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City of Saskatoon - East Sector Summer Natural Area Screening Study

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REPORT



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1.0 INTRODUCTION

As part of the long-term urban planning objectives, the City of Saskatoon (City) is evaluating a land area on the southeast boundary of the existing City limits. A component of the planning process, amongst other variables, is to identify and evaluate biophysical attributes that may potentially need to be protected, preserved, and/or considered as part of future developments. To initiate the aforementioned, the City retained Stantec Consulting Ltd. (Stantec) in 2010 to conduct the Fall Natural Area Screening Review in order to provide baseline ecological information for the East Sector Plan Study.

Subsequent to the fall survey, the City issued a Request for Proposal (RFP) on July 4, 2011 for work pertaining to the completion of the summer component (second part) of the East Sector Summer Natural Area Screening Study (Project). Golder Associates Ltd. (Golder) was selected to conduct surveys to supplement the Fall Natural Area Screening review conducted by Stantec.

The baseline vegetation and wildlife field surveys conducted in the late fall of 2010 identified 31 quarter sections with habitat types, primarily wetlands, wooded patches, shelterbelts, and remnant native grassland, that may be suitable for or support rare species. Stantec (2010) recommended that further plant and wildlife assessments be conducted during the appropriate time period (e.g., during the active growing and breeding period). In addition to conducting vegetation, wildlife, and habitat surveys/assessments, Golder conducted a wetland classification, as well as water and sediment quality surveys. Water quality measurements (i.e., water temperature, dissolved oxygen [DO], pH, and conductivity) were taken, and water and sediment samples were collected for chemical analysis from representative waterbodies in the Project Area.

For the purpose of this report, all species identified by the Saskatchewan Conservation Data Centre (SKCDC), Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Schedule 1 of the *Species at Risk Act* (SARA) will be referred to as “listed species”. Specific rankings and/or designations for a species was also provided in relevant tables contained within the report.

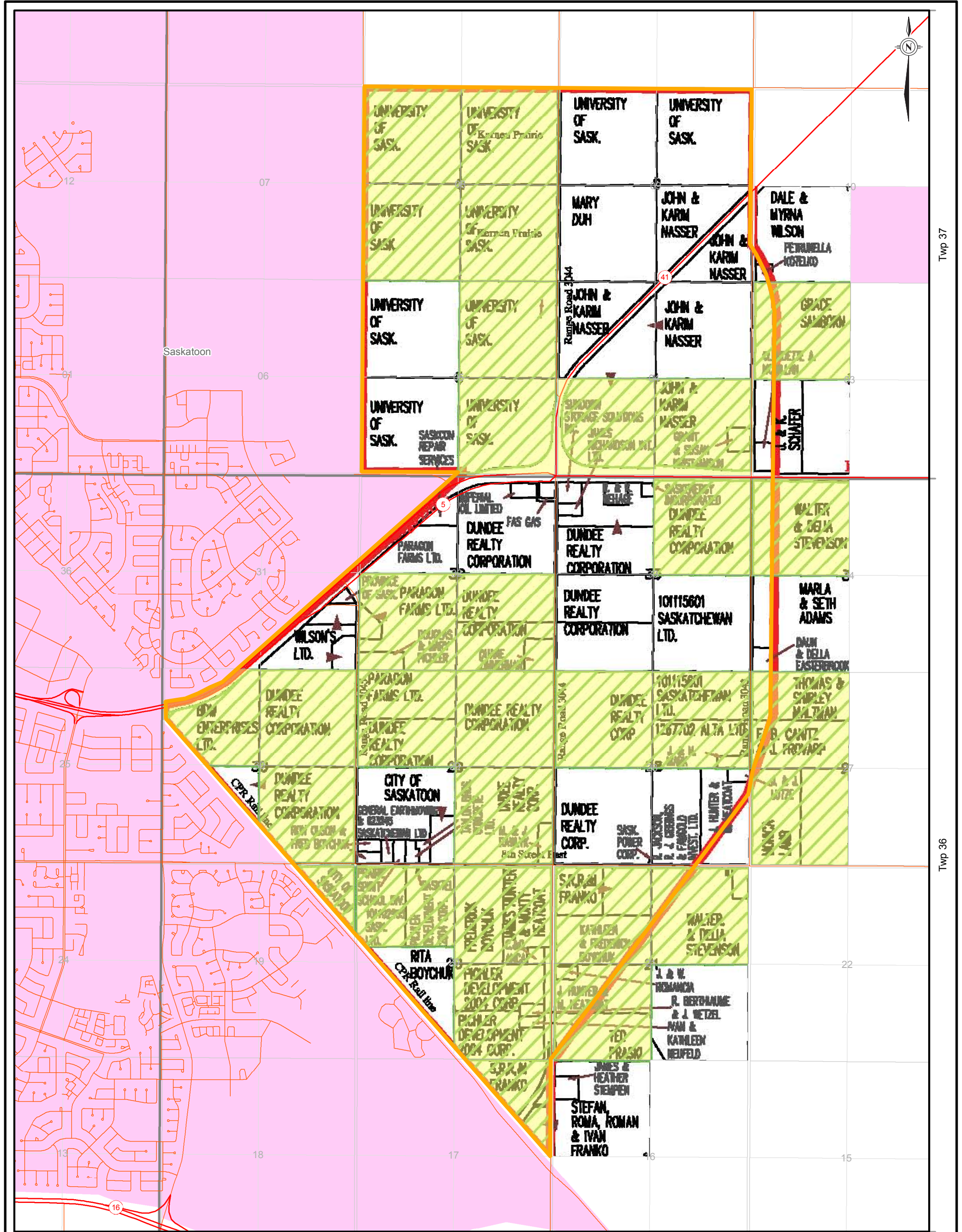
A portion of the Project Area in NE 19-36-4 West of the Third Meridian (W3M) was also identified by the City as requiring further investigation with regards to an archaeological site. Golder contacted the Heritage Conservation Branch regarding this location and further discussion regarding this site is presented in Section 5.0 of this report.

1.1 Study Area

Figure 1 outlines the Study Area and the 31 quarter sections that were identified by Stantec (2010) as requiring additional assessments for listed plant and wildlife species.

2.0 VEGETATION COMMUNITIES AND LISTED PLANT SPECIES

Based on a review of the SKCDC database, Stantec (2010) identified four provincially tracked plant species that were previously documented in the Study Area and designated 500 m buffer. These species, along with species found during the Golder 2011 survey are illustrated in Figure 2 and are listed in Table 1 along with their provincial ranking and preferred habitat types.



Twp 37

Twp 36

Rge 5 W3M

Rge 4 W3M

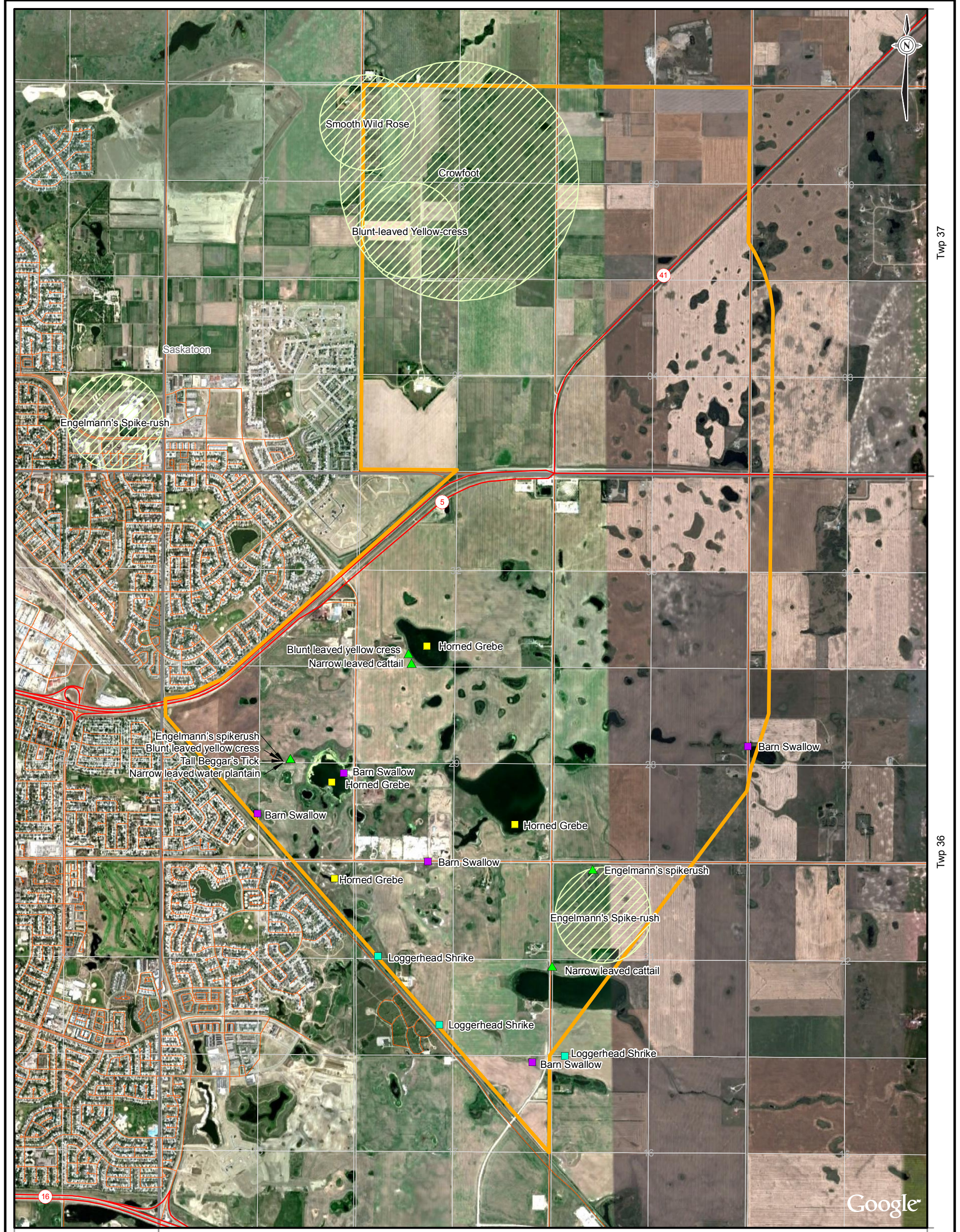
500 0 500
SCALE 1:30,000 METRES

Legend	
	Highway
	Road
	Township/Range Boundary
	Section Boundary
	Quartersection Boundary
	Urban Municipality
	East Sector Boundary
	Spring and Summer Survey Target Area

Reference:
City of Saskaton, Community Services,
Planning and Development Branch, 2011
DMTI Highways and Roads
NAD 83 UTM Zone 13

PROJECT			
CITY OF SASKATON EAST SECTOR NATURAL AREA			
TITLE			
SPRING AND SUMMER VEGETATION AND WILDLIFE SURVEY TARGET AREAS			
PROJECT		11-1361-0051	FILE No.
DESIGN	MK	18/08/11	SCALE AS SHOWN
GIS	MK	18/08/11	REV. 0
CHECK	DW	30/08/11	FIGURE: 1
REVIEW	DW	30/08/11	





Rge 5 W3M

Rge 4 W3M

500 0 500
SCALE 1:30,000 METRES

Note: The size of the polygons for the rare species are based on the location of the observation and its degree of spatial uncertainty

Reference:
Image © 2011 DigitalGlobe; Image © GeoEye
Google Earth Imagery, 2009
Saskatchewan Conservation Data Centre, 2011
DMTI Highways and Roads
NAD 83 UTM Zone 13

Legend		Golder 2011 Observations	
	Highway		Barn Swallow Sighting
	Road		Horned Grebe Sighting
	Township/Range Boundary		Loggerhead Shrike Sighting
	Section Boundary		Rare Plant Location
	Quartersection Boundary		East Sector Boundary
	Historical Rare Plant Occurrence (SKCDC)		

PROJECT	CITY OF SASKATOON EAST SECTOR NATURAL AREA		
TITLE	SENSITIVE PLANT AND WILDLIFE LOCATIONS IN THE STUDY AREA		
	PROJECT	11-1361-0051	FILE No.
	DESIGN		SCALE AS SHOWN
	GIS	MK	23/08/11
	CHECK	DW	30/08/11
	REVIEW	DW	30/08/11
			REV. 0
		FIGURE: 2	



Table 1: Provincially Tracked Plant Species Documented in the Study Area

Common Name	Scientific Name	Provincial Ranking	Preferred Habitat (Harms et al. 1992)
Crowfoot violet	<i>Viola pedatifida</i>	S3	Mesic usually sandy grasslands
Engelmann's spikerush	<i>Eleocharis engelmannii</i>	S2	Drying open slough bottoms and tilled field depressions
Smooth wild rose	<i>Rosa blanda</i>	S1S2	Open riparian deciduous or mixed woods and shrub thickets
Blunt leaved yellow cress	<i>Rorippa curvipes</i> var. <i>truncata</i>	S2S3	Margins of prairie sloughs and moist depressions in cultivated fields

Provincial Rank Definitions

S1 Extremely Rare – 5 or fewer occurrences in Saskatchewan, or very few remaining individuals.

S2 Rare – 6 to 20 occurrences in Saskatchewan, or few remaining individuals.

S3 Rare/Uncommon – 21 to 100 occurrences in Saskatchewan; may be rare and local throughout province or may occur in a restricted provincial range (may be abundant in places).

2.1 Methods

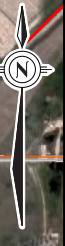
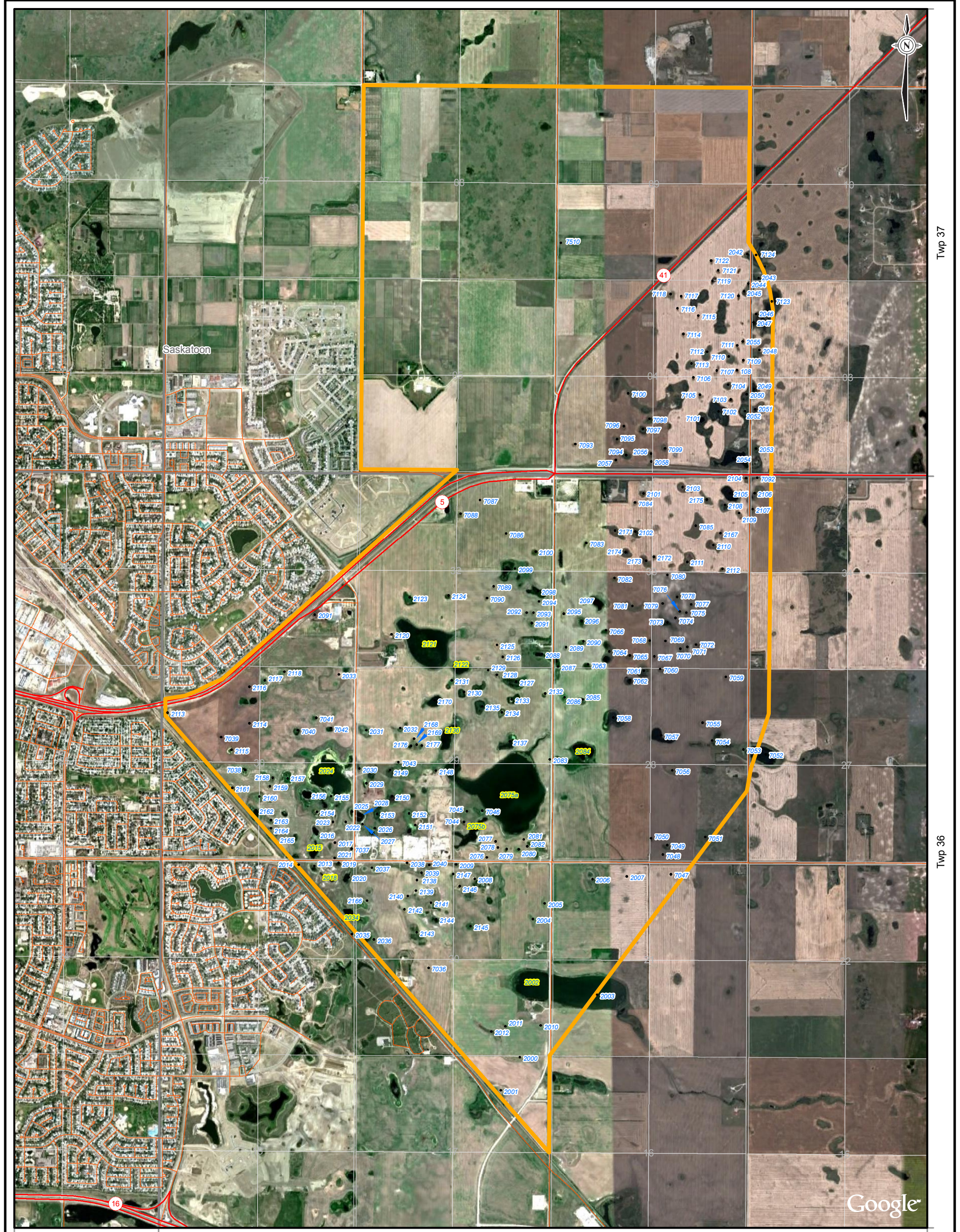
To assess general vegetation community composition and structure, as well as the presence of listed species or occurrence of their preferred habitat, a combination of road-side and pedestrian surveys were conducted in the Study Area on August 3 and 5, 2011, by Beryl Wait (vegetation specialist, Golder). From information provided in the Stantec (2010) report and Google Earth images, representative wetland and terrestrial communities were selected from the 31 quarter sections of the Study Area for the field assessments.

As the Study Area supports mostly agricultural or previously disturbed landscapes, the majority of the native vegetation communities are associated with wetlands, low areas or isolated treed patches and shelter belts. Considering that surface hydrological features are often the only remaining ecological habitat in intensely modified landscapes and because they can be important habitats to both plant and wildlife species, an attempt was made to sample a variety of wetland types (e.g., ephemeral, temporary, seasonal, semi-permanent, and permanent).

The selection of the wetland and type of wetland to be assessed was completed prior to the field survey and was based on the information provided in the Stantec (2010) report and the City provided map “City of Saskatoon Wetland Policy Study” (2009) (Figure 3). For consistency, the wetland ID numbers provided in the Stantec (2010) report were used in this report when referencing specific wetlands.

