September 2012

City of Saskatoon West/Southwest Sector Natural Area Screening Study

Submitted to:
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Saskatoon, Saskatchewan
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REPORT

Report Number: 12-1361-0028
Distribution:

5 Copies - City of Saskatoon, Saskatoon, Saskatchewan (+cd)
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Golder Associates

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APPENDICES

1.0 INTRODUCTION

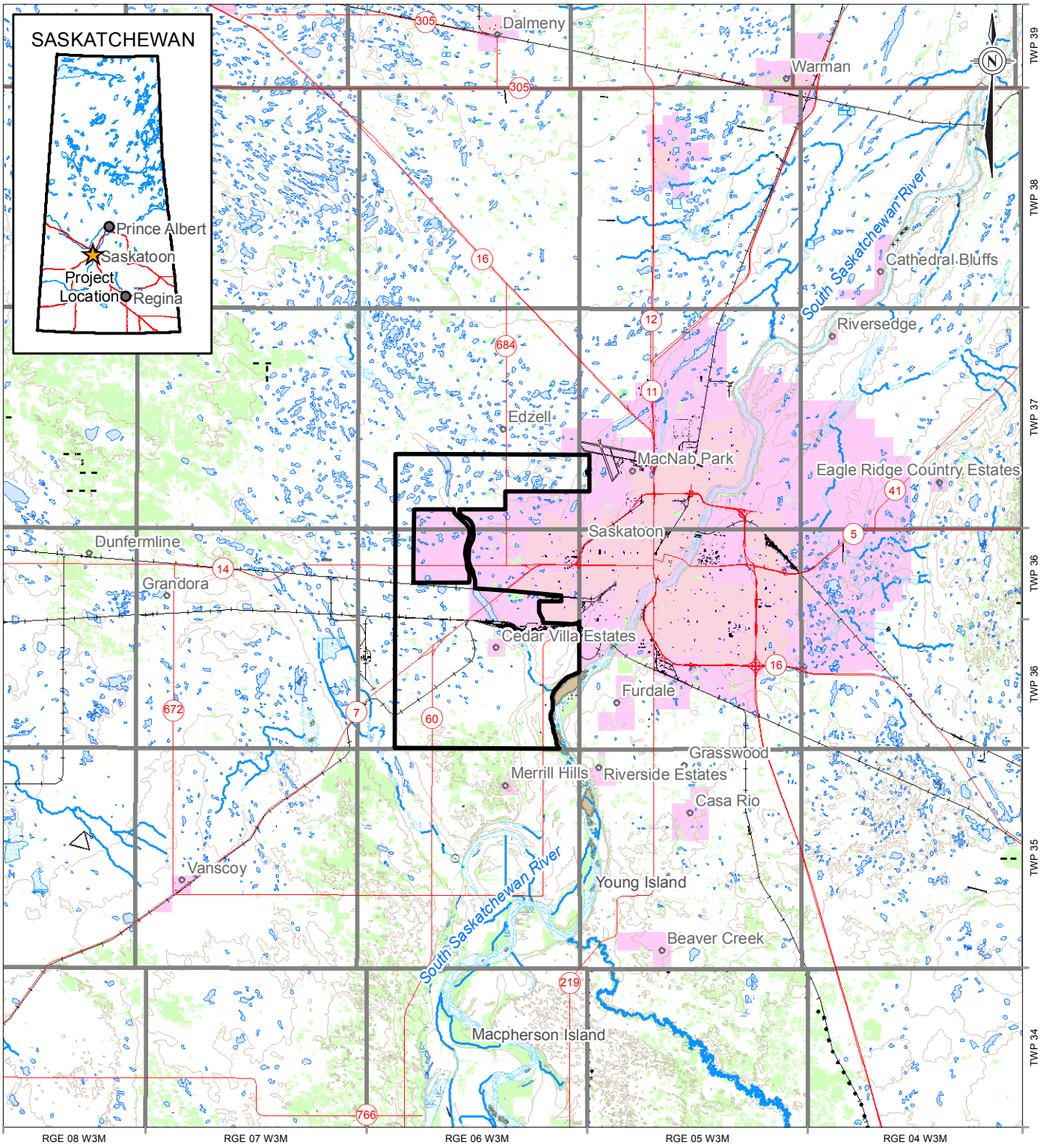
The City of Saskatoon issued a Request for Proposal on March 27, 2012, for work pertaining to a Natural Screening to supplement the physical characteristics section of the Southwest Sector Plan and Planning District Concept Plan Area 3. Golder Associates Ltd. (Golder) was selected on April 27, 2012, to complete the West/Southwest Natural Area Screening Study (Screening Study). The Screening Study, required by the City of Saskatoon's Official Community Plan Bylaw No. 8769 prior to development, considers the health and safety of people in the area, as well as the conservation of important ecological areas, vegetation communities, wildlife and wildlife habitat, and wetlands and drainage patterns. The Screening Study will aid the City of Saskatoon in identifying areas of interest (ecologically or for potential developments) to support future planning direction.

For the purpose of this report, 'listed species' will refer to 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*). Specific rankings and/or designations for species are provided in relevant tables contained within this report.

1.1 Study Area

The general location of the Study Area identified by the City of Saskatoon for field assessments of listed plant and wildlife species is shown in Figure 1-1. The majority of the Study Area is private land. The Chappell Marsh Conservation Area, a Ducks Unlimited Canada project (2011), is located in the central part of the Study Area, which is south of the City of Saskatoon land in the NW 14-36-6 W3M. There also is a quarter section of Agricultural Crown land, an occupied agricultural lease, in SW 11-36-6 W3M (Ministry of Agriculture 2012). Figure 1-2 shows the areas within the Study Area that were targeted for focused, pedestrian field surveys; however, additional areas within the Study Area were also assessed through road side surveys.

The Study Area is located in the Saskatoon Plain and the Moose Wood Sand Hills landscape areas of the Moist Mixed Grassland Ecoregion (Acton et al. 1998). This area has a sub-humid continental climate with a short, warm summer. The Moist Mixed Grassland of the Study Area is a broad plain characterized by Dark Brown Chernozemic soils. It is a mosaic of mid- and short-grass prairie and stands of woody vegetation in low areas and around wetlands. Common grass species include wheatgrasses (*Elymus* spp., *Pascopyrum smithii*) and speargrasses (*Hesperostipa* spp., *Nassella viridula*), with blue grama grass (*Bouteloua gracilis*) on drier uplands Fescue (*Festuca* spp.), sedges (*Carex* spp.), and June grass (*Koeleria macrantha*) also occur. Woodlands primarily are dominated by trembling aspen (*Populus tremuloides*) with an understory of shrubs, herbs, and grasses. The Moist Mixed Grassland supports up to 51 mammal species including coyote (*Canus latrans*), striped skunk (*Mephitis mephitis*), mule and white-tailed deer (*Odocoileus hemionus* and *O. Virginianus*), porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), and a variety of voles and mice. Of the 198 species of birds found in this area, 92 are summer residents, 10 are permanent residents, 16 are non-breeding summer residents, and 73 are transient species.



5 0 5

SCALE 1:250,000 KILOMETRES

LEGEND

STUDY AREA

REFERENCE

CANVEC © 2012, NATURAL RESOURCES CANADA
ROADS AND HIGHWAYS © DMTI, 2011
NTS MAPSHEET: 73B02
NAD 83 UTM ZONE 13

PROJECT

CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE

GENERAL LOCATION MAP

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.3000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JW	29/08/12	**FIGURE: 1-1**	
CHECK	MT	29/08/12		
REVIEW	ME	29/08/12		

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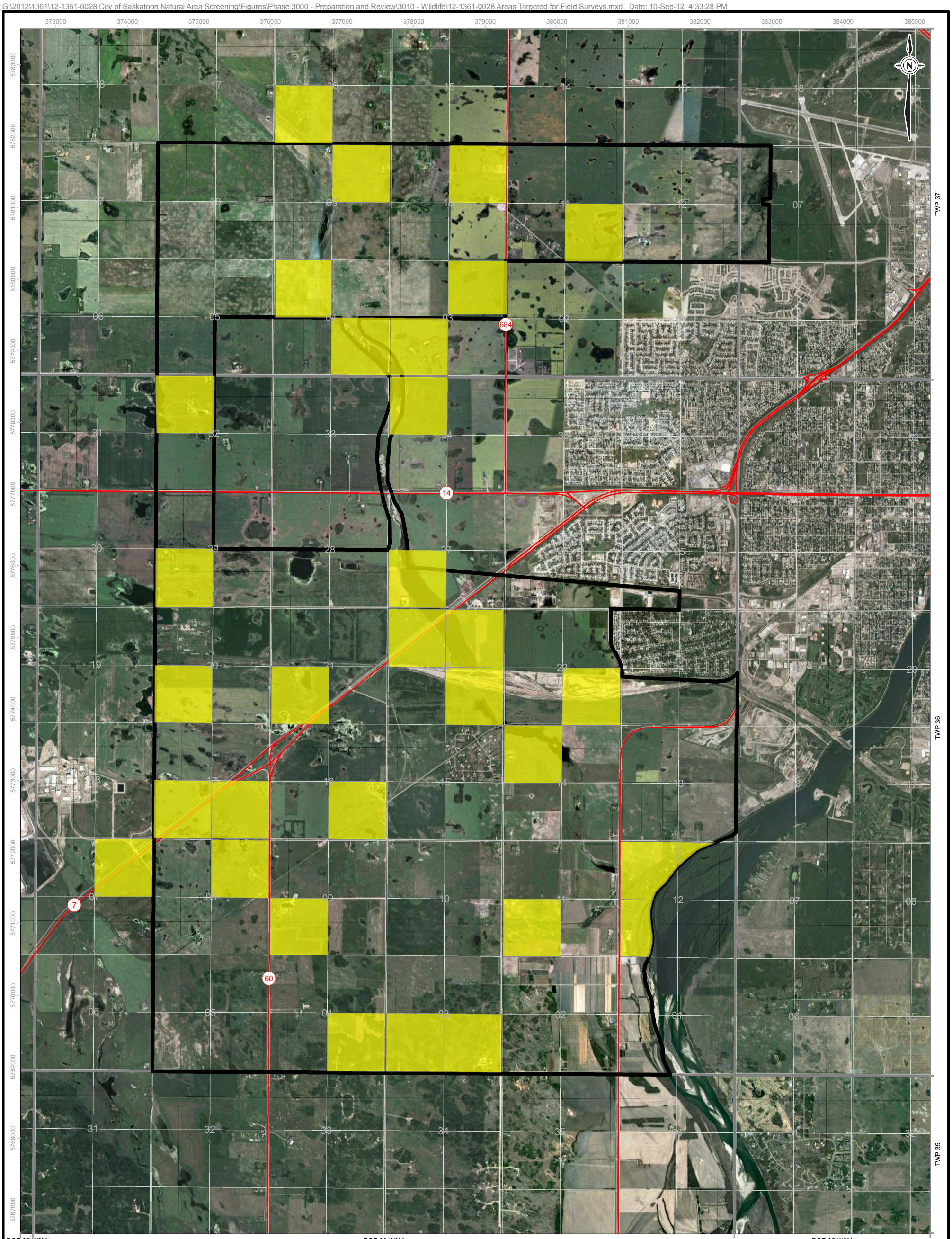
G:\2012\1361\12-1361-0028 City of Saskatoon Natural Area Screening\Figures\Phase 3000 - Preparation and Review\3010 - Wildlife\12-1361-0028 Areas Targeted for Field Surveys.mxd Date: 10-Sep-12 4:33:28 PM



LEGEND

- TOWNSHIP / RANGE BOUNDARY
- SECTION BOUNDARY
- HIGHWAY
- STUDY AREA
- TARGETED AREA

1 0 1
SCALE 1:50,000 KILOMETRES

REFERENCE

DMTI HIGHWAYS AND ROADS © 2011
DIGITAL GLOBE, GEOEYE IMAGERY © GOOGLE, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 13

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
AREAS TARGETED FOR FIELD SURVEYS

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.3000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	LMR	29/08/12		
CHECK	MT	10/09/12		
REVIEW	ME	10/09/12		

FIGURE: 1-2

The Saskatoon Plain, comprising most of the Study Area, is a level glacial lake and eroded glacial till plain overlaid with dark brown, loamy soils. For the most part, this landscape area is cultivated; however, remnant native grassland remains in sandy areas or areas with stony or gravelly soil. Native vegetation communities also exist along the South Saskatchewan River valley. The southern portion of the Study Area is located in the Moose Wood Sand Hills, which includes a region of sand dunes south of Saskatoon along the South Saskatchewan River. Native vegetation is more commonly found in this landscape area; only 40% of the land is cultivated, with the rest primarily used as rangeland, residential acreages, and limited industrial and commercial development (e.g., greenhouses and sod farms).

2.0 VEGETATION COMMUNITIES AND LISTED PLANT SPECIES

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 pedestrian and roadside surveys were conducted in the Study Area on June 27 and 28, 2012, by Andrew Stewart (ecologist, Golder). Direct observation of species were documented and recorded. Significant sightings such as listed species or weed species of concern were marked using Global Positioning System (GPS) units.

2.2 Results

2.2.1 Vegetation Communities

The surveys in the Study Area were focused in and around native grassland, modified grassland, and wetland plant communities. Most of the Study Area has been disturbed previously through cultivation and other developments, particularly in the northern region. Common cultivated crops in this area include wheat and canola.

Some small native grassland communities are located in the southern portion of the Study Area, usually in association with hills and in and around trembling aspen bluffs. Common species include needle-and-thread (*Hesperostipa comata*), Canada violet (*Viola canadensis*), June grass (*Koeleria macrantha*), and prairie cinquefoil (*Potentila pensylvanica*). Modified grasslands are located in the Study Area, often in association with fields that have been planted for forage/hay, along road ditches, and around development sites. These areas are dominated typically by smooth brome (*Bromus inermis*), alfalfa (*Medicago sativa*), and sweet clover (*Melilotus officinalis*). Class IV wetlands, which are too large to be cultivated, also are present in the Study Area. Several low lying areas that have been previously tilled have become flooded out and have now started supporting some volunteer aquatic vegetation due to the higher than normal water levels.

A natural swale, called the West Swale, meanders through the Study Area, and high precipitation this year, as well as the previous consecutive years, has caused increased inundation and creation of large open wetlands within the swale. In the centre of the Study Area, the swale is occupied by a large wetland and the Chappell Marsh Conservation Area. Small low areas or drainages in between the larger open waterbodies connect the swale complex. The swale passes through Chappell Marsh before connecting with the South Saskatchewan River. Terrain in the swale is relatively level with numerous small, scattered wetland areas, providing abundant habitat for aquatic vegetation, in addition to belts of native and modified grassland on its peripheries.

Complete lists of all vegetation species observed during the field program are provided in Table 2-1 (native grassland communities), Table 2-2 (modified grassland communities), and Table 2-3 (wetland communities).

Table 2-1: Plant Species Observed in Native Grassland Communities, 2012

Common Name	Scientific Name	Common Name	Scientific Name
Trees and Shrubs			
Saskatoon	*Amelanchier alnifolia*	Prairie rose	*Rosa arkansana*
Common bearberry	*Arctostaphylos urva-usi*	Wood rose	*Rosa woodsii*
Red-osier dogwood	*Cornus sericea*	Red raspberry	*Rubus idaeus*
Northern hawthorn	*Crataegus chrysocarpa*	Pussy willow	*Salix discolor*
Wolf willow	*Elaegnus commutata*	Sandbar willow	*Salix exigua*
Balsam poplar	*Populus balsamifera*	Slender willow	*Salix petiolaris*
Trembling aspen	*Populus tremuloides*	Northern snowberry	*Symphoricarpos albus*
Chokecherry	*Prunus virginiana*	Western snowberry	*Symphoricarpos occidentalis*
Prickly rose	*Rosa acicularis*	-	-
Forbs			
Common yarrow	*Achillea miilefolium*	Northern bedstraw	*Galium boreale*
Prairie onion	*Allium textile*	Wild licorice	*Glycyrrhiza lepidota*
Canada anemone	*Anemone canadensis*	Hairy golden aster	*Heterotheca villosa*
Small-leaved everlasting	*Antennaria parviflora*	Narrow-leaved hawkweed	*Hieracium umbellatum*
Spreading dogbane	*Apocynum androsaemifolium*	Common blue lettuce	*Lactuca tatarica* var. *pulchella*
Canada sagewort	*Artemisia campestris*	Starflower false solomon's-seal	*Maianthemum stellatum*
Pasture sage	*Artemesia frigida*	Blunt-leaved sandwort	*Moehringia lateriflora*
Prairie sage	*Artemisia ludoviciana*	Wild bergamot	*Monarda fistulosa*
Lindley's aster	*Aster ciliolatus*	Silver psoralea	*Pediomelum argophyllum*
Heath aster	*Aster ericoides*	Indian breadroot	*Pediomelum esculentum*
Smooth aster	*Aster laevis*	Prairie cinquefoil	*Potentilla pensylvanica*
Purple milk-vetch	*Astragalus agrestis*	Entire-leaved groundsel	*Senecio integerrimus*
Harebell	*Campanula rotundifolia*	Canada goldenrod	*Solidago canadensis*
Canada thistle	*Cirsium arvense*	Missouri goldenrod	*Solidago missouriensis*
Pale comandra	*Comandra umbellatum*	Decumbent goldenrod	*Solidago simplex*
Purple clover	*Dalea purpurea*	Annual sow-thistle	*Sonchus oleraceus*
Flixweed	*Descuriana sophia*	Veiny meadow-rue	*Thalictrum venulosum*
Philadelphia fleabane	*Erigeron philadelphicus*	Golden-bean	*Thermopsis rhobifolia*
Wormseed mustard	*Erysimum cheiranthoides*	Seaside arrow-grass	*Triglochin maritima*
Leafy spurge	*Euphorbia esula*	American milk-vetch	*Vicia americana*
Wild smooth strawberry	*Frageria virginiana*	Canada violet	*Viola canadensis*
Graminoids			
Rough hair grass	*Agrostis scabra*	June grass	*Koeleria macrantha*
Smooth brome	*Bromus inermis*	Indian rice grass	*Oryzopsis hymenoides*
Downy brome	*Bromus tectorum*	Western wheatgrass	*Pascopyrum smithii*
Silvery-flowered sedge	*Carex aenea*	Kentucky bluegrass	*Poa pratensis*
Blunt sedge	*Carex obtusata*	Purple oatgrass	*Schizachne purpurascens*
Graceful manna grass	*Glyceria pulchella*	Needle-and-thread grass	*Hesperostipa comata*
Baltic rush	*Juncus balticus*	-	-

