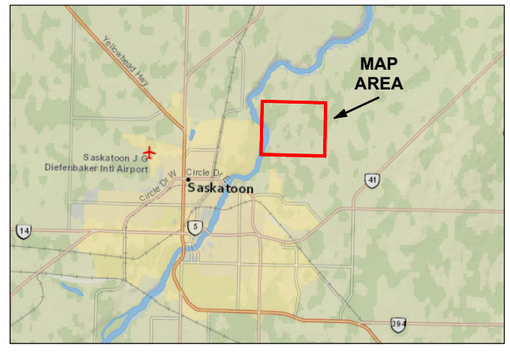


Legend

- Project Boundary
- Road
- QSec
- LSD

Environmental Sensitivities

- Sharp-Tailed Grouse Survey Point
- Sharp-Tailed Grouse Lek



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Map Scale = 1:12,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N

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Data Sources

- Imagery. World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
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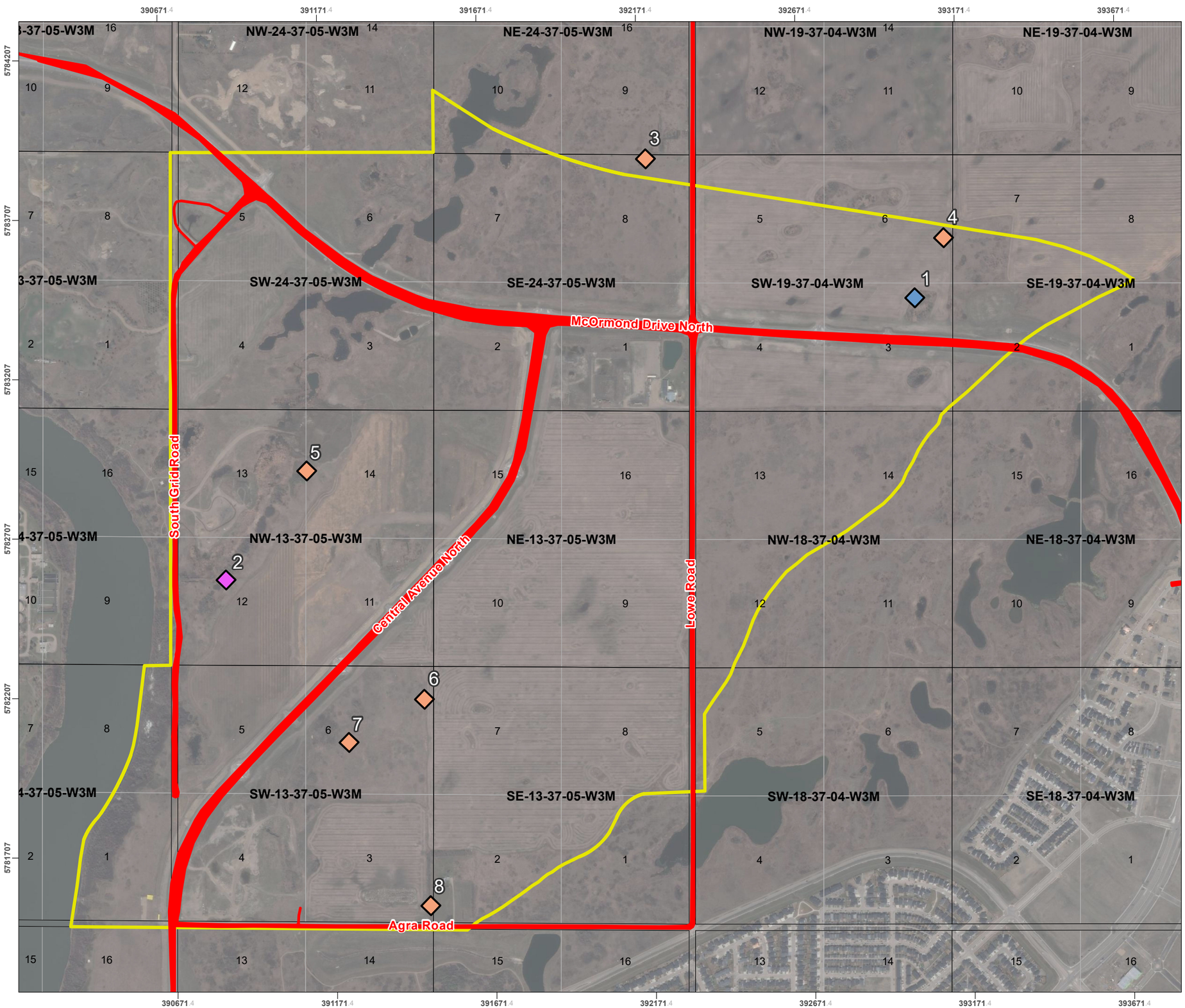
Drawn: YN	Checked: CJ/HT	Appendix C Figure C2	Date: 2021-03-16

ENVIRONMENTAL DYNAMICS INC.

Path: L:\PROJECTS\20\19\19S0049_COS_UH3\Mapping\Report\19S0049_AppxC_FigC2_Sharp_Tailed_Grouse_202007.mxd

Raptor Stick Nests Identified in the Study Area

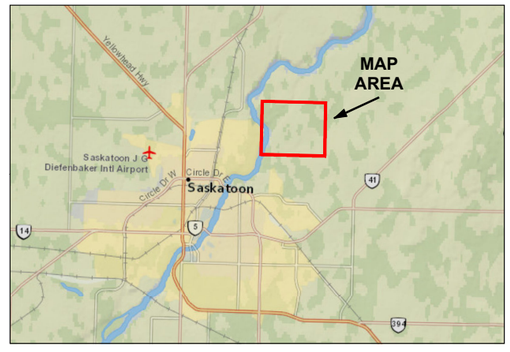
CITY OF SASKATOON



Legend

Environmental Sensitivities

- Occupied Stick Nest-Great Horned Owl
- Occupied Stick Nest-Swainson's Hawk
- Unoccupied Stick Nest
- Project Boundary
- Road
- QSec
- LSD



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Map Projection: NAD 1983 UTM Zone 13N

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Data Sources

- Imagery World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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EDI ENVIRONMENTAL DYNAMICS INC.

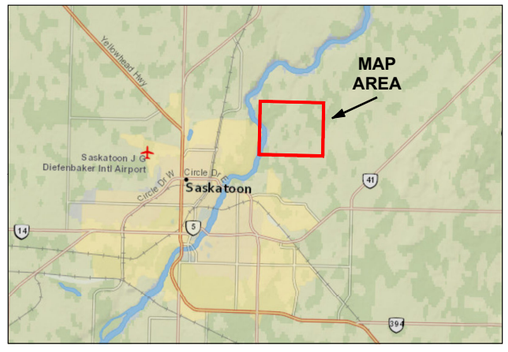
Path: L:\PROJECTS\20\19\19S0049_COS_UH3\Mapping\Report\19S0049_AppxC_FigC3_Raptor_Stick_Nest_20200?.mxd

Breeding Bird Survey Points Completed in the Study Area

CITY OF SASKATOON

Legend

- Breeding Bird Survey Point
- Project Boundary
- Road
- QSec
- LSD



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Data Sources

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Drawn:	Checked:	Appendix C	Date:
YN	JS/CJ/HT	Figure C4	2021-03-16

EDI ENVIRONMENTAL DYNAMICS INC.

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Common Nighthawk/Short-eared Owl Survey Points Completed in the Study Area

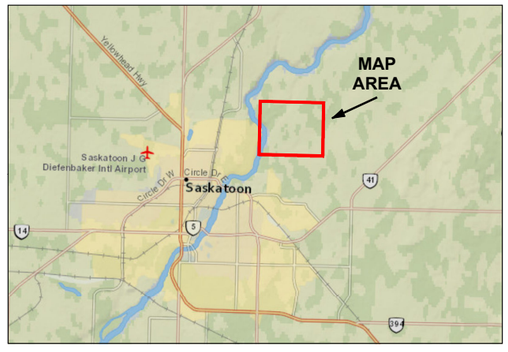
CITY OF SASKATOON

Legend

- Project Boundary
- Road
- QSec
- LSD

Environmental Sensitivities

- Short-Eared Owl/Common Nighthawk Survey Point



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Data Sources

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Drawn:	Checked:	Appendix C Figure C5	Date: 2021-03-16
YN	CJ/HT		

EDI ENVIRONMENTAL DYNAMICS INC.

Path: L:\PROJECTS\20\19\19S0049_COS_UH3\Mapping\Report\19S0049_AppxC_FigC5_Common_Nighthawk_20220207.mxd

Amphibian Survey Points Completed in the Study Area

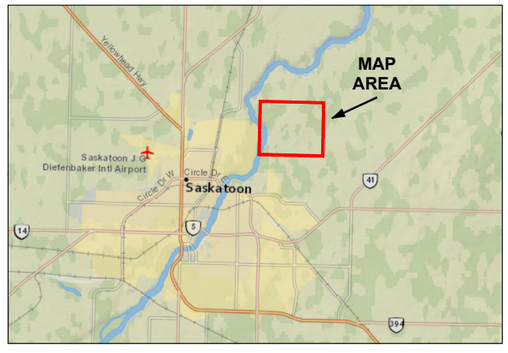
CITY OF SASKATOON

Legend

- Project Boundary
- QSec
- LSD
- Road

Environmental Sensitivities

- Amphibian Survey Point



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Meters

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Data Sources

- Imagery. World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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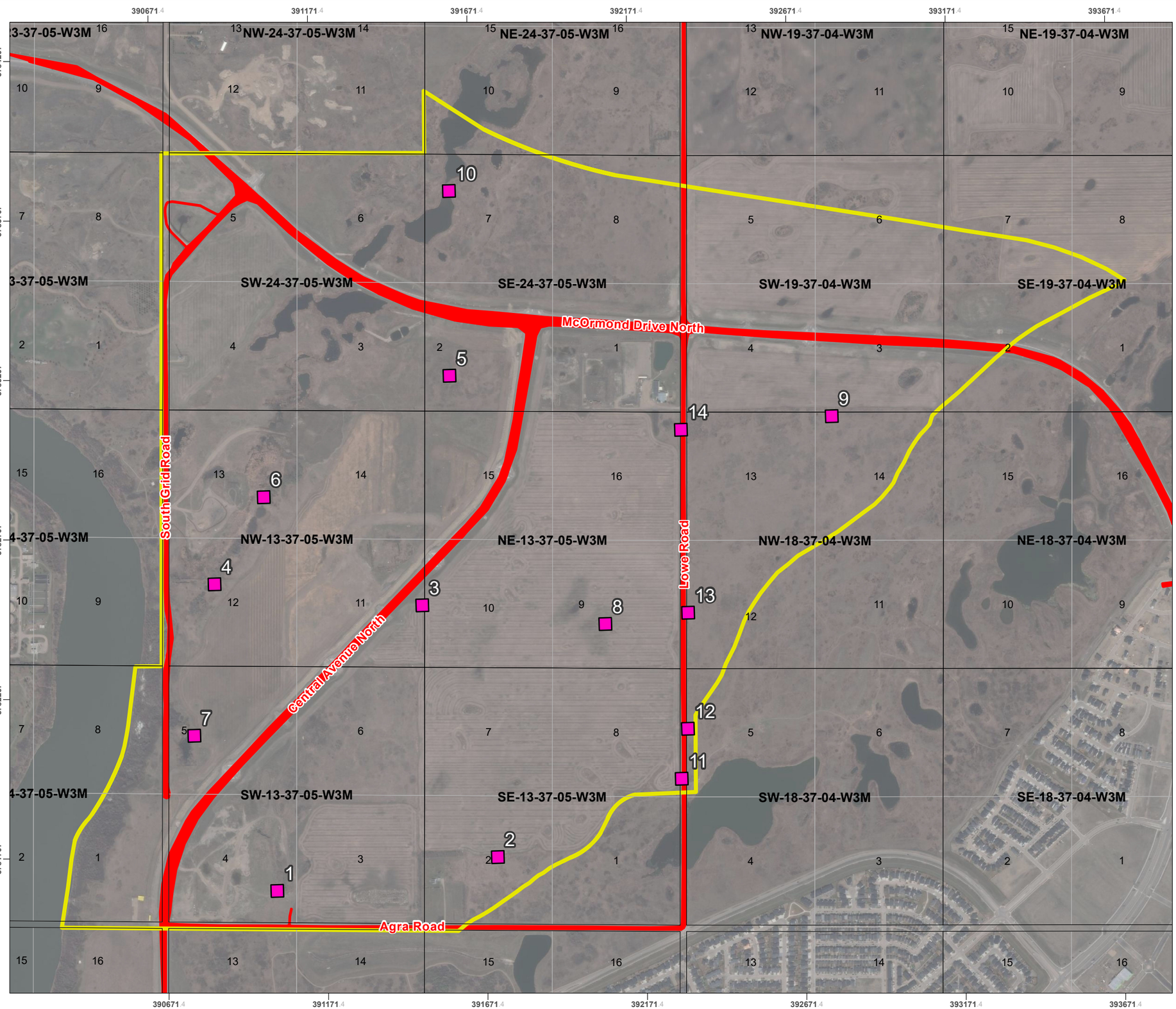
EDI ENVIRONMENTAL DYNAMICS INC.