2.2 Results

The following five provincially tracked plant species were observed during the field surveys: Engelmann's spikerush (*Eleocharis engelmannii*), narrow leaved cattail (*Typha angustifolia*), narrow leaved water plantain (*Alisma gramineum*), blunt leaved yellow cress (*Rorippa curvipes* var. *truncata*), and beggar's tick (*Bidens frondosa*). All the above named plants were located in association with the margins of wetlands and with the exception of narrow leaved cattails, the remaining four were found in the gradually drying mudflat areas around wetlands. The status of each of these species and Golder's 2011 observations within the Study Area are described in Table 2 and their locations are presented in Figure 2.



Twp 37

Twp 36

Google

Rge 5 W3M

Rge 4 W3M



Legend	
	Highway
	Road
	Township/Range Boundary
	Section Boundary
	Quartersection Boundary
	East Sector Boundary
	Wetland
	Aquatics Sampled Wetland

Reference:
 Image © 2011 DigitalGlobe
 Image © GeoEye
 Google Earth Imagery, 2009
 DMTI Highways and Roads
 NAD 83 UTM Zone 13

PROJECT			
CITY OF SASKATOON EAST SECTOR NATURAL AREA			
TITLE			
WETLAND INVENTORY MAP			
PROJECT	11-1361-0051	FILE No.	
DESIGN		SCALE AS SHOWN	REV. 0
GIS	MK	23/08/11	
CHECK	DW	30/08/11	
REVIEW	DW	30/08/11	
			FIGURE: 3



Table 2: Provincially Tracked Plant Species Found in the Study Area during 2011 surveys

Common Name	Scientific Name	Provincial Ranking	Golder 2011 Observations*
Narrow leaved cattail	<i>Typha angustifolia</i>	S1?	Observed in wetland 2003 and wetland 2121.
Narrow leaved water plantain	<i>Alisma gramineum</i>	S3	Located on the drying mudflat at the north end of wetland 2024.
Engelmann's spikerush	<i>Eleocharis engelmannii</i>	S2	Species historically documented in the NW 21-36-4 W3M (SKCDC 2011) was relocated on the north end of wetland 2006. Also located on the drying mudflat at the north end of wetland 2024.
Blunt leaved yellow cress	<i>Rorippa curvipes</i> var. <i>truncata</i>	S2S3	Blunt leaved yellow cress was observed around the south margin of wetland 2121. Also located on the drying mudflat at the north end of wetland 2024.
Tall beggar's tick	<i>Bidens frondosa</i>	S2S3	Located on the drying mudflat at the north end of wetland 2024.

* Coordinates for listed species locations found during the 2011 field surveys are included in Appendix C; wetland Id number corresponds to Stantec (2010).

Representative photographs of wetlands and other habitat assessed during the 2011 survey period can be found in Appendix A. A complete list of plant species observed within the Study Area is presented in Appendix B and the results of the vegetation assessment for each of the 31 quarter sections, with special attention to listed plant species potential, is presented in Appendix C. The legal land locations and associated Global Positioning System (GPS) location for each of the listed plant species observed within the Study Area are also presented at the end of Appendix C.

2.3 Discussion

Narrow Leaved Cattail

Narrow leaved cattail appears to be more common in Saskatchewan than currently documented, particularly on the east side of the province. This is an eastern species that appears to be establishing in wetlands in a gradual westward trend. The provincial S1 ranking means that the species is extremely rare having fewer than five documented locations in the province (SKCDC 2011). The “?” is attached because there are currently taxonomic classification uncertainties regarding this species that have yet to be resolved, making its assigned ranking tentative. According to the Flora of North America (2011) there is also some debate on whether the species should be considered introduced and thus classified as an evasive exotic in North America.

Cattails are prolific producers of light, wind blown seeds and are also vigorous vegetative reproducers from creeping rootstocks. They generally establish well and persist in and around the margins of suitable wetland habitats (i.e., slough, ditches, wetlands, dugouts, and creeks). Narrow leaved cattails differ from common cattail (*Typha latifolia*) in that they are generally taller, a darker green in color, have narrower leaves and longer and narrower seed heads with a distinct separation/gap between female and male flowering structures. However, one of the problems in the identification of the narrow leaved cattail is the occurrence of possible hybrids between it and common cattail, resulting in plants exhibiting characteristics of both species. Where both species are present, narrow leaved cattail tends to be located in areas with deeper standing water than common cattail. The majority of cattails observed around the wetlands in the Study Area were common cattail. In the Study Area, narrow leaved cattail appears to be limited in establishment to small clumps within semi-permanent and permanent wetlands.



Although this species was only observed at two locations within the Study Area, it is likely to occur in other wetlands, both within and outside the Study Area. Wetlands with the most potential to support this species are wetlands with established cattail bands and in particular Class 4 and Class 5 wetlands (Stewart and Kantrud 1971) with more persistent to permanent standing water.

Narrow Leaved Water Plantain

Narrow leaved water plantain is restricted in its North American distribution to the central and eastern plains regions. Its distribution in Saskatchewan marks part of its known northern range.

This species is similar in appearance to common water plantain (*Alisma trivale*, previously *Alisma plantago-aquatica*). However, narrow leaved water plantain, has narrow more linear leaves and the flower head is decumbent (flopped over) rather than erect (standing straight up). The majority of water plantain observed in the Study Area was common water plantain. In the one location where narrow leaved water plantain was observed, common water plantain was also present. Little is known about narrow leaved water plantain's preferred habitat, but is assumed that it is similar to common water plantain. The latter is typically found in the central depressions of Class 2 or Class 3 wetlands (Stewart and Kantrud 1971), where water is very shallow or dries into exposed mud flats. However, the species is also found around the drying mud margins or very shallow standing water areas of Class 4 or Class 5 wetlands. Suitable habitat for plantain species is present around several wetlands both within and outside the Study Area. It appears that the plant either establishes only occasionally or is frequently over looked due to similarity in appearance to a commonly occurring species.

Engelmann's Spikerush

The habitat for this annual species is described as fresh shores, marshes, and disturbed places (Flora of North America) or as drying open slough bottoms and tilled field depressions (Harms et al. 1992). Spike rushes, like many sedge species, are a difficult group of plants to identify at a field level or because correct identification is often determined by characteristics that can only be observed under a microscope. As such, the distribution of less common species within this group of plants could be under estimated due to limited collection and proper identification. Its limited occurrence could also be attributed to site specific growing conditions required on an annual basis or that suitable growing conditions for this species are found around the transitional margins of wetland depressions which, depending upon annual water levels, are usually tilled or cultivated during seeding. According to the Flora of North America (2011), this species is documented in most states (except the eastern seaboard) and most provinces along the 49th parallel. However, in Saskatchewan and a few central States, its distribution has not been confirmed. As such the, documented occurrences of this species in the province is very limited to 12 locals (Harms et al. 1992) and the lack of documentation in provinces/territories and northern states could indicate the documented locations of this species are isolated outliers along its northern most distribution.

Blunt Leaved Yellow Cress

Blunt leaved yellow cress is a widespread annual species found in western and central North America with its occurrence in the province representing part of its northern distribution. This plant is short-lived and found in terrestrial or wet, but not submerged habitat. This species can be found along muddy shores of lakes and wetlands, stream beds and banks, edges of cultivated fields, wet roadside, meadows, seepage areas, ditches, creeks, and gravel bars.



Factors that may influence blunt leaved yellow cress occurrence could be either their site dependent growing conditions that may change on an annual basis or suitable growing conditions for this species may often occurs in an area, that for the most part, is typically cultivated in most fields. This small non-descript weedy species is also likely and easily overlooked.

Like several annuals, this species may be more abundant in some years than others, and located in an area one year and not the next if conditions are unsuitable. This species likely occurs around the uncultivated margins of other wetlands in the Study Area; however, location and abundance from year to year could be highly unpredictable.

Tall Beggar's Tick

Tall beggar's tick is a widespread species in North America with the Canadian provinces demarking the northern extent of its range. This annual species can be found in a variety of habitats including moist woods, meadows, thickets, fields, roadsides, railroads, borders of streams, wetlands, sloughs, swamps, and ditches.

Although this species was only found at one location, it likely occurs sporadically throughout the Study Area, depending on site-specific conditions and advantageous annual establishment. The conditions preferred by this species are often already occupied by highly competitive perennial plant species. As an annual, suitable seed establishment sites may be limited in established plant communities.

2.4 Summary

During the 2011 survey, no rare or endangered plants, as defined by SARA and COSEWIC, were observed. In regards to the five provincially tracked species that were identified, their present habitats are typically associated with wetlands and wetland margins (e.g., wetland 2024). These habitat types in the Study Area are not limited in the region. Nonetheless, wetlands and their margins are under continuous pressure by development and agricultural practices that influence the features directly and indirectly by altering surface flow (recharge) to the basins and/or create isolation between basins.

3.0 WILDLIFE AND WILDLIFE HABITAT ASSESSMENT

A previous assessment conducted by Stantec (2010) identified 31 quarter sections that contained habitat that could potentially support a number of wildlife species, including listed species.

3.1 Methods

A search of the SKCDC (2011) database was conducted to determine if listed wildlife species were known to occur within in the Study Area. From information provided in the Stantec (2010) report, coupled with Google Earth images, representative habitat types that could support listed wildlife species within the 31 quarters were selected for a field assessment.

Surveys consisted of roadside and pedestrian observations, with wetland and surrounding terrestrial habitat scanned with the aid of binoculars and a spotting scope when required. Don Weidl (wildlife specialist, Golder) and Terry Hams (ecologist, Golder) conducted the surveys during the mornings of July 13, July 31, August 3, and August 17, 2011. A late evening survey was conducted by Don Weidl on August 8, 2011 to assess the area for species that are more active or exhibit crepuscular or nocturnal habits (e.g., common nighthawk [*Chordeiles minor*] and yellow rail [*Coturnicops noveboracensis*]).



Direct observations of species, as well as their detection sign (e.g., tracks, dens, burrows, burrow plugs, nests, feeding cavities, beds, scat/pellets, digs, and browse scars) were documented and recorded. Significant sightings such as listed species were marked using GPS coordinates.

3.2 Results

The search of the SKCDC (2011) database indicated one wildlife species adjacent to the Study Area. A historical record of a loggerhead shrike (*Lanius ludovicianus excubitorides*) was identified in the SE 4-36-4 W3M, approximately 2.4 km south of the Study Area. However, the SKCDC data does not identify whether this observation was a nest or sighting, and does not give the date or year of the observation.

Of the nine listed wildlife species that were identified as potentially occurring in the Study Area (Stantec 2010), loggerhead shrike and horned grebe (*Podiceps auritus*) were observed during the 2011 surveys conducted by Golder. Since the completion of the Stantec (2010) field work, the barn swallow (*Hirundo rustica*) has been identified by COSEWIC as a threatened species. Barn swallows were also identified within the Study Area during the 2011 surveys. Table 3 describes the ranking, habitat preference and occurrence of the ten potential species, with specific information regarding the three species observed in 2011. The locations of the three listed species that were observed within the Study Area are shown in Figure 2.

Sixty-one wetlands within the 31 quarter sections, as well as the Kernan Prairie in E½ 8-37-4 W3M, were surveyed for wildlife and wildlife sign (Appendix C). Sixty-three species of birds, two species of mammals (muskrat [*Ondatra zibethicus*] and thirteen-lined ground squirrel [*Spermophilus tridecemlineatus*]), one reptile (western plains garter snake [*Thamnophis radix*]), and one amphibian (wood frog [*Rana sylvatica*]) were observed or heard during the surveys (Appendix D). The most common species recorded within the Study Area were American coot (*Fulica americana*) and red-winged blackbird (*Agelaius phoeniceus*), observed at 53% and 33% of the wetlands respectively.

3.3 Discussion

Although only three listed wildlife species were observed within the Study Area during the 2011 field survey, as described in Table 3, suitable habitat is present that could support other listed wildlife species depending on weather conditions and year to year habitat changes.

Loggerhead Shrike

The pair of loggerhead shrike located near the southeast boundary of the Study Area, likely relies on the east-west shelterbelt that consisted of Siberian elm (*Ulmus pumila*) and Manitoba maple (*Acer negundo*) as nesting habitat and the surrounding land for hunting. Loggerhead shrikes may also be taking advantage of house sparrows (*Passer domesticus*), which are associated with farmyards and houses on the east side of the City limits, as a prey source. This especially may be the case where residents have erected purple martin (*Progne subis*) houses that often attract house sparrows. Loggerhead shrike numbers have dwindled in the Saskatoon area over the past 35 years, which makes this nesting pair of special interest. Although nesting and foraging habitat is present at Kernan Prairie, no loggerhead shrikes were observed in this area during the 2011 survey. The activity restriction guidelines for development near an occupied loggerhead shrike nest are 400 m between May 1 and August 15 (Saskatchewan Environment [SE] 2003).



Table 3: Federal and Provincial Listed Wildlife Species that Could Occur or were Observed Within the Study Area

Common Name	Scientific Name	National Status ^(a)	Provincial Status ^(b)	Habitat	Occurrence rating and Golder 2011 observations in the Study Area*
Loggerhead Shrike	<i>Lanius ludovicianus excubitorides</i>	Threatened	S4B	Loggerhead shrikes prefer open areas with scattered shrubby growth. They can be found in open country, savannah, and desert scrub (Godfrey 1986). They typically breed in shelterbelts and willow-ringed wetlands on the prairies (Smith 1996). In the Saskatoon area, they are partial to farmyards, shelterbelts, and rural cemeteries, favouring caraganas or Manitoba maples as nest sites (Nature Saskatchewan 2002).	Moderate to High - potential habitat in the Study Area is limited to planted hedgerows and tall shrub areas. A pair with two fledged young was observed on the southeast edge of the Study Area. Single adults were also observed along the southwest perimeter of the Study Area near the Hillcrest Cemetery.
Barn Swallow	<i>Hirundo rustica</i>	Threatened	S5B S5M	During the breeding season, this species prefers to be in the vicinity of water for drinking, foraging, and providing mud for nest building.	High - suitable foraging and nesting habitat is found throughout the Study Area. In the City, barn swallows have been frequently observed in newer neighbourhoods (5 to 10 years old) when they appear to have available forage and find suitable nesting structures in covered, raised decks and below irregular protected roof lines of new homes (M. Ealey, pers. comm. 2011). Although a search for nests was not conducted during the 2011 surveys, barn swallows were observed at wetland 2024, 7052, 2000, and 2162 and over the City Yard.
Common Nighthawk	<i>Chordeiles minor</i>	Threatened	S5B S5M	This species forages in the air over cities or open country. They roost in trees in open woodlands, fence posts in open areas, or on the ground. Nests on the ground in woodland openings and clearings, natural open areas, burnt lands, (Godfrey 1986; Smith 1996).	Moderate - foraging and nesting habitat is present within the Study Area, especially in E½ 8-37-4 W3M. Although this species was not recorded in the Study Area during the 2011 surveys, common nighthawks were reported over the south side of Saskatoon during the 2011 breeding season (D. Weidl, pers. comm. 2011) and likely could use segments of the Study Area for foraging or nesting.



Table 3: Federal and Provincial Listed Wildlife Species that Could Occur or were Observed Within the Study Area (continued)

Common Name	Scientific Name	National Status ^(a)	Provincial Status ^(b)	Habitat	Occurrence rating and Golder 2011 observations in the Study Area*
Horned Grebe	<i>Podiceps auritus</i>	Special Concern	S5B	This species prefers small waterbodies (slough, wetlands, and dugout) with extensive marshy areas.	Moderate to High - suitable habitat for this species is present in the Study Area. Individual horned grebes were observed at four locations: wetland 2121, 2018, 2075, and 2024.
Short-eared Owl	<i>Asio flammeus</i>	Special Concern	S3B S2N	Short-eared owls typically prefer open grassland and hayland. Potential nesting and foraging habitat for short-eared owls is in the low areas containing native vegetation or grassy wetland margins (Godfrey 1986; Smith 1996).	Low to Moderate - potential habitat is present in the Study Area, but is limited to haylands, draws and patches of native grassland. No short-eared owls were identified during the 2011 surveys; however, habitat within the E½ 8-37-4 W3M (Kernen Prairie) would be considered suitable to support this species. This species has been recorded as nesting at Kernen Prairie in the 1960s (Nature Saskatchewan 2002).
Yellow Rail	<i>Coturnicops noveboracensis</i>	Special Concern	S3B S2M	Typically found nesting in marshes dominated by sedges, grasses, and rushes where there is little or no standing water (generally 0.0 cm to 12.0 cm water depth) and where the substrate remains saturated throughout the summer (Smith 1996).	Moderate - suitable habitat is present in the Study Area; however, this species was not observed or heard during the 2011 surveys. According to Nature Saskatchewan (2002), the closest known nesting areas include Pike Lake, Porter Lake, and North End Slough at Blackstrap Reservoir.
Olive-sided Flycatcher	<i>Contopus borealis</i>	Threatened	S4	Nesting habitat includes many forest types; mixed age stands with openings and tall snags are much preferred to homogeneous forests (Smith 1996).	Low to Moderate - this species is a spring and fall migrant through the Study Area. Olive-sided flycatchers are often observed within City limits during migration (D. Weidl, pers. comm. 2011), however, due to the timing of the 2011 survey, this species was not observed in the Study Area.
Rusty Blackbird	<i>Euphagnus carolinus</i>	Special Concern	S4B	Rusty blackbirds typically prefer wet woods and tall shrubbery around pools of water (Godfrey 1986). It is a fairly common resident of the bogs and fens of the north, and nests in trees generally near standing water (Godfrey 1986; Smith 1996).	Low - species is a transient or winter visitant for the Study Area. This species was not seen during the 2011 surveys; however, timing of these surveys would be considered to be too early to observe any fall migrants or winter visitants.



Table 3: Federal and Provincial Listed Wildlife Species that Could Occur or were Observed Within the Study Area (continued)

Common Name	Scientific Name	National Status ^(a)	Provincial Status ^(b)	Habitat	Occurrence rating and Golder 2011 observations in the Study Area*
Northern Leopard Frog	<i>Rana pipiens</i>	Special Concern	S3	The northern leopard frog requires a mosaic of habitat types to meet the life stages and inhabits scattered, permanent, small water bodies with emergent vegetation in the spring for breeding, and over-wintering, and moves out to the permanent wet areas, which may be adjacent to the breeding sites in summer (AFW 1991; ASRD 2003).	Low to Moderate - potential habitat (i.e., permanent, clear wetlands and watercourses) is limited in the Study Area. Northern leopard frogs have previously been documented within the South Saskatchewan River within the City D. Weidl, pers. comm. 2011).