Table 2-2: Plant Species Observed in Modified Grassland Communities, 2012

Common Name	Scientific Name	Common Name	Scientific Name
Trees and Shrubs			
Caragana	*Caragana arborescens*	Skunk currant	*Ribes glandulosum*
White spruce	*Picea glauca*	Thorny buffalo-berry	*Shepherdia argentea*
Blue spruce	*Picea pungens*	Canada buffalo-berry	*Shepherdia canadensis*
Jack pine	*Pinus banksiana*	American elm	*Ulmus americana*
Eastern cottonwood	*Populus deltoides*	-	-
Forbs			
Common yarrow	*Achillea miilefolium*	Leafy spurge	*Euphorbia esula*
Pygmyflower	*Androsace septentrionalis*	Three flowered avens	*Geum triflorum*
Absinthe	*Artemisia absinthium*	Narrow-leaved hawkweed	*Hieracium umbellatum*
Nodding thistle	*Carduus nutans*	Alfalfa	*Medcago sativa*
Lamb's quarters	*Chenopodium album*	Yellow sweet clover	*Melilotus officinalis*
Canada thistle	*Cirsium arvense*	Common plantain	*Plantago major*
Wavy-leaved thistle	*Cirsium undulatum*	Rough cinquefoil	*Potentilla norvegica*
Rough fleabane	*Erigeron asper*	Small flowered buttercup	*Ranunculus abortivus*
Philadelphia fleabane	*Erigeron philadelphicus*	Goat's beard	*Tragopogon dubius*
Wormseed mustard	*Erysimum cheiranthoides*	-	-
Graminoids			
Smooth brome	*Bromus inermis*	Prairie cord grass	*Spartina pectinata*
Kentucky bluegrass	*Poa pratensis*	-	-

Table 2-3: Plant Species Observed In or Around Wetland Communities, 2012

Common Name	Scientific Name	Common Name	Scientific Name
Trees and Shrubs			
Skunk currant	*Ribes glandulosum*	Canada buffalo-berry	*Shepherdia canadensis*
Thorny buffalo-berry	*Shepherdia argentea*	-	-
Forbs			
Water plantain	*Alisma trivale*	Water crowfoot	*Ranunculus trichophyllus*
Tall scouring rush	*Equisetum hyemale*	Western dock	*Rumex aquaticus* var. *fenestratus*
Sea-milkwort	*Glaux maritima*	Curled dock	*Rumex crispus*
Duckweed	*Lemna minor*	Golden dock	*Rumex maritimus*
American water hore-hound	*Lycopus asper*	Perennial sow-thistle	*Sonchus arvensis*
Tall buttercup	*Ranunculus acris*	Scentless chamomile	*Tripleurospermum inodorum*
Celery-leaved buttercup	*Ranunculus sceleratus*	Cattail	*Typha latifolia*
Graminoids			
Slough grass	*Beckmania syzigachne*	Quackgrass	*Elytrigia repens*
Prairie bulrush	*Bolboschoenus maritimus*	American manna grass	*Glyceria grandis* var. *grandis*
Awned sedge	*Carex atheroides*	Graceful manna grass	*Glyceria pulchella*
Water sedge	*Carex aquatilis*	Foxtail barley	*Hordeum jubatum*
Woolly sedge	*Carex pellita*	Baltic rush	*Juncus balticus*
Sartwell's sedge	*Carex sartwellii*	Canary reed grass	*Phalaris arundinacea*
Common spike-rush	*Eleocharis palustris*	Three square bulrush	*Schoenoplectus pungens*

2.2.2 Listed Plant Species

No provincial or federal listed plant species were identified during the 2012 field surveys, although suitable habitat is sporadically available in the Study Area, generally in association with non-modified uplands and wetlands. Based on a review of the SKCDC (2012) database, nine provincially tracked plant species have been documented previously in the Study Area and designated 500 m buffer (Table 2-4; Figure 2-1). Suitable growing habitat requirements for these species typically is found around low areas and dry, sandy areas with eroded slopes. Potential habitat for these species is present around many of the low areas throughout the Study Area, but open, dry, sandy habitat is limited.

Table 2-4: Provincially Tracked Plant Species Previously Documented in the Study Area

Common Name	Scientific Name	Provincial Ranking	Preferred Habitat (Harms et al. 1992)
Indian milk-vetch	*Astragalus aboriginum*	S2	Dry, eroded, sandy prairie slopes.
Low milk-vetch	*Astragalus lotiflorus*	S3	Sandy, often eroded grasslands.
Chaffweed	*Centunculus minimus*	S2	Drying slough margins and prairie depressions.
Mud purslane	*Elatine rubella*	S2	Wet and drying mud flats, slough bottoms, and tilled field potholes.
Blue wild rye	*Elymus glaucus* spp. *glaucus*	S2	Mesic, open woods, and thickets.
Five-foliate cinquefoil	*Potentilla nivea* var. *pentaphylla*	S2	Dry, sandy prairie.
Pale bulrush	*Scirpus pallidus*	S2	Marshy shores, moist ravine-bottoms, and low meadows.
Prairie ragwort	*Senecio plattensis*	S3S4	Mesic grasslands, sloughs, open woods.
Small dropseed	*Sporobolus neglectus*	S1	Dry, often disturbed, gravelly barrens.

Provincial Rank Definitions

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

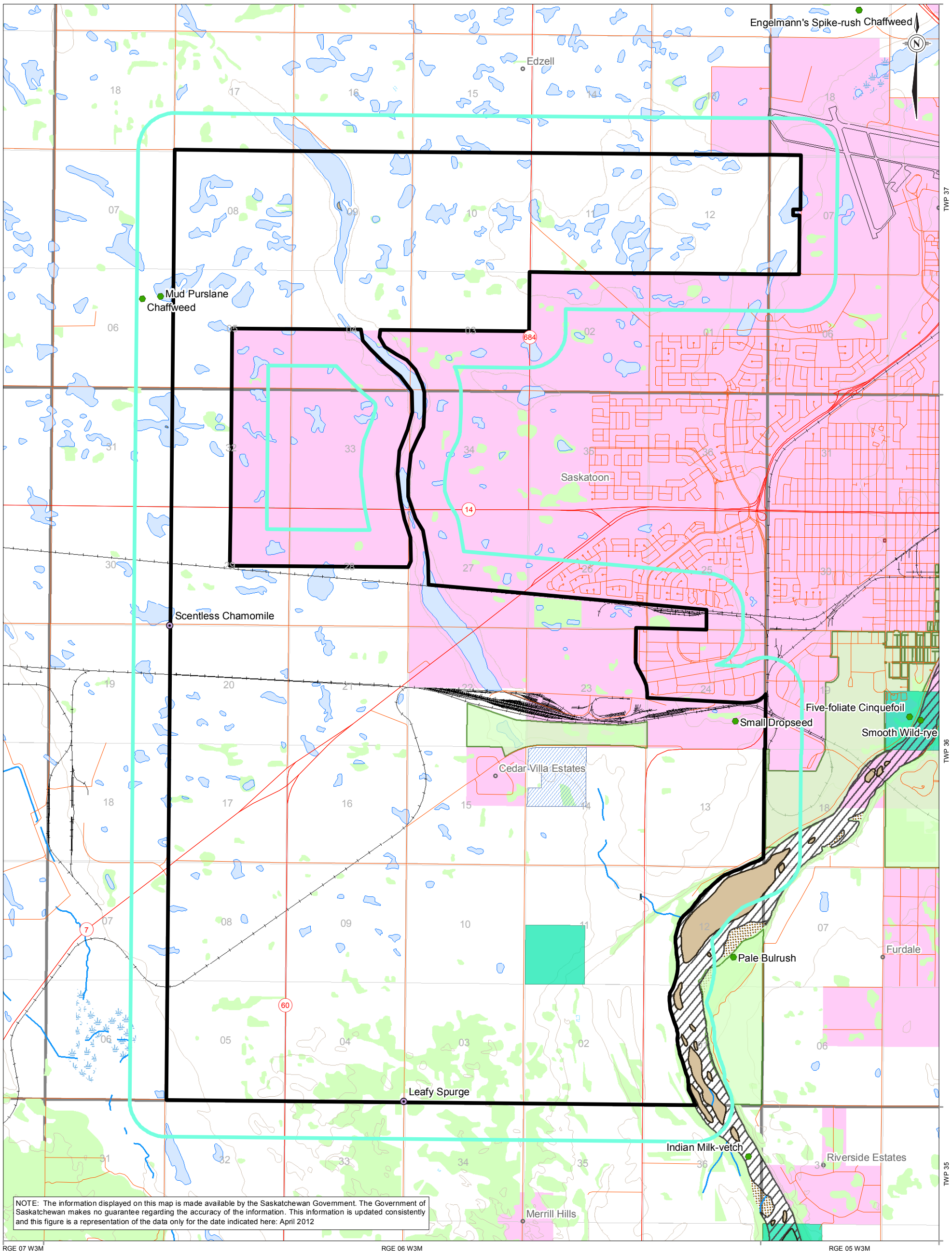
S2 Rare – 6 to 20 occurrences in Saskatchewan or few remaining individuals.

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).

2.2.3 Weeds

Several nuisance and noxious weeds are present in the Study Area (Table 2-5). Noxious weeds observed include absinthe (*Artemisium absinthum*), downy brome (*Bromus tectorum*), nodding thistle (*Carduus nutans*), Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), perennial sow thistle (*Sonchus arvensis*), annual sow thistle (*Sonchus oleracea*), and scentless chamomile (*Tripleurospermum perforatum*). Several nuisance weeds are found throughout the area and the most common ones include quack grass (*Elytrigia repens*), foxtail barley (*Hordeum jubatum*), blue lettuce (*Lactuca tatarica* ssp. *pulchella*), dandelion (*Taraxacum officinale*), and goat's beard (*Tragopogon dubius*). Three species listed in Table 2-5 are of particular concern. These include downy brome, leafy spurge, and scentless chamomile. These species can spread aggressively and are difficult to control. They can displace or out compete endemic species in native plant communities and can be problematic in cultivated and hay lands. Downy brome was identified in a native grassland location along the southern boundary of the Study Area, while leafy spurge was found scattered sporadically along the southern boundary of the Study Area and scentless chamomile was found at a wetland (WET013; Figure 2-1) in the west central portion of the Study Area.

G:\2012\1361\12-1361-0028 City of Saskatoon Natural Area Screening\Figures\Phase 3000 - Preparation and Review\3010 - Wildlife\12-1361-0028 Listed Plant and Weed Species Location in the Study Area.mxd Date: 8/29/2012 2:08:22 PM



NOTE: The information displayed on this map is made available by the Saskatchewan Government. The Government of Saskatchewan makes no guarantee regarding the accuracy of the information. This information is updated consistently and this figure is a representation of the data only for the date indicated here: April 2012

LEGEND

- STUDY AREA
- 500 METRE BUFFER
- TOWNSHIP AND RANGE BOUNDARY
- SECTION BOUNDARY
- URBAN MUNICIPALITY
- WOODED AREA
- LAKE
- RESERVOIR
- WATERCOURSE
- LISTED PLANT OCCURRENCE
- WEED SPECIES OCCURENCE
- AGRICULTURAL CROWN LAND
- MIGRATORY BIRD CONCENTRATION SITE
- PARKS AND RECREATION
- PRIVATE CONSERVATION LAND

1 0 1
SCALE 1:50,000 KILOMETRES

REFERENCE

SASKTACHEWAN WILDLIFE FEDERATION, 2012
SASKATCHEWAN CONSERVATION DATA CENTRE, 2012
SASKATCHEWAN GOVERNMENT, MINISTRY OF AGRICULTURE
ROADS AND HIGHWAYS © DMTI, 2011
CANVEC © NATURAL RESOURCES CANADA, 2012
NTS MAPSHEET 73B02
DATUM: NAD83 PROJECTION: UTM ZONE 13

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
LISTED PLANT AND WEED SPECIES LOCATIONS IN THE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.3000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JW/LR	24/08/12	**FIGURE: 2-1**	
CHECK	MT	29/08/12		
REVIEW	ME	29/08/12		

Table 2-5: Weed Species Listed under the Saskatchewan *Weed Control Act* (2010)

Common Name	Scientific Name	Native Grassland	Modified Grassland	Wetland	Cultivated Land
Noxious Species					
Absinthe	*Artemisium absinthum*		X		
Downy brome	*Bromus tectorum*	X			
Nodding thistle	*Carduus nutans*		X		
Canada thistle	*Cirsium arvense*	X	X		X
Leafy spurge	*Euphorbia esula*	X	X		
Perennial sow-thistle	*Sonchus arvensis*			X	X
Annual sow-thistle	*Sonchus oleracea*	X			
Scentless chamomile	*Tripleurosperumum perforatum*			X	
Nuisance Species					
Quack grass	*Elytrigua repens*			X	
Foxtail barley	*Hordeum jubatum*			X	
Blue lettuce	*Lactuca tatarica* ssp. *pulchella*	X			
Dandelion	*Taraxacum officinale*				X
Goat's beard	*Tragopogon dubius*		X		

2.3 Recommendations

Site-specific pre-development surveys are recommended to identify the presence/absence of listed plant species prior to development, particularly in areas supporting native vegetation communities or where listed plant species have been previously identified. Remnant native communities include wetlands and native grassland/woodland areas in the south of the Study Area and in the West Swale. Should listed species be identified in areas targeted for development, it is suggested that development activity take place outside the recommended setback distances for listed plant species described in the Saskatchewan Activity Restriction Guidelines (Saskatchewan Environment 2003); this may include designating a green space, park, or conservation easement where the plant is identified. A copy of these guidelines is provided in Appendix A. If development cannot avoid disturbance to listed plants, options such as plant re-location or seed harvesting and subsequent seeding may be discussed with the Ministry of Environment (MOE), provided suitable and compatible habitat is available nearby. Another alternative may include completing plan surveys in adjacent lands to determine if the species is locally abundant (i.e., loss of a few individuals may not jeopardize local populations or cause local extinctions).

2.4 Summary

No rare or endangered plants, as defined by *SARA* and COSEWIC, were observed during the 2012 survey. The habitats of the nine provincially-tracked species previously recorded in the area are typically associated with wetlands and wetland margins, or sandy areas. Wetland and wetland margin areas are common in the Study Area, while sandy areas are limited.

Despite being relatively common across the landscape, 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.

Consequently, growing conditions can vary year to year. This, combined with the isolation of several of the wetlands and the continued encroachment of non-endemic species in the fragmented landscape, can negatively influence the sustainability of listed species where they occur.

The natural swale that passes through the area supports important plant communities that are not commonly found in the rest of the Study Area, particularly native wetland and grassland communities. The terrain in the swale is relatively level and likely experiences high variation in moisture and water levels. Using this swale for stormwater drainage would increase the variation in water volume that passes through the swale and likely would increase the flooded area due to the level terrain. In turn, the current vegetation community composition could change because of species preference for specific moisture regimes (i.e., growing site that changes from submesic to hygric).

3.0 WILDLIFE AND WILDLIFE HABITAT ASSESSMENT

3.1 Methods

Wildlife surveys consisted of roadside and pedestrian surveys and, when required, wetland and surrounding terrestrial habitat were scanned with the aid of binoculars and a spotting scope. Dan Coffen (biologist, Golder) conducted the surveys on June 27 and 28, 2012. Direct observations of wildlife species, as well as their sign (e.g., tracks, dens, burrows, nests, feeding cavities, beds, scat/pellets, digs, and browse scars) were documented. The locations of significant wildlife sightings, such as listed species, were recorded using GPS units.

3.2 Results

3.2.1 Wildlife Habitat

Most of the Study Area, particularly the northern third is comprised of cultivated or otherwise developed land (Figure 3-1), which provides limited natural wildlife habitat. Cultivated land in the central and southern portions of the Study Area is interspersed with modified grassland; this matrix may provide some suitable wildlife habitat. Native grassland generally is limited to the swale portion in the north-central portion of the Study Area, as well as several small isolated areas along the southern boundary and the South Saskatchewan River bank. Chappell Marsh Conservation Area in the centre of the Study Area, as well as the large wetland to the northwest and the connecting water, provide higher quality wildlife habitat that is relatively unique in the area. However, these areas are semi-isolated habitat patches surrounded or dissected by disturbed lands and corridors (e.g., roads, highways, and rail lines) that collectively combine to diminish the connectivity necessary to provide a quality movement corridor to larger areas of wildlife habitat that may be found outside of the Study Area. Representative photographs of habitat types assessed during the 2012 survey period are provided in Appendix B.

The diversity of plant communities in native and modified grassland provides an array of habitat types for many terrestrial and avian wildlife species. Several rare and endangered species are dependant particularly on native grassland for breeding and foraging opportunities that are not present on cultivated land. For example, Sprague's pipits (*Anthus spragueii*) typically nest in dense tufts of grass in areas of low forb and shrub density (COSEWIC 2010a). Areas such as this are commonly found in native grassland and some modified grassland.