Path: L:\PROJECTS\2019\19S0049_COS_UH3\Mapping\Report\19S0049_AppxC_FigC6_Amphibian_20200?.mxd

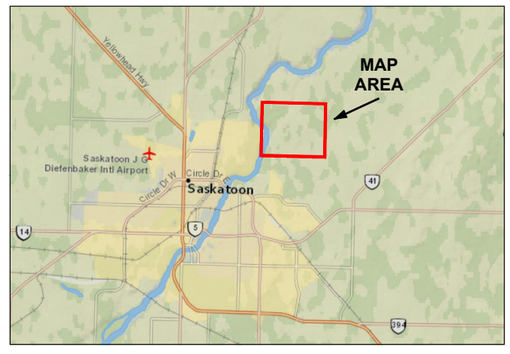
Remote Camera Survey Points Completed in the Study Area

CITY OF SASKATOON



Legend

- Remote Camera (RC) Survey Points
- Project Boundary
- Road
- QSec
- LSD



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Data Sources

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- Spatial Data, SK Grid. Government of Saskatchewan
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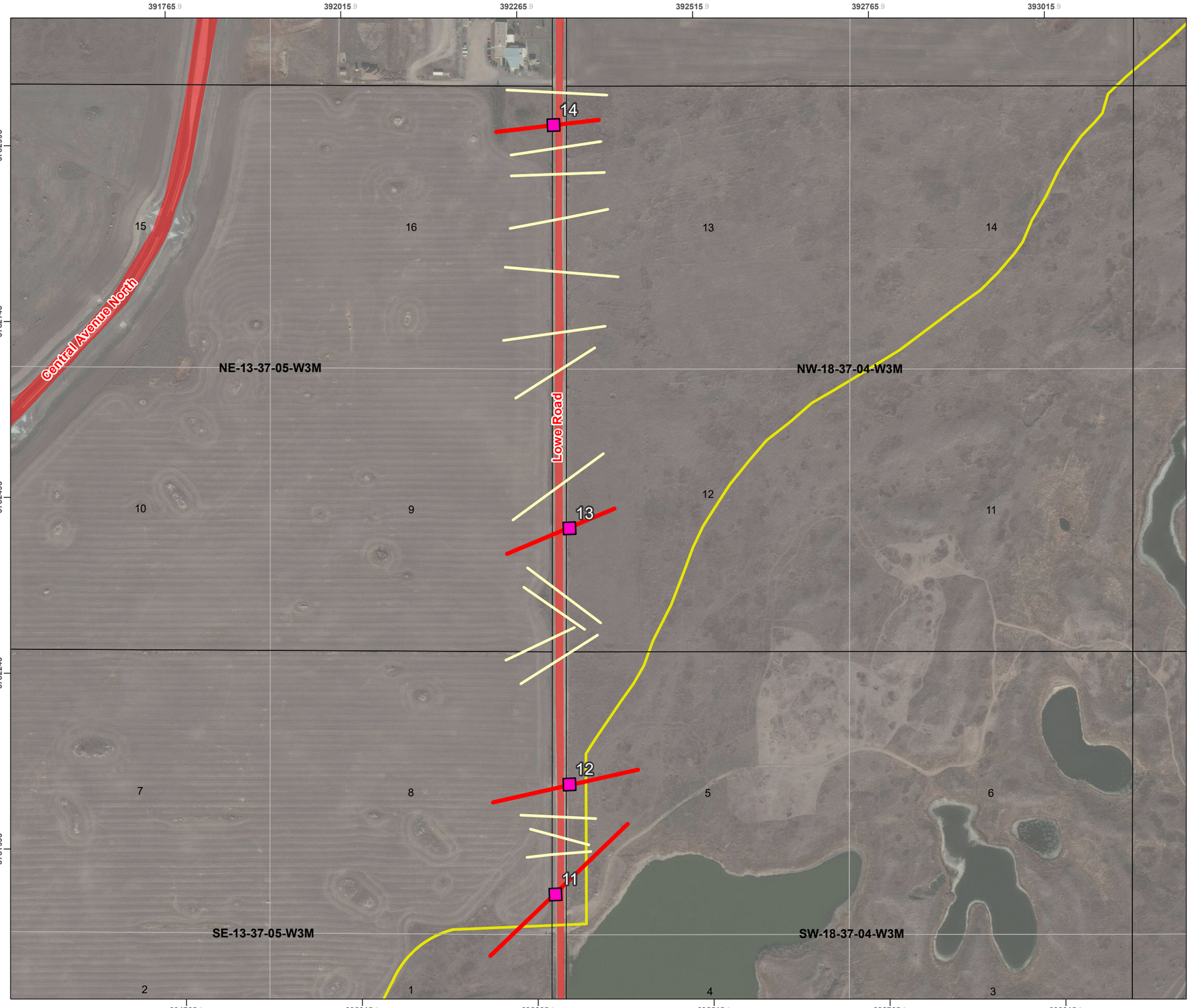
Drawn:	Checked:	Appendix C	Date:
YN	JS/CJ/HT	Figure C7	2021-03-16

EDI ENVIRONMENTAL DYNAMICS INC.

Path: L:\PROJECTS\20\19\19S0049_COS_UH3\Mapping\Report\19S0049_AppxC_FigC7_SurveyPlot_202007.mxd

Lowe Road Wildlife Trail Crossings

CITY OF SASKATOON



Legend

- Remote Camera (RC) Survey Points
- High Use Wildlife Trail Crossing
- Wildlife Trail Crossing
- QSec
- LSD
- Project Boundary
- Road

0 50 100 150 200 250
Meters

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Data Sources

- Imagery. World Imagery. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- Spatial Data, SK Grid. Government of Saskatchewan
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Drawn:	Checked:	Appendix C Figure C8	Date: 2020-07-30
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APPENDIX D. VEGETATION SPECIES DOCUMENTED DURING THE 2019 FIELD PROGRAM

Table D1. Vegetation Species Detected in the Small Swale and Adjacent Grasslands Area Within S½ 24 37-05 W3M during the 2019 Vegetation Surveys.

Latin Name	Common Name	Native / Introduced
Acer negundo	Manitoba Maple	Native
Achillea millefolium	Common Yarrow	Native
Agropyron cristatum	Crested Wheatgrass	Introduced
Agropyron repens	Quack Grass	Introduced
Alisma triviale	Broad-leaved Water-plantain	Native
Allium textile	Prairie Onion	Native
Amelanchier alnifolia	Saskatoon	Native
Androsace septentrionalis	Pygmy Flower	Native
Anemone cylindrica	Long-fruited Anemone	Native
Anemone patens	Prairie Crocus	Native
Antennaria neglecta	Field Pussytoes	Native
Antennaria parvifolia	Small-leaved Pussytoes	Native
Antennaria sp.	Everlasting species	Native
Apocynum cannabinum	Indian Hemp	Native
Arabis holbelii	Reflexed Rock-cress	Native
Artemisia absintha	Absinthe	Native
Artemisia campestris	Plains Wormwood	Native
Artemisia frigida	Pasture Sage	Native
Artemisia ludoviciana	Prairie Sage	Native
Astragalus canadensis	Canadian Milk-vetch	Native
Astragalus cicer	Cicer Milk-vetch	Introduced
Astragalus flexuosus	Slender Milk-vetch	Native
Astragalus sp.	Milk-vetch species	Native
Beckmannia syzigachne	Slough Grass	Native
Bouteloua gracilis	Blue Grama	Native
Bromus inermis	Smooth Brome	Introduced
Calamagrostis canadensis	Marsh Reed-grass	Native
Calamovilfa longifolia	Sand Grass	Native
Campanula rotundifolia	Harebell	Native
Capsella burasa-pastoris	Shepherd's Purse	Introduced
Caragana arborescens	Caragana	Introduced
Carduus nutans	Nodding Thistle	Introduced
Carex aquatilus	Water Sedge	Native
Carex filifolia	Thread-leaved Sedge	Native
Carex obtusata	Blunt Sedge	Native
Chenopodium album	Lamb's Quarters	Introduced
Chenopodium rubrum	Red Goosefoot	Native
Cicuta maculata	Water Hemlock	Native
Cirsium arvense	Canada Thistle	Introduced
Cirsium flodmanii	Flodman's Thistle	Native

Latin Name	Common Name	Native / Introduced
Cirsium undulatum	*Wavyleaf thistle*	Native
Comandra umbellata	*Pale Comandra*	Native
Convolvulus arvensis	Field Bindweed	Introduced
Conyza canadensis	Canada Fleabane	Native
Crataegus chrysocarpa	Round-leaved/Firebelly Hawthorn	Native
Dalea purpurea	Purple Prairie Clover	Native
Descurainia sophia	Flix-weed	Introduced
Dodecatheon pauciflorum	Saline Shooting-star	Native
Echinochloa crusgalli	Barnyard Grass	Introduced
Eleagnus commutata	Wolf Willow	Native
Eleocharis palustris	Creeping Spike Rush	Native
Elymus lanceolatus ssp. *lanceolatus*	Northern Wheatgrass	Native
Elymus trachycaulus	Slender Wheatgrass	Native
Elymus trachycaulus ssp. *subsecundum*	Awned Wheatgrass	Native
Epilobium palustre	Marsh Willow-herb	Native
Equisetum arvense	Common Horse-tail	Native
Equisetum hyemale var. *affine*	Common Scouring Rush	Native
Equisetum laevigatum	Smooth Scouring Rush	Native
Erigeron philadelphicus	Philadelphia Fleabane	Native
Euphorbia esula	Leafy Spurge	Introduced
Festuca hallii	Plains Rough Fescue	Native
Festuca trachyphylla	Sheep Fescue	Introduced
Fragaria vesca	American Wild Strawberry	Native
Gaillardia aristata	Gaillardia	Native
Galium boreale	Northern Bedstraw	Native
Gaura coccinea	Scarlet Gaura	Native
Gentiana affinis	Prairie Gentian	Native
Geum triflorum	Three Flowered Avens	Native
Glyceria striata	Fowl Manna Grass	Native
Glycyrrhiza lepidota	Wild Licorice	Native
Grindelia squarrosa	Curly-cup Gumweed	Native
Gutierrezia sarothrae	Common Broomweed	Native
Helianthus annuus	Annual Sunflower	Native
Helianthus laetiflorus var. *subrhomboideus*	Beautiful Sunflower	Native
Helianthus nuttallii	Common Tall Sunflower	Native
Hesperostipa comata ssp. *comata*	Needle and Thread Grass	Native
Hesperostipa curtiseta	Western Porcupine Grass	Native
Heterotheca villosa	Hairy Golden-aster	Native
Heuchera richardsonii	Alum Root	Native
Hierochloe odorata	Sweet Grass	Native
Hordeum jubatum	Wild Barley	Native
Juncus balticus	Baltic Rush	Native