Bold = species observed within the Study Area during the Golder 2011 surveys.

^(a) COSEWIC (2011).

^(b) SKCDC (2011).

*Coordinates for listed species locations found in Appendix C.

AFW = Alberta Fish and Wildlife; ASRD = Alberta Sustainable Resource Development.

Provincial Rank Definitions

S1 Extremely Rare – 5 or fewer occurrences in Saskatchewan, or very few remaining individuals.

S2 Rare – 6 to 20 occurrences in Saskatchewan or few remaining individuals.

S3 Rare/Uncommon – 21 to 100 occurrences in Saskatchewan; may be rare and local throughout province or may occur in a restricted provincial range (may be abundant in places).

S4 Common – more than 100 occurrences; generally widespread and abundant, but may be rare in parts of its range.

S5 Very Common – more than 100 occurrences wide spread and abundant, but may be rare in parts or its range.

SH – Historically known from Saskatchewan, but not verified recently (typically not recorded in the province in the last 20 years. Suitable habitat is thought to be still present in the province and there is reasonable expectation that the species may be rediscovered.

B – for a migratory species, rank applies to the breeding population in the province.

M – for a migratory species, rank applies to the transient population in the province.

N – for a migratory species, rank applies to the non-breeding population in the province.



Horned Grebe

Horned grebes were found at four wetland locations, but likely are present on several other wetlands in the Study Area. One of the wetlands was a Class 3 (Stewart and Kantrud 1971) and the other three were Class 5. The wetland classification system used is described in more detail in the following section and in Appendix E. Horned grebe numbers continue to decline, possibly due to the loss of suitable habitat through drainage of sloughs (Nature Saskatchewan 2002). Saskatchewan activity restriction guidelines recommend a 200 m set-back distance for horned grebe nests between May 15 and July 15 (SE 2003).

Barn Swallow

The barn swallow was added to the threatened list by COSEWIC in May 2011, and although the eastern Canadian populations have drastically declined, populations in western Canada have not seen the same impacts. However, the magnitude and geographic extent of the decline are cause for conservation concern (COSEWIC 2011). At this time, there are no recommendations for activity set-back distances for barn swallow nests.

3.4 Summary

Typically, wetland habitats that consist of greater structural heterogeneity will support a wider variety of wildlife species, as more ecological niches are available, and therefore have a higher relative importance or “value” (Waple 1999). Parameters of the basin size and structure, and hydrological regime of each wetland dictate the types of vegetation communities and habitat associations, and ultimately which wildlife species they will support (Environment Canada 2000).

During the wetland surveys, the largest number of species observed was at the 2024 Class 5 wetland (Stewart and Kantrud 1971) with 25 species. The 2121 and 2075 Class 5 wetlands had 21 and 20 species observed respectively. These wetlands provide habitat and food for breeding and staging waterbirds such as grebes, Canada geese (*Branta canadensis*), diving and dabbling ducks, coots, terns and gulls. Several broods of ducks, coots and grebes were observed on most wetlands in the Study Area. Although time and effort during the surveys likely has an influence on the number of species observed, species diversity was much higher at Class 5 wetlands than other wetland classes. For example, as noted above, wetland 2024, had a diverse number of species including three species of grebes, one species of heron, seven species of ducks, four wading birds, two gull/tern species, one nonpasserine (nonperching) species, and four passerine (perching) birds.

The five larger waterbodies in the Study Area, 2024, 2121, 2075, 2002 and 2003, support a diverse number of wildlife species and although they are not connected by waterways, it is likely that wildlife, especially birds, rely on their close proximity to each other. If birds are disturbed off one of these waterbodies by human activity or predators, escape cover in adjoining waterbodies is very close. Although not observed during the 2011 survey, a wildlife corridor could be present between wetlands 2075 and 2024, a distance of approximately 800 m with several Class 1 wetlands (Stewart and Kantrud 1971) providing limited cover for wildlife.

As part of a more detailed Neighbourhood Concept Plan process, it would be valuable to conduct further surveys at the five waterbodies listed above. These surveys could concentrate on detailed spring and fall staging waterbird use, as well as more detailed breeding waterbird information. In addition, confirmation of the loggerhead shrike nest in NW 16-36-4 W3M and continued listed species searches at the Kernan Prairie for this species as well as other listed wildlife species could provide valuable information in the preparation of the Neighbourhood Concept Plan. On going consultation with the University of Saskatchewan is recommended to incorporate wildlife and plant assessments conducted by their staff and students into the planning process.



4.0 WETLAND CLASSIFICATION AND WATER QUALITY

4.1 Watercourses and Wetlands

An external drainage is a local water run or channel connecting internal drainage basins or depressions. No external drainages were observed in the Study Area; however, due to high water levels, wetlands 2121 and 2122, as well as two basins of 2075, were connected through low, water-filled depressions. Where not impacted by structural disturbances (i.e., railroad tracks, roads), slopes surrounding the wetlands were flat to moderate, characteristic of the flat to moderately rolling topography throughout the Study Area.

Based on a review of Google Earth images and vegetation information gathered during the 2011 field surveys, the 61 wetlands that were assessed were classified as per Stewart and Kantrud (1971) wetland classification methods (see Appendix E). Using this method, a permanency class is determined based on the distributional pattern of vegetation zones occupying greater than five percent of the wetland and occurring in the central or deeper part of the wetland area being classified. These permanency classes range from ephemeral to permanent and include both alkali and fen wetlands and lakes. The classification assigned to each of the wetlands visited is presented in Appendix E with the Class distribution as follows: Class 1 = 12, Class 2 = 18, Class 3 = 7, Class 4 = 11, and Class 5 = 13.

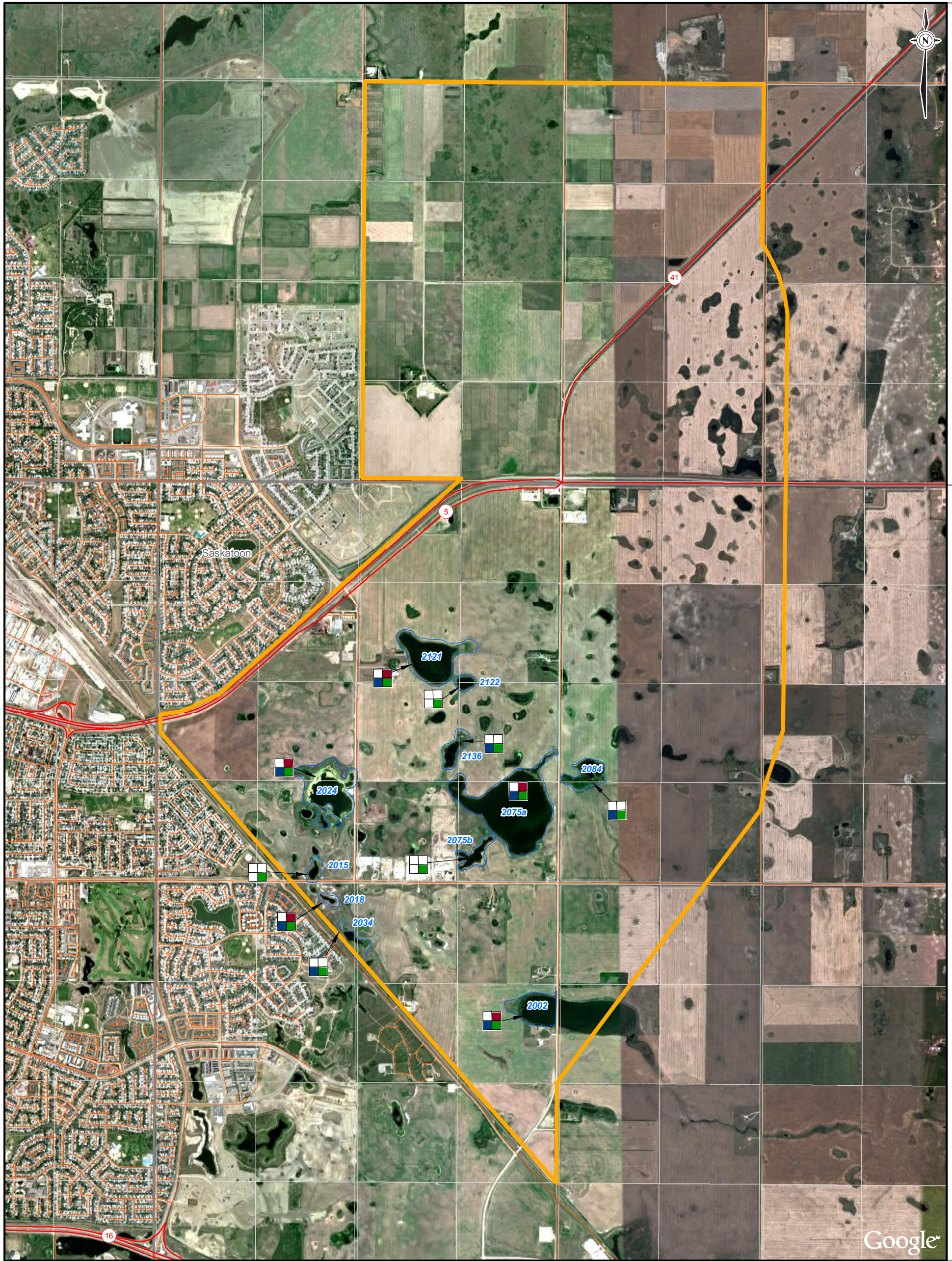
The majority of wetlands present in the Study Area vary from shallow basins that support surface water on a temporary basis in cultivated fields or hayfields, to permanent open water sloughs with well developed emergent vegetation communities dominated by cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.).

A wetland classification survey to investigate and document wetlands with water surface areas in excess of 1.0 hectares in size and associated surface hydrological features occurring in the Study Area was completed on selected waterbodies August 3 to 5, 2011, by Francine Audy (aquatic biologist, Golder) and Jamie Sparrow (ecologist, Golder). In addition, these wetlands were characterized according to their surrounding slope and catchment characteristics.

All of the eleven wetlands that were sampled for hydrological features (Figure 4) were considered permanent wetlands, characterized by dominant vegetation species as duckweed (*Lemna* spp.), and pondweed, bulrushes, and cattails. These wetlands supported open water with scattered diffuse open stands of emergent cover or central expanses of open water surrounded by peripheral bands of emergent cover.

4.2 Water and Sediment Quality

Golder originally proposed water and sediment quality sampling of the eleven largest waterbodies within the Project Area boundary. However, at the client's request (T. Fusco, pers. comm. 2011a), the list of waterbodies selected for water and sediment quality sampling was modified to move the focus of the sampling to waterbodies located in the area of Section 29. This area is part of Phase 1 of the Project. Eleven wetlands in this area were assessed (Table 4) between August 3 and 5, 2011.



Twp 37

Twp 36

Rge 5 W3M

Rge 4 W3M

500 0 500
SCALE 1:30,000 METRES

Reference:
Image © 2011 DigitalGlobe
Image © GeoEye
Google Earth Imagery, 2009
DMTI Highways and Roads
NAD 83 UTM Zone 13

Note: Estimated August 2011 shoreline boundaries were expanded from the Google Earth background coverage (current 2009) due to high water levels during field programme.

Legend

- Highway
- Road
- Township/Range Boundary
- Section Boundary
- Quartersection Boundary
- East Sector Boundary
- Sampled Wetland
- Water Sample
- Sediment
- Water Quality
- Limnology/Depth

PROJECT	CITY OF SASKATOON EAST SECTOR NATURAL AREA		
TITLE	AQUATICS INVENTORY MAP		
	PROJECT	11-1361-0051	FILE No.
	DESIGN	MK	18/08/11
	CHECK	DW	30/08/11
	REVIEW	DW	30/08/11
	FIGURE: 4		SCALE AS SHOWN REV. 0

Golder Associates
Saskatoon, Saskatchewan



Table 4: Revised List of Waterbodies Selected for Water Depth, Limnology, and Water and Sediment Quality Sampling

City of Saskatoon Wetland Number	Estimated Surface Area ^(a) (hectares)	Water Depth ^(b) (m)	Limnology and Depth	Water Chemistry	Sediment Chemistry
2002	8.63	1.8	yes	yes	yes
2015	2.11	1.25	yes	-	-
2018	1.26	1.4	yes	yes	yes
2024	16.88	1.9	yes	yes	yes
2034	5.02	1.0	yes	yes	-
2075a	34.58	2.0	yes	yes	yes
2075b	4.08	1.6	yes	-	-
2084	5.97	0.7	yes	yes	-
2121	15.71	1.6	yes	yes	yes
2122	1.87	1.8	yes	-	-
2136	3.95	2.1	yes	yes	-

^(a) Estimated August 2011 shoreline boundaries were expanded from the Google Earth background coverage (current to 2009) due to high water levels during the 2011 field program.

^(b) As measured during August 2011 field survey.

- = not applicable.

4.3 Methods

Limnology measurements (i.e., water temperature, DO, pH, and specific conductivity) were collected using a YSI 600QS-O-M sonde, at the deepest location in each wetland. The YSI was calibrated according to manufacturer directions. Water depth was initially assessed using a hand-held depth sounder, and the value was confirmed using a weighted line at the end of the sampling session. Limnology measurements were measured at each 0.5 m of depth, from the water surface to the wetland bottom. Secchi depth was measured on the shaded side of the canoe, without sunglasses on which otherwise could lead to inaccurate reading.

Surface grab water samples were collected approximately 30 cm below the water surface, using a triple rinsed 4 litres jug. Preservatives were added to the water samples when required for laboratory analysis purposes. For parameters requiring field filtration, the water samples were filtered at Golder's office using a filtering tower in association with a geo-pump, and a sterile, 47 mm diameter, 0.45 µm mesh filter. Appropriate preservatives were added to the filtered samples. For chlorophyll-a, water was processed as above, but the filters were retained, wrapped in aluminum foil, identified, and frozen. Water samples and filters for chlorophyll-a analysis were submitted to Saskatchewan Research Council Environmental Analytical Laboratories for chemical analysis of conventional parameters, major ions, and nutrients. Data quality was assessed using the results of a field duplicate and a field blank samples. A duplicate sample is a sample of water used to check the precision of the analytical results. A field blank is a set of bottles filled with de-ionized water in the field. This set of samples was treated the same as the actual samples (i.e., filter when required, add preservative when required).



Sediment samples were collected using a standard Ekman grab (0.0232 m²). The Ekman sampler (jaw opened) was rinsed twice with ambient water prior to sampling, to ensure no sediment or other material was attached. Each sediment sample was placed into an individual unlabelled polyethylene bag. The sample was then double bagged and a waterproof paper label was inserted between the bags. The outer bag was labelled with a waterproof label. Sediment samples were submitted to ALS Environmental for chemical analysis of metals and mercury in the sediments. A duplicate sediment sample was also submitted to the laboratory in order to assess data analysis quality.

Chain-of custody (COC) forms were completed to track each sample during shipment. The COC forms accompanied the water and sediment samples to their respective laboratories.

Fish presence/absence surveys were not carried out, since the deepest wetland of those sampled was only 2.1 m deep, much less than the minimum depth required for overwinter fish survival in central Saskatchewan.

4.4 Results

Eleven wetlands were assessed for limnology. Eight wetlands were assessed for water quality (plus a duplicate and a field blank). Five wetlands were assessed for sediment quality (plus a duplicate). Location (UTM coordinates) of all sampling stations are presented in Table 5.

Table 5: Sampling Locations in City of Saskatoon East Sector, August 3 to 5, 2011

Station Name	UTM Coordinates (NAD 83, Zone 13)	
	Easting	Northing
2002*	395250	5773877
2015	393442	5775042
2018	393588	5774779
2024	393575	5775588
2034	393723	5774489
2075a	395160	5775469
2075b	394711	5775104
2084	395687	5775833
2121	394486	5776612
2122	394675	5776532
2136	394580	5775982

* Duplicate taken.

4.4.1 Limnology

Limnology was measured at 11 selected wetlands (Figure 4; Appendix F, Table F-1). Most measured surface water parameters were highly variable (Table 6). DO values ranged from 4.8 to 17.0 milligram per litre (mg/L). DO levels tended to increase as maximum water depth increased in sampled wetlands (Figure 5). However, no similar relationship was observed between increasing surface area (hectares) and DO levels in the same wetlands. Water temperatures measured during the sampling period were relatively warm and ranged from 19.4°C to 25.2°C. Specific conductivity ranged from 660 to 2,879 microSiemens per centimetre (µS/cm); pH ranged from 8.4 to 10.0.



Table 6: Summary of Surface Limnology Measurements for Sampled Wetlands, City of Saskatoon East Sector, August 3 to 5, 2011

Waterbody	Secchi Depth (m)	Max Depth (m)	Dissolved Oxygen (mg/L)	Water Temperature (°C)	Specific Conductivity (µS/cm)	pH
2002	1.4	1.8	11.3	22.3	861	9.0
2015	1.25	1.25	9.1	22.5	1,693	8.7
2018	1.0	1.4	4.9	19.4	2,879	8.5
2024	0.7	1.9	11.0	21.9	1,629	8.7
2034	1.0	1.0	6.6	21.5	1,722	8.4
2075b	1.6	1.6	12.3	24.7	1,528	9.1
2075a	0.75	2.0	17.0	25.2	1,206	9.7
2084	0.25	0.7	4.8	19.5	1,481	8.9
2121	1.6	1.6	10.5	21.4	660	10.0
2122	1.8	1.8	11.8	21.4	739	9.4
2136	0.4	2.1	12.9	24.9	1,434	8.6

m = metre; mg/L = milligrams per litre; °C = degrees Celsius; µS/cm = microSiemens per centimetre.