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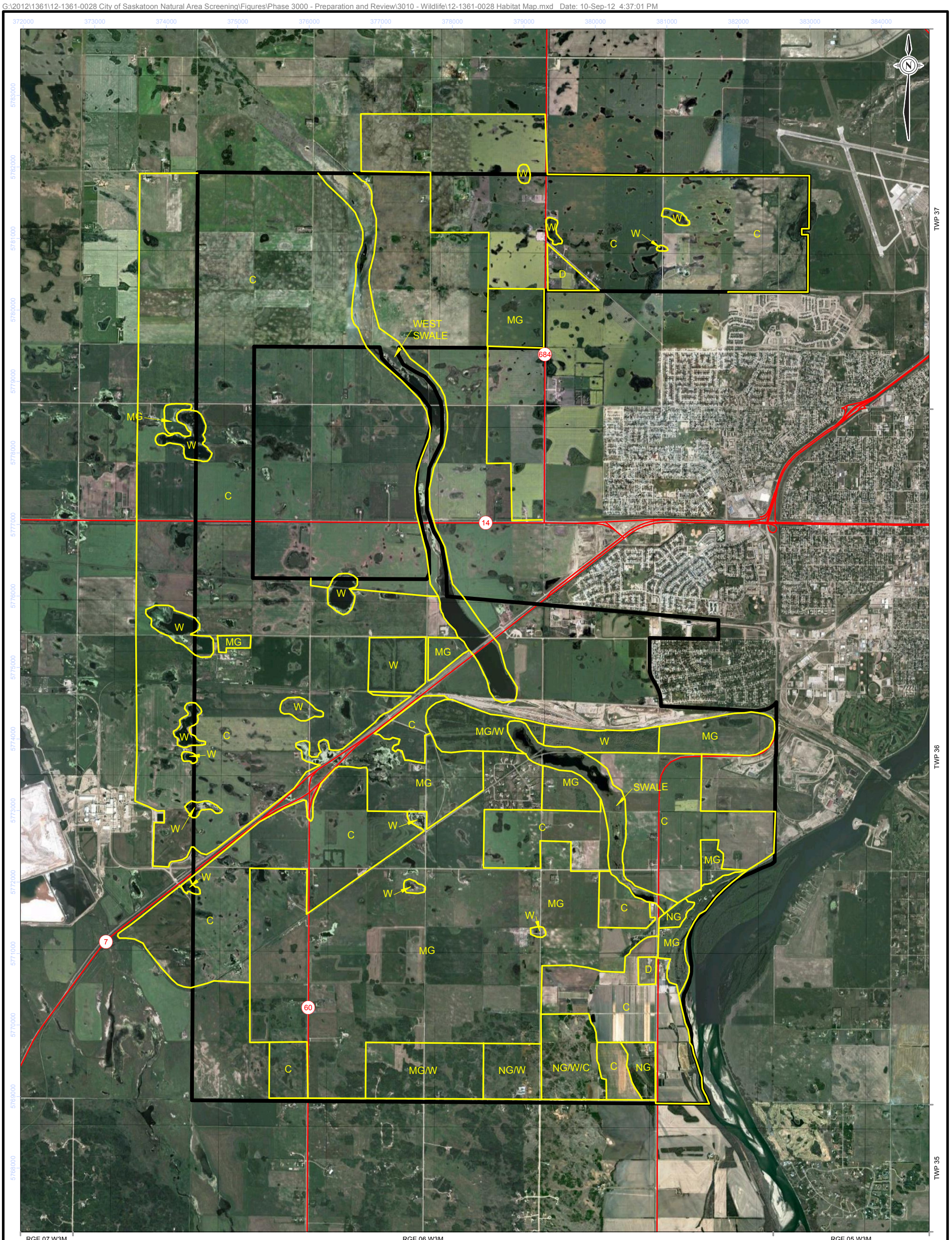


LEGEND

- STUDY AREA
- HABITAT DELINEATION
- HIGHWAY
- C CULTIVATED
- D DISTURBED
- MG MODIFIED GRASSLAND
- NG NATIVE GRASSLAND
- W WETLAND

REFERENCE

DMTI HIGHWAYS AND ROADS © 2011
DIGITAL GLOBE, GEOEYE IMAGERY © GOOGLE, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 13

1 0 1
SCALE 1:50,000 KILOMETRES

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
HABITAT MAP

Golder Associates
Saskatoon, Saskatchewan

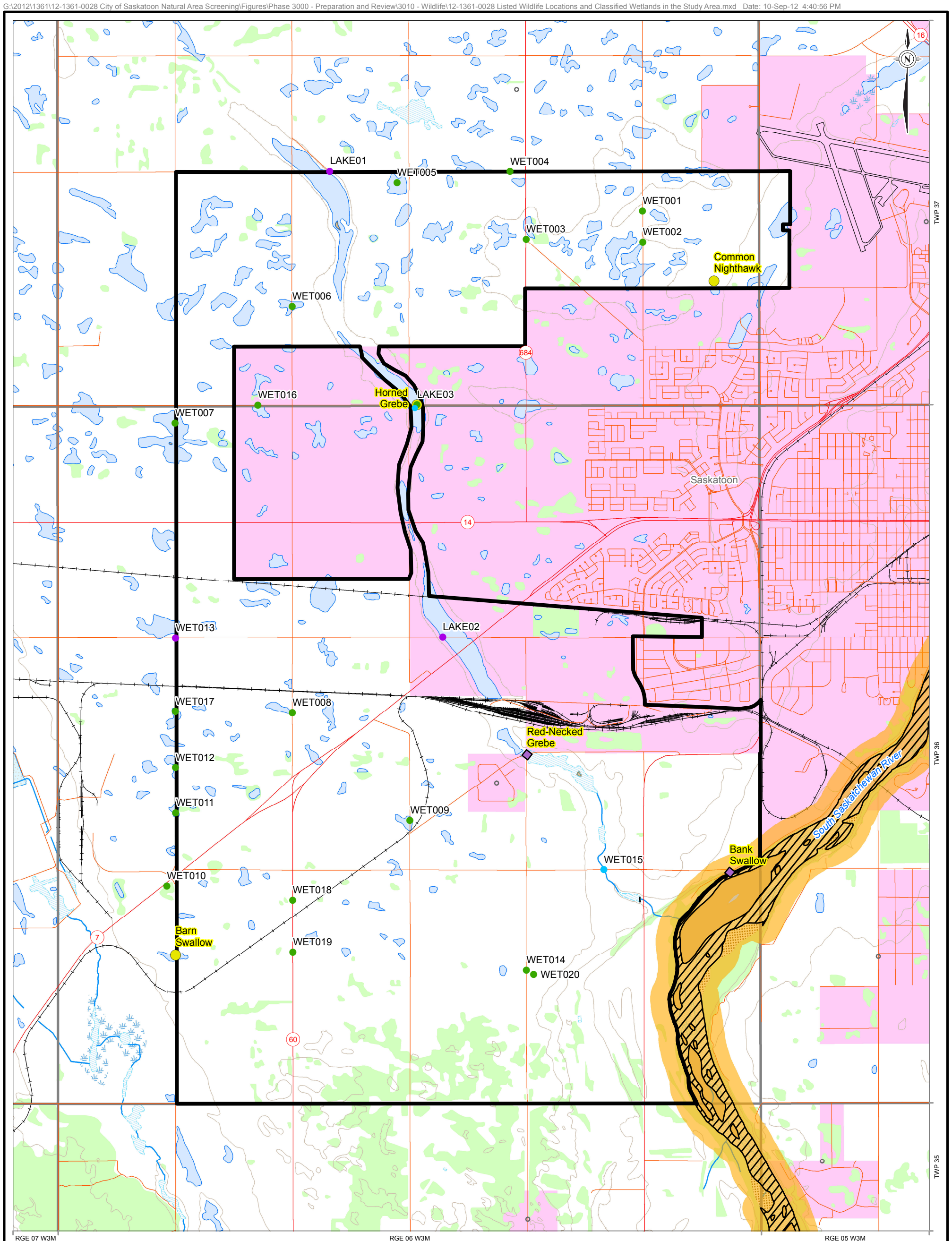
PROJECT	12-1361-0028.3000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JW	29/08/12	FIGURE: 3-1	
CHECK	MT	10/09/12		
REVIEW	ME	10/09/12		

The Study Area supports a number of semi-permanent to permanent wetlands and waterbodies, which provide suitable wildlife habitat for a variety of waterbird and amphibian species, as well as aquatic mammals such as muskrat (*Ondatra zibethicus*). Horned grebes (*Podiceps auritus*) and northern leopard frogs (*Rana pipiens*) are some examples of listed species that occur in the area and use wetlands during important stages of their life cycle. Details of surveyed wetland locations, classification, and dominant vegetation are outlined in Table 3-1 and shown in Figure 3-2. The Stewart and Kantrud Wetland Classification System (1971) was used to classify the wetlands within the Study Area; details on this system can be found in Appendix C.

Table 3-1: Wetland Classification in the Study Area during the 2012 Field Program

Wetland Identification	GPS Location	Classification	Dominant Vegetation
WET004	13U 379056 5781763	Class IV – Semi-permanent Wetland	Cattail and awned sedge
WET005	13U 377478 5781652	Class IV – Semi-permanent Wetland	Cattail and reed canary grass
LAKE01	13U 376545 5781834	Class V – Permanent Wetland	Lesser duckweed and western dock
WET003	13U 379256 5780815	Class IV – Semi-permanent Wetland	Cattail and lesser duckweed
WET002	13U 380875 5780729	Class IV – Semi-permanent Wetland	Cattail and lesser duckweed
WET001	13U 380885 5781163	Class IV – Semi-permanent Wetland	Cattail and golden dock
LAKE03	13U 377675 5778547	Class IV – Semi-permanent Wetland	Cattail and quack grass
WET006	13U 375971 5779966	Class IV – Semi-permanent Wetland	Cattail and American manna grass
WET016	13U 375458 5778602	Class IV – Semi-permanent Wetland	Cattail and spike-rush
WET007	13U 374298 5778379	Class IV – Semi-permanent Wetland	Cattail and lesser duckweed
WET008	13U 375826 5774303	Class IV – Semi-permanent Wetland	Cattail and slough grass
WET013	13U 374227 5775384	Class V – Permanent Wetland	Cattail and western dock
WET017	13U 374198 5774363	Class IV – Semi-permanent Wetland	Cattail and water crowfoot
WET012	13U 374179 5773580	Class IV – Semi-permanent Wetland	Cattail and lesser duckweed
WET011	13U 374166 5772954	Class IV – Semi-permanent Wetland	Cattail and lesser duckweed
WET010	13U 374015 5771935	Class IV – Semi-permanent Wetland	Cattail and water crowfoot
WET018	13U 375763 5771692	Class IV – Semi-permanent Wetland	Cattail and lesser duckweed
WET019	13U 375746 5770971	Class IV – Semi-permanent Wetland	Baltic rush
WET014	13U 378992 5770632	Class IV – Semi-permanent Wetland	Cattail, reed canary grass, and Baltic rush
WET020	13U 379090 5770572	Class IV – Semi-permanent Wetland	Cattail and sedge
WET015	13U 380107 5772004	Class III – Seasonal Wetland	Cattail and graceful manna grass
WET021	13U 377220 5772077	Class IV – Semi-permanent Wetland	Cattail and lesser duckweed
WET009	13U 377425 5772761	Class IV – Semi-permanent Wetland	Cattail and lesser duckweed

G:\2012\1361\12-1361-0028 City of Saskatoon Natural Area Screening\Figures\Phase 3000 - Preparation and Review\3010 - Wildlife\12-1361-0028 Listed Wildlife Locations and Classified Wetlands in the Study Area.mxd Date: 10-Sep-12 4:40:56 PM



LEGEND

- STUDY AREA
- TOWNSHIP AND RANGE BOUNDARY
- LISTED WILDLIFE OCCURENCE
- OTHER WILDLIFE OCCURENCE

CLASSIFIED WETLAND

- CLASS III - SEASONAL WETLAND
- CLASS IV - SEMI-PERMANENT WETLAND
- CLASS V - PERMANENT WETLAND

- MIGRATORY BIRD CONCENTRATION SITE
- 250 METRE BUFFER

REFERENCE

CANVEC © 2012, NATURAL RESOURCES CANADA
ROADS AND HIGHWAYS © DMTI, 2011
NTS MAPSHEET: 73B02
DATUM: NAD83 PROJECTION: UTM ZONE 13

1 0 1
SCALE 1:50,000 KILOMETRES

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
LISTED WILDLIFE LOCATIONS AND CLASSIFIED WETLANDS IN THE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.3000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JW/LR	24/08/12	**FIGURE: 3-2**	
CHECK	MT	10/09/12		
REVIEW	ME	10/09/12		

A Migratory Bird Concentration Site is located in the southeast portion of the Study Area. The area encompasses the boundaries of the South Saskatchewan River from Moon Lake (south of Saskatoon) downstream to the town of Hague, located approximately 35 km northeast of Saskatoon. The Migratory Bird Concentration Site is considered an important breeding, moulting, and staging site for a variety of migratory bird species (SKCDC 2012). A 250 m buffer, shown in Figure 3-2, is recommended for Migratory Bird Concentration Sites during specific times of the year to prevent disturbance to migratory birds during periods of peak use. The peak use of the area for nesting waterfowl and colonial birds occurs each year between May 1 and June 30, while the peak use for staging waterfowl peak occurs each year between September 1 and October 15. Staging shorebird peak use in spring occurs annually between May 15 and May 31, and each summer, the peak use for shorebird staging occurs between July 15 and August 15. Development within the 250 m buffer of the Migratory Bird Concentration Site should be completed outside of these peak use periods.

3.2.2 Wildlife

A total of 35 bird species and one mammal (a muskrat) were observed or heard in the Study Area during the 2012 field surveys (Table 3-2).

Table 3-2: Wildlife Species Observed in the Study Area during the 2012 Field Program

Common Name	Scientific Name	Common Name	Scientific Name
Bird Species			
Red-winged blackbird	*Agelaius phoeniceus*	Franklin's gull	*Larus pipixcan*
Grasshopper sparrow	*Ammodramus savannarum*	Brown-headed cowbird	*Molothrus ater*
Northern shoveler	*Anas clypeata*	Ruddy duck	*Oxyura jamaicensis*
Blue-winged teal	*Anas discors*	Black-billed magpie	*Pica hudsonia*
Mallard	*Anas platyrhynchos*	Horned grebe*	*Podiceps auritus*
Redhead	*Aythya affinis*	Red-necked grebe	*Podiceps grisegena*
Lesser scaup	*Aythya affinis*	Eared grebe	*Podiceps nigricollis*
Cedar waxwing	*Bombycilla cedrorum*	Vesper sparrow	*Pooecetes gramineus*
Canada goose	*Branta canadensis*	Sora	*Porzana carolina*
Red-tailed hawk	*Buteo jamaicensis*	Common grackle	*Quiscalus quiscala*
American goldfinch	*Carduelis tristis*	Bank swallow	*Riparia riparia*
Snow goose	*Chen caerulescens*	Tree swallow	*Tachycineta bicolor*
American coot	*Fulica americana*	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Barn swallow*	*Hirundo rustica*	-	-
Mammals			
Muskrat	*Ondatra zibethicus*	-	-

***COSEWIC (2012) listed species.

3.2.3 Listed Wildlife Species

A search of the SKCDC (2012) database was conducted for records of previously documented listed wildlife species within the Study Area, but no records were found for previously documented listed wildlife species in the Study Area and designated 500 m buffer. However, based on known ranges and habitat types within the Study Area, ten wildlife species were identified as having the potential to occur. Of these ten species, two were identified during the 2012 field season.

Though not associated with the surveys, a third species, common nighthawk (*Chordeiles minor*), was routinely observed and heard foraging during the spring and early summer of 2012, in the northeast portion of the Study Area near Hampton Village by Golder personnel (M. Ealey, pers. comm. 2012). Monarch butterfly (*Danaus plexippus*), also a listed species, has been observed in the Saskatoon area in 2012; a Golder staff member has recorded caterpillars of this species on milkweed (*Asclepias* spp.) he is growing in his yard located within the City of Saskatoon (W. Falk, pers. comm. 2012).

The ranking, habitat preferences, and occurrences of the nine listed wildlife species with potential to occur in the Study Area is described in Table 3-3. The locations of the two listed species that were observed with the Study Area are shown in Figure 3-2.

Barn Swallow

One barn swallow was observed in a woodland area near modified grassland and a wetland located in SW 08-36-06 W3M (13U 5770972 N, 374111 E). 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, conservation concern stems from the magnitude, short time-span, and geographic extent of the decline (COSEWIC 2012). At this time, there are no recommendations for activity set-back distances from barn swallow nests.

Horned Grebe

A horned grebe was observed at one Class V wetland located in SW 03-37-06 W3M (13U 5778547 N, 377674 E) but may be present on other wetlands in the Study Area. Horned grebe numbers continue to decline, possibly due to the loss of suitable habitat through drainage of wetlands (Nature Saskatchewan 2002). Provincial activity restriction guidelines recommend a 200 m set-back distance from horned grebe nests annually between May 15 and July 15 (Saskatchewan Environment 2003).

3.3 Recommendations

Site-specific pre-development surveys are recommended to identify the presence/absence of listed wildlife species prior to development, particularly in areas that support native wildlife habitat or where listed wildlife species have been previously identified. Native wildlife habitat areas include wetlands and native grassland/woodland areas in the south of the Study Area and in the West Swale.

Should listed species be identified in areas targeted for development, it is recommended that development activity take place outside the recommended setback distances for listed wildlife species described in the Saskatchewan Activity Restriction Guidelines (Saskatchewan Environment 2003). A copy of these guidelines is provided in Appendix A. An alternative may also include enhancing other suitable habitat in the immediate area and/or designating appropriate green spaces or conservation easements.

Table 3-3: 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 2012 Observations in the Study Area
Loggerhead Shrike	*Lanius ludovicianus excubitorides*	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. Confirmed breeding of this species has been documented in the region (Smith 1996). This species was not observed in the Study Area during the 2012 field survey.
Barn Swallow*	*Hirundo rustica*	Threatened	S5B S5M	During the breeding season, this species prefers to be near water for drinking, foraging, and providing mud for nest building.	High - suitable foraging and nesting habitat is found throughout the Study Area. Within the city limits, barn swallows frequently have been observed in newer neighbourhoods (five to ten years old) when they appear to have available forage and they can find suitable nesting structures in covered, raised decks and below irregular protected roof lines of new homes (M. Ealey, pers. comm. 2012). One barn swallow was identified in the southwest corner of the Study Area during the 2012 field survey in a woodland area near modified grassland and a wetland (13U 374111 5770972).

Table 3-3: 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 2012 Observations in the Study Area
Common Nighthawk	*Chordeiles minor*	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. It nests on the ground in woodland openings and clearings, natural open areas, burnt lands, (Godfrey 1986; Smith 1996).	Moderate to High - foraging and nesting habitat is present within the Study Area. Although this species was not recorded in the Study Area during the 2012 surveys, common nighthawks were reported over Saskatoon during the 2011 and 2012 breeding seasons (D. Weidl, pers. comm. 2012; C. Jackson, pers. comm. 2012, M. Ealey, pers. comm. 2012). There is the potential for this species to use portions of the Study Area for foraging or nesting and they were observed independent of the surveys by Golder personnel in the northeast corner of the Study Area.
Horned Grebe*	*Podiceps auritus*	Special Concern	S5B	This species prefers small waterbodies (sloughs, wetlands, and dugouts) with extensive marshy areas.	Moderate to High - suitable habitat for this species is present in the Study Area, particularly associated with moderately sized, more permanent wetland basins. A horned grebe was observed on a large waterbody in the north-central portion of the Study Area during the 2012 field surveys (13U 377675 5778547).
Short-eared Owl	*Asio flammeus*	Special Concern	S3B S2N	Short-eared owls typically prefer open grassland and hayland. Potential nesting and foraging habitat for short-eared owls is found 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 hayland, draws, and patches of native grassland. Confirmed breeding for this species has been documented in the region (Smith 1996). No short-eared owls were identified during the 2012 surveys.

Table 3-3: 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 2012 Observations in the Study Area
Yellow Rail	*Coturnicops noveboracensis*	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 - several wetlands within the Study Area provide marginally suitable habitat for this species; however, habitat is fragmented and this species was not observed or heard during the 2012 surveys. According to Nature Saskatchewan (2002), the nearest known nesting areas include Pike Lake, Porter Lake, and North End Slough at the Blackstrap Reservoir.
Olive-sided Flycatcher	*Contopus borealis*	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 (Smith 1996). Olive-sided flycatchers often are observed within city limits during migration (D. Weidl, pers. comm. 2012). This species was not observed in the Study Area during the 2012 field survey.
Rusty Blackbird	*Euphagnus carolinus*	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 generally nests in trees near standing water (Godfrey 1986; Smith 1996).	Low - this species is a transient or winter visitant for the Study Area. This species was not seen during the 2012 surveys; however, the timing of these surveys would be considered to be too early in the year to observe any fall migrants or winter visitants.
Northern Leopard Frog	*Rana pipiens*	Special Concern	S3	The northern leopard frog requires a mosaic of habitat types to meet the life stages. It 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 (e.g., permanent, clear wetlands and watercourses) is limited in the Study Area. Northern leopard frogs previously have been documented within the South Saskatchewan River within the city limits (D. Weidl, pers. comm. 2012); however, none were observed or heard in the Study Area during the 2012 field survey.