Latin Name	Common Name	Native / Introduced
Kochia scoparia	Kochia	Introduced
Koeleria macrantha	June Grass	Native
Lactuca pulchella	Blue Lettuce	Native
Lemna minor	Lesser Duckweed	Native
Lepidium densiflorum	Common Pepper-grass	Introduced
Liatris ligulistylis	Meadow Blazing-star	Native
Liatris punctata	Dotted Blazing-star	Native
Lilium philadelphicum	Western Red Lily	Native
Linum lewisii	*Wild Blue Flax*	Native
Lithospermum incisum	*Narrow-leaved Puccoon*	Native
Lycopodium sp.	*Clubmoss*	Native
Lycopus asper	*Western Water Horehound*	Native
Lygodesmia juncea	*Skeleton Weed*	Native
Lysimachia maritima	*Sea-milkwort*	Native
Medicago lupilina	*Black Medic*	Introduced
Medicago sativa ssp. *falcata*	Yellow Alfalfa	Introduced
Medicago sativa ssp. *sativa*	Alfalfa	Introduced
Melilotus alba	White Sweet-clover	Introduced
Melilotus officinalis	Yellow Sweet-clover	Introduced
Mentha arvense	Wild Mint	Native
Mirabilis hirsuta	Hairy Umbrellawort	Native
Monarda fistulosa var. *menthaefolia*	Western Wild Bergamot	Native
Monolepis nuttalliana	Spear-leaved Goosefoot	Native
Muhlenbergia cuspidata	Prairie Muhly	Native
Oenothera nuttallii	White Evening-primrose	Native
Pascopyrum smithii	Western Wheatgrass	Native
Pediomellum argophyllum	Silverleaf Psoralia	Native
Phalaris arundinacea	Reed Canary Grass	Native
Phlox hoodii	Moss Phlox	Native
Plantago major	Common Plantain	Introduced
Poa pratensis	Kentucky Bluegrass	Introduced
Populus balsamifera	Balsam/Black poplar	Native
Populus tremuloides	Trembling Aspen	Native
Potentilla anserina	Silverweed	Native
Potentilla arguta	White Cinquefoil	Native
Potentilla concinna	Early Cinquefoil	Native
Primula incana	Mealy Primrose	Native
Prunus virginiana	Choke Cherry	Native
Psoralea argophylla	Silver-leaf Psoralea	Native
Psoralea esculenta	Indian Breadroot	Native
Ranunculus cymbalaria	Alkali Buttercup	Native
Ratibida columnifera	Prairie Coneflower	Native

Latin Name	Common Name	Native / Introduced
Rhamnus cathartica	European Buckthorn	Introduced
Rosa arkansana	Low Prairie Rose	Native
Rosa woodsii	Wood's Rose	Native
Rumex sp.	Dock	Native
Salix bebbiana	Beaked Willow	Native
Salix interior	Sandbar Willow	Native
Salsola kali	Russian Thistle	Introduced
Schizachyrium scoparium	Little Bluestem	Native
Schoenoplectus acutus	Viscid/Hard-stem Bulrush	Native
Schoenoplectus pungens	Three-square Bulrush	Native
Selaginella densa	Prairie selaginella/Spikemoss	Native
Senecio congestus	Marsh ragwort	Native
Setaria viridis	Green Foxtail	Introduced
Sheperdia argentea	Thorny Buffaloberry	Native
Solidago canadensis var. *canadensis*	Canada Goldenrod	Native
Solidago missouriensis	Low Goldenrod	Native
Solidago rigida	Rigid Goldenrod	Native
Solidago spathulata var. *neomexicana*	Mountain Goldenrod	Native
Sonchus arvensis	Perennial Sow-thistle	Introduced
Spiraea alba	Narrow-leaved Meadow Sweet	Native
Symphoricarpos occidentalis	Western Snowberry	Native
Symphyotrichum ciliatum	Rayless Aster	Native
Symphyotrichum ericoides	Many-flowered Aster	Native
Symphyotrichum falcatum var. *commutatum*	White Prairie/Heath Aster	Native
Symphyotrichum laeve	Smooth Blue Aster	Native
Taraxacum officinale	Common Dandelion	Introduced
Thalictrum venulosum	Early Meadow Rue	Native
Thermopsis rhombifolia	Golden-bean	Native
Thlaspi arvense	Stinkweed	Introduced
Tragopogon dubius	Yellow Goat's-beard	Introduced
Triglochin maritima	Seaside Arrow Grass	Native
Typha latifolia	Common Cattail	Native
Ulmus pumila	Manchurian/Siberian Elm	Introduced
Urtica dioica	Common Nettle	Native
Vicia americana	American Vetch	Native
Viola adunca	Early Blue Violet	Native
Viola nephrophylla	Bog Violet	Native
Viola pedatifida	Crowfoot Violet	Native
Zizia aptera	Heart-leaved Alexander	Native
Pinus sp.	Horticultural pine (possibly Scots Pine)	Native
Picea sp.	Horitcultural spruce (possibly Blue Spruce)	Native

Table D2. Weed Species Governed by the Provincial Weed Control Act That Were Detected in the Small Swale and Adjacent Grasslands Survey Area (S ½ 24 37-05 W3M) During the 2019 Vegetation Surveys.

Latin Name	Common Name	Saskatchewan Designation
Agropyron repens	Quack Grass	Nuisance
Carduus nutans	Nodding Thistle	Noxious
Cirsium arvense	Canada Thistle	Noxious
Convolvulus arvensis	Field Bindweed	Noxious
Euphorbia esula	Leafy Spurge	Noxious
Hordeum jubatum	Wild Barley	Noxious
Kochia scoparia	Kochia	Noxious
Rhamnus cathartica	European Buckthorn	Nuisance
Salsola kali	Russian Thistle	Noxious
Sonchus arvensis	Perennial Sow-thistle	Nuisance
Taraxacum officinale	Common Dandelion	Nuisance

Table D3. Vegetation Species Detected in the Grassland Adjacent to the Northeast Swale Survey Area (NW 18-37-4 W3M) During the 2019 Vegetation Surveys.

Latin Name	Common Name	Native / Introduced
Achillea millefolium	Common Yarrow	Native
Agropyron cristatum	Crested Wheatgrass	Introduced
Agropyron repens	Quack Grass	Introduced
Allium stellatum	Pink Flowered Onion	Native
Amelanchier alnifolia	Saskatoon	Native
Anemone cylindrica	Long-fruited Anemone	Native
Anemone multifida	Cut-leaved Anemone	Native
Anemone patens	Prairie Crocus	Native
Artemisia frigida	Pasture Sage	Native
Artemisia ludoviciana	Prairie Sage	Native
Astragalus cicer	Cicer Milk-vetch	Introduced
Astragalus flexuosus	Slender Milk-vetch	Native
Astragalus sp.	Milk-vetch species	Native
Bouteloua gracilis	Blue Grama	Native
Bromus inermis	Smooth Brome	Introduced
Calamovilfa longifolia	Sand Grass	Native
Carduus nutans	Nodding Thistle	Introduced
Carex sp.	Sedge species	Native
Chamaenerion angustifolium	Fireweed	Native
Chenopodium sp.	Goosefoot	Native
Cirsium arvense	Canada Thistle	Introduced
Cirsium flodmanii	Flodman's Thistle	Native
Crataegus chrysocarpa	Round-leaved/Firebelly Hawthorn	Native
*Descurainia sophia**	Flix-weed	Introduced
Eleagnus commutata	Wolf Willow	Native
Elymus lanceolatus ssp. *lanceolatus*	Northern Wheatgrass	Native
Erigeron sp.	Fleabane	Native
Euphorbia esula	Leafy Spurge	Introduced
Festuca trachyphylla	Sheep Fescue	Introduced
Galium boreale	Northern Bedstraw	Native
Geum triflorum	Three Flowered Avens	Native
Gutierrezia sarothrae	Common Broomweed	Native
Hesperostipa comata ssp. *comata*	Needle and Thread	Native
Hesperostipa curtiseta	Western Porcupine Grass	Native
Heterotheca villosa	Hairy Golden-aster	Native
Koeleria macrantha	June Grass	Native
Lactuca pulchella	Blue Lettuce	Native
Linum lewisii	Wild Blue Flax	Native
Lithospermum incisum	Narrow-leaved Puccoon	Native
Medicago lupilina	Black Medic	Introduced

Latin Name	Common Name	Native / Introduced
Melilotus alba	White Sweet-clover	Introduced
Melilotus officinalis	Yellow Sweet-clover	Introduced
Monolepis nuttalliana	Spear-leaved Goosefoot	Native
Nassella viridula	Green Needle Grass	Native
Pascopyrum smithii	Western Wheatgrass	Native
Penstemon gracilis	Lilac-flowered Beardtongue	Native
Poa pratensis	Kentucky Bluegrass	Introduced
Populus balsamifera	Balsam/Black poplar	Native
Populus tremuloides	Trembling Aspen	Native
Potentilla arguta	White Cinquefoil	Native
Potentilla hippiana	Wooly Cinquefoil	Native
Potentilla sp.	Cinquefoil	Native
Prunus virginiana	Choke Cherry	Native
Rhamnus cathartica	European Buckthorn	Introduced
Rosa arkansana	Low Prairie Rose	Native
Salix sp.	Willow	Native
Sheperdia argentea	Thorny Buffaloberry	Native
Solanum triflorum	Wild Tomato	Native
Solidago canadensis var. *canadensis*	Canada Goldenrod	Native
Solidago missouriensis	Low Goldenrod	Native
Solidago rigida	Rigid Goldenrod	Native
Spiraea alba	Narrow-leaved Meadow Sweet	Native
Symphoricarpos occidentalis	Western Snowberry	Native
Symphyotrichum ericoides	Many-flowered Aster	Native
Thermopsis rhombifolia	Golden-bean	Native
Thlaspi arvense	Stinkweed	Introduced

*Denotes introduced species

Table D4. Weed Species Governed by the Provincial Weed Control Act That Were Detected in the Grasslands Adjacent to the Northeast Swale Survey Area (NW 18-37-4 W3M) During the 2019 Vegetation Surveys.

Latin Name	Common Name	Saskatchewan Designation
Agropyron repens	Quack Grass	Nuisance
Carduus nutans	Nodding Thistle	Noxious
Cirsium arvense	Canada Thistle	Noxious
Euphorbia esula	Leafy Spurge	Noxious
Rhamnus cathartica	European Buckthorn	Noxious
Tanacetum vulgare	Common Tansy	Noxious
Taraxacum officinale	Common Dandelion	Nuisance

Table D5. Vegetation Species Detected in the Riverbank Area and Adjacent Upland Survey Area (SE 14-37-5-W3M) and Riddell Paleontological Site Survey Area (SW 13-37-05 W3M) During the 2019 Vegetation Surveys.

Latin Name	Common Name	Native / Introduced
Acer negundo	Manitoba Maple	Native
Achillea millefolium	Common Yarrow	Native
Actaea rubra	Red Baneberry	Native
Agropyron cristatum	Crested Wheatgrass	Introduced
Agropyron repens	Quack Grass	Introduced
Agrostis stolonifera	Creeping Bentgrass	Native
Amaranthus retroflexus	Red-root Pigweed	Introduced
Amelanchier alnifolia	Saskatoon	Native
Anemone canadensis	Canada Anemone	Native
Anemone cylindrica	Long-fruited Anemone	Native
Anemone patens	Prairie Crocus	Native
Apocynum androsaemifolium	Spreading Dogbane	Native
Apocynum cannabinum	Indian Hemp	Native
Artemisia absintha	Absinthe	Native
Artemisia frigida	Pasture Sage	Native
Artemisia ludoviciana	Prairie Sage	Native
Asparagus officinalis	Asparagus	Introduced
Astragalus bisulcatus	Two-grooved Milk-vetch	Native
Auralia nudicualus	Sarsaparilla	Native
Betula occidentalis	River Birch	Native
Betula papyrifera	Paper Birch	Native
Bidens cernua	Nodding/Smooth Beggarticks	Native
Bolboschoenus maritimus	Cosmopolitan Bulrush	Native
Bouteloua gracilis	Blue Grama	Native
Bromus inermis	Smooth Brome	Introduced
Calamovilfa longifolia	Sand Grass	Native
Carduus nutans	Nodding Thistle	Introduced
Carex aquatilus	Water Sedge	Native
Carex obtusata	Blunt Sedge	Native
Chenopodium rubrum	Red Goosefoot	Native
Cicuta maculata	Spotted Water-hemlock	Native
Cirsium arvense	Canada Thistle	Introduced
Conyza canadensis	Canada Fleabane	Native
Cornus canadensis	Bunchberry	Native
Cornus stolonifera	Red Osier Dogwood	Native
Corydalis aurea	Golden Corydalis	Native
Crataegus chrysocarpa	Round-leaved/Firebelly Hawthorn	Native
Crepis sp.	Hawksbeard	Native
Descurainia sophia	Flix-weed	Introduced
Eleagnus commutata	Wolf Willow	Native