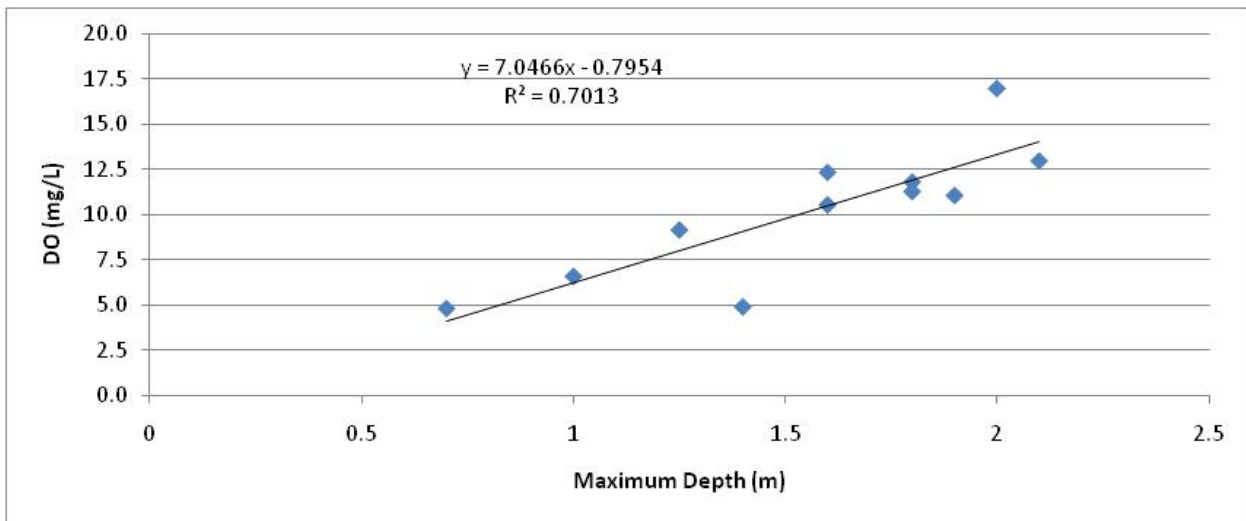


Figure 5: Relationship Between Dissolved Oxygen Levels and Maximum Depth in Selected Wetlands, Saskatoon, August 3 to 5, 2011

Limnology profiles were also measured for the 11 sampled wetlands (Figure 6). Maximum water depth ranged from 0.7 m (Figure 6h, wetland 2084) to 2.1 m (Figure 6k, wetland 2136). Secchi depth ranged from 0.25 m (less than half the wetland depth; Figure 6h, wetland 2084) to 1.8 m (the bottom of the wetland; Figure 6j, wetland 2122).

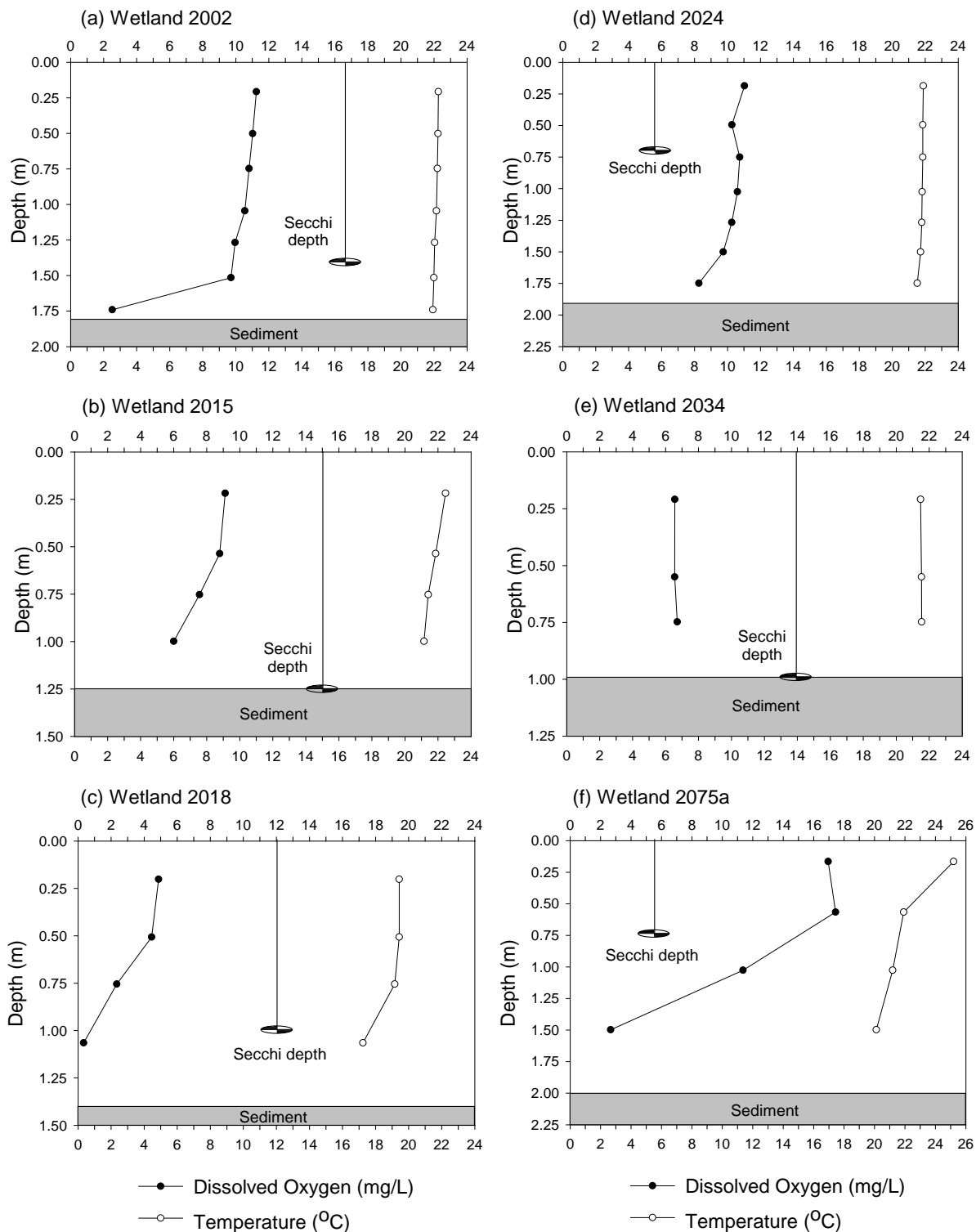


Figure 6: Temperature and Dissolved Oxygen Profiles, and Secchi Depth for Selected Wetlands, Saskatoon, August 3 to 5, 2011

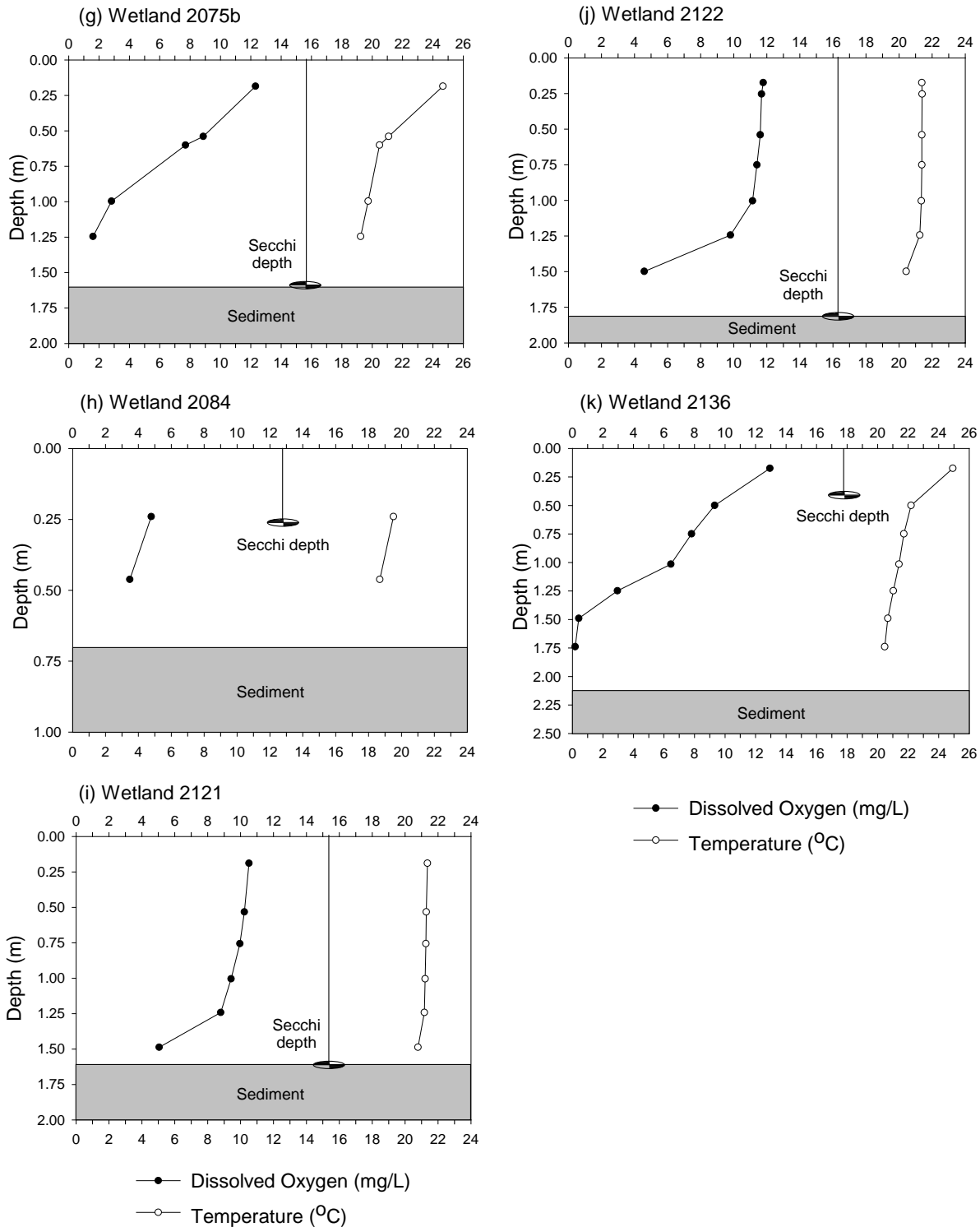


Figure 6: Temperature and Dissolved Oxygen Profiles, and Secchi Depth for Selected Wetlands, Saskatoon August 3 to 5, 2011 (continued)



DO levels throughout all wetland depth profiles ranged from hypoxic (0.2 mg/L) to supersaturated (17.4 mg/L; Appendix F, Table F-1). Three wetlands had DO levels near the wetland bottom less than or equal to 2 mg/L (wetlands 2018, 2075a, and 2136; Figures 6c, 6f, and 6k). Decreased DO levels near the bottom of the wetlands are likely attributable to the oxygen demand from decaying plant material. The odour of hydrogen sulphide was noticed during sediment sampling in wetland 2018. Hydrogen sulphide forms under anoxic (oxygen absent) conditions. Water temperatures through all profiles ranged from 17.2 to 25.2°C (Appendix F, Table F-1). However, water temperatures within individual wetland depth profiles were uniform (range of 0°C) in wetland 2034 (Figure 6e) or varied up to 5.5°C in wetland 2075b (Figure 6g).

4.4.2 Water Quality

Water quality samples were collected from eight wetlands; the results are presented in Appendix F, Table F-2.

Laboratory-measured pH values were basic and ranged from pH 8.11 to 9.72; pH in wetland 2075a (9.68) and wetland 2121 (9.72) were above the Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life (freshwater) of pH 6.5 to 9.0. The hydroxide values were all below detection limits, as would be expected at pH values below 9.8 mg/L (Nalco Chemical Company 1997). The Phenolphthalein alkalinity was below detection limits for wetlands 2018 and 2034 (pH below 8.4), and then generally increased as the pH of the sampled wetlands increased. Total alkalinity values were highly alkaline and ranged from 204 to 368 mg/L.

Laboratory-measured specific conductivity, total dissolved solids (TDS), and sum of ions varied in a similar manner, with minimum values observed in wetland 2121 and maximum values in wetland 2018. Specific conductivity and TDS values ranged from slightly brackish (675 µS/cm and 499 mg/L respectively in wetland 2121) to moderately brackish (2,930 µS/cm and 2,210 mg/L respectively in wetland 2018; Stewart and Kantrud 1972). Sum of ions concentrations ranged from 507 mg/L (wetland 2121) to 2,320 mg/L (wetland 2018). Total suspended solids concentrations ranged from 1 mg/L (wetland 2121) to 11 mg/L (wetland 2136).

Total hardness concentrations ranged from 335 mg/L (wetland 2121) to 1,030 mg/L (wetland 2018) indicating very hard water (greater than 180 mg/L) in the study area (Canadian Council of Ministers of the Environment [CCME] 2007). Calcium and magnesium concentrations ranged from 60 to 111 mg/L and 45 to 184 mg/L, respectively, and account for most of the total hardness. Fluoride concentrations were generally above the CWQG of 0.12 mg/L for most of the wetlands.

Ammonia as nitrogen concentrations ranged from 0.01 to 0.15 mg/L; values for most wetlands were above the pH and temperature dependent Surface Water Quality Objectives (SWQO; Saskatchewan Environment 2006) and CWQG (CCME 2000) for total ammonia of 0.022 mg/L, except for wetland 2018 (0.01 mg/L). Potential natural sources of ammonia include decomposition of organic waste matter, animal waste, the discharge of ammonia by biota, and nitrogen fixation processes (CCME 2000). Potential agricultural sources of ammonia include intensive farming, accidental releases or spills of ammonia-rich fertilizer, and the decomposition of livestock wastes (CCME 2000). The active agricultural use of the study area potentially explains the observed concentrations. Nitrate and nitrite were below the reported detection limits of 0.04 and 0.03 mg/L, respectively, in all wetlands. Concentration of total Kjeldahl nitrogen ranged from 1.4 (wetland 2018) to 3.9 mg/L (wetland 2024). Ortho-phosphate as phosphorus concentrations ranged from <0.01 (wetland 2018) to 2 mg/L (wetland 2084). Concentrations of organic carbon and dissolved organic carbon (DOC) were lowest in wetland 2121 (22 and 21 mg/L, respectively) and highest in wetland 2084 (40 and 39 mg/L, respectively).



Detection limits for analysis of total metals were below the most conservative applicable guideline (SWQO or CWQG). Reported total metal concentrations were generally below the applicable detection limit or were below the applicable guideline, with three exceptions. Total arsenic concentrations at seven wetlands were above SWQO and CWQG of 5 µg/L, ranging from 6.2 µg/L (wetland 2002) to 17 µg/L (wetland 2075a). Potential natural sources of arsenic include weathered rocks and soils; a potential agricultural source of arsenic includes herbicide usages (CCME 2001). The total aluminum concentration in wetland 2024 (0.1 mg/L) and total selenium concentration in wetland 2084 (0.001 mg/L) were equal to the SWQO and CWQG.

4.4.3 Sediment Quality

Sediment samples were collected from five wetlands; the results are presented in Appendix F, Table F-3.

Moisture content in sediment samples was generally similar among wetlands, ranging from 61.7% to 72.4%. Total organic carbon was variable among wetlands; lowest in wetland 2121 (3.15%) compared to highest in wetland 2002 (7.72/8.08%). Levels of inorganic carbon (IC) and carbonate calcium (CaCO₃) were higher in wetland 2018 (1.88% and 15.7%, respectively) compared to the range for all the other wetlands (0.33% to 0.53% and 2.74% to 4.42%, respectively). Levels of calcium (Ca), magnesium (Mg), and sodium (Na) were also higher in wetland 2018 (37,600, 13,200, and 1,460 milligrams per kilogram based on dry weight [mg/kg dw] of sample, respectively) compared to the range for all the other wetlands (12,200 to 17,900 mg/kg dw for Ca; 4,580 to 7,450 mg/kg dw for Mg; 200 to 650 mg/kg dw for Na).

Several sediment quality parameters (i.e., IC, CaCO₃ equivalent, Ca, Mg, Na, molybdenum [Mo], strontium [Sr], and uranium [U]) for wetland 2018 appear to be higher than levels found in the other sampled wetlands. Previous land use (i.e., snow deposit area) (T. Fusco, pers. comm. 2011b) may have had an influence on the sediment quality in this wetland.

In general, total metal concentrations were similar among wetlands, except for aluminum (Al), Mo, Sr, and U. Levels of Al ranged between 12,300 and 13,700 mg/kg in wetlands 2024 and 2075a, while they ranged between 7,850 and 9,890 mg/kg dw in the other wetlands. Mo was detected in wetland 2018 (1.8 mg/kg dw), while Mo levels were below detection limits (1.0 mg/kg dw) in all other wetlands. Levels of Sr were 99.3 mg/kg dw in wetland 2024 and 105 mg/kg dw in wetland 2018. Sr levels ranged from 55.9 to 70.6 mg/kg dw in the other wetlands. The U level was 5.57 mg/kg dw in wetland 2018, while U levels ranged from 1.30 to 2.74 mg/kg dw in the other wetlands.

Arsenic concentration in wetland 2075a (5.98 mg/kg dw) exceeded the Interim Freshwater Sediment Quality Guidelines of 5.9 mg/kg dw; all other concentrations ranged from 3.22 to 5.51 mg/kg dw. No other guideline exceedances were observed.

4.5 Discussion and Summary

Eleven wetlands in the Study Area were assessed for limnological characteristics. Surface DO levels tended to increase with increasing maximum water depth observed in the eleven wetlands. However, no similar relationship was observed between increasing surface area (hectares) and DO levels in the same wetlands. Three wetlands had DO levels near the wetland bottom less than or equal to 2 mg/L (wetlands 2018, 2075a, and 2136). Decreased DO levels near the bottom of the wetlands are likely caused by the oxygen demand resulting from the decay of plant material. A hydrogen sulphide odour was noticed during sediment sampling in wetland 2018. Hydrogen sulphide forms under oxygen depleted conditions. Surface water temperatures were relatively warm during the sampling period; while surface specific conductivity levels were above 1,000 µS/cm in the majority of the wetlands (i.e., wetlands 2015, 2018, 2024, 2034, 2075a, 2075b, 2084, and 2136).