Table 3-3: 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 2012 Observations in the Study Area
Monarch Butterfly	*Danaus plexippus*	Special Concern	S3B	The monarch butterfly is a migratory insect that breeds in Canada and over-winters in California and Mexico (COSEWIC 2010b). The distribution and abundance of monarch butterflies is influenced largely by the distribution of plants of the milkweed family (*Asclepia* spp.) and nectar-bearing flowers such as goldenrod (*Solidago* spp.) and asters (*Aster* spp.). Milkweed plants are essential for female monarchs to lay eggs and as a food source for their larvae (Layberry et al. 1998).	Moderate - species has been known to migrate into the central parts of Saskatchewan (Davis 2009). This species may be found where milkweed (*Asclepias speciosa, A. syriaca,* or *A. viridiflora*) occur (e.g., in moist or dry, sandy areas, or riverbanks [Looman and Best 1987]). Species has been observed in the Saskatoon area in 2012; a Golder staff member has recorded caterpillars of this species on milkweed (*Asclepias* spp.) growing in his yard (Falk, W. pers. comm. 2012).

***** Species observed within the Study Area during the Golder 2012 surveys.

[(a)] COSEWIC (2012).

[(b)] SKCDC (2012).

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.

3.4 Summary

Wildlife habitat in the Study Area consists primarily of modified grassland and wetland areas, with some stands of woody vegetation around wetlands and sporadic patches of native grassland. These remaining areas are important because of their limited distribution and are often isolated (i.e., are not connected to other suitable habitats that some species may not readily disperse to or move freely between). However, because of extensive land development, proximity to major transportation networks, and both rural and urban development, the overall quality of habitat has been somewhat diminished and largely supports species that have adapted to or are tolerant of human activity. It is likely that species diversity in the area would decrease if these areas were developed. Development activity in the southeast corner of the Study Area, within 250 m of the Migratory Bird Concentration Site, may be limited to certain times of year when the area is not being used for breeding, moulting, and staging by migratory birds.

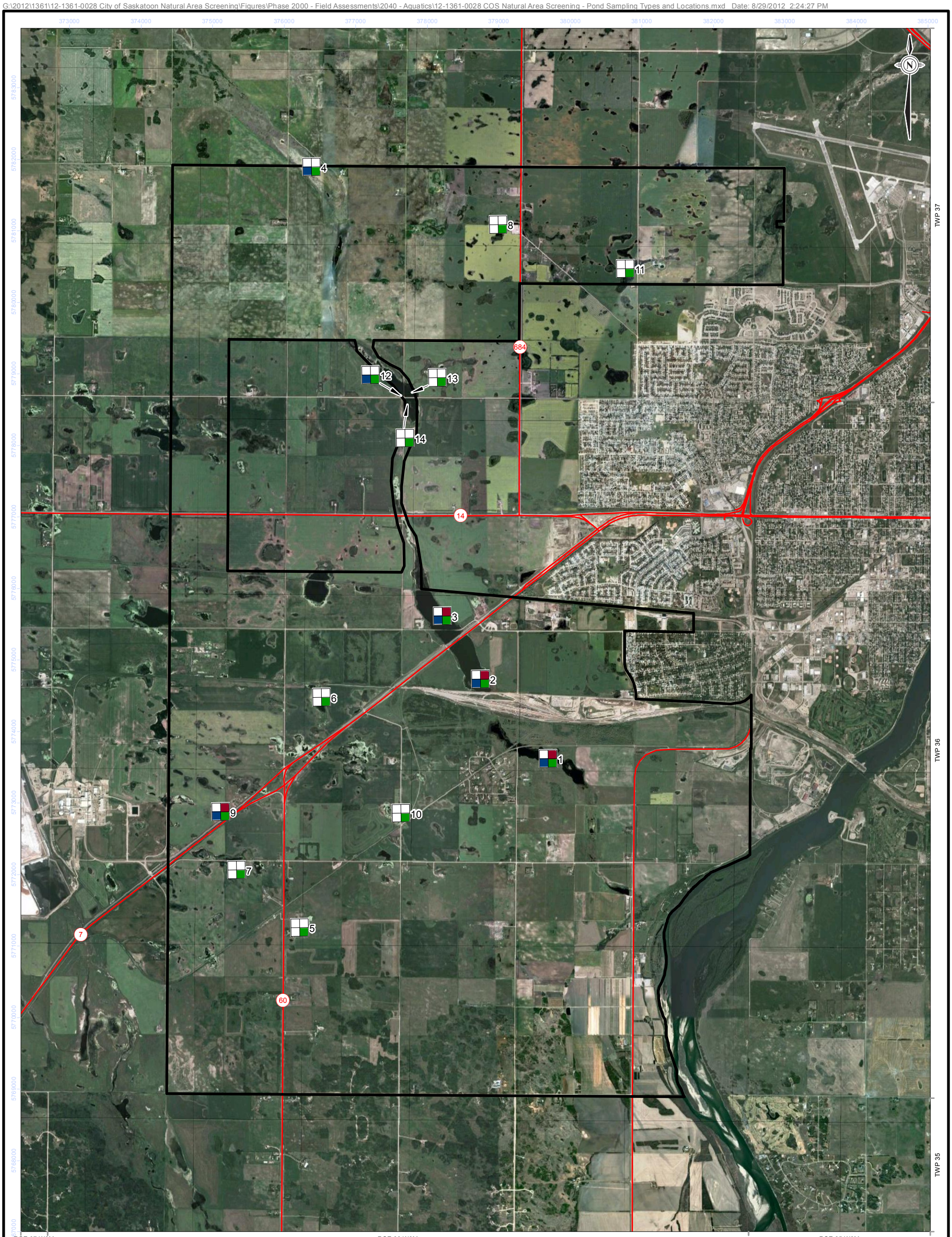
Although only two listed wildlife species, barn swallow and horned grebe, were observed within the Study Area during the 2012 field survey, and a third independently (common nighthawk), suitable habitat that could support other listed wildlife species is present, depending on weather conditions and year-to-year habitat changes. The natural swale that passes through the Study Area provides favourable wildlife habitat in the wetland and native plant communities that it supports. Using the swale for stormwater drainage would alter available wildlife habitat, potentially reducing it by increasing the portion of the swale that is regularly flooded. Alternatively, other species may find this habitat more suitable for various stages of their life cycle (e.g., yellow rail).

4.0 WATERCOURSES AND WETLANDS

The South Saskatchewan River is located on the southeastern boundary of the Study Area. A second prominent hydrological feature is the West Swale, which consists of several permanent wetland areas connected by intermittent channels that become part of a small tributary to the South Saskatchewan River. Numerous wetlands varying in size and permanency also are found throughout the Study Area. Most of the wetlands vary in size 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 survey of the Study Area to investigate and document wetlands with water surface areas in excess of 1.0 ha in size and their associated surface hydrological features was completed on selected waterbodies from June 19 to 21, 2012. All of the waterbodies sampled for limnology features (Figure 4-1) were considered permanent wetlands, characterized by dominant vegetation species such as cattails, bulrushes, pondweed (*Potamogeton* spp.), and duckweed (*Lemna* spp.). 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 vegetation.

G:\2012\1361\12-1361-0028 City of Saskatoon Natural Area Screening\Figures\Phase 2000 - Field Assessments\2040 - Aquatics\12-1361-0028 COS Natural Area Screening - Pond Sampling Types and Locations.mxd Date: 8/29/2012 2:24:27 PM



LEGEND

ROAD

SEDIMENT
LIMNOLOGY/DEPTH
WATER QUALITY

1 0 1
SCALE 1:50,000 KILOMETRES

REFERENCE

DMTI HIGHWAYS AND ROADS © 2011
DIGITAL GLOBE, GEOEYE IMAGERY © GOOGLE, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 13

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
AQUATIC INVENTORY MAP

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.2000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	SM/JW	29/08/12	FIGURE: 4-1	
CHECK	MT	29/08/12		
REVIEW	ME	29/08/12		

4.1 Water and Sediment Quality

Limnology measurements were collected from 14 wetlands in the Study Area. Of these, Golder initially proposed water quality and sediment quality sampling at six and four of the largest waterbodies respectively, within the Study Area boundary. However, two of the waterbodies initially proposed for sampling were replaced with alternate, smaller waterbodies. A landowner denied permission to access one of the wetlands located at 13U 376287 5775865 (B. Prima, pers. comm. 2012); therefore, wetland 006 was changed to its current location. The inability to collect sediment at wetland 012 due to excessive submergent aquatic vegetation growth resulted in completing only the water sampling rather than the sediment and water sampling as originally proposed at this location. Sediment sampling was completed at wetland 009 as an alternative.

Aquatic sampling of all 14 wetlands was carried out between June 19 and 21, 2012 (Table 4-1). The aquatic sampling program (water, limnology, and sediment) was completed separately from the wildlife and wildlife habitat surveys (Section 3, Table 3-1 and Figure 3-2). As such, the wetland identification numbers in Sections 3.0 and 4.0 are not the same.

Table 4-1: Revised List of Waterbodies Selected for Water Depth, Limnology, and Water and Sediment Quality Sampling

Wetland Number	Estimated Surface Area[(a)] (ha)	Water Depth[(b)] (m)	Limnology and Depth Sampling	Water Chemistry Sampling	Sediment Chemistry Sampling
001[(c)]	18.85	1.3	yes	yes	yes
002[(d)]	21.63	1.6	yes	yes	yes
003	23.13	1.8	yes	yes	yes
004	22.50	1.4	yes	yes	-
005	1.05	0.9	yes	-	-
006	2.15	1.2	yes	-	-
007	2.52	1.6	yes	-	-
008	0.55	0.8	yes	-	-
009	1.80	1.1	yes	yes	yes
010	9.20	0.7	yes	-	-
011	3.24	1.2	yes	-	-
012	5.82	1.2	yes	yes	-
013	2.70	0.9	yes	-	-
014	3.63	1.3	yes	-	-

[(a)] Waterbody surface areas in June 2012 were higher than estimated due to high water levels during the 2012 field program.

[(b)] As measured during the June 2012 field program.

[(c)] Duplicate water quality sample collected.

[(d)] Duplicate sediment quality sample collected.

- = sample not collected.

4.2 Methods

Limnology measurements (i.e., water temperature, dissolved oxygen [DO], pH, and specific conductivity) were collected using an YSI 600QS-O-M water quality meter and sonde (probe) at the deepest location in each wetland. The YSI meter was calibrated according to manufacturer directions. Water depth was assessed initially using a hand-held depth sounder; the depth was confirmed using a weighted line at the completion of each sampling session. Limnology measurements were taken 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 (i.e., to mitigate optical error).

Surface grab water samples were collected approximately 30 cm below the water surface, using a triple-rinsed 20 litre jug. Preservatives were added to the water samples when required for laboratory analysis purposes. For parameters requiring filtration, the water samples were filtered and preserved by the analytical laboratory. Water samples were submitted to ALS Environmental Analytical Laboratories (ALS) for chemical analysis of conventional parameters, major ions, and nutrients, and total and dissolved metals. Data quality was assessed using the results of a field duplicate and a field blank sample. 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 in the same manner as the actual samples (i.e., filter when required, add preservative when required).

Sediment samples were collected using a standard Ekman grab (0.0232 square metres). The Ekman sampler (jaws opened) was triple-rinsed with ambient water prior to sampling, to ensure that no sediment or other material was present. Each sediment sample was placed into an individual 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 marker. Sediment samples were submitted to ALS for chemical analysis of standard parameters, as well as metals (including mercury). A duplicate sediment sample also was submitted to the laboratory 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 the laboratory.

Fish presence/absence surveys were not carried out since the deepest of the wetlands sampled was only 1.8 m deep, much less than the minimum depth generally required for overwinter fish survival in central Saskatchewan.

4.3 Results

As identified in Section 4.1, 14 wetlands were assessed for standard limnology parameters. Six wetlands were assessed for water quality (as well as a duplicate and a field blank). Four wetlands were assessed for sediment quality (plus a duplicate). Locations (Universal Transverse Mercator [UTM] coordinates) of all sampling stations are presented in Table 4-2.

Table 4-2: Sampling Locations in City of Saskatoon West-Southwest Sector, June 19 to 21, 2012

Wetland Number	UTM Coordinates (NAD 83, Zone 13)	
	Easting	Northing
001[a]	379493	5773482
002[b]	378570	5774610
003	378054	5775502
004	376347	5781818
005	375976	5771185
006	376545	5774401
007	375112	5772011
008	378941	5780964
009	374905	5772825
010	377423	5772759
011	380704	5780314
012	377566	5778583
013	377700	5778642
014	377618	5778457

NAD 83 = North American Datum (1983).

[a] Water quality duplicate sample collected.

[b] Sediment quality duplicate sample collected.

4.3.1 Limnology

Limnology was measured at 14 selected wetlands (Figure 4-1; Appendix D, Table D-1). Surface water parameters showed a high degree of variability (Table 4-3). Dissolved oxygen values ranged from 3.24 to 12.46 milligrams per litre (mg/L). The measured values of limnology parameters showed no apparent correlation with maximum depth or surface area of the wetlands. Water temperatures measured during the sampling period ranged from 16.0 to 18.28 degrees Celsius (^{o}C). Specific conductivity ranged from 610 to 3,324 microSiemens per centimetre (µS/cm); and pH ranged from 7.76 to 8.99.

Table 4-3: Summary of Surface Limnology Measurements for Sampled Wetlands in City of Saskatoon West-Southwest Sector, June 19 to 21, 2011

Wetland Number	Max Depth (m)	Secchi Depth (m)	Surface Dissolved Oxygen (mg/L)	Water Temperature (°C)	Specific Conductivity (µS/cm)	pH
001	1.3	1.0	5.09	17.63	3090	7.97
002	1.6	1.6	10.72	17.20	2649	8.92
003	1.8	1.8	7.76	16.91	2804	8.68
004	1.4	1.4	8.81	16.46	2987	8.74
005	0.9	0.9	3.24	16.39	3324	7.80
006	1.2	1.0	9.38	17.03	1663	7.76
007	1.6	1.6	12.46	17.05	1272	8.66
008	0.8	0.8	8.45	16.04	1665	8.11
009	1.1	1.1	7.03	16.03	1891	8.05

Table 4-3: Summary of Surface Limnology Measurements for Sampled Wetlands in City of Saskatoon West-Southwest Sector, June 19 to 21, 2011 (continued)

Wetland Number	Max Depth (m)	Secchi Depth (m)	Surface Dissolved Oxygen (mg/L)	Water Temperature (°C)	Specific Conductivity (µS/cm)	pH
010	0.7	0.7	11.87	18.28	1870	8.79
011	1.2	1.2	8.94	16.00	610	8.24
012	1.2	1.2	11.60	16.76	837	8.74
013	0.9	0.9	9.80	16.58	896	8.61
014	1.3	0.5	11.67	16.72	1050	8.99

Limnology profiles also were measured for the 14 sampled wetlands (Figure 4-2). Maximum water depth ranged from 0.7 m in wetland 010 (Figure 4-2j) to 1.8 m in wetland 003 (Figure 4-2c). Secchi depth ranged from 0.5 m (less than half the wetland depth) in wetland 014 (Figure 4-2n) to 1.8 m (the bottom of the wetland) in wetland 003 (Figure 4-2c).

Dissolved oxygen levels throughout all wetland depth profiles ranged from hypoxic (very low) (0.76 mg/L) to super-saturated (12.71 mg/L; Appendix D, Table D-1). One wetland had DO levels near the wetland bottom less than or equal to 1 mg/L (wetland 006; Figure 4-2f). Low or very low DO levels near the bottom of the wetlands likely are attributable to the oxygen demand from decaying plant material in the sediments. The odour of hydrogen sulphide was noticed during sediment sampling in wetlands 002, 003, and 009. Hydrogen sulphide only forms under anoxic (oxygen absent) conditions. Water temperatures through all profiles ranged from 15.54 ^{o}C to 18.28^{o}C (Appendix D, Table D-1). However, water temperatures within individual wetland depth profiles were uniform (range of <0.1^{o}C) in wetlands 004, 011, and, 013 (Figures 4-2d, 4-2k, and 4-2m) or varied up to 2.1^{o}C in wetland 010 (Figure 4-2j).

4.3.2 Water Quality

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

Laboratory-measured pH values were basic and ranged from pH 7.93 in wetland 009 to 8.77 in wetland 002. All measured pH values were within 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). Total alkalinity values were high, ranging from 178 to 432 mg/L (wetlands 009 and 004, respectively).

Laboratory-measured specific conductivity, total dissolved solids (TDS), and sum of ions were variable, with minimum values observed in wetland 012 and maximum values in wetlands 001 and 004, respectively. Specific conductivity and TDS values ranged from slightly brackish (844 µS/cm and 531 mg/L respectively in wetland 012) to moderately brackish (3,110 µS/cm and 2,420 mg/L in wetlands 001 and 004, respectively (Stewart and Kantrud 1971). Total suspended solids concentrations were below the detection limit (5.0 mg/L in all wetlands sampled.