Latin Name	Common Name	Native / Introduced
Elymus lanceolatus ssp. *lanceolatus*	Northern Wheatgrass	Native
Elymus trachycaulus ssp. *subsecundum*	Slender Wheatgrass	Native
Epilobium palustre	Marsh Willow-herb	Native
Equisetum fluviatile	Water Horse-tail	Native
Equisetum pratense	Meadow Horse-tail	Native
Euphorbia serpyllifolia	Thyme-leaved Spurge	Native
Fragaria vesca	American Wild Strawberry	Native
Fragaria virginiana	Smooth Wild Strawberry	Native
Fraxinus pennsylvanica	Green Ash	Native
Galium boreale	Northern Bedstraw	Native
Galium triflorum	Sweet Scented Bedstraw	Native
Geum macrophyllum	Largeleaf Avens	Native
Glycyrrhiza lepidota	Wild Licorice	Native
Gnaphalium palustre	Marsh Cudweed	Native
Gutierrezia sarothrae	Common Broomweed	Native
Hedysarum alpinum	American Hedysarum	Native
Helenium autumnale	Sneezeweed	Native
Helianthus laetiflorus	Beautiful Sunflower	Native
Heracleum maximum	Cow Parsnip	Native
Heterotheca villosa	Hairy Golden-aster	Native
Hierochloe odorata	Sweet Grass	Native
Hordeum jubatum	Wild Barley	Native
Juncus alpinoarticulatus	Northern Green Rush	Native
Juncus balticus	Baltic Rush	Native
Juncus nodosus	Knotted Rush	Native
Juniperus horizontalis	Creeping Juniper	Native
Kochia scoparia	Kochia	Introduced
Lactuca serriola	Lobed Prickly Lettuce	Introduced
Lathyrus ochroleucus	Cream-coloured Vetchling	Native
Lathyrus venosus	Wild Pea	Native
Lonicera dioica	Twining Honeysuckle	Native
Lycopus asper	Western Water Horehound	Native
Lysimachia maritima	Sea-milkwort	Native
Maianthemum canadensis	Canada Mayflower	Native
Maianthemum stellatum	Star-flowered Solomon's-seal	Native
Medicago lupilina	Black Medic	Introduced
Medicago sativa	Alfalfa	Introduced
Melilotus alba	White Sweet-clover	Introduced
Melilotus officinalis	Yellow Sweet-clover	Introduced
Mentha arvense	Wild Mint	Native
Muhlenbergia cuspidata	Prairie Muhly	Native
Nassella viridula	Green Needle Grass	Native

Latin Name	Common Name	Native / Introduced
Oryzopsis asperifolia	White Grained Mountain Ricegrass	Native
Oxytropis sericea	Early Yellow Locoweed	Native
Pascopyrum smithii	Western Wheatgrass	Native
Penstemon sp.	Beardtongue	Native
Phalaris arundinacea	Reed Canary Grass	Native
Plantago major	Common Plantain	Introduced
Poa pratensis	Kentucky Bluegrass	Introduced
Polypogon monspeliensis	Rabbitfoot-grass	Introduced
Populus balsamifera	Balsam/Black Poplar	Native
Populus deltoides	Western/Plains Cottonwood	Native
Populus tremuloides	Trembling Aspen	Native
Potentilla anserina	Silverweed	Native
Prunus pensylvanica	Pincherry	Native
Prunus virginiana	Choke Cherry	Native
Psoralidium lanceolatum	Lance Leaved Psoralea	Native
Puccinellia nuttalliana	Nuttall's Alkaligrass	Native
Pyrola aserifolia	Pink Flowered Wintergreen	Native
Ranunculus cymbalaria	Alkali Buttercup	Native
Rhamnus cathartica	European Buckthorn	Introduced
Ribes oxyacanthoides	Northern/Canada Gooseberry	Native
Rosa arkansana	Low Prairie Rose	Native
Rosa woodsii	Wood's Rose	Native
Rubus idaeus	Wild-red Raspberry	Native
Rubus pubescens	Dewberry	Native
Salix bebbiana	Beaked Willow	Native
Salix interior	Sandbar Willow	Native
Salsola kali	Russian Thistle	Native
Schizachne purpurascens	Purple Oat Grass	Native
Schoenoplectus acutus	Viscid/Hard-stem Bulrush	Native
Setaria viridis	Green Foxtail	Introduced
Sheperdia argentea	Thorny Buffaloberry	Native
Sisyrinchium montanum	Blue-eyed Grass	Native
Sium suave	Water Parsnip	Native
Solidago canadensis	Canada Goldenrod	Native
Sonchus arvensis	Perennial Sow-thistle	Introduced
Sonchus asper	Annual Sowthistle	Introduced
Spiraea alba	Narrow-leaved Meadow Sweet	Native
Symphoricarpos occidentalis	Western Snowberry	Native
Symphyotrichum ciliatum	Rayless Aster	Native
Symphyotrichum laeve	Smooth Blue Aster	Native
Tanacetum vulgare	Common Tansy	Introduced
Taraxacum officinale	Common Dandelion	Introduced

Latin Name	Common Name	Native / Introduced
Thalictrum venulosum	Early Meadow Rue	Native
Thermopsis rhombifolia	Golden-bean	Native
Thlaspi arvense	Stinkweed	Introduced
Toxicodendron radicans	Poison Ivy	Native
Tragopogon dubius	Yellow Goat's-beard	Introduced
Triglochin maritima	Seaside Arrow Grass	Native
Tripleurospermum inodorum	Scentless Chamomile	Introduced
Typha latifolia	Common Cattail	Native
Ulmus pumila	Manchurian/Siberian Elm	Introduced
Urtica dioica	Common Nettle	Native
Vicia americana	American Vetch	Native
Viola adunca	Early Blue Violet	Native
Viola rugulosa	Western Canada Violet	Native
Xanthium strumarium	Cocklebur	Native

*Denotes introduced species

Table D6. Weed Species Governed by the Provincial Weed Control Act that were Detected in the Riverbank Area and Adjacent Upland Survey Area (SE 14-37-5-W3M) and Riddell Paleontological Site Survey Areas (SW 13-37-05 W3M) During the 2019 Vegetation Surveys.

Latin Name	Common Name	Saskatchewan Designation
Carduus nutans	Nodding Thistle	Noxious
Cirsium arvense	Canada Thistle	Noxious
Hordeum jubatum	Wild Barley	Noxious
Kochia scoparia	Kochia	Noxious
Lactuca serriola	Lobed Prickly Lettuce	Noxious
Rhamnus cathartica	European Buckthorn	Noxious
Sonchus arvensis	Perennial Sow-thistle	Noxious
Sonchus asper	Annual Sowthistle	Noxious
Tanacetum vulgare	Common Tansy	Nuisance
Taraxacum officinale	Common Dandelion	Noxious
Tripleurospermum inodorum	Scentless Chamomile	Noxious

APPENDIX E. WILDLIFE SPECIES DOCUMENTED DURING THE REMOTE CAMERA SURVEY

Table E1. Wildlife Species Documented During the Remote Camera Survey.

Plot #	WTDE	MUDE	DESP	COYO	RACO	WTJR	SNHA	NAPO	AMBA	AMBE	MOOS	UNKN_MAMMAL	BBMA	WEKI	EAKB	GRPA	AMCR	NOHA	TRES	RAPTOR	FRGU	HOSP	MALL	UNKN_BIRD
UH3 RC01	61	4	X	X	1	1	X	X	X	X	X	X	1	X	X	X	X	X	X	X	X	X	X	X
UH3 RC02	122	4	X	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
UH3 RC03	12	X	X	3	X	51	X	3	3	X	X	X	1	X	X	X	X	X	X	X	X	X	X	X
UH3 RC04	118	1	X	2	2	X	X	X	X	1	X	X	1	X	X	X	X	X	X	X	X	X	X	X
UH3 RC05	11	X	X	1	X	1	X	X	X	X	X	X	1	1	X	X	X	X	X	X	X	X	X	X
UH3 RC06	42	X	X	3	2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
UH3 RC07	57	1	X	2	3	X	1	X	X	X	X	X	X	X	1	X	X	X	X	X	X	X	X	X
UH3 RC08	40	4	X	1	X	X	X	X	X	X	X	X	X	X	X	4	X	X	X	X	X	X	X	X
UH3 RC09	13	20	3	40	X	1	X	X	X	X	X	1	X	X	X	X	X	X	X	X	X	X	X	X
UH3 RC10	93	5	1	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MW RC01	X	1	X	X	X	X	X	X	X	X	X	X	2	X	X	X	4	1	3	1	X	X	X	11
MW RC02	31	633	24	11	X	1	X	X	X	X	1	1	X	X	X	X	X	X	18	X	X	X	X	X
MW RC03	2	42	1	X	X	X	X	X	X	X	X	X	1	X	X	X	2	2	8	X	42	X	X	X
MW RC04	65	86	35	1	X	5	X	X	X	X	X	X	X	X	X	X	X	X	1	X	X	1	1	X
Totals	**667**	**801**	**64**	**70**	**8**	**60**	**1**	**3**	**3**	**1**	**1**	**2**	**7**	**1**	**1**	**4**	**6**	**3**	**30**	**1**	**42**	**1**	**1**	**11**

APPENDIX F. INDIVIDUAL BUCKS IDENTIFIED DURING THE REMOTE CAMERA SURVEY THAT WERE USED TO ASSESS WILDLIFE MOVEMENT IN THE STUDY AREA

Table F1. Individual Bucks Identified During the Remote Camera Survey.

		Remote Camera Plot													
Buck ID	**Species**	**RC01**	**RC02**	**RC03**	**RC04**	**RC05**	**RC06**	**RC07**	**RC08**	**RC09**	**RC10**	**MVARC01**	**MVARC02**	**MVARC03**	**MVARC04**
A	WTDE	X	X	X	X	X	7-Aug-19 11-Aug-19	X	X	X	X	X	X	X	X
AA	WTDE	X	X	X	X	X	2-Aug-19 3-Aug-19	X	X	X	X	X	X	X	X
AB	WTDE	X	X	X	X	X	4-Aug-19	X	X	X	X	X	X	X	X
AC	WTDE	X	X	X	X	X	7-Aug-19	X	X	X	X	X	X	X	X
A2	MUDE	X	X	X	X	X	X	X	X	X	X	X	29-Sep-19	02-Oct-19 10-Oct-19	10-Oct-19 12-Oct-19
B	WTDE	X	X	X	X	X	11-Aug-19	X	X	X	X	X	X	X	X
B2	MUDE	X	X	X	X	X	X	X	X	X	X	X	29-Sept-19 01-Oct-19 30-Oct-19	02-Oct-19	09-Oct-19 12_Oct-19
C	WTDE	24-Jul-19	X	X	X	5-Aug-19	7-Aug-19 22-Aug-19	X	8-Aug-19 12-Aug-19 21-Aug-19	X	X	X	X	X	X
C2	MUDE	X	X	X	X	X	X	X	X	X	X	X	31-Oct-19	X	X
D	WTDE	X	X	X	X	X	29-Jul-19 2-Aug-19 7-Aug-19 17-Aug-19	X	X	X	X	X	X	X	X
D2	MUDE	X	X	X	X	X	X	X	X	X	X	X	X	02-Nov-19	X
E	WTDE	23-Jul-19	X	X	X	X	29-Jul-19 7-Aug-19	13-Aug-19	8-Aug-19 19-Aug-19	X	26-Jul-19	X	X	X	X

		Remote Camera Plot												
Buck ID	Species	RC01	RC02	RC03	RC04	RC05	RC06	RC07	RC08	RC09	RC10	MVARC01	MVARC02	MVARC03	MVARC04
F	WTDE	X	X	X	X	X	15-Aug-19 27-Aug-19	25-Jul-19 30-Aug-19 9-Sep-19	X	X	X	X	X	X	X
G	WTDE	X	X	X	X	X	15-Aug-19	X	20-Aug-19	X	X	X	X	X	31-Aug-19
H	MUDE	X	X	X	X	X	X	X	25-Jul-19	24-Aug-19	3-Aug-19 19-Aug-19	X	11-Aug-19 04-Sep-19 12-Sep-19 23-Sep-19 03-Oct-19	30-Oct-19	15-Jul-19 15-Aug-19 31-Aug-19
I	MUDE	X	X	X	X	X	X	X	25-Jul-19	17-Jul-19 20-Jul-19 30-Jul-19	X	X	04-Aug-19 11-Aug-19 04-Sep-19 23-Sep-19	30-Oct-19	15-Jul-19 19-Aug-19
J	WTDE	X	X	X	X	X	X	X	11-Aug-19	X	X	X	X	X	13-Aug-19
K	WTDE	X	X	X	X	X	X	X	11-Aug-19 19-Aug-19	X	X	X	19-Aug-19 22-Oct-19 25-Oct-19	X	X
L	WTDE	X	X	X	X	X	X	X	11-Aug-19	X	X	X	23-Sep-19	X	13-Aug-19 25-Sep-19
M	WTDE	X	2-Jul-19 8-Jul-19	X	7-Jul-19	X	X	X	8-Aug-19 14-Aug-19 19-Aug-19	23-Aug-19	X	X	X	X	X
N	WTDE	X	X	X	X	X	X	X	8-Aug-19 17-Aug-19 19-Aug-19	X	X	X	10-Sep-19	X	X