Eight wetlands were assessed for water chemistry. Water was alkaline in all wetlands, with pH values exceeding the CWQG in wetlands 2075a and 2121. Most wetlands had slightly brackish water, while wetland 2018 contained moderately brackish water. Water in the sampled wetlands was very hard; which was mainly attributable to high calcium and magnesium concentrations. Fluoride concentrations were also generally above the CWQG for most of the wetlands. Most ammonia as nitrogen concentrations were above the pH and temperature dependent SWQO and CWQG; the agricultural use of the area likely explains the observed concentrations. Total metal concentrations were generally either below the detection limits or below applicable guidelines. Total arsenic concentrations of most wetlands were above SWQO and CWQG; the soil and agricultural use of herbicides in the area possibly explains the observed concentrations.

Five wetlands were assessed for sediment chemistry. Wetland 2018 had the most distinctive sediment chemistry results among the five wetlands assessed. Several sediment quality parameters (i.e., IC, CaCO₃ equivalent, Ca, Mg, Na, Mo, Sr, and U) appear to be higher in wetland 2018 than levels found in the other sampled wetlands. Previous land use (i.e., snow deposit area) may have had an influence on the sediment quality in this wetland.

5.0 HERITAGE RESOURCE IMPACT ASSESSMENT

The June 29, 2011 RFP identified that an archaeological investigation was required on NE 19-36-4 W3M be conducted and the Saskatchewan Archaeological Resource Record be completed. A search of the Tourism, Parks, Culture and Sport - Heritage Conservation Branch on-line screening tool revealed that this land location was not heritage sensitive (Appendix G). A follow-up conversation with the Heritage Conservation Branch by Patrick Young (archaeologist, Golder) confirmed that no further work was required at this site and a letter from the Heritage Conservation Branch will be issued (Appendix G). Therefore, Golder did not conduct an additional assessment on this site.

6.0 CONCLUSION

Considering the Study Area is largely characterized by an anthropogenically disturbed landscape that has been extensively modified (e.g., cultivation, road/infrastructure construction and use, and occupied dwellings), the natural habitat quality has been diminished. In addition to historical and direct removal of large, inter-connected tracts of habitat, several of the remaining vegetation communities support introduced or alien species that were intentionally planted (e.g., windbreaks or hedgerows) or became established through colonization. Similar changes related to vegetation cover includes the seeding of large tracts of land to a homogenous, monoculture community comprised of agronomic forage and cereal crop species, which may be fallow during some years. Further, the existing urban neighbourhoods in proximity to the Study Area likely have direct and indirect sensory disturbance attributes, primarily associated with noise and light (e.g., artificial light can alter or disrupt habitat use by wildlife species with nocturnal and crepuscular activity patterns). Major roads, such as the highways that border the north and south boundaries of the Study Area can also function as movement barriers for small mammals, reptiles, and amphibians. These may also function as higher risk mortality zones for larger mammals, mesopredators (i.e., medium sized predators such as skunk [*Procyon lotor*], racoon [*Mephitis mephitis*], and coyote [*Canus latrans*]), and avian species that either need to cross the roadway to disperse to new or alternative habitat as part of flight/escape events, or that utilize the road sides for forage, browse, scavenging and reproduction, thereby making them more susceptible to vehicle collisions.



As discussed above, although the natural habitat for plants and wildlife has been extensively modified in the Study Area or is influenced by surrounding land use, suitable habitat still persists for numerous species. These habitats are largely associated with the dispersed, often isolated wetland complexes. However, the lack of connectivity between the wetland patches may result in or increase the potential for local extinctions (i.e., lack of connectivity of habitats can impair recruitment, in and out migration, function as a movement/distance barrier or increase predation risk when leaving cover to travel between patches) and creation of metapopulations (i.e., small population occupying a habitat patch). In this case, the aforementioned may be more applicable to small mammals, reptiles, amphibians and invertebrates, but all are important in ecological processes such as predator-prey interactions and activity of pollinators.

The landscape that currently characterizes the Study Area appears to be mostly suited to highly mobile taxa (e.g., birds) and species that are considered habitat generalists (i.e., can utilize or adapt to a variety of habitat types or conditions); however, some of the wetlands (e.g., wetland 2024) appear to be suitable for habitat specialists (i.e., species that require specific habitat conditions such as presence of type of prey, or a host plant, soil type, water quality). In addition to birds, terrestrial species that likely frequently utilize the habitat matrix in the Study Area are mesopredators or scavenger species such as raccoon, skunk, and coyote.

As identified in Section 3.4, during the City's Neighbourhood Concept Plan process, consideration for establishing a habitat corridor that includes wetlands 2024, 2121, 2075, 2002, and 2003 or 2075 and 2024 may maintain or provide some level of habitat spatio-temporal dynamic. If this habitat corridor is rejected, the City could also consider connecting the habitat within the planned neighbourhood to habitat east, south, or north of the Project Area. An interconnected habitat of this type could provide a wildlife movement and recruitment corridor between the urban and rural settings. This may mitigate the creation of isolated habitat patches, which will otherwise mostly likely change from their current characteristics, function and process on account of a variety of urban related impacts and influences. However, it is appreciated that trying to maintain sustainable habitats in the urban planning process can be a difficult task when trying to incorporate economic and societal expectations, the latter of which may range from conservation expectations to indifference.

From a water and sediment quality perspective, the wetland ponds sampled as part of this survey appear to be fairly typical of shallow, highly productive, semi-permanent and permanent prairie pothole wetlands. Most appear to be in relatively undisturbed condition, with the exception of wetland pond 2018, where previous land use alteration adjacent to the waterbody is evident (especially in terms of altered sediment quality). Wetland ponds 2075a, 2024, and 2121 represent the most stable, least disturbed aquatic ecosystems surveyed of the 11 wetlands selected for limnology, water quality, or sediment quality sampling. This is due, for the most part, to their greater depth and relatively large surface areas compared to other wetlands in the City of Saskatoon East Sector survey area.

If the City is considering the conservation, preservation or establishment of natural areas that can be utilized as habitat patches or corridors, it is recommended that additional assessments be conducted to identify key species or habitat types that should be focused on; as well as what the expected and realistic end objectives are. If considering the maintenance or establishment of isolated habitat patches, there needs to be awareness that an important factor in which species will continue to use the patch appears to be the interactions of the patches with the surrounding habitat matrix or land use (Bierregaard and Stuffer 1997).



It also needs to be recognized that development of the Project will likely result in the permanent displacement of some wildlife species. For example, loggerhead shrikes require large open habitats for foraging and will not adapt or habituate to urban settings. As well, some wildlife displaced from the remaining habitats in the planning area that are removed, may migrate to other suitable habitat in the region, which could lead to temporal over-crowding at these alternate locations. However, alternate habitat crowding is typically observed shortly after fragmentation or removal of the habitat in the area of question, but is followed by relaxation in subsequent year (Debinski and Holt 2000).

As discussed above, habitat in the Study Area has been influenced and altered by previous land use. Nonetheless, remnant patches of useable habitat persist that are utilized by a variety of wildlife species and provide suitable growing sites for numerous plants. The persistence of biological populations to continue to inhabit patchy landscapes within an urban setting is still characterized by many unknowns and is open to debate. Albeit, research continues to enhance this knowledge and efforts should be employed to at least apply sound ecological principles as part of the planning process.



7.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

GOLDER ASSOCIATES LTD.



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Associate, Senior Ecologist/Reclamation Specialist

DAW/BW/FA/BCME/lmg

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APPENDIX A

Photoplates



Photo 1: Engelmann's Rush located in wetland 2006 in NW 21-36-4 W3M.



Photo 2: Narrow leaved water plantain in wetland 2024 in NE 30-36-4 W3M.



Photo 5: Drying mud flat on northend of wetland 2024 location of four provincially tracked plant species.



Photo 6: Permanent wetland 2121 in SW 32-36-4 W2M.



Photo 3: Loggerhead shrike at the southeast corner of the Study Area in NW 16-36-4 W3M.



Photo 4: Ring-billed gull, willet, and duck brood at a Class 5 wetland.



APPENDIX B

List of Plants Observed within the Study Area



Common Name	Scientific Name	Common Name	Scientific Name
Common yarrow	<i>Achillea millefolium</i>	June grass	<i>Koeleria macrantha</i>
Crested wheatgrass	<i>Agropyron cristatum</i>	Bluebur	<i>Lappula occidentalis</i>
Northern bentgrass	<i>Agrostis scabra</i>	Peppergrass	<i>Lepidium densiflorum</i>
Redtop	<i>Agrostis stolonifera</i>	Black medick	<i>Medicago lupulina</i>
Narrow leaved water plantain	<i>Alisma gramineum</i>	Alfalfa	<i>Medicago sativa</i>
Common water plantain	<i>Alisma trivale</i> (previously <i>Alisma plantago-aquatica</i>)	White sweet clover	<i>Melilotus alba</i>
Water foxtail	<i>Alopecurus aequalis</i>	Yellow sweet clover	<i>Melilotus officinalis</i>
Redroot pigweed	<i>Amaranthus retroflexus</i>	Wild mint	<i>Mentha arvensis</i>
Saskatoon	<i>Amelanchier alnifolia</i>	Green needle grass	<i>Nassella viridula</i>
Pygmy flower	<i>Androsace septentrionalis</i>	Western wheatgrass	<i>Pascopyrum smithii</i>
Canada anemone	<i>Anemone canadensis</i>	Water smartweed	<i>Persicaria amphibia</i>
Silverweed	<i>Argentina anserina</i>	Pale smartweed	<i>Persicaria lapathifolia</i>
Plains wormwood	<i>Artemisia campestris</i>	Common reedgrass	<i>Phragmites australis</i>
Pasture sage	<i>Artemisia frigida</i>	Reed canary grass	<i>Phalaris arundinacea</i>
Prairie sage	<i>Artemisia ludoviciana</i>	Moss phlox	<i>Phlox hoodii</i>
Hooker's oatgrass	<i>Avenula hookeri</i>	White spruce	<i>Picea glauca</i>
Wild oats	<i>Avena fatua</i>	Spruce (planted horticultural varieties)	<i>Picea species</i>
Russian pigweed	<i>Axyris amaranthoides</i>	Scotch pine (planted)	<i>Pinus species</i>
American sloughgrass	<i>Beckmannia syzigachne</i>	Popcorn flower	<i>Plagiobothrys scouleri</i>
Tall beggar's tick	<i>Bidens frondosa</i>	Common plantain	<i>Plantago major</i>
Blue grama grass	<i>Bouteloua gracilis</i>	Kentucky bluegrass	<i>Poa pratensis</i>
Canola	<i>Brassica rapa</i>	Balsam poplar	<i>Populus balsamifera</i>
Fringed brome	<i>Bromus ciliatus</i>	Plains cottonwood	<i>Populus deltoides</i>
Smooth brome	<i>Bromus inermis</i>	Trembling aspen	<i>Populus tremuloides</i>
Northern reedgrass	<i>Calamagrostis stricta</i>	Hybrid poplars (Horticultural)	<i>Populus species</i>
Creeping bellflower	<i>Campanula rapunculoides</i>	Rough cinquefoil	<i>Potentilla norvegica</i>
Harebell	<i>Campanula rotundifolia</i>	Chokecherry	<i>Prunus virginiana</i>
Shepherd's purse	<i>Capsella bursa-pastoris</i>	Nuttall's alkali grass	<i>Puccinellia nuttalliana</i>
Caragana	<i>Caragana arborescens</i>	Crocus	<i>Pulsatilla patens</i>
Nodding thistle	<i>Carduus nutans</i>	Seaside buttercup	<i>Ranunculus cymbalaria</i>
Thread leaf sedge	<i>Carex filifolia</i>	Long headed prairie coneflower	<i>Ratibida columnifera</i>
Sun loving sedge	<i>Carex pensylvanica</i>	Blunt leaved yellow cress	<i>Rorippa curvipes</i> var. <i>truncata</i>
Field chickweed	<i>Cerastium arvense</i>	Prickly rose	<i>Rosa acicularis</i>
Lamb's quarters	<i>Chenopodium album</i>	Prairie rose	<i>Rosa arkansana</i>
Saline goosefoot	<i>Chenopodium glaucum</i> var. <i>salinum</i>	Wood's rose	<i>Rosa woodsii</i>
Canada thistle	<i>Cirsium arvense</i>	Western dock	<i>Rumex occidentalis</i>
Pale comandra	<i>Comandra umbellata</i>	Arum leaved arrowhead	<i>Sagittaria cuneata</i>



Common Name	Scientific Name	Common Name	Scientific Name
Horseweed	<i>Conyza canadensis</i>	Willow species	<i>Salix</i> species
Red osier dogwood	<i>Cornus sericea</i> ssp. <i>stolonifera</i>	Russian thistle	<i>Salsola kali</i>
Flixweed	<i>Descurainia sophia</i>	Soft stem bulrush	<i>Schoenoplectus tabernaemontani</i>
Inland saltgrass	<i>Distichlis spicata</i> var. <i>stricta</i>	Spangletop	<i>Scolochloa festucacea</i>
Barnyard grass	<i>Echinochloa crusgalli</i>	Prairie clubmoss	<i>Selaginella densa</i>
Wolf willow	<i>Elaeagnus commutata</i>	Green foxtail	<i>Setaria viridis</i>
Needle spikerush	<i>Eleocharis acicularis</i>	Thorny buffaloberry	<i>Shepherdia argentea</i>
Engelmann's spikerush	<i>Eleocharis engelmannii</i>	Tumbling mustard	<i>Sisymbrium altissimum</i>
Creeping spikerush	<i>Eleocharis palustris</i>	Blue eyed grass	<i>Sisyrinchium montanum</i>
Quackgrass	<i>Elymus repens</i>	Water parsnip	<i>Sium suave</i>
Northern wheatgrass	<i>Elymus lanceolatus</i> var. <i>lanceolatus</i>	Canada goldenrod	<i>Solidago canadensis</i>
Slender wheatgrass	<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>	Perennial sowthistle	<i>Sonchus arvensis</i>
Awned wheatgrass	<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>	Prickly sowthistle	<i>Sonchus asper</i>
Common horsetail	<i>Equisetum arvense</i>	Bur reed	<i>Sparganium</i> species
Northern willowherb	<i>Epilobium ciliatum</i>	Narrow leaved meadowsweet	<i>Spiraea alba</i>
Prairie rocket	<i>Erysimum capitatum</i> var. <i>capitatum</i>	Large duckweed	<i>Spirodela polyrrhiza</i>
Wallflower	<i>Erysimum inconspicuum</i>	Western snowberry	<i>Symphoricarpos occidentalis</i>
Rough fescue	<i>Festuca halli</i>	Smooth aster	<i>Symphyotrichum laeve</i>
Wild strawberry	<i>Fragaria virginiana</i>	Many white flowered aster	<i>Symphyotrichum ericoides</i>
Blanket-flower	<i>Gaillardia aristata</i>	Common lilac	<i>Syringa vulgaris</i>
Northern bedstraw	<i>Galium boreale</i>	Dandelion	<i>Taraxacum officinale</i>
Three flowered avens	<i>Geum triflorum</i>	Goldenbean	<i>Thermopsis rhombifolia</i>
Tall baby's breath	<i>Gypsophila paniculata</i>	Stinkweed	<i>Thlaspi arvense</i>
Needle and thread	<i>Hesperostipa commata</i>	Goat's beard	<i>Tragopogon dubius</i>
Western porcupine grass	<i>Hesperostipa curtisetata</i>	Wheat	<i>Triticum aestivum</i>
Alumroot	<i>Heuchera richardsonii</i>	Clover	<i>Triflorum</i> species
Foxtail barley	<i>Hordeum jubatum</i>	Narrow leaved cattail	<i>Typha angustifolia</i>
Barley	<i>Hordeum vulgare</i>	Common cattail	<i>Typha latifolia</i>
Himalayan impatiens	<i>Impatiens glandulifera</i>	American elm	<i>Ulmus americana</i>
Baltic rush	<i>Juncus balticus</i>	Siberian elm	<i>Ulmus pumila</i>
Toad rush	<i>Juncus bufonius</i>	Stinging nettle	<i>Urtica dioica</i>
Rush	<i>Juncus</i> species	American vetch	<i>Vicea americana</i>
Kochia	<i>Kochia scoparia</i>		



APPENDIX C

Habitat Descriptions and Listed Plant and Wildlife Species Observed During the Summer 2011 Field Assessment



Locations of Federal and Provincial Listed Plant and Wildlife Species Observed Within the East Sector Natural Area

Common Name	Scientific Name	Land Location	UTM (NAD 83, Zone 13)	
			Easting	Northing
Loggerhead shrike	<i>Lanius ludovicianus excubitorides</i>	NW 16-34-04 W3M	395486	5773275
		SW 20-36-04 W3M	393898	5774091
Horned grebe	<i>Podiceps auritus</i>	SW 32-36-04 W3M	394487	5776610
		NE 19-36-04 W3M	393587	5774784
		SE 29-36-04 W3M	394711	5775103
		SE 30-36-04 W3M	393575	5775588
Barn swallow	<i>Hirundo rustica</i>	SE 30-36-04 W3M	393575	5775588
		NW 27-36-04 W3M	397053	5775834
		NE 17-36-04 W3M	395486	5773275
		SW 29-36-04 W3M	392953	5775334
		SE 32-36-04 W3M	394367	5774915
Narrow leaved cattail	<i>Typha angustifolia</i>	SW 21-36-04 W3M	395392	5774024
		NW 29-36-04 W3M	394255	5776569
Narrow leaved water plantain	<i>Alisma gramineum</i>	NE 30-36-04 W3M	393232	5775790
Engelmann's spikerush	<i>Eleocharis engelmannii</i>	NW 21-36-04 W3M	395742	5774827
		NE 30-36-04 W3M	393232	5775790
Blunt leaved yellow cress	<i>Rorippa curvipes</i> var. <i>truncata</i>	NW 29-36-04 W3M	394231	5776650
		NE 30-36-04 W3M	393232	5775790
Tall beggar's tick	<i>Bidens frondosa</i>	NE 30-36-04 W3M	393232	5775790



Quarter Section	Land Use	Description (Stantec 2010)	2011 Assessment
NE 17-36-4 W3M	Cropland	Cropland interspersed with wetlands, which have a cover type of foxtail barley, cattails, and dock species.	A barn swallow was observed over the road near wetland 2000.
NE 19-36-4 W3M	Tame Pasture	Tame pasture on the outskirts of the City, which looks to have been unoccupied for several years. Undeveloped portion of the quarter section consists of small shrubs and a wetland surrounded by cattails.	An adult horned grebe was observed in wetland 2018 on July 23, 2011.
NE 20-36-4 W3M	Cropland	Cropland with two farmyards surrounded by mature treed shelterbelts. The west half has several wetlands surrounded by mature trembling aspen and a wetland directly adjacent to the high grade gravel road, which consists of trembling aspen, willows, and cattails.	Potential nesting and perch sites for raptors, no raptors observed in the area; no listed species seen.
NW 20-36-4 W3M	Cropland	Cropland with wetlands surrounded by trembling aspen and willows interspersed throughout the quarter section.	No listed species seen.
SE 20-36-4 W3M	Cropland	Cropland with two farmyards located in the east central portion of the quarter section. The farmyards are surrounded by mature poplar shelterbelt. A large wetland covers most of the northeast portion of the quarter section. Cattails, bulrush and dock present. Mature trees and shrubs line the west side of the large wetland and the shelterbelts from the farmyards line the north and south sides	An adult loggerhead shrike was observed hunting in the southeast corner of this quarter on July 31, 2011. Fledged young were observed in treed hedgerow in NW 16-36-4 W3M.
NE 21-36-4 W3M	Cropland	Cropland with a mature caragana shelterbelt located on the west side of the quarter section.	No raptors or loggerhead shrikes observed; however, the caragana hedgerows could provide nesting habitat for loggerhead shrikes.
NW 21-36-4 W3M	Cropland	Cropland with a shelterbelt of American elm and shrub species including lilacs located along the south side of the quarter section. Also, along the south portion of the quarter section is an old farmyard with a shelterbelt of trees and a row of shrubs on the east portion of the quarter section.	Although no listed species were observed on this quarter, the shelterbelts could provide nesting habitat for loggerhead shrike especially since shrikes were found in the adjoining quarter section in SW 21-36-4 W3M. Engelmann's spikerush was historically documented in the quarter section and was relocated during the 2011 field survey along the north end of wetland 2006. Plants located in the transition zone between the ring of sloughgrass and center of common water plantain.