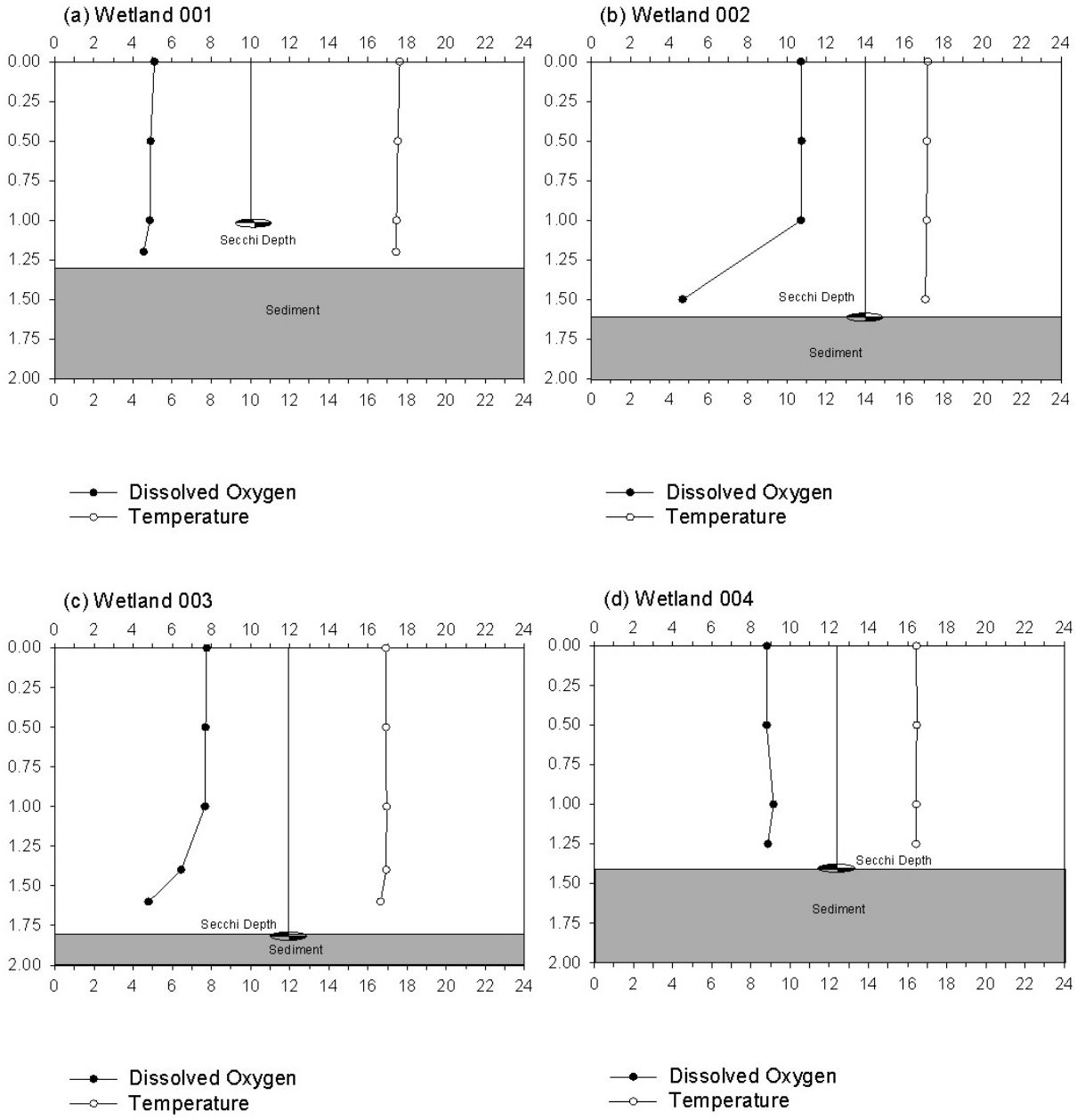


Figure 4-2: Temperature, Dissolved Oxygen Profiles and Secchi Depths for Selected Wetlands, City of Saskatoon West/Southwest Sector, June 19 to 21, 2012

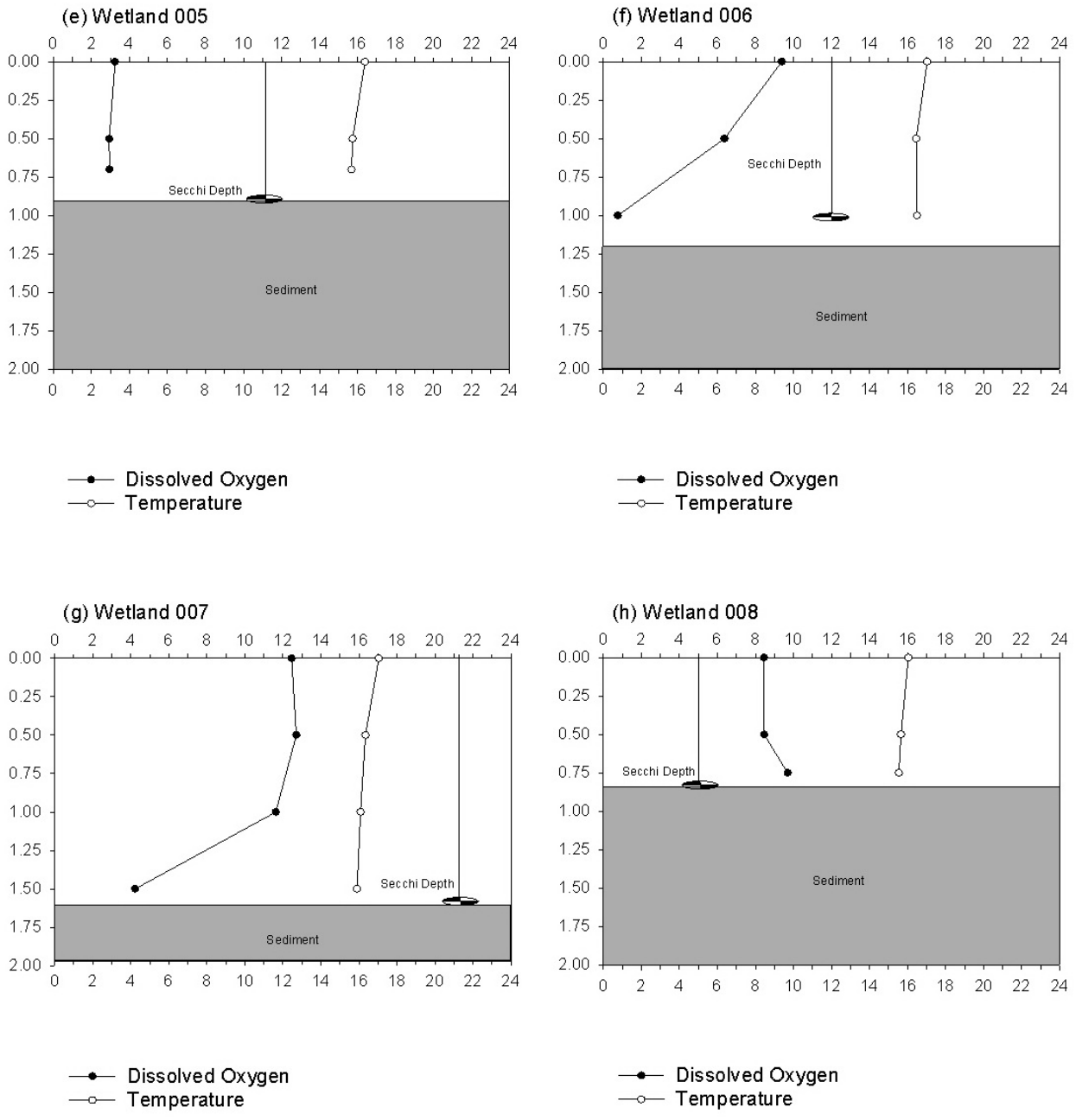


Figure 4-2: Temperature, Dissolved Oxygen Profiles and Secchi Depths for Selected Wetlands, City of Saskatoon West/Southwest Sector, June 19 to 21, 2012

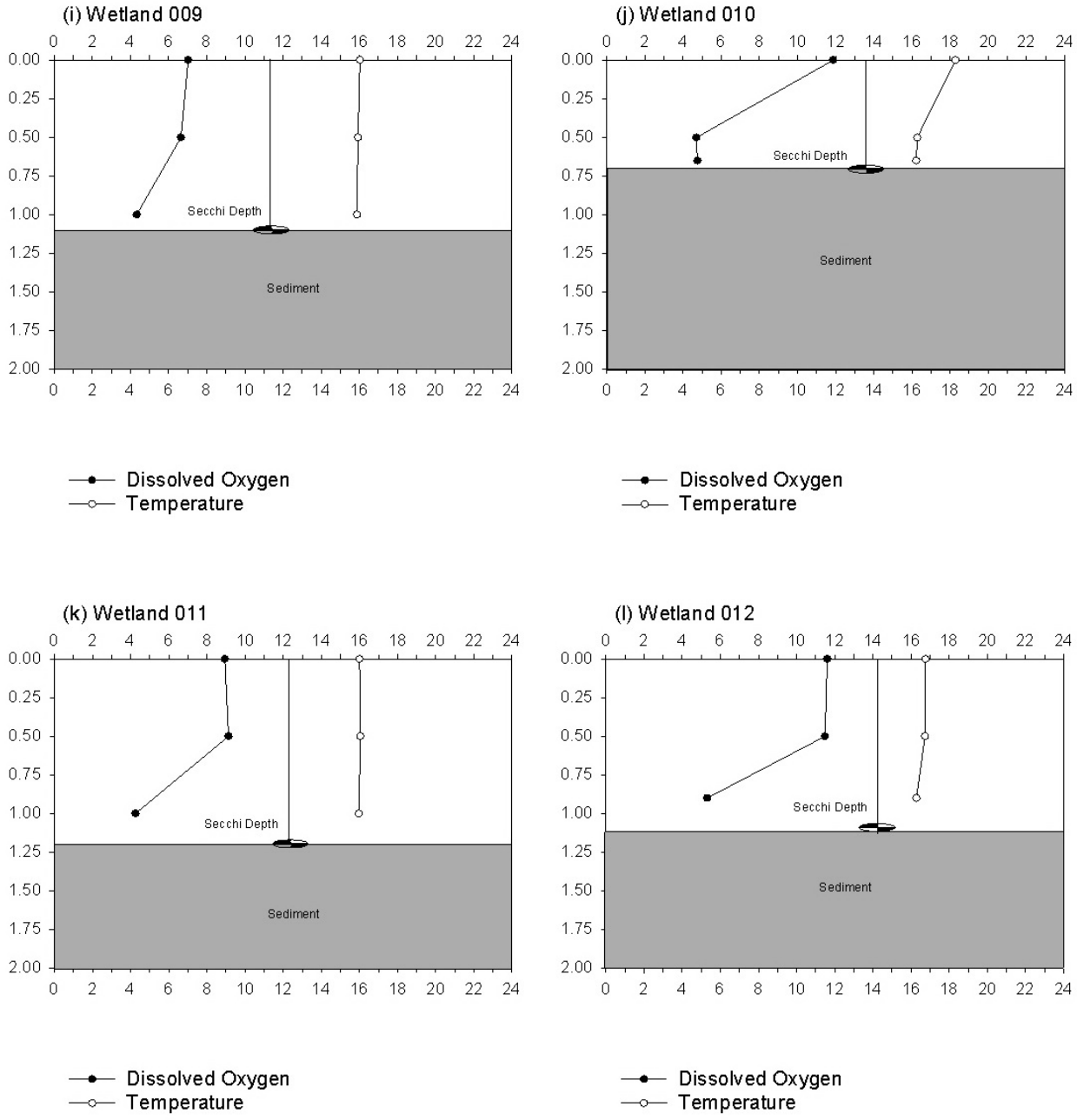


Figure 4-2: Temperature, Dissolved Oxygen Profiles and Secchi Depths for Selected Wetlands, City of Saskatoon West/Southwest Sector, June 19 to 21, 2012

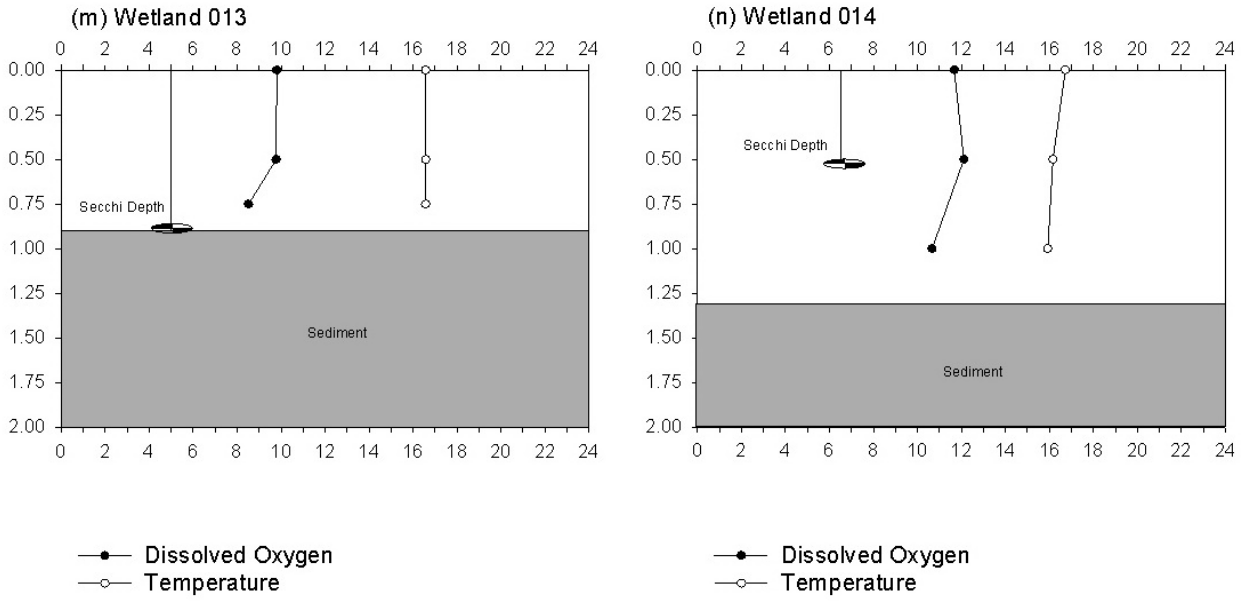


Figure 4-2: Temperature, Dissolved Oxygen Profiles and Secchi Depths for Selected Wetlands, City of Saskatoon West/Southwest Sector, June 19 to 21, 2012

Total hardness concentrations ranged from 338 mg/L (wetland 012) to 1,350 mg/L (wetland 001) indicating very hard water (greater than 180 mg/L) in the Study Area (Canadian Council of Ministers of the Environment [CCME] 2012). Calcium and magnesium concentrations ranged from 51.6 to 194 mg/L and 47.7 to 209 mg/L, respectively, and account for most of the total hardness. Fluoride concentrations ranged from below detection limits to above the CWQG of 0.12 mg/L (wetlands 001 and 009 respectively). Chloride concentrations ranged from 21.6 mg/L (wetland 012) to 359 mg/L (wetland 003) and exceeded the CWQG of 120 mg/L in wetlands 001, 002, and 003.

Ammonia as nitrogen concentrations ranged from below the detection limit (<0.050 mg/L; in wetland 012) to 2.29 mg/L (wetland 001); 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, except for wetland 012 (<0.050 mg/L). Potential natural sources of ammonia include the 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 0.50 mg/L and 0.050 mg/L, respectively, in all wetlands. Concentration of total Kjeldahl nitrogen ranged from 1.57 mg/L (wetland 009) to 4.22 mg/L (wetland 001). Ortho-phosphate as phosphorus concentrations ranged from <0.050 mg/L (wetland 009) to 0.836 mg/L (wetland 004). Concentrations of organic carbon and dissolved organic carbon were lowest in wetland 009 (21.6 mg/L and 21.6 mg/L, respectively) and highest in wetland 004 (37.5 mg/L and 45.4 mg/L, respectively).

Detection limits for analysis of total metals were below the most conservative applicable guideline (SWQO or CWQG), with the exception of mercury which had a higher detection limit. Reported total metal concentrations were generally below the applicable detection limit or were below the applicable guideline, with one exception. Total arsenic concentrations at four wetlands were above SWQO and CWQG of 0.005 mg/L, ranging from 0.0053 mg/L (wetland 001) to 0.00849 mg/L (wetland 004). Potential natural sources of arsenic include weathered rocks and soils; a potential agricultural source of arsenic is herbicide usage (CCME 2001).

4.3.3 Sediment Quality

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

Moisture content in sediment samples generally was similar among wetlands, ranging from 77.7% to 88.4%, except in the sediment from wetland 009, which was 54.4%. Total organic carbon was variable among wetlands; lowest in wetland 009 (1.56%) and highest in wetland 002 (8.46/10.9%). Levels of inorganic carbon were similar among wetlands, ranging from 0.48% to 0.77% in wetland 002 to 2.93% in wetland 001. Calcium carbonate ($CaCO_3$) equivalent was much higher in wetland 001 (24.4%) compared to the other wetlands (4.0% to 9.98%). Levels of calcium (Ca), magnesium (Mg), and potassium (K) also were much higher in wetland 001 (86,300, 11,100, and 5,080 milligrams per kilogram based on dry weight [mg/kg dw] of sample, respectively) compared to the range for the other wetlands (17,800 to 29,700 mg/kg dw for Ca; 6,450 to 10,400 mg/kg dw for Mg; 1,900 to 4,220 mg/kg dw for K).

Total metal concentrations generally were similar among wetlands, except for arsenic (As), Lead (Pb), Lithium (Li), and Strontium (Sr). Concentrations of As were 5.64 mg/kg in wetland 009, while they ranged between 2.98 mg/kg dw and 3.80 mg/kg dw in the other wetlands. The Pb level was 19.3 mg/kg dw in wetland 003, while levels ranged from 8.1 mg/kg dw to 12.4/13.6 mg/kg dw in the other wetlands. The Li concentration was higher in wetland 001 (25.6 mg/kg dw than in all other wetlands (ranged from 11.7 mg/kg dw to 13.8 mg/kg dw). Levels of Sr were higher (410 mg/kg dw) in wetland 001 than in all other wetlands (76.6 mg/kg dw to 111/161 mg/kg dw).

No exceedences of the CCME Interim Freshwater Sediment Quality Guidelines (CCME 2002) were observed for any of the parameters measured.

4.4 Discussion and Summary

Fourteen wetlands in the Study Area were assessed for limnological characteristics. Limnological parameters did not correlate with depth or surface area of the wetlands. Low DO levels near the bottom of the wetlands likely are caused by the oxygen demand that results from the decay of plant material. A hydrogen sulphide odour was noticed during sediment sampling in wetlands 002, 003, and 009 (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., only wetlands 011, 012, and 013 had levels below 1,000 µS/cm).

Six wetlands were assessed for water chemistry. Water was alkaline in all wetlands, with no pH values exceeding the CWQG. Water in the sampled wetlands was very hard; which was mainly attributable to high calcium and magnesium concentrations. Fluoride and chloride concentrations were above the CWQG for some of the wetlands (wetlands 001 and 009, and 001, 002, and 003, respectively). Most ammonia as nitrogen concentrations were above the pH and temperature dependent SWQO and CWQG (agricultural use of the area could explain the observed concentrations). Total metal concentrations generally were either below the detection limits or below applicable guidelines. Total arsenic concentrations of most wetlands were near or above SWQO and CWQG (local soil chemistry and agriculture in the area could explain the observed concentrations).

Four wetlands were assessed for sediment chemistry. Sediment quality parameters generally were similar amongst the wetlands sampled. The only differences noted among wetlands were related to differences in As, Pb, Li, and Sr levels. No exceedences of the CCME interim sediment quality guidelines were noted.

5.0 HYDROLOGY ASSESSMENT

5.1 Methods

A high level desktop assessment was conducted to consider the validity of developing a stormwater management facility within the West Swale. This desktop assessment evaluates certain general components of a stormwater facility and compares these attributes to the known existing characteristics and configuration of the West Swale. Known characteristics of the West Swale were determined through measurements taken during the wetland classification and water quality field assessment conducted from June 19 to 21, 2012, and from existing National Topographic System (NTS) 1:50,000 scale topographic maps of the area. Details and results of the field assessment are provided in Section 4.0. This desktop assessment does not provide detailed design elements or water quality comparisons, but rather, the objective of the high level desktop assessment is to evaluate the potential of the West Swale or sections of the West Swale as a suitable stormwater facility.