		Remote Camera Plot													
Buck ID	Species	RC01	RC02	RC03	RC04	RC05	RC06	RC07	RC08	RC09	RC10	MVARC01	MVARC02	MVARC03	MVARC04
									22-Aug-19						
O	WTDE	X	X	X	X	X	X	X	X	X	26-Jul-19	X	X	X	X
											30-Jul-19				
P	WTDE	X	X	X	X	X	X	X	X	X	1-Aug-19	X	X	X	X
											9-Aug-19				
Q	WTDE	9-Jul-19	X	X	X	25-Jul-19	X	X	20-Aug-19	X	X	X	X	X	28-Aug-19
						27-Jul-19									
R	WTDE	8-Jul-19	24-Jun-19	X	X	X	X	X	X	X	X	X	X	X	X
S	WTDE	1-Jul-19	X	X	X	X	X	X	X	X	X	X	X	X	X
T	WTDE	X	26-Jun-19	X	X	X	X	X	X	X	X	X	X	X	X
			2-Jul-19												
			7-Jul-19												
			15-Jul-19												
U	WTDE	X	16-Jul-19	X	X	X	X	X	X	X	X	X	X	X	X
V	MUDE	X	X	X	10-Jul-19	X	X	X	X	X	26-Jul-19	X	23-Sep-19	X	03-Sep-19
													28-Sep-19		25-Sep-19
															02-Oct-19
W	WTDE	X	X	X	27-Jun-19	X	X	X	X	X	X	X	X	X	X
					1-Jul-19										
X	WTDE	X	X	X	X	27-Jul-19	X	X	X	X	X	X	X	X	X
Y	WTDE	X	X	X	X	X	X	X	X	30-Jul-19	X	X	X	X	X
Z	WTDE	X	X	X	X	X	2-Aug-19	13-Aug-19	8-Aug-19	X	X	X	X	02-Nov-19	25-Sep-19
							7-Aug-19	3-Sep-19	21-Aug-19						

WTDE – White-tailed deer; MUDE – Mule deer

X – Not present

Jun – June; Jul – July; Aug – August; Sept – September; Oct – October; Nov - November

Figure F1. Buck A2.

Figure F2. Buck B2.

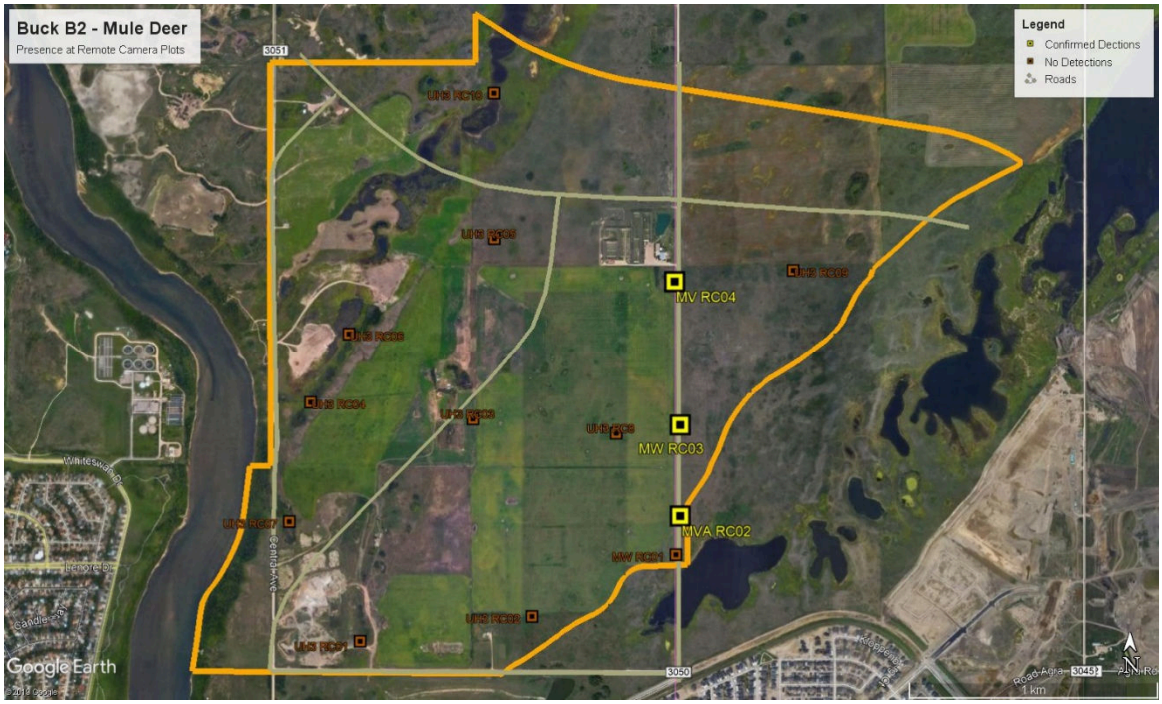


Figure F3. Buck C.

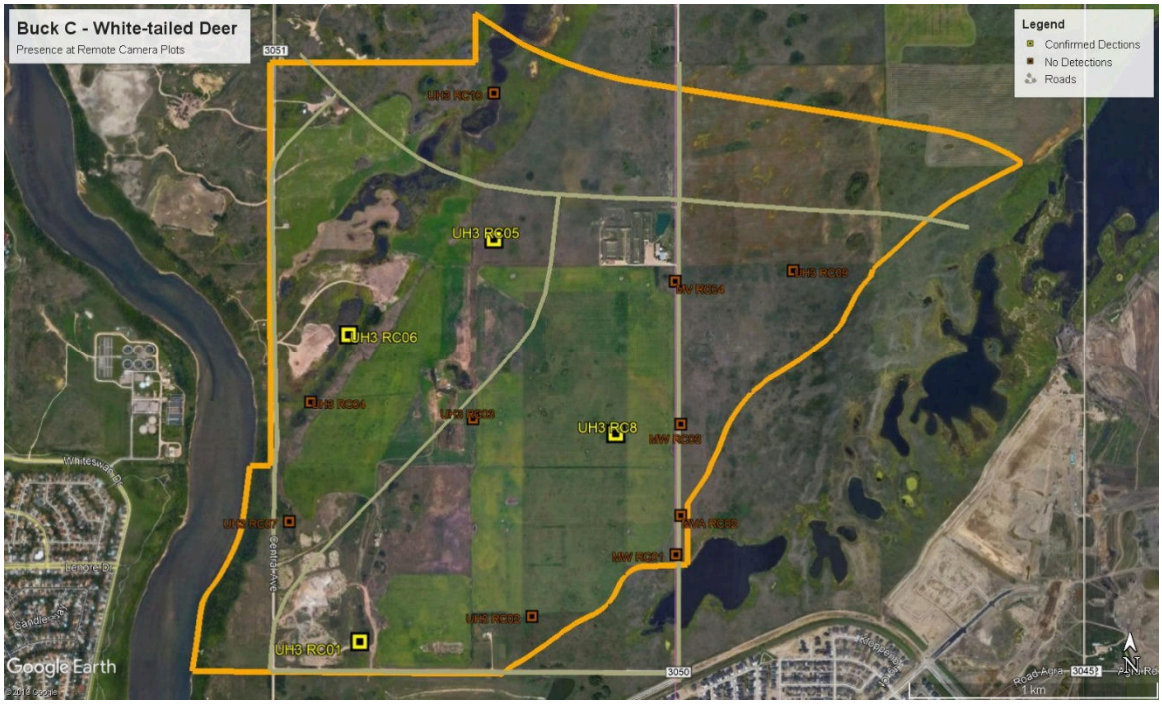
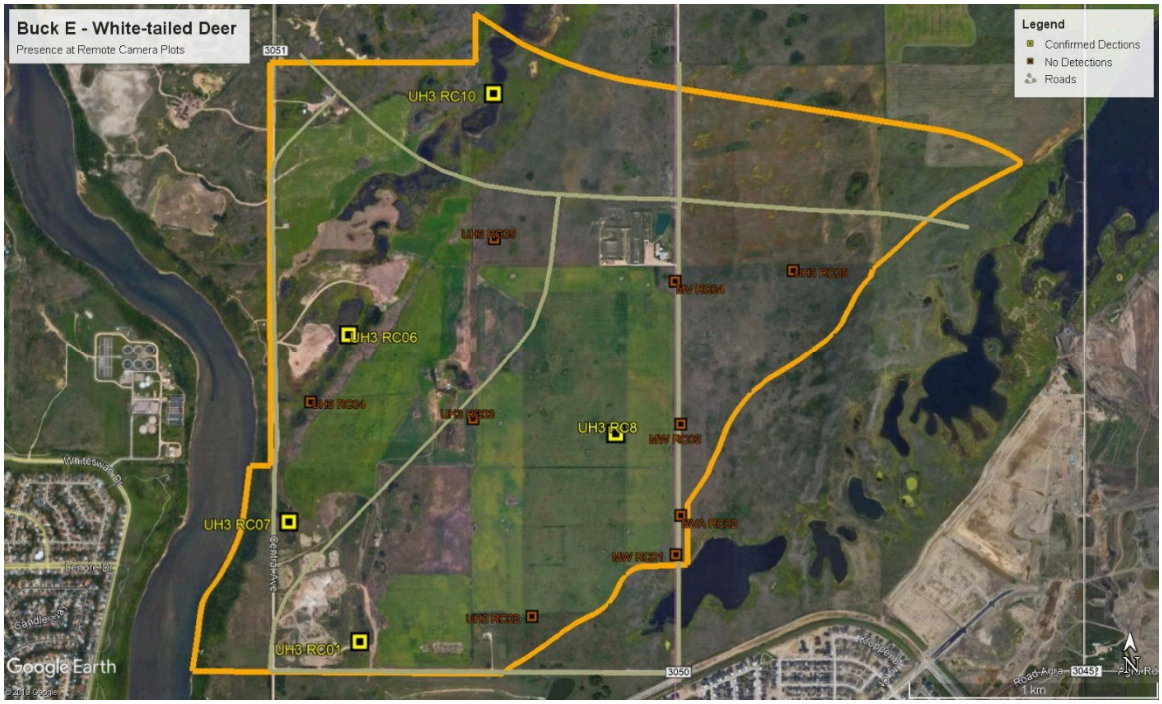


Figure F4. Buck E.