Quarter Section	Land Use	Description (Stantec 2010)	2011 Assessment
SW 21-36-4 W3M	Cropland	Cropland with a hedgerow of shrubs and poplars bordering south side. A large wetland existing in the north half with a shelterbelt of American elm and shrub species bordering the north side of the quarter section and a large tree on the south side of the quarter section. Cattails and bulrushes border the wetland.	Loggerhead shrikes were observed in the east-west hedgerow between SW 21-36-4 W3M and NW 16-36-4 W3M. Narrow leaved cattail was observed as established clumps within the common cattail band surrounding wetland 2003.
NW/SW 27-36-4 W3M	Hayland/Cropland	North half consists of hayland and the south half of cropland. A large wetland located in the north half of the quarter section	Six barn swallows were observed flying over the road and wetland 7052 on July 31, 2011. The birds likely nested in a building at the yard to the west.
NE 28-36-4 W3M	Cropland	Cropland with a farmyard located in the southeast corner that is surrounded by a mature tree shelterbelt. Wetland in the NW 27-36-4 W3M extends into this quarter section and is surrounded by shrub species.	No listed wildlife species observed.
NW 28-36-4 W3M	Cropland	Cropland with wetlands interspersed throughout the quarter section. Some wetlands were surrounded by trembling aspen and willows, while others were surrounded by cattails.	No listed wildlife species observed.
NE 29-36-4 W3M	Cropland	Cropland with multiple treed wetlands throughout including a large one extending into the south portion of the quarter section.	No listed wildlife species observed.
NW 29-36-4 W3M	Cropland	Cropland with multiple small wetlands surrounded by cattails.	No listed wildlife species observed. Narrow leaved cattail was observed as established clumps within the common cattail band surrounding wetland 2121. Blunt leaved yellow cress observed in open area between crop and wet margin of wetland 2121.
SE 29-36-4 W3M	Cropland	Cropland with a large wetland that has an open expanse of water. Multiple trees and shrubs surround the wetland. A farm yard in the southeast corner with a few pine trees.	An adult horned grebe was observed at wetland 2075 on July 23, 2011.
SW 29-36-4 W3M	Industrial/Commercial	South portion of the quarter section is industrial businesses; however, a large wetland is located just north with a large expanse of water. The northern portion of the quarter section consists of a dog park and a snow drop off area. Trembling aspen tree patches present.	A barn swallow was observed flying over the City Yard on August 8, 2011. The bird likely nested in buildings in the yard.



Quarter Section	Land Use	Description (Stantec 2010)	2011 Assessment
NE 30-36-4 W3M	Cropland	Cropland with a large wetland extending into the south portion of the quarter section. The quarter section also includes multiple smaller wetlands surrounded by trees and shrubs.	No listed wildlife species observed. Engelmann's spikerush, narrow leaved water plantain, blunt leaved yellow cress, and tall beggar's tick were observed in the drying mudflat on the north end of wetland 2024.
NW 30-36-4 W3M	Cropland	Cropland with multiple wetlands throughout the quarter section with cattails, dock, trembling aspen, and willows present.	No listed wildlife species observed.
SE/SW 30-36-4 W3M	Cropland	Cropland with weedy species and multiple wetlands which range from being surrounded by cattail species and dock to one surrounded by trees and shrubs. The north half of SE 30-36-4 W3M consists of a large wetland.	A barn swallow was observed flying over wetland 2162 on August 17, 2011. Four horned grebes were seen swimming on wetland 2024 on August 4, 2011.
SE 32-36-4 W3M	Cropland	Cropland with a large grassy wetland in the north portion of the quarter section which extends to a treed wetland surrounded by mature trees and shrubs (trembling aspen and willow). Several smaller wetlands are located throughout this quarter sections surrounded by cattails. A farmyard is situated in the southern portion of the quarter section surrounded by a mature treed shelterbelt.	No listed wildlife species observed.
SW 32-36-4 W3M	Hayland/Cropland	Hayland/cropland with a farmyard located in the south portion of the quarter section with a mature treed shelterbelt consisting of poplar trees and other coniferous and deciduous species. Large wetland in middle of quarter section. One coniferous tree located next to grid road.	No listed wildlife species observed. An adult Swainson's hawk was observed perched on a piece of equipment on July 31, 2011; however, no nest was observed in the area.
NE 33-36-4 W3M	Cropland	Cropland with multiple grassy wetlands surrounded mostly by cattails. The wetlands located in the northeast corner of the quarter section contained water.	No listed wildlife species observed.
NW 33-36-4 W3M	Cropland	Cropland with multiple wetlands throughout the quarter section. A farmyard with a mature tree shelterbelt is located in the north portion of the quarter section.	No listed wildlife species observed.
NW 34-36-4 W3M	Cropland	Cropland with two highly disturbed wetlands, with cattails and grasses but no trees or shrubs surrounding it. A wetland in the northwest quarter had visible water.	No listed wildlife species observed. According to the Google Earth imagery there is an area of trees and potentially native grassland located south of the yard site that was not mentioned in the initial 2010 survey.



Quarter Section	Land Use	Description (Stantec 2010)	2011 Assessment
SW 34-36-4 W3M	Cropland	Cropland with a farmyard located in the south east corner of the quarter section surrounded by a mature tree shelterbelt.	According to the Google Earth imagery an area of pasture with trees, shrubs, and potentially native grassland is located on the east half of the quarter section; however, this area was not mentioned in the initial 2010 survey.
NW 3-37-4 W3M	Cropland	Cropland with a large wetland complex on the westside with cattails, bulrush and willows. The wetland had visible standing water. Between the wetland and the road is uncultivated and consists of grass species	No listed wildlife species observed.
SE 4-37-4 W3M	Cropland	Cropland with a large complex of trembling aspen groves along the east side of the quarter section. A large wetland is located in the southeast corner with an open expanse of water. Wetland is surrounded by trees and shrubs. A farmyard is located just north from the large wetland and is surrounded by mature poplar trees and a trembling aspen grove. Multiple wetlands throughout the quarter section.	No listed wildlife species observed.
SW 4-37-4 W3M	Cropland	Cropland with multiple small wetlands. Wetlands most likely surrounded by cattails with no tree or shrub species.	No listed wildlife species observed.
NE 5-37-4 W3M	Cropland	In the northeast corner of the quarter section a set of towers is present on weedy land with dock, sow thistle, and grasses. This quarter is directly south from a native prairie sections and it is possible for this grassy area to contain native prairie species. The rest of the quarter is crop land with not visible wetlands or tree patches	No listed wildlife species observed.
SE 5-37-4 W3M	Cropland	Cropland with a wetland, which extends through the central portion of the quarter section. This wetland appears to contain vegetation and a good possibility of native vegetation species.	No listed wildlife species observed.
NE 8-37-4 W3M	Native Prairie	Native prairie with a large trembling aspen tree patch. Visible vegetation included goldenrod, thistle, and multiple native grass species. Several shrub patches are also scattered throughout.	No listed wildlife species observed. There is a historical documented occurrence for crowfoot violet in this section; however, the exact location is not known. The August survey was conducted too late in the season to identify this plant species; a survey for this species is best conducted in the late spring/early summer (late May-early June) when it is in bloom.



Quarter Section	Land Use	Description (Stantec 2010)	2011 Assessment
NW 8-37-4 W3M	Cropland	Cropland with two wetlands in the west portion of the quarter section, reedgrass and cattail present. No trees or shrubs are present in the quarter section.	No listed wildlife species observed. While the historical documented occurrence for crowfoot violet and smooth rose overlap this quarter section, given the lack of native habitat neither species is likely to be present in the quarter. The historical description indicates that smooth rose was found around the margin of an aspen bluff.
SE 8-37-4 W3M	Native Prairie	Native Prairie with small patches of shrubs and trees. Vegetation species identified include western snowberry, goldenrod a wheatgrasses.	No listed wildlife species observed. A historical occurrence for crowfoot violet is documented in this section. The August survey was conducted too late to identify this plant species, a survey for this species is best conducted in the late spring/early summer (late May/early June) when it is in bloom.
SW 8-37-4 W3M	Cropland	Cropland with no visible wetlands or tree patches.	No listed wildlife species observed. There is a historical documented occurrence for crowfoot violet somewhere in this section; however, given the lack of native prairie habitat it is unlikely that this species would be present. Blunt leaved yellow cress is documented from this quarter section; it is possible for this species to occur in drying mud areas of depressions or low lying flats left fallow at the time of seeding due to wet conditions.



APPENDIX D

Wildlife Species Observed at Selected Wetlands and at Kern Prairie



Wetlands 2013 - 2084

SPECIES	SCIENTIFIC NAME	2013	2015	2018	2019	2021	2020	2037	2038	2040	2009	2075	2079	2080	2082	Kernen Prairie	7037	2025	2024	2031	2033	2052	2051	2050	2049	2104	7092	2105	2106	2136	2122	2084	TOTAL
*Wetland Classification		4	5	5	4	3	4	2	3	4	3	5	2	2	1	-	1	4	5	4	3	2	4	2	3	2	2	4	2	5	5	5	
Pied-billed Grebe	<i>Podilymbus podiceps</i>	x	x	x														x	x														5
Horned Grebe	<i>Podiceps auritus</i>			x								x						x															3
Red-necked Grebe	<i>Podiceps grisegena</i>											x						x												x			3
Eared Grebe	<i>Podiceps nigricollis</i>											x						x												x			3
Great Blue Heron	<i>Ardea herodias</i>											x																					1
Canada Goose	<i>Branta canadensis</i>											x						x															2
Gadwall	<i>Anas strepera</i>											x						x															2
American Wigeon	<i>Anas americana</i>											x																					1
Mallard	<i>Anas platyrhynchos</i>		x									x						x													X	4	
Blue-winged Teal	<i>Anas disors</i>	x						x				x						x											x		X	6	
Northern Shoveler	<i>Anas clypeata</i>											x						x	x														3
Canvasback	<i>Aythya valisineria</i>											x						x						x					x	X		5	
Redhead	<i>Aythya americana</i>																	x														1	
Lesser Scaup	<i>Aythya affinis</i>											x																					1
Ruddy Duck	<i>Oxyura jamaicensis</i>	x	x									x						x	x											x			6
Swainson's Hawk	<i>Buteo swainsoni</i>																			x													1
American Kestrel	<i>Falco sparverius</i>															x																	1
Sora	<i>Porzana carolina</i>		x	x								x								x					x								5
American Coot	<i>Fulica americana</i>	x	x	x	x		x	x				x					x	x	x	x	x	x	x	x	x			x	x	x	X	19	
Killdeer	<i>Charadrius vociferus</i>									x									x								x						3
Greater Yellowlegs	<i>Tringa melanoeuca</i>						x												x														2
Lesser Yellowlegs	<i>Tringa flavipes</i>																		x														1
Spotted Sandpiper	<i>Actitis macularia</i>											x							x														2
Wilson's Snipe	<i>Gallinago gallinago</i>						x																										1
Franklin's Gull	<i>Larus pipixcan</i>																		x														1
Ring-billed Gull	<i>Larus delawarensis</i>																		x														1
Black Tern	<i>Chlidonias niger</i>		x	x	x		x					x						x	x														7
Mourning Dove	<i>Zenaida macroura</i>						x																										1
Northern Flicker	<i>Colaptes auratus</i>																		x														1
Eastern Kingbird	<i>Tyrannus tyrannus</i>										x	x						x	x					x									5
Black-billed Magpie	<i>Pica hudsonia</i>	x									x					x		x	x					x									6



SPECIES	SCIENTIFIC NAME	2013	2015	2018	2019	2021	2020	2037	2038	2040	2009	2075	2079	2080	2082	Kernen Prairie	7037	2025	2024	2031	2033	2052	2051	2050	2049	2104	7092	2105	2106	2136	2122	2084	TOTAL
<i>*Wetland Classification</i>		4	5	5	4	3	4	2	3	4	3	5	2	2	1	-	1	4	5	4	3	2	4	2	3	2	2	4	2	5	5	5	
Purple Martin	<i>Progne subis</i>			x																													1
Barn Swallow	<i>Hirundo rustica</i>																	x															1
Marsh Wren	<i>Cistothorus palustris</i>		x	x	x																												3
European Starling	<i>Sturnus vulgaris</i>										x																						1
Common Yellowthroat	<i>Geothlypis trichas</i>				x	x																											2
Clay-coloured Sparrow	<i>Spizella pallida</i>		x	x			x	x			x					x																	6
Savannah Sparrow	<i>Passerculus sandwichensis</i>															x																	1
Song Sparrow	<i>Melospiza melodia</i>	x	x				x				x											x			x					x	X	8	
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	x	x			x	x	x	x	x		x		x					x		x							x		x	X	14	
Western Meadowlark	<i>Sturnella neglecta</i>						x	x																									2
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>				x	x	x			x		x																					5
Common Grackle	<i>Quiscalus quiscula</i>									x																							1
American Goldfinch	<i>Carduelis tristis</i>		x																				x										2
House Sparrow	<i>Passer domesticus</i>		x																														1
Muskrat	<i>Ondatra zibethicus</i>	x	x	x																										x			4
Thirteen-lined ground squirrel	<i>Spermophilus tridecemlineatus</i>	x																															1
Western Plains Garter Snake	<i>Thamnophis radix haydeni</i>															x								x									2
Wood Frog	<i>Rana sylvatica</i>						x																										1
TOTAL NUMBER OF SPECIES		9	13	9	5	3	11	5	1	4	5	20	0	1	0	5	0	3	25	5	4	2	1	4	4	0	0	2	1	5	5	7	

*Following Stewart and Kantrud (1971).

BOLD = listed species (COSEWIC 2011).



Wetlands 2107 - 2160

SPECIES	SCIENTIFIC NAME	2107	2109	7053	7052	7047	2006	2005	2004	2002	2003	2010	2000	2034	2166	2028	2121	2156	2157	2158	7038	2115	7035	2114	2116	2117	2118	2165	2164	2163	2162	2160	TOTAL
<i>*Wetland Classification</i>		2	1	2	5	1	1	1	1	5	5	2	3	5	2	4	5	4	5	1	2	2	4	1	1	1	1	2	2	2	3	2	
Pied-billed Grebe	<i>Podilymbus podiceps</i>										x			x			x																3
Horned Grebe	<i>Podiceps auritus</i>																	x															1
Red-necked Grebe	<i>Podiceps grisegena</i>									x								x															2
Eared Grebe	<i>Podiceps nigricollis</i>				x													x	x														3
Canada Goose	<i>Branta canadensis</i>																	x															1
Gadwall	<i>Anas strepera</i>																	x													x		2
American Wigeon	<i>Anas americana</i>																		x														1
Mallard	<i>Anas platyrhynchos</i>				x					x				x	x		x	x	x												x		8
Blue-winged Teal	<i>Anas discors</i>			x	x						x			x			x	x	x												x		8
Northern Shoveler	<i>Anas clypeata</i>			x	x						x							x	x														5
Green-winged Teal	<i>Anas crecca</i>																	x															1
Canvasback	<i>Aythya valisineria</i>				x					x								x									x						4
Redhead	<i>Aythya americana</i>				x									x																			2
Ruddy Duck	<i>Oxyura jamaicensis</i>				x					x				x			x	x													x		6
Northern Harrier	<i>Circus cyaneus</i>																													x			1
Cooper's Hawk	<i>Accipiter cooperii</i>																			x													1
Swainson's Hawk	<i>Buteo swainsoni</i>																		x														1
Gray Partridge	<i>Perdix perdix</i>								x																								1
Sora	<i>Porzana carolina</i>					x											x		x	x	x				x	x	x					x	9
American Coot	<i>Fulica americana</i>			x	x		x			x	x	x		x	x		x	x	x				x								x		13
Killdeer	<i>Charadrius vociferus</i>									x				x				x															3
Greater Yellowlegs	<i>Tringa melanoeuca</i>																															x	2
Solitary Sandpiper														x																			1
Willet	<i>Catoptrophorus semipalmatus</i>									x																							1
Red-necked Phalarope	<i>Phalaropus lobatus</i>				x																												1
Franklin's Gull	<i>Larus pipixcan</i>																														x		1
Ring-billed Gull	<i>Larus delawarensis</i>										x																						1
Black Tern	<i>Chlidonias niger</i>									x	x			x					x														5
Downy Woodpecker	<i>Picoides pubescens</i>																		x														1
Western Kingbird	<i>Tyrannus verticalis</i>									x																							5
Eastern Kingbird	<i>Tyrannus tyrannus</i>				x					x				x											x								4



SPECIES	SCIENTIFIC NAME	2107	2109	7053	7052	7047	2006	2005	2004	2002	2003	2010	2000	2034	2166	2028	2121	2156	2157	2158	7038	2115	7035	2114	2116	2117	2118	2165	2164	2163	2162	2160	TOTAL
<i>*Wetland Classification</i>		2	1	2	5	1	1	1	1	5	5	2	3	5	2	4	5	4	5	1	2	2	4	1	1	1	1	2	2	2	3	2	
Loggerhead Shrike	<i>Lanius ludovicianus</i>												x																				1
Black-billed Magpie	<i>Pica hudsonia</i>																x	x			x				x								4
American Crow	<i>Corvus brachyrhynchos</i>																	x															1
Purple Martin	<i>Progne subis</i>																										x						1
Barn Swallow	<i>Hirundo rustica</i>				x								x																	x			3
Marsh Wren	<i>Cistothorus palustris</i>																										x						1
Gray Catbird	<i>Dumetella carolinensis</i>																								x								1
Cedar Waxwing	<i>Bombycilla cedrorum</i>										x						x																2
Common Yellowthroat	<i>Geothlypis trichas</i>													x					x											x	x		4
Clay-coloured Sparrow	<i>Spizella pallida</i>													x					x		x	x					x	x		x			7
Unknown sparrow																													x				1
Savannah Sparrow	<i>Passerculus sandwichensis</i>							x																x									2
Song Sparrow	<i>Melospiza melodia</i>				x									x			x		x	x	x					x					x		8
Red-winged Blackbird	<i>Agelaius phoeniceus</i>					x					x				x		x										x			x			6
American Goldfinch	<i>Carduelis tristis</i>				x										x		x										x			x			5
House Sparrow	<i>Passer domesticus</i>																x																1
Muskrat	<i>Ondatra zibethicus</i>									x				x						x	x	x											5
Wood Frog	<i>Rana sylvatica</i>														x																		1
TOTAL NUMBER OF SPECIES		0	0	3	13	2	2	1	1	11	8	1	2	14	5	2	21	10	11	3	5	2	1	1	5	1	7	1	1	0	13	3	

*Following Stewart and Kantrud (1971).