To determine if the West Swale has the potential to be used as a stormwater facility, the current characteristics of the swale were compared to the design guideline for a wet pond as specified by MOE's *Stormwater Guidelines, EPB 322* (2006). Under *The Environmental Management and Protection Act* (2002) and *The Water Regulations* (2002)*;* stormwater quality and most aspects of its management at present are not specifically regulated. Therefore, MOE's *Stormwater Guidelines, EPB 322* (2006) were developed to provide high-level technical guidance to municipal authorities, individuals, and consultants who plan to develop and implement drainage systems for stormwater in urban/built-up municipal areas, commercial, and industrial areas in Saskatchewan.

5.2 Results

In general, the drainage within the Study Area occurs over a relatively flat topography, but is gently sloping to the southeast, resulting in a weakly developed and intermittently flowing natural drainage system. The West Swale is a well-defined long, broad, shallow depression that forms part of a small tributary to the South Saskatchewan River. This long shallow depression consists of several permanent wetland areas connected by intermittent stream channels. The connecting stream channels act as a flow pathway that directs outflow spilling from one upstream wetland to the next downstream wetland during high flow years. The entire West Swale extends almost 20 km, with its upstream end beginning outside of the Study Area (as far north as land description 25-37-6 W3M), and the downstream end terminating at the confluence with the South Saskatchewan River.

During low run-off years, much of the West Swale is dry, except for some larger or deeper wetlands. These larger permanent and semi-permanent wetlands are labelled LAKE01, LAKE02, and LAKE03 in Figure 3-2. LAKE01 is located in Sections 9, 16, and 17 of 37-6 W3M; LAKE02 is located in Sections 22 and 27 of 36-6 W3M; and LAKE03 is located in Section 34 of 36-6 W3M and Sections 3 and 4 of 37-6 W3M.

Wet detention ponds are stormwater control structures designed to retain and treat the contaminated stormwater run-off. They also can attenuate peak flows downstream, depending on the size and flow rate. There are several different versions of the wet pond design, but the most common design is the extended detention wet pond where adequate storage is provided above the permanent pool to detain stormwater run-off and to provide a means of settling of suspended solids. Run-off from each rainfall event is detained and treated in the pond until it is displaced by run-off from the next storm. The storm flow also could be flowing through the pond and the total suspended solids will be reduced as sediment-laden water encounters low velocities within the pond and some settlement occurs. Sedimentation processes remove particulates, organic matter, and metals, while nutrients are removed through biological uptake. Wet ponds are among the most cost-effective and widely-used stormwater practices. Generally a higher level of nutrient removal and better stormwater quality control can be achieved in wet ponds than can be achieved with other practices, such as dry ponds, infiltration trenches, or sand filters (Saskatchewan Environment 2006). A typical wet pond is shown in Figure 5-1.

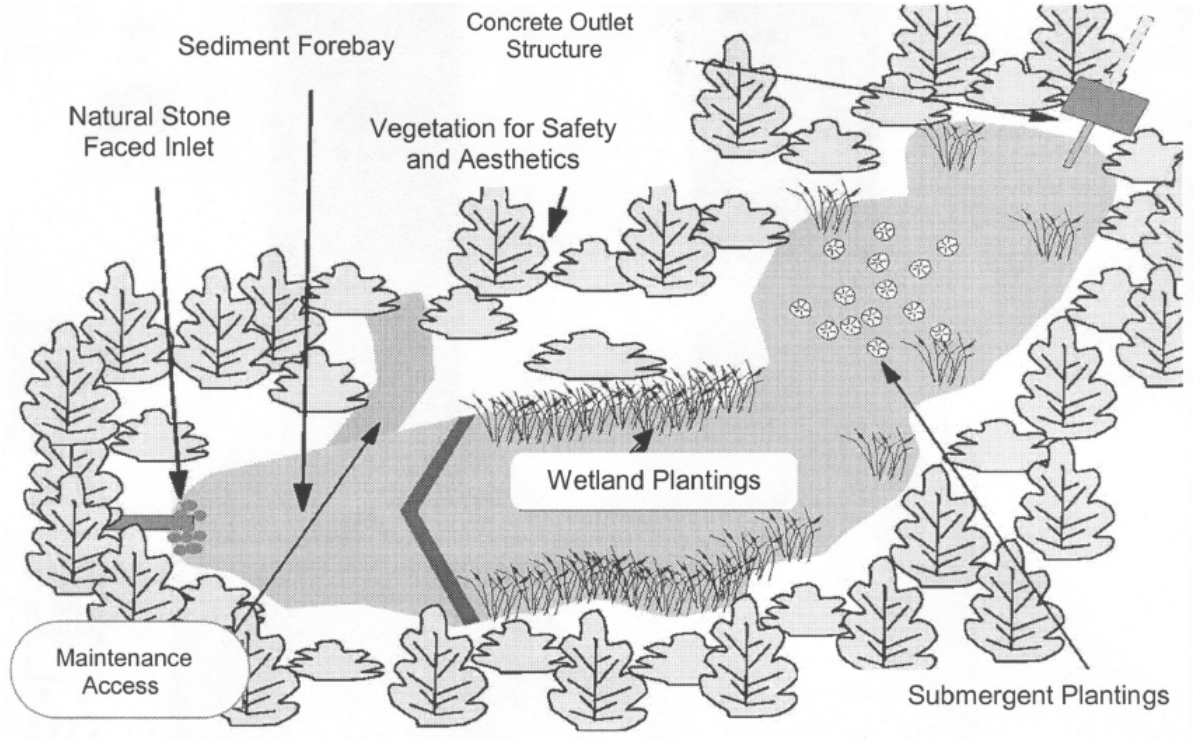


Figure 5-1: Schematic Illustration of a Wet Detention Pond, taken from Saskatchewan Environment (2006)

A list of wet pond design components, as well as MOE's recommended minimum and preferred criteria is provided in Table 5-1. This table also compares the West Swale characteristics, as determined from field investigations and a NTS map, to the MOE recommended criteria.

5.3 Summary

The West Swale (or parts of the West Swale) has the potential to be used as stormwater facilities. However, to meet the MOE *Stormwater Guidelines, EPB 322* (2006), the ponds used specifically for the stormwater would need to be deepened and graded accordingly.

The three larger permanent or semi-permanent wetlands within the West Swale (labelled LAKE01, LAKE02, and LAKE03 in Figure 3-2) were measured to be approximately 1.4 m, 1.8 m, and 1.3 m deep, respectively, during the wetland classification and water quality field assessment in June 2012. These sections of the West Swale would be more suitable than others for use as a stormwater facility because of their depth, shape, and size.

Developing a stormwater management facility within the West Swale would change the natural water regime by increasing variation in water volume and levels, and by decreasing flow peaks due to increased flow attenuation. A change in water regime can affect current plant communities and wildlife habitat. However, from an environmental perspective, it appears that there are no specific areas that should be avoided when developing a stormwater management facility within the West Swale. For example, the results of the vegetation communities and listed plant species assessment described in Section 2.0 found that no provincial or federal listed plant species were identified nor previously documented within the West Swale. During the 2012 wildlife survey, a listed wildlife species (horned grebe) was observed around LAKE03. It was not confirmed if this species was nesting in this area or if it was just using the site for staging or foraging. If grebes are using the area for nesting, raising or lowering water levels rapidly could decrease nesting success (e.g., nests flooded out or exposed to predators). However, the majority of the West Swale provides habitat that could support other listed wildlife species.

6.0 HERITAGE AND CULTURAL RESOURCES

Heritage resources include all of Saskatchewan's Historic and Precontact archaeological sites, architecturally significant structures, and paleontological resources. Heritage resources are property of the Provincial Crown and are protected under *The Heritage Property Act*.

6.1 Methods

The Heritage Conservation Branch has identified two primary factors for determining whether a Heritage Resources Impact Assessment (HRIA) is required for a project as per Section 63 of *The Heritage Property Act*. This includes the presence of previously recorded heritage resources and the archaeological sensitivity or potential for undocumented heritage resources to be present in the Project Area. Secondary factors include the nature and extent of previous land disturbance (including cultivation), and the nature and scope of proposed land alteration.

Table 5-1: MOE's Design Guidelines for Wet Ponds Compared to the West Swale Characteristics

Design Component	Minimum Criteria	Preferred Criteria	West Swale Characteristics	Does West Swale Meet Guidelines?
Drainage area	5 hectares	≥ 10 hectares	Drainage area to entire West Swale ~10,000 ha. Drainage area to each individual pond would depend on its location within the overall watershed, but would likely have a drainage area > 10 ha.	YES
Detention time	24 hours	24 hours	Variable depending on storm magnitude.	POTENTIALLY
Side slopes	Above permanent pool: 4:1 to 5:1	Above permanent pool: 4:1 to 5:1	Uncertain	POTENTIALLY (side slopes can be graded accordingly)
	In permanent pool: 5:1 to 7:1	In permanent pool 5:1 to 7:1		
Length to width ratio	4:1 to 5:1.	4:1 to 5:1	Various along swale, but approximately 5:1 to 7:1 in larger wetland areas.	POTENTIALLY (certain areas along the total length of swale meet the guidelines and larger ponds can be restructured accordingly)
	Forebay: minimum 2:1			
Permanent pool depth	Maximum: 3 m	Maximum: 2.5 m	Pond depths measured during the wetland classification and water quality field assessment ranged from 0.9 m to 1.8 m.	POTENTIALLY (pond would likely need to be deepened)
	Mean: 1 to 2 m	Mean: 1 to 2 m		
Forebay	Minimum depth: 1 m	Minimum depth: 1.5 m		POTENTIALLY (the forebay would need to be shaped accordingly)
		Length to width ratio: ≥ 2:1		
		Surface area not to exceed 1/3 of permanent pool surface area.		
Active storage depth	Water quality and erosion control: maximum 1.5 m	Water quality and erosion control: maximum 1 m		POTENTIALLY (pond would likely need to be deepened)
	Total (including quality control): 2 m	Total (including quality control): 2 m		

For the prairies and southern parklands of Saskatchewan, the Heritage Conservation Branch considers lands to be archaeologically sensitive if they are:

- within the same quarter section as a previously recorded site(s);
- within 500 m of a Site of Special Nature (e.g., burials, effigies, medicine wheels);
- within 1 km of permanent rivers/streams;
- within 1 km of well-formed valleys;
- within 1 km of permanent/seasonal water bodies greater than 2 km in length/width;
- within 1 km of smaller waterbodies that are located in well-defined drainage basins;
- adjacent to readily identifiable strandlines;
- within (or on the periphery of) sand dune complexes; and
- on escarpments, prominent uplands, and/or hummocky terrain.

The Heritage Conservation Branch has applied these criteria to regions of the province to identify potentially heritage sensitive areas.

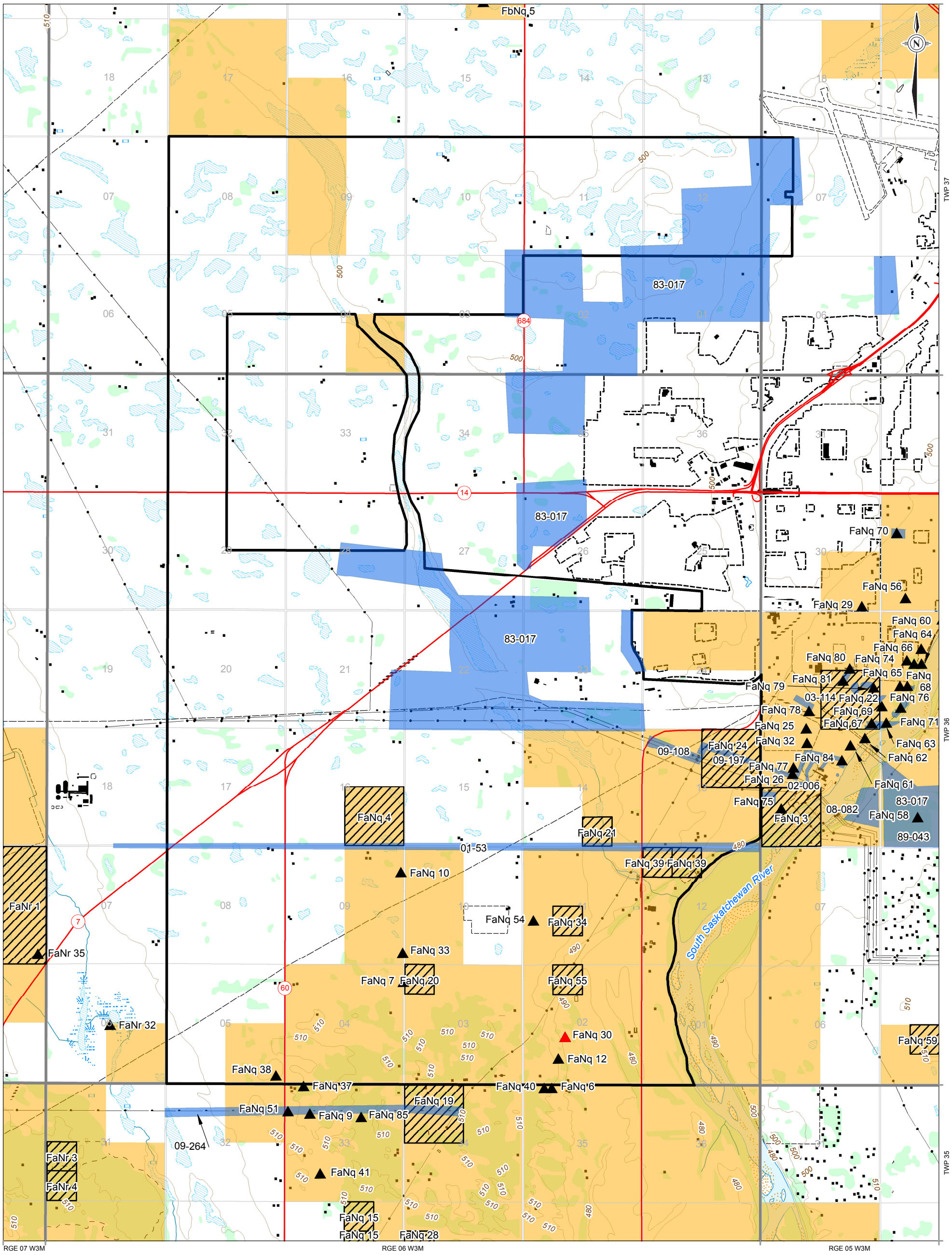
6.2 Results

The Developer's Online Screening Tool maintained by the provincial government was consulted to determine locations within the Study Area that are considered heritage sensitive. Thirty-six quarter sections have been identified as heritage sensitive (Table 6-1; Figure 6-1). Most of these quarter sections are located near the southern part of the Study Area and adjacent to the South Saskatchewan River. This land includes a portion of a major terrace of the South Saskatchewan River known as the Saskatoon Terrace, as well as a stabilized sand dune environment associated with the Moose Woods Sand Hills (Dyck 1970; Walker 1992). The remaining two heritage sensitive quarters in the northern portion of the Study Area are associated with the West Swale.

Table 6-1: Heritage Sensitive Quarter Sections within the Study Area

Heritage Sensitive Quarter Sections			
NW 9-37-6 W3M	SE 13-36-6 W3M	NW 12-36-6 W3M	NE 3-36-6 W3M
SW 9-37-6 W3M	NE 9-36-6 W3M	NE 12-36-6 W3M	SW 3-36-6 W3M
SE 16-36-6 W3M	SE 9-36-6 W3M	SW 12-36-6 W3M	SE 3-36-6 W3M
NW 14-36-6 W3M	NW 10-36-6 W3M	SE 5-36-6 W3M	NW 2-36-6 W3M
NE 14-36-6 W3M	SW 10-36-6 W3M	NW 4-36-6 W3M	NE 2-36-6 W3M
SE 14-36-6 W3M	NW 11-36-6 W3M	NE 4-36-6 W3M	SW 2-36-6 W3M
NW 13-36-6 W3M	NE 11-36-6 W3M	SW 4-36-6 W3M	SE 2-36-6 W3M
NE 13-36-6 W3M	SW 11-36-6 W3M	SE 4-36-6 W3M	NW 1-36-6 W3M
SW 13-36-6 W3M	SE 11-36-6 W3M	NW 3-36-6 W3M	SW 1-36-6 W3M

G:\2012\1361\12-1361-0028 City of Saskatoon Natural Area Screening\Figures\Phase 2000 - Field Assessments\2050 - Heritage\12-1361-0028 Heritage Resources and Sensitivities Map.mxd Date: 10-Sep-12 4:53:31 PM



LEGEND

- KNOWN HERITAGE RESOURCE
- SITE OF SPECIAL NATURE
- KNOWN HERITAGE RESOURCE
- HERITAGE SENSITIVE
- AREAS PREVIOUSLY ASSESSED UNDER HRIA PERMIT
- STUDY AREA
- TOWNSHIP/ RANGE BOUNDARY
- SECTION BOUNDARY
- URBAN MUNICIPALITY
- HIGHWAY

1 0 1
SCALE 1:50,000 KILOMETRES

REFERENCE

HERITAGE CONSERVATION BRANCH, MINISTRY OF TOURISM, PARKS, CULTURE AND SPORT, 2012
DMTI HIGHWAYS AND ROADS
NTS MAPSHEET 73B02
NAD83 UTM ZONE 13

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
HERITAGE RESOURCES AND HERITAGE SENSITIVITIES MAP

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JW	09/07/12	FIGURE: 6-1	
CHECK	KZ	10/07/12		
REVIEW	PY	10/07/12		

The database for previously recorded heritage resources also maintained by the provincial government was consulted to identify the types of archaeological sites recorded in the Study Area. The results indicate that 15 documented heritage resources occur within the proposed Study Area. These sites include artifact finds (n = 4), artifact scatters (n = 10), and one Site of Special Nature (Table 6-2; Figure 6-1). Nine of these sites contain diagnostic artifacts indicating that the area has been occupied since the Early Precontact Period beginning at least 8,800 years ago with Cody Complex projectile points, through to the Late Precontact Period, and contact with Europeans, as indicated by Plains Side-notched points (Dyck 1983, Walker 1999). The Site of Special Nature consists of a burial associated with a McKean Complex projectile point that dates from approximately 4,100 to 3,100 before present. Sites of Special Nature are heritage resources that have spiritual or sacred significance and are offered additional protection under Section 64 of *The Heritage Property Act*. The Heritage Conservation Branch reviews potential impacts to Sites of Special Nature on a case by case basis; however, a minimum avoidance buffer of 250 m is typically required (Friesen, pers. comm., 2012).

Table 6-2: Previously Recorded Heritage Resources within the Study Area by Type

Site Type	Definition	No. of Sites
Artifact Find	Archaeological sites consisting of five or fewer artifacts. An artifact is any object used or modified by humans (e.g., projectile point, pottery shards, or lithic flakes).	4
Artifact Scatter	Archaeological sites consisting of six or more artifacts.	10
Site of Special Nature	Sites that have a spiritual or cultural significance and are offered additional protection under Section 64 of *The Heritage Property Act* (i.e., burials or medicine wheels).	1
	Total	**15**

All archaeological sites in the Study Area were recorded in the 1960's and 1970's (Table 6-3). According to the Saskatchewan Archaeological Resources Record forms, these sites were identified based on information provided by local landowner and informant reports, which was recorded by the Saskatchewan Museum of Natural History (now the Royal Saskatchewan Museum). Some sites were identified during the course of academic research (Dyck 1970).