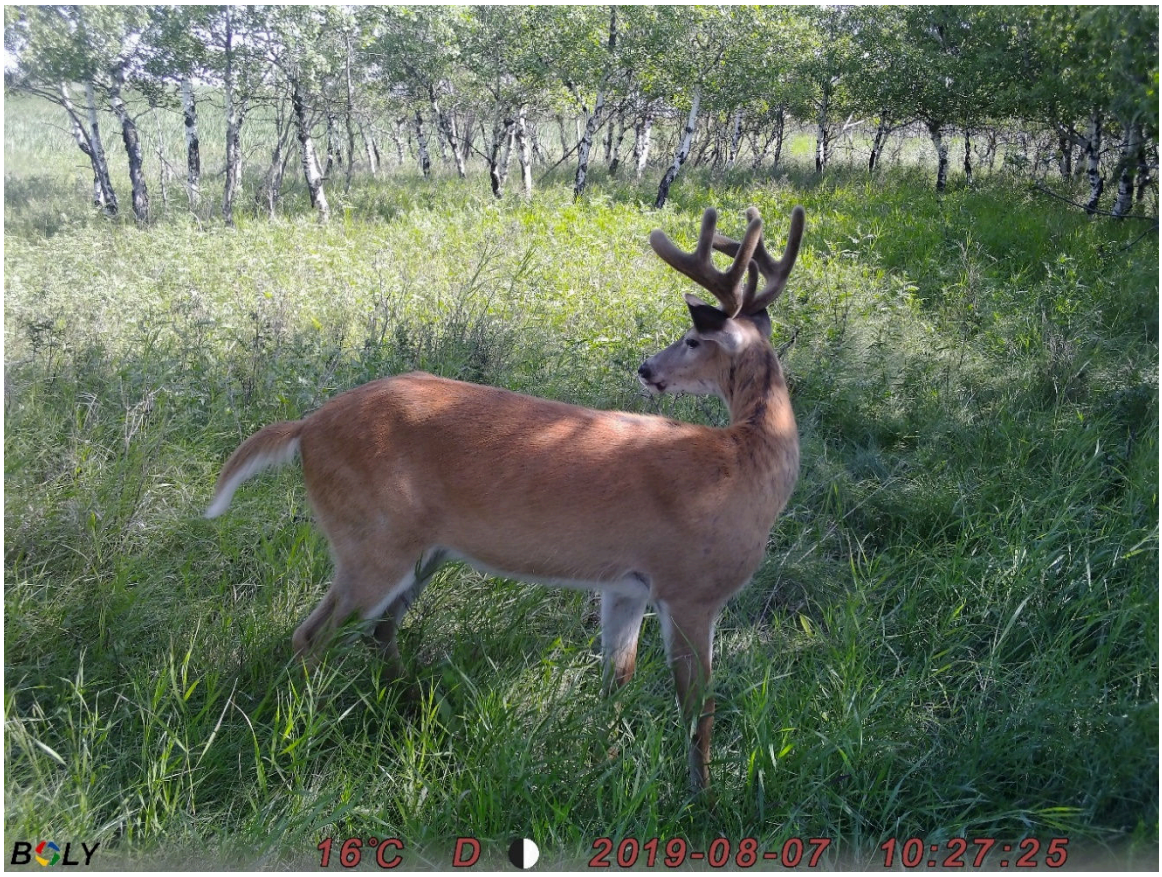
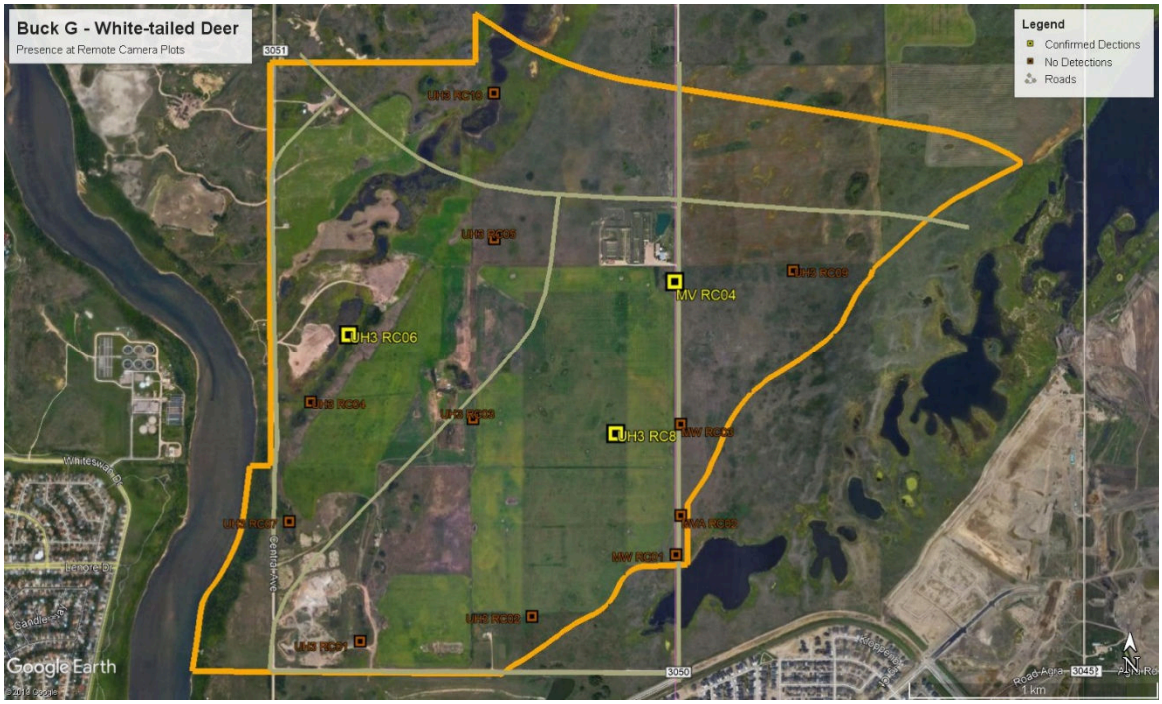


Figure F5. Buck G.



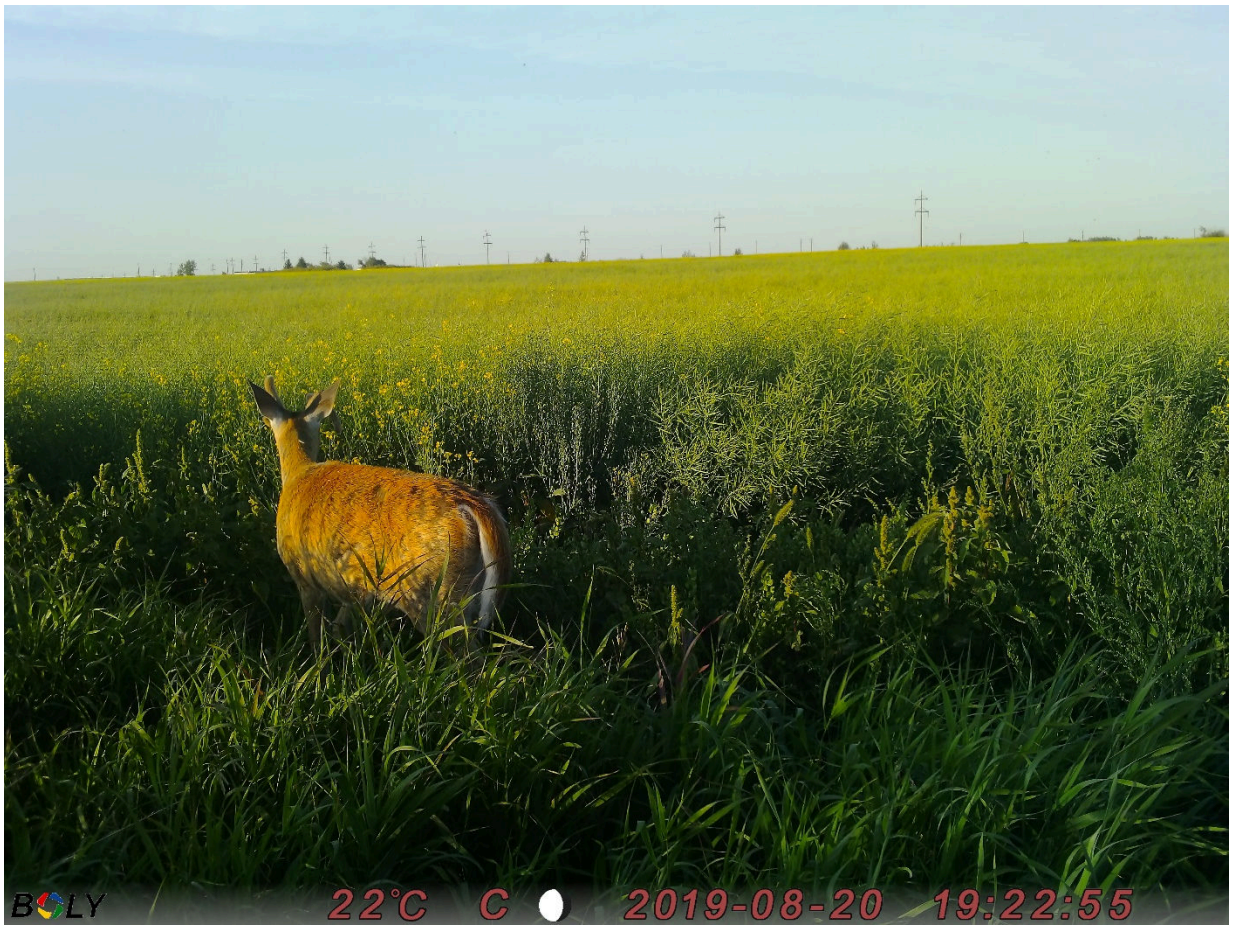
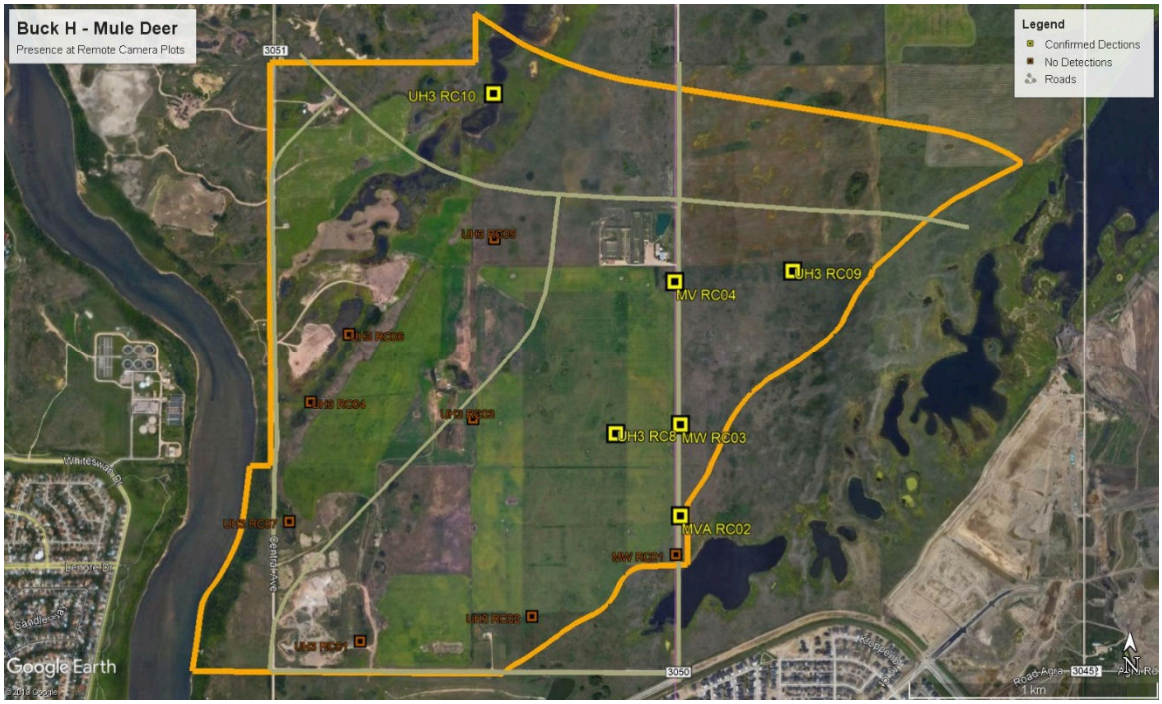


Figure F6. Buck H.