BOLD = COSEWIC (2011) listed species.



APPENDIX E

Wetland Classification (Stewart and Kantrud 1971)



Classification of Natural Ponds and Lakes in the Glaciated Prairie Region

Major Classes of Natural Ponds and Lakes

Seven major classes of wetlands in natural basins are recognized on the basis of ecological differentiation. **Each class is distinguished by the vegetational zone occurring in the central or deeper part and occupying 5 percent or more of the total wetland area being classified.** The plant species characteristic of these classes are listed in appendix A. The classes are designated as follows:

Class I-ephemeral ponds.

The wetland-low-prairie zone dominates the deepest part of the pond basin. A pond of this class is illustrated in plate 1.

Class II-temporary ponds.

The wet-meadow zone dominates the deepest part of the wetland area. A peripheral low-prairie zone is usually present. Ponds of this class are illustrated in plates 2 to 5.

Class III-seasonal ponds and lakes.

The shallow-marsh zone dominates the deepest part of the wetland area. Peripheral wet-meadow and low-prairie zones are usually present. Ponds of this class are illustrated in plates 6 to 12.

Class IV-semipermanent ponds and lakes.

The deep-marsh zone dominates the deepest part of the wetland area. Shallow-marsh, wet-meadow, and low-prairie zones are usually present, and isolated marginal pockets of fen zones occasionally occur. Ponds or lakes of this class are illustrated in plates 13 to 23.

Class V-permanent ponds and lakes.

The permanent-open-water zone dominates the deepest part of the wetland area. Peripheral deep-marsh, shallow-marsh, wet-meadow, and low-prairie zones are often present, and isolated marginal pockets of fen zone occasionally occur. Permanent lakes are illustrated in plates 24 to 26.

Class VI-alkali ponds and lakes.

The intermittent-alkali zone dominates the deepest part of the wetland area. Peripheral shallow-marsh, wet-meadow, and low-prairie zones are usually present. A deep-marsh zone is normally absent except occasionally for isolated patches near marginal seepage areas. A few isolated pockets of fen zone are normally present along the margins. Alkali lakes are illustrated in plates 27 and 28.

Class VII-fen (alkaline bog) ponds.

The fen zone dominates the deepest part of the wetland area. Peripheral wet-meadow and low-prairie zones are often present. The central part of a large fen is illustrated in plate 29.

Illustrations of the spatial relations of vegetational zones in the major classes of ponds and lakes are shown in figure 2. Normally, wetland classes are easily distinguished in the field. Occasionally, a pond or lake intermediate

between two classes will be encountered in which the deepest part of the wetland area is occupied by a mixture of species characteristic of two different zones (plates 10 and 11). In such a case the class designation would depend on which characteristic species group represents more than 50 percent of the vegetational growth in the deeper central area.

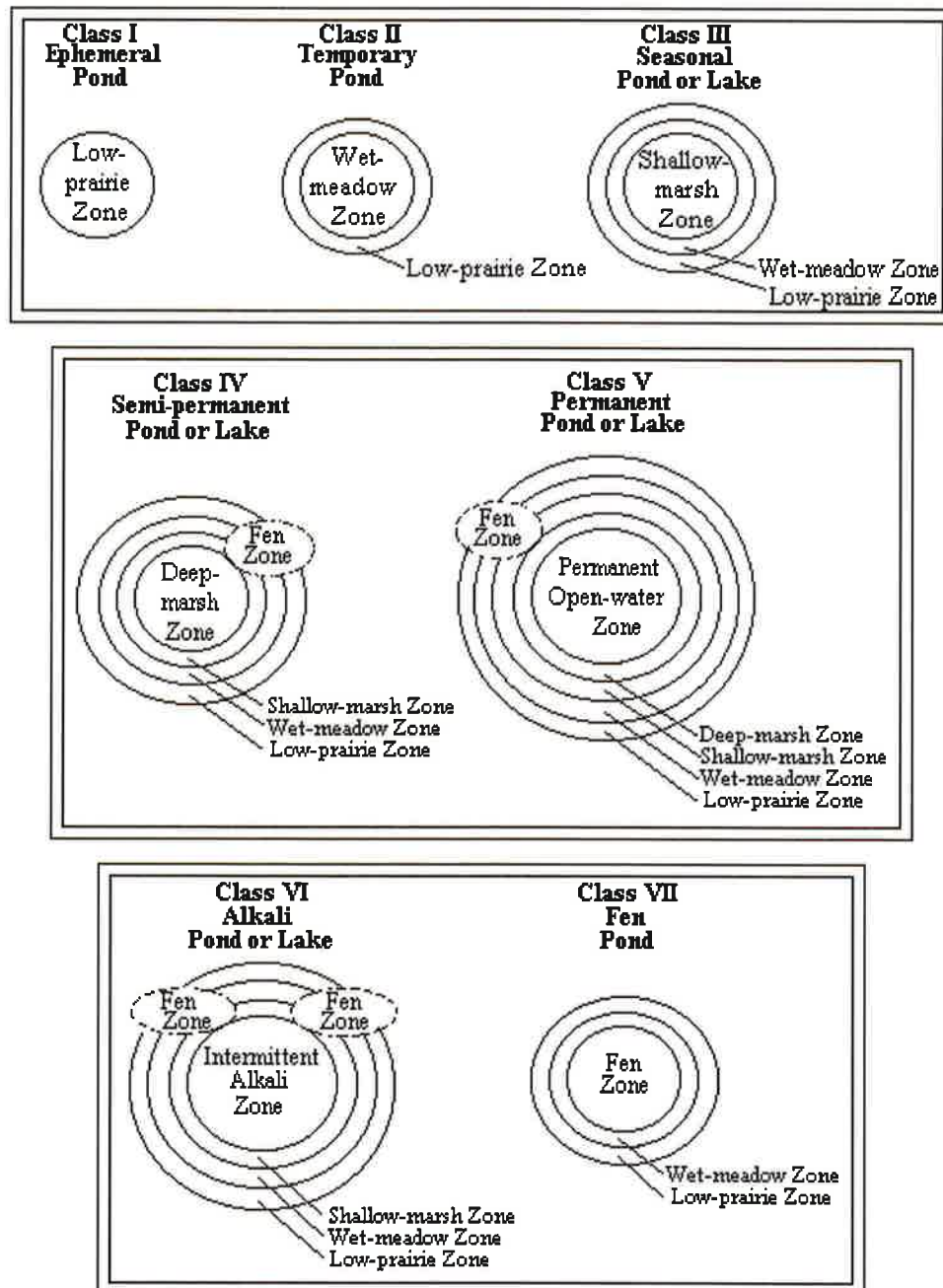


Figure 2. Spatial relation of vegetational zones in major classes of natural ponds and lakes.

During extended periods of abnormal water conditions, certain ponds and lakes may shift from one class to another. For example, in Stutsman County, N. Dak., in 1966, many shallow-marsh species, responding to extremely high water levels, invaded typical wet-meadow zones. During this period, some wetlands were transformed from temporary (Class II) to seasonal (Class III) ponds. Conversely, extreme drought in 1961 allowed wet-meadow vegetation to become established in many zones formerly dominated by shallow-marsh species, converting these wetlands from seasonal (Class III) to temporary (Class II) ponds. Immediately after the transition from one class to another, there may be a temporary reversal in the usual spatial relations of vegetational zones. For instance, stands of shallow-marsh emergents may develop in the deeper parts of a pond formerly occupied by the deep-marsh open-water phase, while surrounding bands of deep-marsh emergents may persist for a time in shallower water (plate 12).

Seasonal (Class III) and semipermanent (Class IV) ponds and lakes are the predominant wetlands in terms of total

acreage throughout the glaciated prairie region. Large numbers of ephemeral ponds (Class I) and temporary ponds (Class II) are present, but their total acreage is somewhat less. Permanent and alkali ponds and lakes (Classes V and VI), although often quite large individually, are few in number and therefore only of secondary significance. Fen ponds (Class VII) are usually small and quite local in occurrence.



APPENDIX F

Aquatic Communities and Water and Sediment Quality

Table F-1: Supporting Environmental Variables and Limnology Data for Selected Ponds Located in City of Saskatoon East Sector, August 2011

Waterbody	Station Code	Date	Air Temperature (°C)	Cloud Cover (%)	Precipitation Type	Wind Direction	Wind Rate	Secchi Depth (m)	Max Depth (m)	Profile Depth (m)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH	Comments
2002	COS-2002-WQ01-U11	4-Aug-11	22	<25%	none	north	light	1.4	1.8	0.2	22.3	11.3	861	9.0	water sample and duplicate.
										0.5	22.2	11.0	861	9.0	sediment sample and duplicate.
										0.7	22.2	10.8	862	9.0	
										1.0	22.2	10.6	862	9.0	
										1.3	22.0	10.0	864	9.0	
										1.5	22.0	9.7	864	9.0	
										1.7	21.9	2.5	866	8.7	
2015	COS-2015-WQ01-U11	4-Aug-11	26	<25%	none	north-west	light	1.25	1.25	0.2	22.5	9.1	1693	8.7	
										0.5	21.9	8.8	1696	8.7	
										0.8	21.4	7.6	1699	8.7	
										1.0	21.2	6.0	1699	8.7	
2018	COS-2018-WQ01-U11	4-Aug-11	21	<25%	none	north	light	1.0	1.4	0.2	19.4	4.9	2879	8.5	water and sediment samples.
										0.5	19.4	4.5	2879	8.4	
										0.8	19.2	2.3	2890	8.1	
										1.1	17.2	0.3	3578	7.1	
2024	COS-2024-WQ01-U11	4-Aug-11	21	<25%	none	north	light	0.7	1.9	0.2	21.9	11.0	1629	8.7	water and sediment samples.
										0.5	21.9	10.3	1629	8.8	
										0.8	21.9	10.7	1630	8.8	
										1.0	21.8	10.6	1631	8.8	
										1.3	21.8	10.3	1631	8.8	
										1.5	21.7	9.7	1633	8.8	
2034	COS-2034-WQ01-U11	4-Aug-11	19	<25%	none	north	light	1.0	1.0	0.2	21.5	6.6	1722	8.4	water sample.
										0.6	21.5	6.6	1723	8.4	
										0.7	21.5	6.7	1722	8.4	
2075a	COS-2075a-WQ01-U11	3-Aug-11	27	<25%	none	north	light	0.75	2.0	0.2	25.2	17.0	1206	9.7	water and sediment samples.
										0.6	21.9	17.4	1201	9.8	
										1.0	21.2	11.4	1198	9.7	
										1.5	20.1	2.7	1209	9.5	
2075b	COS-2075b-WQ01-U11	3-Aug-11	27	<25%	none	north	light	1.6	1.6	0.2	24.7	12.3	1528	9.1	
										0.5	21.1	8.9	1554	9.0	
										0.6	20.5	7.7	1559	9.0	
										1.0	19.7	2.8	1575	8.8	
										1.2	19.2	1.6	1573	8.7	
2084	COS-2084-WQ01-U11	5-Aug-11	30	25-50%	none	north	light	0.25	0.7	0.2	19.5	4.8	1481	8.9	water sample.
										0.5	18.7	3.5	1522	8.7	
2121	COS-2121-WQ01-U11	5-Aug-11	23	25-50%	none	none	calm	1.6	1.6	0.2	21.4	10.5	660	10.0	water and sediment samples.
										0.5	21.3	10.2	659	10.0	
										0.8	21.3	10.0	659	10.0	
										1.0	21.2	9.4	659	10.0	
										1.2	21.2	8.8	660	10.0	
										1.5	20.8	5.1	669	9.8	
2122	COS-2122-WQ01-U11	5-Aug-11	19	25-50%	none	none	calm	1.8	1.8	0.2	21.4	11.8	739	9.4	
										0.3	21.4	11.7	739	9.4	
										0.5	21.4	11.6	738	9.5	
										0.8	21.4	11.4	738	9.5	
										1.0	21.4	11.1	738	9.5	
										1.2	21.3	9.8	744	9.4	
										1.5	20.4	4.6	777	9.2	
2136	COS-2136-WQ01-U11	3-Aug-11	31	<25%	none	north	light	0.4	2.1	0.2	24.9	12.9	1434	8.6	water sample.
										0.5	22.2	9.3	1435	8.5	
										0.8	21.7	7.8	1440	8.5	
										1.0	21.4	6.5	1440	8.5	
										1.2	21.0	3.0	1451	8.4	
										1.5	20.7	0.4	1454	8.3	
										1.7	20.5	0.2	1454	8.3	

°C = degrees Celsius; % = percent; m = metre; mg/L = milligrams per litre; µS/cm = microSiemens per centimetre; Aug = August.

Table F-2 Water Chemistry for Wetlands in the City of Saskatoon East Sector, August 2011