Table 6-3: Previously Recorded Heritage Resources Found Within the Study Area

Borden No.	Site Type	Year Recorded	Cultural Affiliation
FaNq 4	artifact scatter	1960	Oxbow, McKean, Pelican Lake, Avonlea, Prairie Side Notched, Plains Side Notched
FaNq 7	artifact scatter	1973	Oxbow, Pelican Lake, Besant
FaNq 8	artifact scatter	1973	Oxbow, Besant
FaNq 10	artifact scatter	1966	Unknown
FaNq 12	artifact scatter	1973	Late Precontact (unidentified pottery)
FaNq 20	artifact scatter	1973	Cody, Oxbow, Pelican Lake, Besant
FaNq 21	artifact find	1973	Oxbow
FaNq 24	artifact find	1973	Unknown
FaNq 30	Site of Special Nature	1978	McKean Burial
FaNq 33	artifact scatter	1967	Unknown
FaNq 34	artifact scatter	1978	Unknown
FaNq 38	artifact scatter	1973	Oxbow, Besant

Table 6-3: Previously Recorded Heritage Resources Found Within the Study Area (continued)

Borden No.	Site Type	Year Recorded	Cultural Affiliation
FaNq 39	artifact scatter	1973	Oxbow
FaNq 54	artifact find	1966	Unknown
FaNq 55	artifact find	1966	Unknown

Study Area plot data obtained from the Heritage Conservation Branch indicate that four HRIAs have also been carried out in the Study Area (Table 6-4; Figure 6-1). This includes the Saskatoon Perimeter Archaeological Resource Assessment conducted by Walker in 1983 under Archaeological Investigation Permit No. 83-017 and a Saskatchewan Water Corporation Pipeline carried out by Stantec (2001) under Archaeological Investigation Permit No. 01-053. More recently, assessments were carried out by Golder (2009a and 2009b) as part of TransGas pipeline assessments under Archaeological Investigation Permits No. 09-108 and No. 09-197. No heritage resources were identified in the Study Area as a result of these assessments.

Table 6-4: HRIAs Conducted Within the Study Area

Archaeological Investigation Permit No.	Permit Holder	Project
83-017	Ernest Walker	Saskatoon Perimeter Archaeological Resource Assessment
01-053	Stantec	Saskatchewan Water Corporation Pipeline
09-108	Golder	TransGas Limited Grandora Pipeline
09-197	Golder	TransGas Limited Queen Elizabeth 'D' Plant Pipeline

6.3 Summary

Based on the results of this desktop screening, plans for any development in the heritage sensitive areas identified in the Table 6-1 above and Figure 6-1 should be submitted to the Heritage Conservation Branch for review to determine if an HRIA is required prior to any development activities.

7.0 TERRAIN AND SOILS

Terrain and soils are important to functioning ecosystems. Terrain influences how soils develop within an area and how soils are distributed across the landscape. Soil is a complex heterogeneous medium consisting of variable amounts of minerals, organic matter, water, and air, which supports micro-organisms, invertebrates, agricultural and other plant communities, and other animal life.

7.1 Methods

A desktop resource investigation was completed to identify terrain and soil conditions present in the Study Area.

7.1.1 Terrain

The desktop terrain investigation identified terrain characteristics, including landscape and topography, based on Acton et al. (1998).

7.1.2 Soil Associations

The desktop soil investigation identified soil associations and map units, agriculture capability, erosion sensitivity, soil salinity, and stoniness specific to the Study Area. Information for mapped soil polygon distribution within the Study Area (soil map unit, association, and agriculture capability) was obtained from published soil surveys from Saskatchewan Land Resource Unit (SLRU) (2004).

Soil map units represent the soil associations found within an individual mapped area (soil polygon). Soil association is a term used to show the relationship between different soil profiles that have formed on the same geological deposit within a particular climatic zone (Agriculture and Agri-Food Canada et al. 2005). Soil map units identify the variations in the kinds and distribution of soil profiles within an association from one area to the next. Soil map units are defined as simple or compound units (Agriculture Canada 1982 and 1991). Simple soil map units are delineated when one soil association represents over 85% of the polygon area. Compound soil map units are delineated when two soil associations occur in the same polygon as dominant (60% to 70% of the polygon area) and a subdominant (25% to 30% of the polygon area). All soil polygons may have up to 15% soil inclusions of other soil types that are not described in the soil map unit. These are soil types that occur within a soil map unit but are not extensive enough to be distinguished separately or defined as subdominant.

Areas for soil map units and their associated soil capability for agriculture were quantified in a Geographic Information System platform for the Study Area so that areas of soil map units, soil associations, and agriculture capabilities could be determined. For estimations of areas of soil associations, it was assumed that the simple soil map units were 100% of the soil polygon area, and compound map units were 70% and 30% of the soils polygon area. However, these soil polygons still may contain 15% inclusions of other soil types not described in the soil map unit.

Agriculture Capability

Soil capability for agriculture provides a framework to determine the soil capability ratings to support agricultural practices for different soil types in Canada (Agriculture and Agri-Food Canada et al. 2005). Descriptions of the Agriculture Capability Classes are presented in Table 7-1. Class 1 soils are considered as excellent, Class 2 as good, Class 3 as fair, and Class 4 as poor for the production of common field crops. Class 5 and Class 6 soils may support forage crop production, and Class 7 soils are not capable of supporting field crop production or forage crops. The factors considered in assigning agriculture capability class are described by capability subclasses (Table 7-2) (Agriculture and Agri-Food Canada et al. 2005). These subclasses, include climate, steepness of slope, complexity of landform, soil structure, salinity, wetness, water holding capacity, adverse fertility characteristics, stoniness, susceptibility to flooding, and damage from water and wind erosion.

Table 7-1: Descriptions of Agriculture Capability Classes

Agriculture Capability Class	Description of Capability Class
Class 1	Soils have no significant limitations in use for crops.
Class 2	Soils have moderate limitations that restrict the range of crops or require special conservation practices.
Class 3	Soils have moderately severe limitations that restrict the range of crops or require special conservation practices.

Table 7-1: Descriptions of Agriculture Capability Classes (continued)

Agriculture Capability Class	Description of Capability Class
Class 4	Soils have severe limitations that restrict the range of crops or require special conservation practices, or both.
Class 5	Soils have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible.
Class 6	Soils are capable of only producing perennial forage crops and improvement practices are not feasible.
Class 7	Soils have no capability for arable agriculture or permanent pasture.

Source: Agriculture and Agri-Food Canada et al. (2005).

Table 7-2: Descriptions of Agriculture Capability Subclasses

Agriculture Capability Subclass	Description of Subclass
C adverse climate (Cm, Cs)	Indicates areas of an adverse climate for crop production as compared to the median climate, which is defined as a climate with sufficiently high growing season temperatures and sufficient precipitation to bring crops to maturity. Includes subclass Cm that indicates the climatic limitation is due to moisture deficiencies caused by insufficient precipitation. Include subclass Cs that indicates a heat deficiency expressed in terms of length of growing season and frost free period.
D adverse soil structure	Indicates areas of adverse soil structure in the upper layers that affects the condition of the seed bed, prevents or restricts root growth and penetration, or adversely affects moisture permeability or percolation.
E erosion damage	Indicates soils where damage from erosion is a limitation to agricultural use.
F adverse fertility	Indicates areas of soils having naturally low inherent fertility due to lack of available nutrients, high acidity or alkalinity, high calcium carbonate content, or inadequate cation exchange capacity.
I inundation	Indicates areas where the limitation is caused by inundation and applies to soils subjected to flooding by lakes and streams, but does not include local ponding in undrained depressions.
M moisture limitation	Consists of soils where crops are affected by drought because of inherent soil characteristics such as an insufficient water-holding capacity.
N salinity	Includes soils with enough soluble salts to adversely affect crop growth or restrict the range of crops that can be grown.
P excess stones	Depicts a limitation caused by excess stones and applies to soils that are sufficiently stony to increase the difficulty of tillage, seeding, and harvesting.
R shallowness to bedrock	Applies to soils where the rooting zone is restricted by solid bedrock. This subclass has a limited application in the agricultural area of Saskatchewan as most soils are developed on areas devoid of bedrock.
S soil limitations	Limitations may include one or more of the following: undesirable structure, low permeability, restricted rooting zone, low natural fertility, low moisture holding capacity, salinity.
T topography	Includes soils where the steepness and/or frequency of slopes in the landscape are the limitation to agricultural use.
W excess water	Includes soils where excess water is the limiting factor, and does not include those soils affected by flooding. The excess water is a result of poor soil drainage, a high water table, or seepage or run-off from surrounding areas.
X cumulative minor adverse characteristics	Consists of soils with a moderate limitation caused by the cumulative effect of two or more adverse characteristics, which singly are not serious enough to affect the class rating.

Source: Agriculture and Agri-Food Canada et al. (2005).

Agriculture capability ratings are based on a 1:100,000 soil polygon information scale. The information summarized by agriculture capability ratings describes the dominant soils that occur within a delineated soil area. Individual areas within these delineations may have different properties from the overall soil polygon.

7.1.3 Soil Characteristics

Erosion

Soils within the Study Area are rated for wind erosion and water erosion based on published soil survey digital information obtained from SLRU (2004). Water and wind are the main mechanisms of soil erosion on arable land. Water and wind erosion can cause loss and movement of topsoil and nutrients and degradation of soil structure, negatively affecting crop yields and reducing the ability of a soil to support plant growth (Agriculture and Agri-Food Canada [AAFC] 2011). Soil sensitivity to water and wind erosion is dependent on soil properties including texture, cohesiveness, structure, aggregate stability, organic matter content, and moisture. Furthermore, the extent of water and wind erosion is dictated by site-specific parameters including previous disturbance, slope gradient, surface roughness, topography, residue cover, crop management, and weather (Cruse et al. 2001; Kuhn and Bryan 2004; Transportation Association of Canada 2005; Li et al. 2007; AAFC 2011).

Water Erosion

Soil water erosion potential is affected by soil texture, organic matter content, water content, permeability, topography, slope length and gradient, and vegetation cover. Water erosion potential for soil map units within the Study Area was determined based on digital information obtained from SLRU (2004). These ratings are an estimation of potential erosion for an entire map unit and individual soils found within the area may vary from the assigned water erosion potential.

Wind Erosion

The potential for wind erosion of soil is affected by vegetation cover, wind velocity, soil water content, soil texture, soil structure, and soil disturbance. Coarse (sandy) textured soils are more prone to wind erosion than finer (clay) textured soils. Sandy textured soils typically do not have a well-developed soil structure due to limited soil aggregation or adhesion of the soil particles so they do not form larger and more stable soil aggregates. Aggregated soil particles are less likely to be moved by wind.

Wind erosion potential represents the erosion risk for a soil type when it is left unvegetated or without other surface protection. Wind erosion potentials for soil map units within the Study Area were determined based on digital information obtained from SLRU (2004). These ratings are an estimation of potential erosion for the entire soil map unit and individual soils found within the area may vary from the assigned wind erosion potential.

Salinity

Soils within the Study Area are rated for salinity based on published soil survey information in the form of digital information obtained from SLRU (2004).

Stoniness

Soils within the Study Area are rated for stoniness based on published soil survey information in the form of digital information obtained from SLRU (2004).

7.2 Results

7.2.1 Terrain

The northern and central portion of the Study Area (approximately 70% of the Study Area) is within the Saskatoon Plain Landscape Area and the remaining southern portion of the Study Area (approximately 30%) is within the Moose Wood Sand Hills Landscape Area of the Mixed Grassland Ecoregion. Saskatoon Plain and Moose Wood Sand Hills Landscape areas are within the Prairie Ecozone. The Saskatoon Plain Landscape Area is characterized by very gently undulating glaciolacustrine and eroded glacial till plains. The Moose Wood Sand Hills Landscape Area is characterized by very gently undulating glaciofluvial landscapes with sand dunes adjacent to the South Saskatchewan River, south of Saskatoon (Acton et al. 1998).

7.2.2 Soils

Soil plays a key role in ecosystem function and is the medium that supports vegetation communities and agriculture in the Study Area. Soil can also provide habitat for wildlife such as amphibians and small rodents and it supports a diverse fauna of soil macro- and micro-organisms that are critical for the functioning of a healthy ecosystem. These organisms are responsible for organic matter decomposition, nutrient cycling, and organic waste decomposition, which in turn influence the health and state of the ecosystem.

7.2.2.1 Soil Associations

The locations of soil map units within the Study Area are shown in Figure 7-1. A description of each soil map unit within the Study Area, and its associated soil associations is listed in Table 7-3. Soils occurring within the Study Area are generally subgroup variations of the Dark Brown great group in the Chernozemic soil order. There are also significant areas of soils belonging to the Solonetzic soil order, including Solonetz and Solod soils. Both Solonetz and Solod soils have salt accumulation in the B horizon.

The Study Area is comprised of 15 soil associations and 18 soil map units. The Bradwell (Br3) soil map unit is the most dominant soil map unit within the Study Area and makes up 20.5% (4,398 ha) of the Study Area. Soil map units that include soils from the Solonetzic soil order are Elstow-Hanley (EwHy1), Meadow Complex (Mw2), Tuxford (Tu1), Tuxford-Bradwell (TuBr1), and Tuxford-Weyburn (TuWr4). Combined, these soil map units make up 27.7% (5,953 ha) of the Study Area. Of this area, approximately 20% (approximately 4,200 ha) may be saline. Saline soils typically occur in depressions, sloughs, dissection, or runways.

7.2.2.2 Agriculture Capability

Soils within the Study Area are rated for agriculture capability based on published soil surveys in the form of digital information obtained from SLRU (2004). The definitions for the agriculture capability classes and subclasses that occur within the Study Area are outlined in Table 7-1 and Table 7-2. Agriculture capability classes for soils within the Study Area are shown in Figure 7-2, and range from Class 2 to Class 7 (Table 7-4). The Urban (Ur) soil map unit is the only unit that has a Class 7 Agriculture Capability rating. The major limitations for crop production within the agriculture capability classes include insufficient soil water holding capacity, excess water, erosion damage, salinity, climate, and adverse structure in the upper soil horizons that may affect seed bed conditions.

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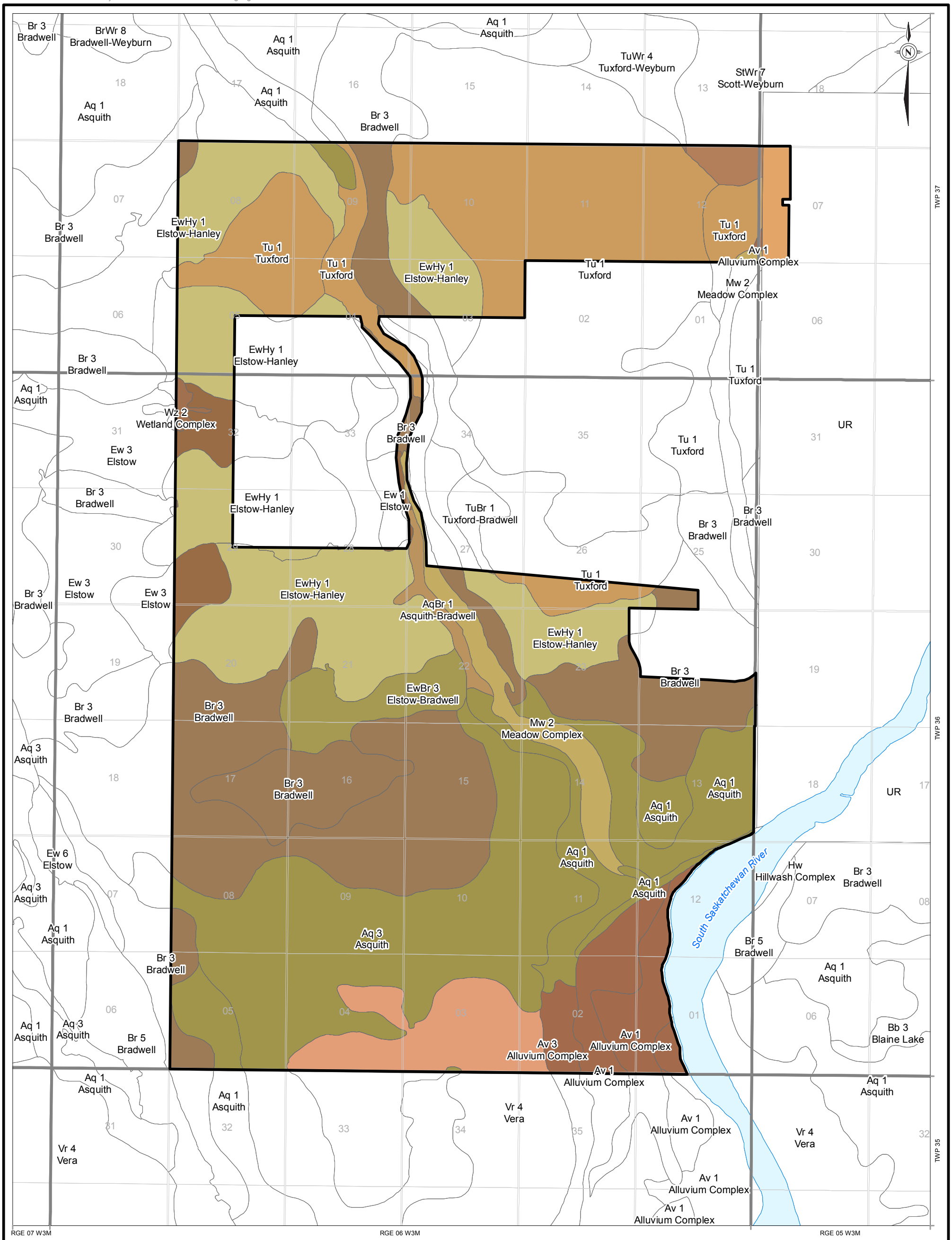

LEGEND

- STUDY AREA
- TOWNSHIP/RANGE BOUNDARY
- SECTION BOUNDARY

Symbol Sequence

Association Symbol ← An 2 Allan → Map Unit

Association Name

Note: The numbers behind association labels are termed map units and indicate different and specified combinations of soil subgroup profiles within an association, that are the result of variations in topography, drainage, or aspect.

1 0 1

SCALE 1:50,000 KILOMETRES

REFERENCE

SASKATCHEWAN LAND RESOURCE UNIT, 2004. SKSISV2, DIGITAL SOIL RESOURCE INFORMATION FOR AGRICULTURAL SASKATCHEWAN, 1:100,000 SCALE. AGRICULTURE AND AGRI-FOOD CANADA, SASKATOON, SASK.