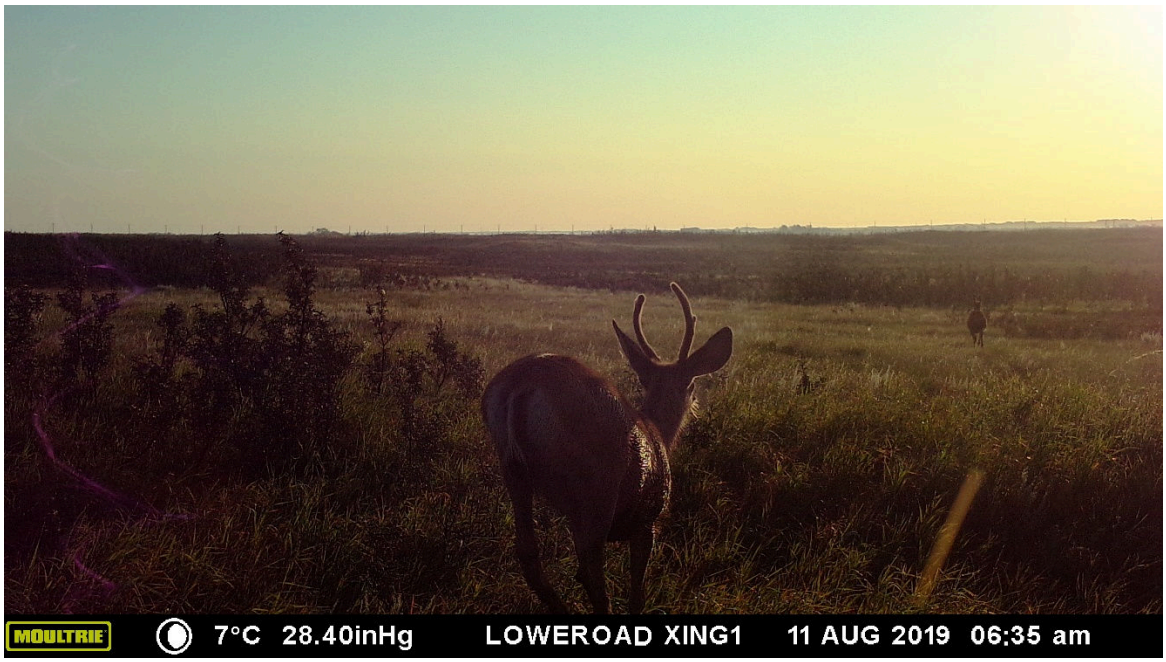


Figure F7. Buck I.

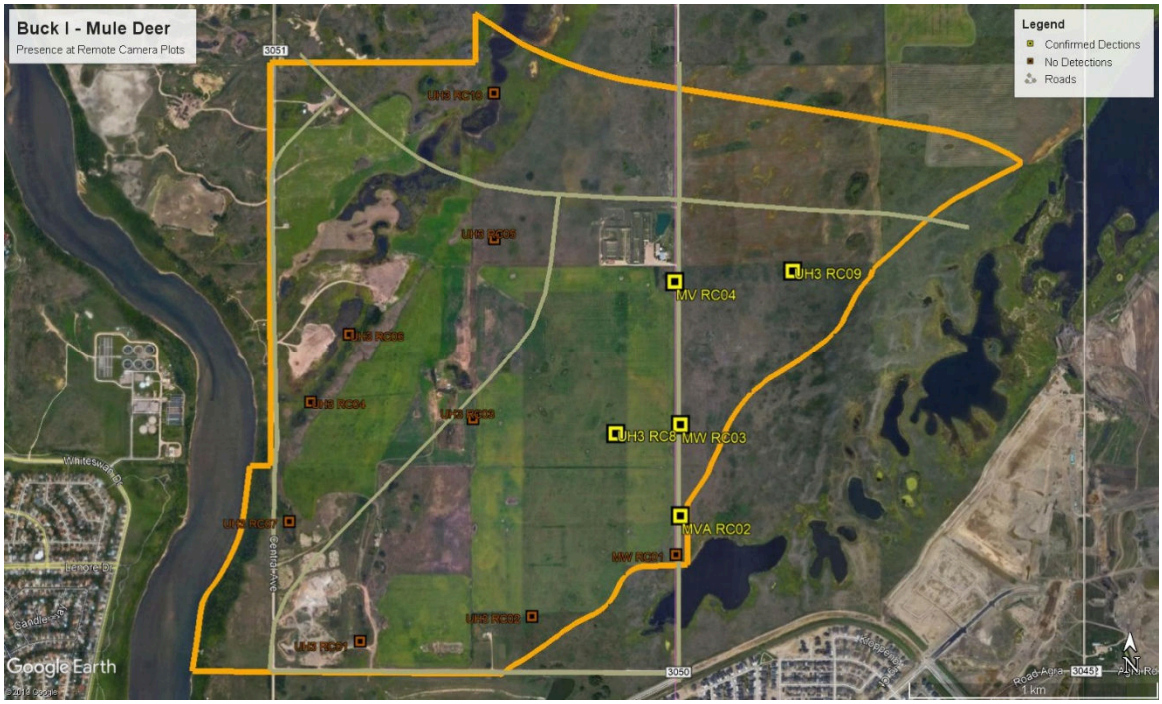


Figure F8. Buck L.

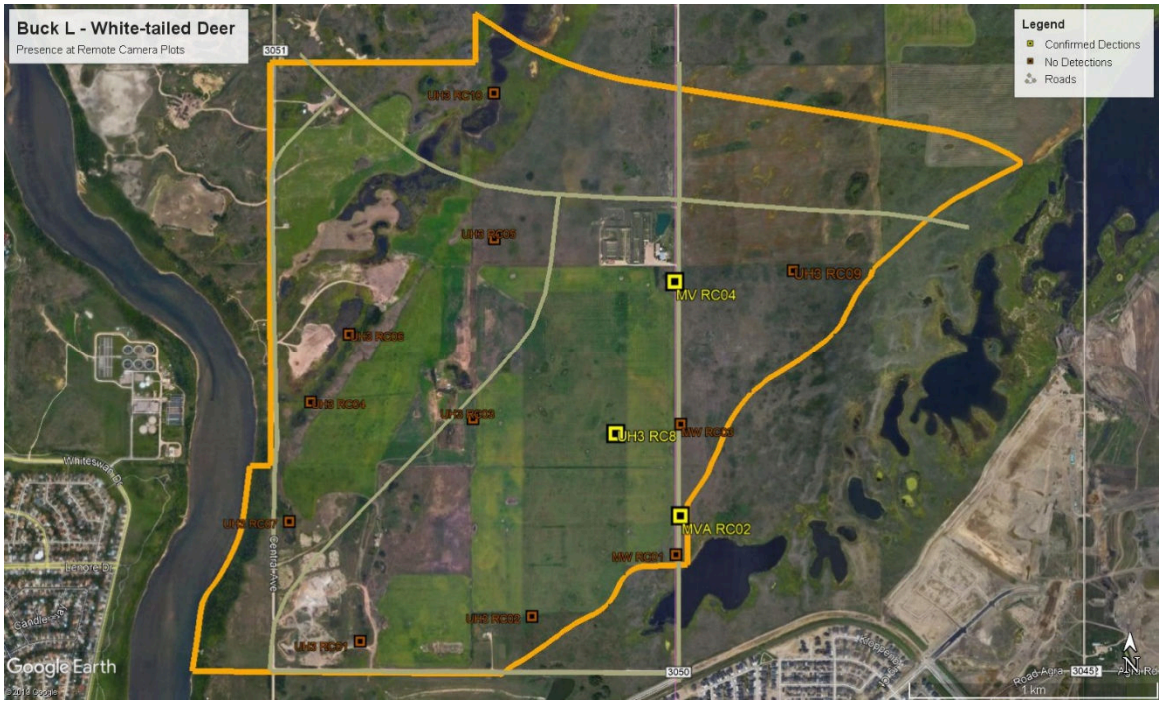


Figure F9. Buck M.

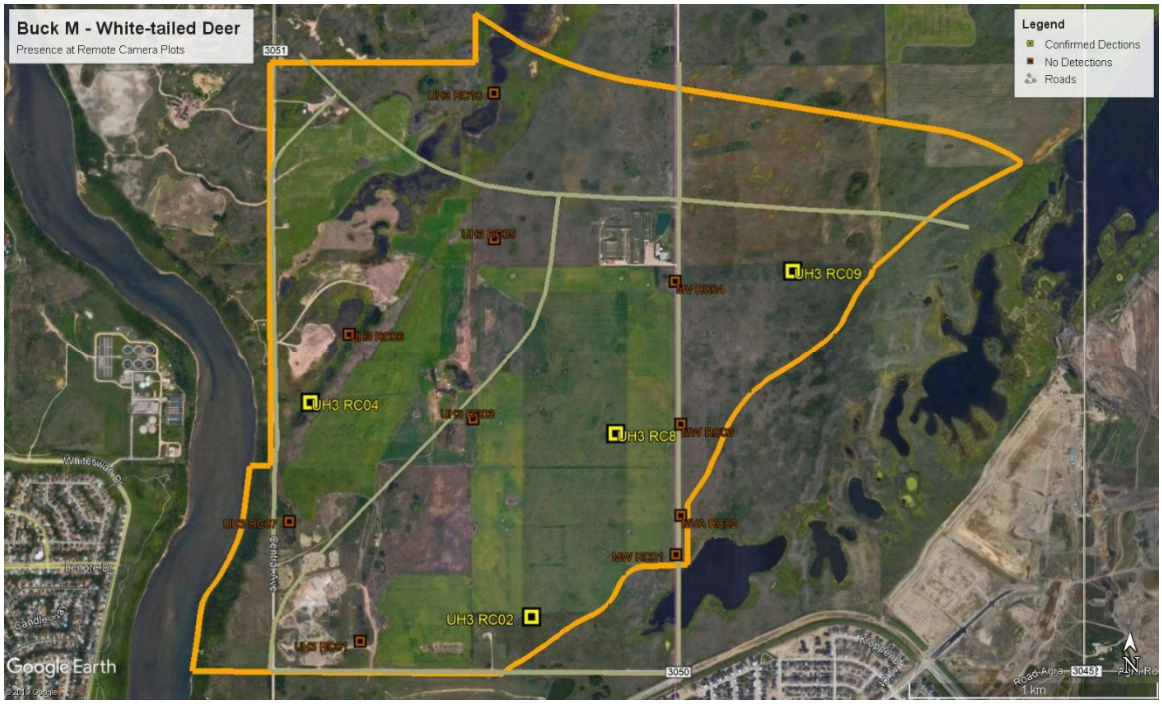
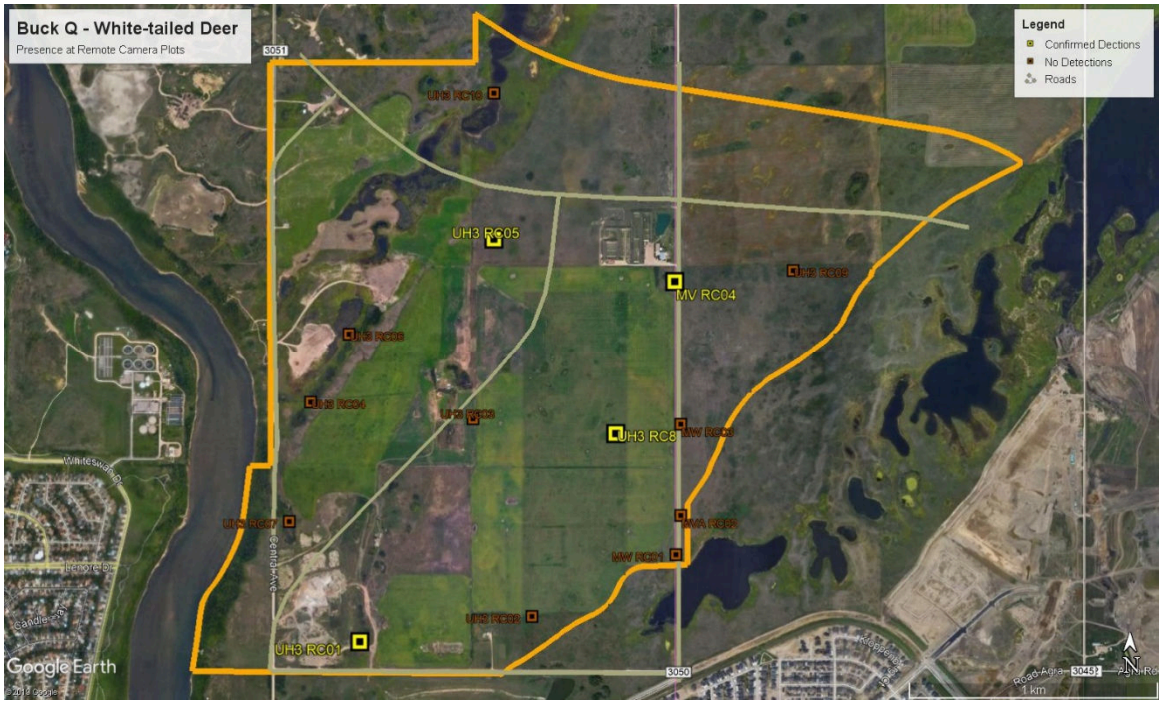


Figure F10. Buck Q.