Parameter Name	Units	Guidelines		Detection Limits	Wetland 2002	Wetland 2018	Wetland 2024	Wetland 2034	Wetland 2075a	Wetland 2084	Wetland 2121	Wetland 2136	Field Blank
		SSWQO ^(a)	CWQG ^(b)		n = 2 ^(c)	n = 1	n = 1	n = 1	n = 1	n = 1	n = 1	n = 1	n = 1
Conventional Parametres (Field-Measured)													
Dissolved oxygen	mg/L	-	-	-	11.3	4.9	11.0	6.6	17.0	4.8	10.5	12.9	-
Water temperature	°C	-	-	-	22.3	19.4	21.9	21.5	25.2	19.5	21.4	24.9	-
pH	pH units	-	6.5-9.0	-	9.0	8.5	8.7	8.4	9.7	8.9	10.0	8.6	-
Specific conductivity	µS/cm	-	-	-	861	2,879	1,629	1,722	1,206	1,481	660	1,434	-
Conventional Parametres (Laboratory-Measured)													
pH	pH units	-	6.5-9.0	0.07	8.73/8.74	8.11	8.49	8.28	9.68	8.47	9.72	8.39	6
Phenolphthalein alkalinity	mg/L	-	-	1	25/26	<1	18	<1	82	16	74	7	<1
Specific conductivity	µS/cm	-	-	1	892/890	2,930	1,680	1,700	1,220	1,550	675	1,460	1
Total alkalinity	mg/L	-	-	1	255/253	241	368	339	220	352	204	313	<1
Total dissolved solids	mg/L	-	-	1	641/651	2,210	1,180	1,320	886	1,190	499	1,000	3
Total hardness	mg/L	-	-	1	435/456	1,030	624	695	440	787	335	536	<1
Total suspended solids	mg/L	-	-	1	4/4	2	10	2	16	3	1	11	<1
Nutrients													
Ammonia as nitrogen	mg/L	0.022 ^(d)	0.022 ^(d)	0.01	0.08/0.08	0.01	0.15	0.08	0.10	0.08	0.07	0.08	<0.01
Nitrate	mg/L	-	-	0.04	<0.04/<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Nitrite	mg/L	-	-	0.03	<0.03/<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Organic carbon	mg/L	-	-	0.2	23/22	26	34	30	26	40	22	27	0.2
Organic carbon, dissolved	mg/L	-	-	0.2	22/24	26	32	30	24	39	21	25	<0.2
Ortho-phosphate as P	mg/L	-	-	0.01	0.78/0.78	<0.01	0.92	0.81	0.24	2	0.16	0.76	<0.01
Total Kjeldahl nitrogen	mg/L	-	-	0.05	2.1/2.1	1.4	3.9	1.9	3.1	1.7	1.7	1.9	<0.05
Major Ions													
Bicarbonate	mg/L	-	-	1	250/245	294	405	414	68	390	68	365	<1
Calcium	mg/L	-	-	0.1	74/74	111	100	109	66	111	60	98	<0.1
Carbonate	mg/L	-	-	1	30/31	<1	22	<1	98	19	89	8	<1
Chloride	mg/L	-	-	0.1	17/16	222	168	117	152	33	17	177	<0.1
Fluoride	mg/L	-	0.12	0.01	0.1/0.1	0.13	0.16	0.13	0.17	0.11	0.16	0.17	<0.01
Hydroxide	mg/L	-	-	1	<1/<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium	mg/L	-	-	0.1	61/66	184	91	103	67	124	45	71	<0.1
Potassium	mg/L	-	-	0.1	28/28	15	28	27	26	34	27	25	<0.1
Silicon, soluble	mg/L	-	-	0.01	2.2/2.2	0.6	9.7	8.4	2.2	3	0.16	6.1	0.08
Silicon, soluble, dissolved	mg/L	-	-	0.01	2.2/2.2	0.59	9.6	8.3	2.1	3	0.16	6	0.09
Sodium	mg/L	-	-	0.1	32/32	327	146	136	111	67	21	119	<0.1
Sulfate	mg/L	-	-	0.2	230/240	1,170	340	500	260	540	180	250	<0.2
Sum of ions	mg/L	-	-	1	722/732	2,320	1,300	1,410	848	1,320	507	1,110	<1
Metals (Total and Dissolved)													
Aluminum	mg/L	0.1 ^(e)	0.1 ^(e)	0.0005	0.0015/0.002	<0.0005	0.1	<0.0005	0.034	0.0022	0.0034	0.075	<0.0005
Aluminum, dissolved	mg/L	-	-	0.0005	0.0009/0.0008	<0.0005	0.024	0.0009	0.0058	0.0018	0.001	0.026	0.0006
Antimony	mg/L	-	-	0.0002	0.0002/0.0002	0.0002	0.0004	0.0002	0.0004	0.0004	0.0003	0.0003	<0.0002
Antimony, dissolved	mg/L	-	-	0.0002	0.0002/0.0002	0.0002	0.0004	<0.0002	0.0003	0.0004	0.0003	<0.0002	<0.0002
Arsenic	µg/L	5	5	0.1	6.2/6.4	4.6	13	7.6	17	11	9	8.6	<0.1
Arsenic, dissolved	µg/L	-	-	0.1	6.3/6.1	4.7	14	7.8	17	11	9.2	8.7	<0.1
Barium	mg/L	-	-	0.0005	0.11/0.11	0.038	0.093	0.062	0.11	0.2	0.035	0.12	<0.0005
Barium, dissolved	mg/L	-	-	0.0005	0.11/0.11	0.038	0.091	0.063	0.11	0.17	0.034	0.11	<0.0005
Beryllium	mg/L	-	-	0.0001	<0.0001/<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Beryllium, dissolved	mg/L	-	-	0.0001	<0.0001/<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Boron	mg/L	-	-	0.01	<0.01/<0.01	0.13	0.06	0.03	0.06	0.03	0.04	<0.01	<0.01
Boron, dissolved	mg/L	-	-	0.01	<0.01/<0.01	0.15	0.07	0.03	0.07	0.03	0.04	0.01	<0.01
Cadmium	mg/L	0.00010 ^(f)	0.000094 ^(g)	0.00001	0.00001/0.00003	0.00001	0.00001	<0.00001	0.00003	0.00002	0.00003	0.00001	<0.00001
Cadmium, dissolved	mg/L	-	-	0.00001	0.00001/<0.00001	0.00002	0.00001	<0.00001	0.00005	<0.00001	0.00001	<0.00001	<0.00001
Chromium	mg/L	-	0.0010/0.0089 ^(h)	0.0005	<0.0005/<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium, dissolved	mg/L	-	-	0.0005	<0.0005/<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L	-	-	0.0001	0.0003/0.0003	0.0001	0.0004	0.0002	0.0007	0.0004	0.0003	0.0004	<0.0001
Cobalt, dissolved	mg/L	-	-	0.0001	0.0002/0.0002	<0.0001	0.0004	0.0002	0.0006	0.0004	0.0003	0.0002	<0.0001
Copper	mg/L	0.004 ⁽ⁱ⁾	0.00664 ^(j)	0.0002	0.0002/0.0002	<0.0002	<0.0002	<0.0002	0.0009	<0.0002	0.0003	0.0002	<0.0002

Parameter Name	Units	Guidelines		Detection Limits	Wetland 2002	Wetland 2018	Wetland 2024	Wetland 2034	Wetland 2075a	Wetland 2084	Wetland 2121	Wetland 2136	Field Blank
		SSWQO ^(a)	CWQG ^(b)		n = 2 ^(c)	n = 1	n = 1	n = 1	n = 1	n = 1	n = 1	n = 1	n = 1
Copper, dissolved	mg/L	-	-	0.0002	<0.0002/<0.00002	<0.0002	<0.0002	<0.0002	0.0007	<0.0002	0.0002	<0.0002	<0.0002
Iron	mg/L	0.3	0.3	0.0005	0.021/0.021	0.027	0.11	0.0078	0.051	0.099	0.006	0.13	<0.0005
Iron, dissolved	mg/L	-	-	0.0005	0.0059/0.0059	0.011	0.037	0.021	0.008	0.03	0.0021	0.075	<0.0005
Lead	mg/L	0.007 ^(k)	0.01483 ^(l)	0.0001	<0.0001/<0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0003
Lead, dissolved	mg/L	-	-	0.0001	<0.0001/<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Manganese	mg/L	-	-	0.0005	0.052/0.052	0.37	0.83	0.2	0.069	1.78	0.014	0.35	<0.0005
Manganese, dissolved	mg/L	-	-	0.0005	0.038/0.037	0.35	0.81	0.28	0.03	1.69	0.0092	0.35	0.0006
Mercury	µg/L	0.026 ^(m)	0.026 ⁽ⁿ⁾	0.02	<0.02/<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Molybdenum	mg/L	-	0.073	0.0001	0.0006/0.0006	0.0002	0.0002	0.0002	0.0019	0.0002	0.0005	0.0009	<0.0001
Molybdenum, dissolved	mg/L	-	-	0.0001	0.0005/0.0005	0.0001	0.0003	0.0003	0.0016	0.0002	0.0005	0.0007	<0.0001
Nickel	mg/L	0.150 ^(o)	0.23954 ^(p)	0.0001	0.0017/0.0017	0.0012	0.0021	0.0017	0.0026	0.0023	0.0019	0.0022	<0.0001
Nickel, dissolved	mg/L	-	-	0.0001	0.0014/0.0014	0.0012	0.002	0.0017	0.0022	0.0021	0.0015	0.002	<0.0001
Selenium	mg/L	0.001	0.001	0.0001	0.0003/0.0003	0.0002	0.0002	0.0004	0.0005	0.001	0.0005	0.0004	<0.0001
Selenium, dissolved	mg/L	-	-	0.0001	0.0003/0.0004	0.0002	0.0003	0.0004	0.0004	0.001	0.0003	0.0004	<0.0001
Silver	mg/L	0.0001	0.0001	0.00005	<0.00005/<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Silver, dissolved	mg/L	-	-	0.00005	<0.00005/<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Strontium	mg/L	-	-	0.0005	0.43/0.43	1.34	0.82	0.86	0.49	0.69	0.36	0.63	<0.0005
Strontium, dissolved	mg/L	-	-	0.0005	0.41/0.42	1.39	0.86	0.9	0.47	0.67	0.37	0.62	<0.0005
Thallium	mg/L	-	0.0008	0.0002	<0.0002/<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thallium, dissolved	mg/L	-	-	0.0002	<0.0002/<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tin	mg/L	-	-	0.0001	<0.0001/<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0024	<0.0001
Tin, dissolved	mg/L	-	-	0.0001	0.0004/0.0005	0.0007	0.0003	<0.0001	0.0016	0.0006	0.0002	<0.0001	0.0007
Titanium	mg/L	-	-	0.0002	0.0003/0.0004	<0.0002	0.0042	0.0002	0.0035	0.001	0.0002	0.0022	<0.0002
Titanium, dissolved	mg/L	-	-	0.0002	<0.0002/<0.0002	<0.0002	0.0014	0.0002	0.0003	0.0008	<0.0002	0.0008	<0.0002
Uranium	µg/L	15	15	0.1	3.9/3.9	1.6	0.8	1.3	4.9	1.4	2.9	2.3	<0.1
Uranium, dissolved	µg/L	-	-	0.1	2.8/2.9	1.8	1.7	1	3.3	1.2	3	1.3	<0.1
Vanadium	mg/L	-	-	0.0001	0.0013/0.0013	0.0002	0.0016	<0.0001	0.004	0.0006	0.0026	0.0014	<0.0001
Vanadium, dissolved	mg/L	-	-	0.0001	0.0012/0.0012	0.0002	0.0016	0.0003	0.0036	0.0006	0.0024	0.0013	<0.0001
Zinc	mg/L	0.03	0.03	0.0005	0.0015/0.0015	0.0006	0.0011	0.0006	0.0016	0.0025	<0.0005	0.001	<0.0005
Zinc, dissolved	mg/L	-	-	0.0005	0.0008/0.0007	<0.0005	0.0006	<0.0005	<0.0005	0.0008	<0.0005	0.0006	0.001
Others													
Chlorophyll a	µg/L	-	-	0.1	46/47.2	5.7	186	5.3	23.5	13	2.8	39.7	<0.1

Notes: Values that are equal to or exceed the SSWQO are **bolded**. Values that are equal to or exceed the CWQG are underlined. Non-detect values that are higher than one or more guideline are *italized*.

(a) = Saskatchewan Environment's (2006) Saskatchewan Surface Water Quality Objectives (SSWQO).

(b) = Canadian Council of Ministers of the Environment's (CCME) Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life -freshwater (CCME 2007).

(c) = second entry represents value of duplicate sample.

(d) = The guidelines for ammonia are dependent on temperature and pH; therefore, the guideline for each station was calculated and the lowest overall value was used for screening.

(e) = The guidelines for aluminum are pH-dependent; the guideline is 0.1 mg/L at pH ≥ 6.5. Field pH values were used in the screening.

(f) = The guidelines for cadmium are hardness-dependent; at hardnesses greater than 194 mg/L as CaCO₃, the guideline is 0.00010 mg/L.

(g) = The guidelines for cadmium are hardness-dependent; therefore, the guideline for each station was calculated using the equation $10^{0.00019[\ln(\text{hardness})]-0.4}$ with the guideline in µg/L; the lowest overall value was used for screening. The value presented is based on a hardness of 335 mg/L.

(h) = The guidelines for chromium are speciation-dependent; the guideline is 0.0089 mg/L for trivalent chromium and 0.0010 mg/L for hexavalent chromium.

(i) = The guidelines for copper are hardness-dependent; at hardnesses greater than 180 mg/L (very hard) as CaCO₃, the guideline is 0.004 mg/L.

(j) = The guidelines for copper are hardness-dependent; therefore, the guideline for each station was calculated using the equation $e^{0.8545[\ln(\text{hardness})]-1.465} * 0.2$ with the guideline in µg/L; the lowest overall value was used for screening. The value presented is based on a hardness of 335 mg/L.

(k) = The guidelines for lead are hardness-dependent; at hardnesses greater than 180 mg/L (very hard) as CaCO₃, the guideline is 0.007 mg/L.

(l) = The guidelines for lead are hardness-dependent; therefore, the guideline for each station was calculated using the equation $e^{1.273[\ln(\text{hardness})]-4.705}$ with the guideline in µg/L; the lowest overall value was used for screening. The value presented is based on a hardness of 335 mg/L.

(m) = Mercury objective is for inorganic mercury only.

(n) = Mercury guidelines differ depending on mercury type: inorganic mercury = 0.026 µg/L; methylmercury = 0.004 µg/L.

(o) = The guidelines for nickel are hardness-dependent; at hardnesses greater than 180 mg/L (very hard) as CaCO₃, the guideline is 0.150 mg/L.

(p) = The guidelines for nickel are hardness-dependent; therefore, the guideline for each station was calculated using the equation $e^{0.76[\ln(\text{hardness})]+1.06}$ with the guideline in µg/L; the lowest overall value was used for screening. The value presented is based on a hardness of 335 mg/L.

mg/L = milligrams per litre; °C = degrees Celsius; µg/L = micrograms per litre; µS/cm = microSiemens per centimetre; < = less than; ≥ = greater than or equal to; - = not applicable or not collected; CaCO₃ = calcium carbonate.

Table F-3 Sediment Chemistry for Wetlands in the City of Saskatoon East Sector, August 2011

Parameter Name	Units	CCME Sediment Quality Guidelines		Detection Limit	Wetland 2002	Wetland 2018	Wetland 2024	Wetland 2075a	Wetland 2121
		ISQG ^(a)	PEL ^(b)		n = 2 ^(c)	n = 1	n = 1	n = 1	n = 1
Physical Properties									
Loss on Ignition	%	-	-	1	18/17	11	15	15	9
% Moisture	%	-	-	0.1	72.4/71.6	68.1	69.5	61.7	66.7
Nutrients									
Total Nitrogen	%	-	-	0.02	0.796/0.818	0.442	0.612	0.674	0.322
Phosphorus (P)	mg/kg dw	-	-	50	651/660	587	744	682	549
Total Phosphorus	mg/kg dw	-	-	50	669/691	591	779	722	583
Total Organic Carbon	%	-	-	0.1	7.72/8.08	5.07	5.54	6.51	3.15
Inorganic Carbon	%	-	-	0.1	0.39/0.33	1.88	0.53	0.36	0.34
CaCO ₃ Equivalent	%	-	-	0.7	3.23/2.74	15.7	4.42	2.99	2.82
Total Carbon by Combustion	%	-	-	0.1	8.1/8.4	6.9	6.1	6.9	3.5
Major Ions									
Calcium (Ca)	mg/kg dw	-	-	100	13,900/12,200	37,600	17,900	13,000	12,700
Magnesium (Mg)	mg/kg dw	-	-	100	5,250/5,080	13,200	7,450	6,860	4,580
Potassium (K)	mg/kg dw	-	-	100	3,640/3,600	2,000	4,430	3,980	2,970
Sodium (Na)	mg/kg dw	-	-	100	220/200	1,460	650	500	200
Metals and Metalloids									
Aluminum (Al)	mg/kg dw	-	-	50	9,890/9,570	7,850	13,700	12,300	8,250
Antimony (Sb)	mg/kg dw	-	-	0.1	0.37/0.36	0.33	0.32	0.47	0.24
Arsenic (As)	mg/kg dw	5.9	17.0	0.1	5.51/4.97	3.22	5.35	5.98	4.09
Barium (Ba)	mg/kg dw	-	-	1	172/164	165	198	171	127
Beryllium (Be)	mg/kg dw	-	-	0.5	0.55/0.53	<0.50	0.62	0.65	<0.50
Bismuth (Bi)	mg/kg dw	-	-	1	<1.0/<1.0	<1.0	<1.0	<1.0	<1.0
Cadmium (Cd)	mg/kg dw	0.6	3.5	0.1	0.49/0.50	0.30	0.47	0.47	0.31
Chromium (Cr)	mg/kg dw	37.3	90.0	0.5	17.8/17.3	26.1	27.4	21.1	17.6
Cobalt (Co)	mg/kg dw	-	-	1	6.3/5.8	5.6	7.2	7.7	5.2
Copper (Cu)	mg/kg dw	35.7	197	1	20.3/20.1	16.5	20.1	24.0	14.3
Iron (Fe)	mg/kg dw	-	-	50	15,200/14,400	15,000	18,200	19,000	13,600
Lead (Pb)	mg/kg dw	35.0	91.3	1	13.6/13.3	17.1	12.4	13.4	7.8
Lithium (Li)	mg/kg dw	-	-	1	9.2/8.4	11.7	14.4	14.4	8.4
Manganese (Mn)	mg/kg dw	-	-	1	321/291	414	397	256	336
Mercury (Hg)	mg/kg dw	0.17	0.486	0.005	0.0359/0.0390	0.0237	0.0267	0.0393	0.0237
Molybdenum (Mo)	mg/kg dw	-	-	1	<1.0/<1.0	1.8	<1.0	<1.0	<1.0
Nickel (Ni)	mg/kg dw	-	-	1	18.3/17.6	18.0	22	23.2	14.7
Selenium (Se)	mg/kg dw	-	-	0.2	0.71/0.69	0.49	0.49	0.74	0.4
Silver (Ag)	mg/kg dw	-	-	0.2	<0.20/<0.20	<0.20	<0.20	<0.20	<0.20
Strontium (Sr)	mg/kg dw	-	-	1	70.6/64.8	105	99.3	70.2	55.9
Thallium (Tl)	mg/kg dw	-	-	0.1	0.20/0.20	0.17	0.22	0.23	0.16
Tin (Sn)	mg/kg dw	-	-	2	<2.0/<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg dw	-	-	5	50.2/51.1	69.5	57.7	57.8	59.9
Uranium (U)	mg/kg dw	-	-	0.1	2.28/2.22	5.57	2.70	2.74	1.30
Vanadium (V)	mg/kg dw	-	-	1	27.8/26.6	24.1	34.8	34.2	22.9
Zinc (Zn)	mg/kg dw	123	315	5	75.3/74.8	63.6	77.1	86.7	53.5

Notes: Values greater than or equal to ISQGs are **bolded**. Values greater than or equal to PELs are **bolded** and underlined.

Non-detect values that have detection limits that are greater than guidelines are *italicized*.

(a) = ISQG = Interim Freshwater Sediment Quality Guidelines (CCME 2002).

(b) = PEL = Probable Effect Levels (CCME 2002).

(c) = second entry represents value of duplicate sample.

CCME = Canadian Council of Ministers of the Environment; % = percentage; mg/kg dw = milligrams per kilogram based on dry weight of sample; < = less than; - not applicable.

n = number of samples analyzed; CaCO₃ = calcium carbonate.



APPENDIX G

Heritage Resource Review



ABOUT TOURISM, PARKS, CULTURE AND SPORT

Inquiry was made on August 3, 2011 at 12:45 PM

You are inquiring about the heritage sensitivity of the following land location:

Quarter-section: NE

Section: 19

Township: 36

Range: 4

Meridian: 3

This quarter-section is NOT heritage sensitive.

It is not necessary to submit the project to the Heritage Conservation Branch for screening. These results can be printed for submission to other regulatory bodies (e.g. Saskatchewan Environment, Saskatchewan Industry and Resources). Please email arms@gov.sk.ca if you have any questions.

Inquiry was made on August 3, 2011 at 12:45 PM

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