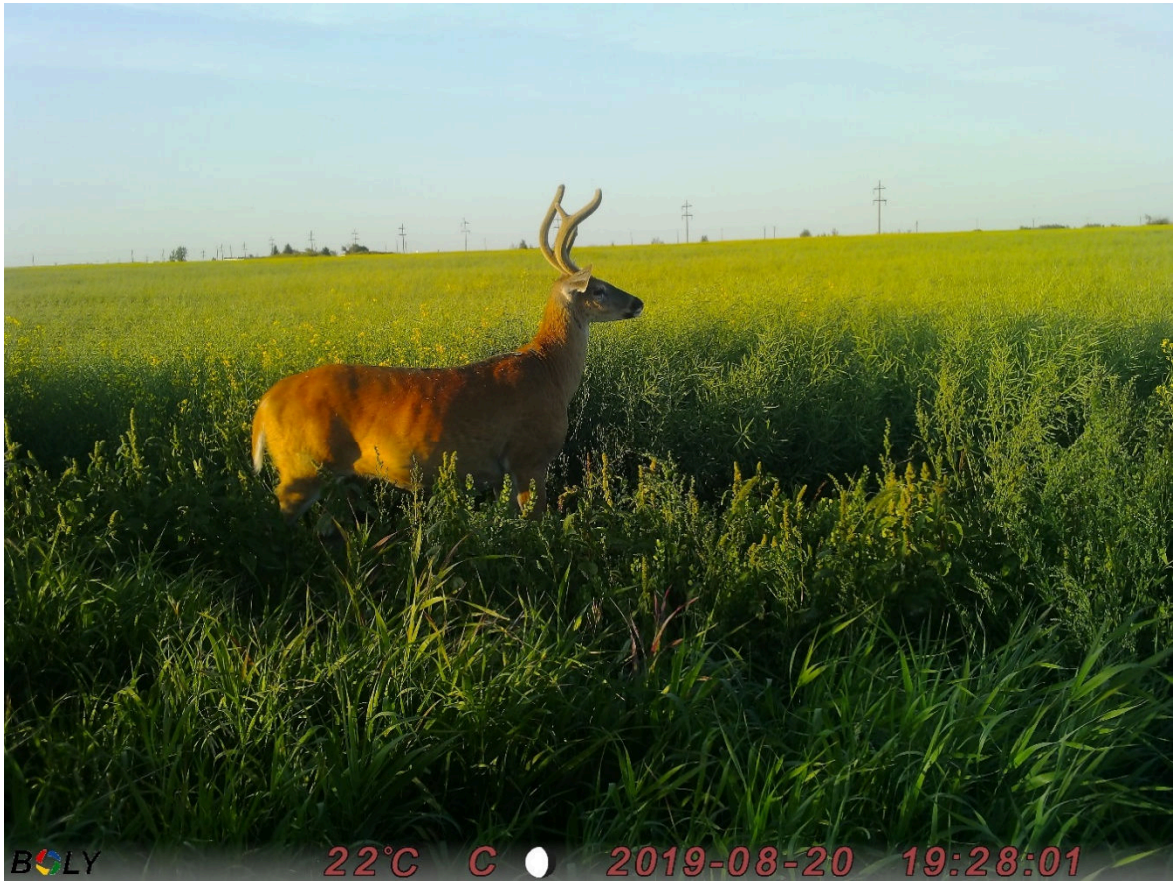


Figure F11. Buck V.

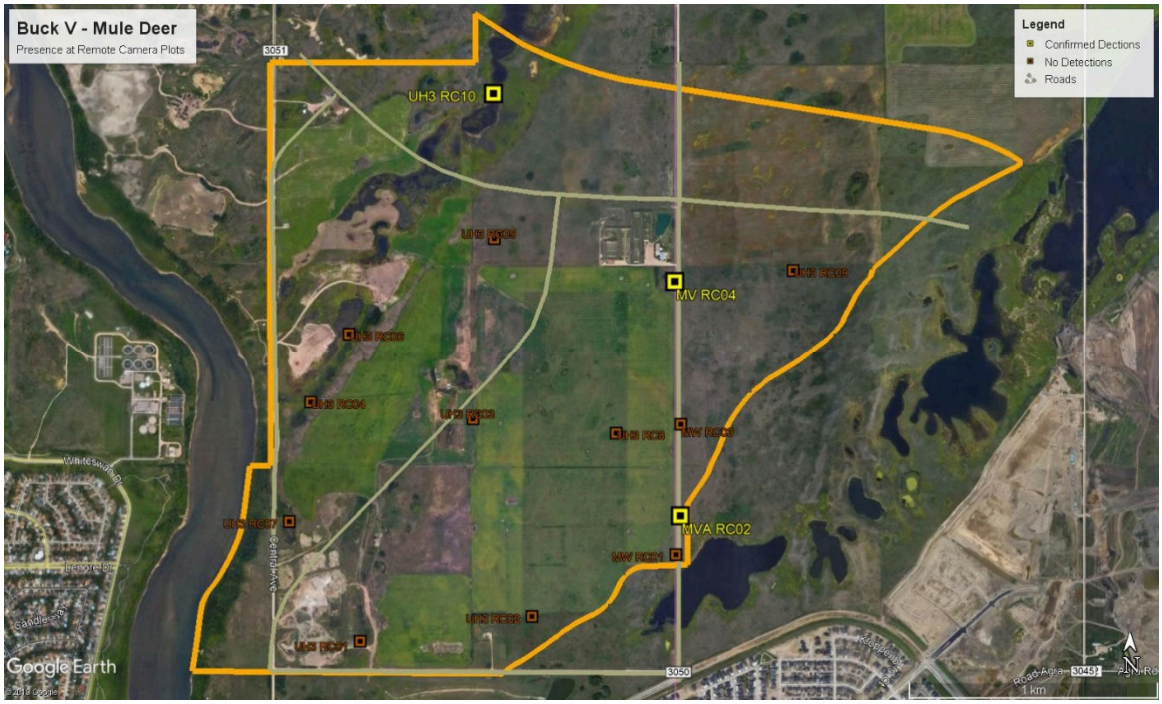
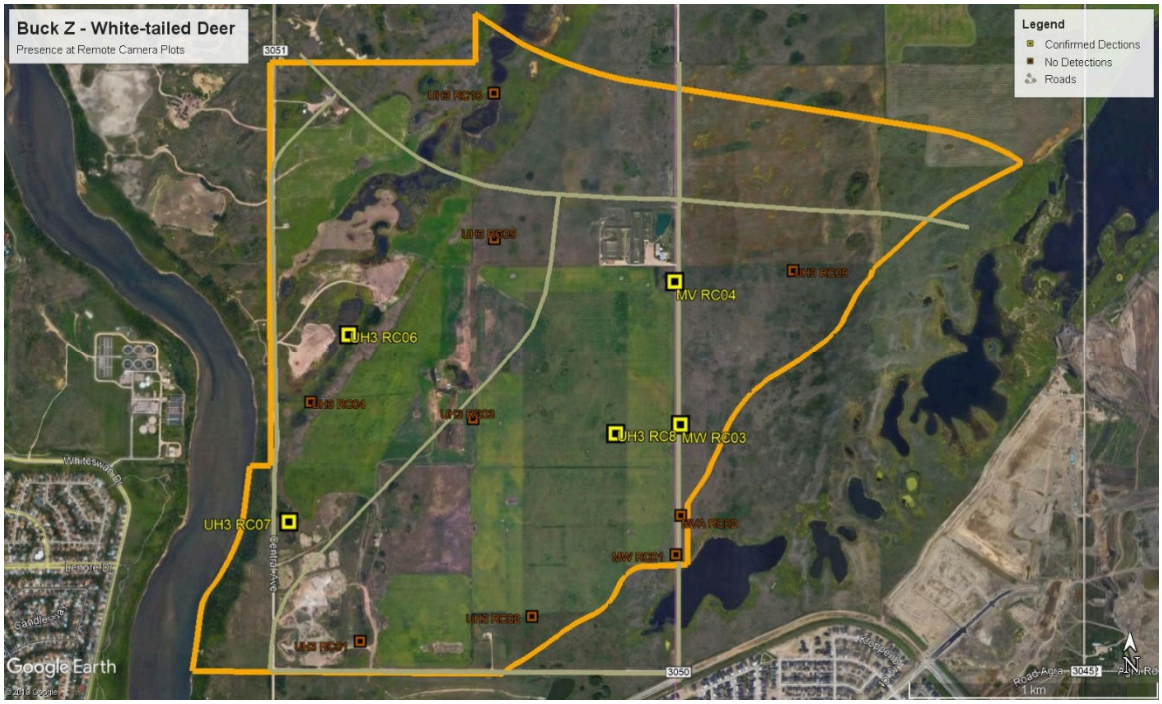


Figure F12. Buck Z.



APPENDIX G. BEST MANAGEMENT PRACTICES FOR THE INTEGRATION WITH DEVELOPMENT AROUND THE RIDDELL PALEONTOLOGICAL SITE

Riddell Paleontological Site

To: Saskatoon Land
Attn. Ms. Nola Stein
201 3rd Avenue North
Saskatoon, SK
S7K 2H7

From: Mr. Mike Markowski
Atlheritage Services Corp.
#150-203 Packham Avenue
Saskatoon, SK
S7N 4K5
o. (306) 242-2822

Date: March 9, 2021

Re.: Best Management Practices for Integration with Development Around the Riddell Paleontological Site

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Riddell Paleontological Site

Very little is known about the Riddell Paleontological Site, aside from Dr. Skwara-Woolf's (Department of Geological Sciences, University of Saskatchewan) permit report based on paleontological exploration and collection at the Riddell Site in 1976 (T.C. Woolf 1977) and a Field Report that was later prepared by Dr. John Storer (previous curator at the Royal Saskatchewan Museum). Based on discussions with Mr. Ryan McKellar (Curator of Invertebrate Paleontology at the Royal Saskatchewan Museum, pers. comm. 2019), the paleontological exploration and collection work completed at the Riddell site was completed before the creation and implementation of *The Heritage Property Act*. Therefore, the requirements for fieldwork, permits and reporting were not yet fixed in their current form.

During the paleontological exploration program at the Riddell Paleontological site in 1976, vertebrate fossils, ocherous wood and shells were found. In addition, 19 taxa of large mammals (3 of which are extinct) from the late Pleistocene epoch (Late Rancholabrean Age) were discovered

in a stratified and cross-bedded sand deposit known as the Riddell Member (T.C. Woolf 1977). Unfortunately, due to the vagueness of past reports, there is no definitive information on what is left of the paleontological site; however, intact components of the Riddell Paleontological Site likely exist. Dr. Storer's Field Report recommended that the site be marked with a sign and considered as a future candidate for designation as Provincial Heritage Property.

Best Management Practices

To determine the best management practices for integration with the development of this Project around the Riddell Paleontological site, the first step was to consult with the Ministry of Parks, Culture and Sport – Heritage Conservation Branch (HCB). The HCB are the regulators for heritage resources, which includes paleontological sites, in Saskatchewan. Since this site was discovered and excavated prior to the implementation of *The Heritage Property Act,* A Heritage Resource Review Referral Form (HRRRF) memorandum was submitted to the HCB for review on May 21, 2019. The HRRRF explained the UH3 Project and its goals for best practices for integration with development around the Riddell site. The HCB reviewed the Project and issued a Heritage Resource Review (HRR) on June 27, 2019 (HCB File No. 19-678). The HRR determined that a paleontological Heritage Resources Impact Assessment (pHRIA) is required to attempt to determine the status, size and location of the site (e.g., the exact LSD location) and level of disturbance (HCB File No. 19-678). Following the successful completion of the pHRIA, recommendations from the fieldwork results will provide the best outcome for the site.

Atlheritage's Recommendations for integration with development around the Riddell Paleontological Site include the following:

- An interpretive trail and walking path: the Riddell Palaeontological Site already acts as a trail head to active informal riverbank trails. One option is to end the existing portion of Central Avenue at Peggy McKercher Conservation Area where a small turnout to park could be placed. The road between the site and Peggy McKercher could then be turned into a walking trail by placing jersey barriers across the road.

- The trail could loop along an upland portion of the Riddell Palaeontological Site and along the wetlands. Interpretive signs would be posted along the trail providing ecological and historical information.

Results and recommendations from the pHRIA should also be taken into consideration to ensure all regulatory approvals are in place.

Closing

If you have any questions, please contact me at your convenience. We are happy to advise on further best management practices. Furthermore, Atlheritage also specializes in tourism initiatives and can assist with interpretation, signage, etc.

Sincerely,

Mike Markowski, B.A. (hon.), M.A.
Heritage Division Manager
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o. 306.242.2822
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