PROJECT

CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE

SOIL MAP UNITS AND ASSOCIATIONS IDENTIFIED WITHIN THE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.2000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	LMR/JW	19/07/12	FIGURE: 7-1	
CHECK	MT	29/08/12		
REVIEW	ME	29/08/12		

Table 7-3: Soil Associations and Soil Map Units Within the Study Area

Association(s)	Soil Map Unit[a]	Soil Map Unit Description[b]	Approximate Area (ha)	Proportion of Study Area (%)	Parent Material[b]	Dominant Surface Texture(s)[a]
Alluvium	Av1	Rego Chernozems[c]	968	4.5	Undifferentiated alluvial deposits	Very fine sandy clay and silty clay
	Av3	Orthic Regosols[d]	575	2.7		Sand
Asquith	Aq1	Orthic Dark Brown Chernozems	1,270	5.9	Coarse texture, weakly calcareous, glacio-fluvial and lacustrine deposits	Sandy loam and loamy sand
	Aq3	Dominant soils - Orthic Dark Brown Chernozems	1,610	7.5		Sandy loam
		Subdominant soils - carbonated and/or saline Dark Brown Chernozems				
Asquith-Bradwell	AqBr1	Dominant soils - Asquith Orthic Dark Brown Chernozems	51	< 1	Mixture of sandy fluvial (Asquith) and loamy lacustrine (Bradwell) materials	Fine sandy loam
		Subdominant soils - Bradwell Orthic Dark Brown Chernozems				
Bradwell	Br3	Dominant soils - Orthic Dark Brown Chernozems	4,398	20.5	Medium to moderately fine texture, moderately calcareous, sandy glacio-fluvial and lacustrine deposits	Very fine sandy clay, fine sandy loam, and loam
		Subdominant soils - Calcareous Dark Brown Chernozems				
Elstow	Ew1	Orthic Dark Brown Chernozems	54	< 1	Medium to moderately fine texture, moderately calcareous, silty glacio-lacustrine deposits	Loam
	Ew3	Dominant soils - Orthic Dark Brown Chernozems	467	2.2		Loam
		Subdominant soils - Calcareous Dark Brown Chernozems				
Elstow-Bradwell	EwBr3	Dominant soils - Elstow Orthic Dark Brown Chernozems	184	< 1	Mixture of silty (Elstow) and loamy (Bradwell) lacustrine materials	Loam
		Subdominant soils - Bradwell Orthic Dark Brown Chernozems and Elstow Eluviated Dark Brown Chernozems				

Table 7-3: Soil Associations and Soil Map Units Within the Study Area (continued)

Association(s)	Soil Map Unit[a]	Soil Map Unit Description[b]	Approximate Area (ha)	Proportion of Study Area (%)	Parent Material[b]	Dominant Surface Texture(s)[a]
Elstow-Hanley	EwHy1	Dominant soils - Elstow Orthic Dark Brown Chernozems Subdominant soils - Hanley Dark Brown Solonetzic[e]	2,479	11.6	Silty lacustrine materials	Loam and clay loam
Meadow Complex	Mw2	Carbonated and/or saline Rego Humic Gleysols[f]	296	1.4	Very coarse to fine texture colluvial deposits associated with local intermittently flooded areas	Clay and sandy loam
Scott-Weyburn	StWr7	Dominant soils - Scott Orthic Dark Brown Chernozems Subdominant soils - Weyburn Orthic Dark Brown Chernozems and Calcareous Dark Brown Chernozems, and Scott Eluviated Dark Brown Chernozems	756	3.5	Mixture of shallow, silty lacustrine materials underlain by glacial till (Scott) and loamy glacial till (Weyburn)	Loam
Tuxford	Tu1	Dominant soils - Dark Brown Solonetz[g] Subdominant soils - Dark Brown Solod[h]	2,838	13.2	Fine texture, moderately calcareous and usually saline, frequently varved glaciolacustrine deposits	Clay loam
Tuxford-Bradwell	TuBr1	Dominant soils - Tuxford Dark Brown Solonetz Subdominant soils - Bradwell Orthic Dark Brown Chernozems and Tuxford Dark Brown Solod	52	< 1	Clayey lacustrine materials	Clay loam
Tuxford-Weyburn	TuWr4	Dominant soils - Tuxford Dark Brown Solonetz Subdominant soils - Weyburn Orthic Dark Brown Chernozems, a combination of Weyburn Calcareous Dark Brown Chernozems and Orthic Regosols, and Tuxford Dark Brown Solod	288	1.3	Clayey lacustrine materials (Tuxford) and loamy glacial till (Weyburn)	Clay loam

Table 7-3: Soil Associations and Soil Map Units Within the Study Area (continued)

Association(s)	Soil Map Unit[a]	Soil Map Unit Description[b]	Approximate Area (ha)	Proportion of Study Area (%)	Parent Material[b]	Dominant Surface Texture(s)[a]
Urban Land	UR	Urban land	4,030	18.8	N/A	N/A
Vera	Vr4	Orthic Regosols	1,121	5.2	Sandy aeolian or wind-worked fluvial materials	Sand
Wetland Complex	Wz2	Undifferentiated Gleysolic soils and shallow open water	27	< 1	Alluvial materials in low-lying depression areas	Unclassified

[a] SLRU (2004).

[b] SLRU (2009).

[c] Chernozem – well developed, organic matter enriched grassland soils.

[d] Regosol – weakly developed soils.

[e] Solonetzic – soils developing from saline and sodic parent material.

[f] Gleysolic – poorly drained or wetland soils.

[g] Solonetz – a soil great group of the Solonetzic order.

[h] Solod – a soil great group of the Solonetzic order.

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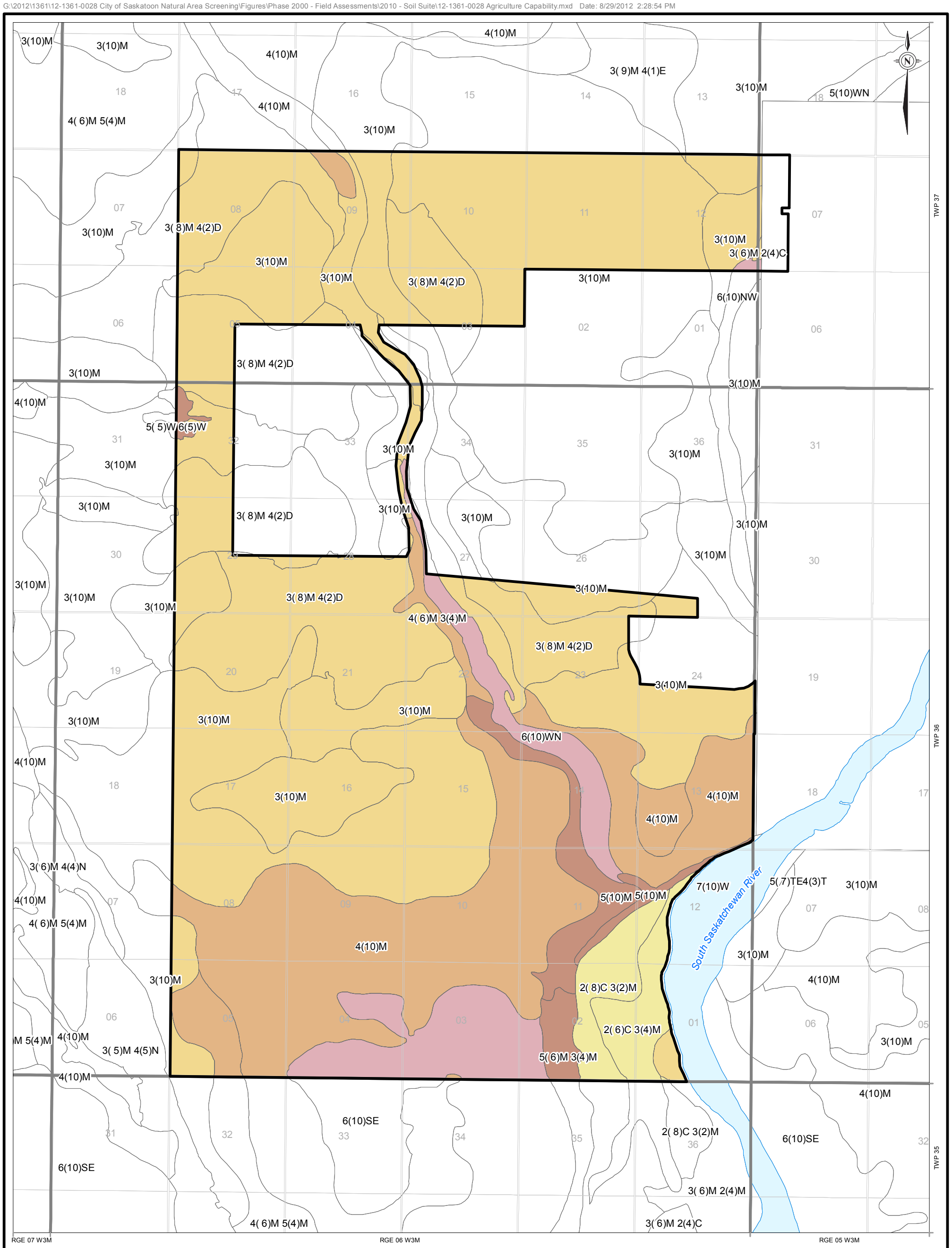

LEGEND

- STUDY AREA
- TOWNSHIP/RANGE BOUNDARY
- SECTION BOUNDARY

SCALE 1:50,000 — 1 0 1 KILOMETRES

Symbol Sequence
3(6)M5(4)TE
Capability Class
Percentage of Delineation
Limitation(s)
Limitation(s)
Percentage of Delineation
Capability Class

REFERENCE

SASKATCHEWAN LAND RESOURCE UNIT, 2004. SKSISV2, DIGITAL SOIL RESOURCE INFORMATION FOR AGRICULTURAL SASKATCHEWAN, 1:100,000 SCALE. AGRICULTURE AND AGRI-FOOD CANADA, SASKATOON, SASK.

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
AGRICULTURE CAPABILITY IDENTIFIED WITHIN THE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.2000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	LMR/JW	19/07/12	FIGURE: 7-2	
CHECK	MT	29/08/12		
REVIEW	ME	29/08/12		

Table 7-4: Soil Characteristics for Soil Map Units Occurring Within the Study Area

Soil Map Unit	Agriculture Capability Symbol[a, b]	Erosion Potentials[a, c]	Extent of Area Affected by Salinity (%)[a]
Av1	3(6)M2(4)C	Wind - very low Water - very low dissected	0 - 3
	2(6)C3(4)M	Wind - very low Water - very low dissected	0
	2(8)C3(2)M	Wind - very low Water - very low	0 - 3
	3(6)M2(4)M	Wind - very low Water - very low dissected	0 - 3
Av3	5(6)M3(4)M	Wind - very high Water - very low	0 - 3
Aq1	4(10)M	Wind - moderate Water - low dissected	0 - 10
	5(10)M	Wind - high to very high Water - very low to low dissected	0
	4(6)M5(4)M	Wind - high Water - low dissected	0 - 3
Aq3	4(10)M	Wind - moderate Water - low dissected	10 - 20
AqBr1	4(6)M3(4)M	Wind - moderate Water - low dissected	0
Br3	3(10)M	Wind - low to moderate Water - very low to low dissected	0 - 10
Ew1	3(10)M	Wind - low Water - very low dissected	0 - 3
Ew3	3(10)M	Wind - low Water - very low to low	0 - 10
EwBr3	3(10)M	Wind - low Water - low dissected	0 - 3
EwHy 1	3(8)M4(2)D	Wind - low Water - very low	0 - 10
Mw2	6(10)NW	Wind - very low Water - very low	> 70
	6(10)WN	Wind - low Water - very low	> 70
StWr 7	3(10)M	Wind - low Water - very low	0 - 3
Tu1	3(10)M	Wind - low Water - very low dissected to low dissected	0 - 10
TuBr1	3(10)M	Wind - low Water - very low	0

Table 7-4: Soil Characteristics for Soil Map Units Occurring Within the Study Area (continued)

Soil Map Unit	Agriculture Capability Symbol[a, b]	Erosion Potentials[a, c]	Extent of Area Affected by Salinity (%)[a]
TuWr4	3(9)M4(1)E	Wind - low Water - very low	0 - 3
UR	7	N/A	N/A
Vr4	6(10)SE	Wind - extremely high Water - very low	0 - 3
Wz2	5(5)W6(5)W	Unclassified	3 - 10 (weak salinity at edges of depressions, sloughs or runways)

Ratings assigned to an area are an average for the entire map unit and individual soils may occur within the map unit that differ from the assigned rating.

[a] SLRU (2004).

[b] The first number indicates the capability class, the bracketed number indicates the percent of the area, and the letters indicate the subclass. Example: 5(10) TE means that 100% of the area was placed in Class 5 because of limitations due to topography and erosion damage. See Section 6.1 for an explanation of agriculture capability ratings.

[c] Water and wind erosion potentials are based unprotected, bare soils. Dissected refers to areas of shallow gullies that indicate that higher rates of erosion may occur on the steeper slopes along the edges of the dissections if they are left unprotected.

7.2.2.3 Soil Characteristics

7.2.2.3.1 Erosion

Water Erosion

A summary of the water erosion potential for each soil map unit within the Study Area is presented in Table 7-4 and Figure 7-3. Soils within the Study Area typically have very low to low water erosion potential.

Wind Erosion

A summary of the wind erosion potential for each soil map unit within the Study Area is presented in Table 7-4 and Figure 7-4. Soils within the Study Area typically have very low to low wind erosion potentials. Soil map units with high (Aq1), very high (Av3 and Aq1), or extremely high (Vr4) wind erosion potentials have sandy, sandy loam, or loamy sand textures (Table 7-3).

Salinity

Some of the soil map units found within the Study Area are classified as Solonetzic soils, which have developed on saline or sodic parent material and have salt accumulation into the B horizon. The extent of each soil map unit affected by salinity for each soil map unit is summarized in Table 7-4 and Figure 7-5. The majority of the soil map units within the Study Area have between 0% and 3% of soils within the map unit affected by salinity. More than 70% of the soils in the area affected by salinity are in the Meadow Complex (Mw2).

Although the extent of salinity is provided in the soil database (SLRU 2004), the degree of salinity is provided only for the wetland complex (Wz2) map unit, which has weak salinity (electrical conductivity between 2 and 4 deciSiemens per metre) at edges of depressions, sloughs, and runways. Saline soils typically occur in depressions, sloughs, dissection, or runways.

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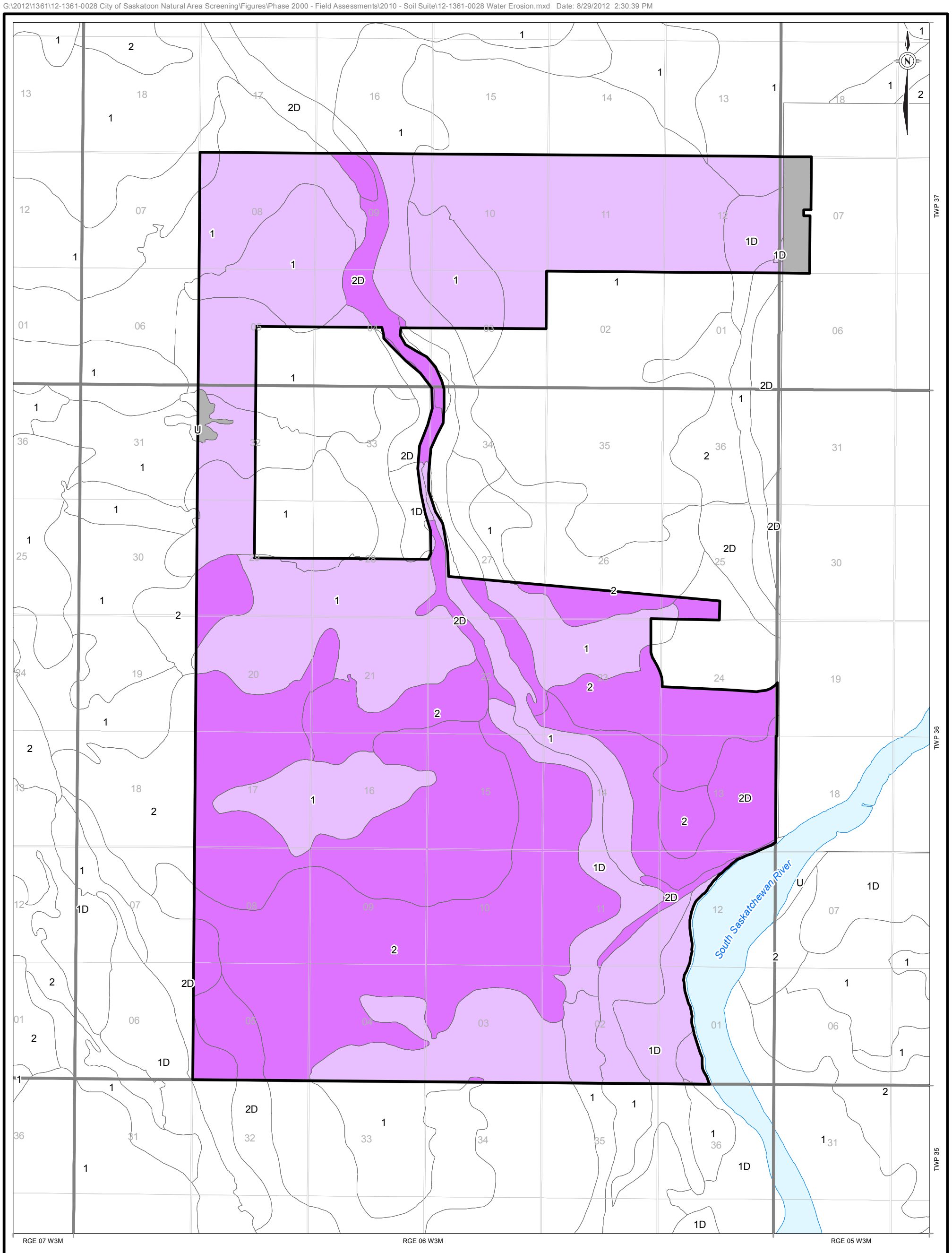

LEGEND

- STUDY AREA
- TOWNSHIP/RANGE BOUNDARY
- SECTION BOUNDARY
- 1 - VERY LOW
- 2 - LOW
- U - UNCLASSIFIED

MODIFIERS:
D - DISSECTED
G - GULLIED

SCALE 1:50,000 — 1 0 1 KILOMETRES

REFERENCE

SASKATCHEWAN LAND RESOURCE UNIT, 2004. SKSISV2, DIGITAL SOIL RESOURCE INFORMATION FOR AGRICULTURAL SASKATCHEWAN, 1:100,000 SCALE. AGRICULTURE AND AGRI-FOOD CANADA, SASKATOON, SASK.

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
WATER EROSION POTENTIAL IDENTIFIED WITHIN THE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.2000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	LMR/JW	19/07/12	FIGURE: 7-3	
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REVIEW	ME	29/08/12		

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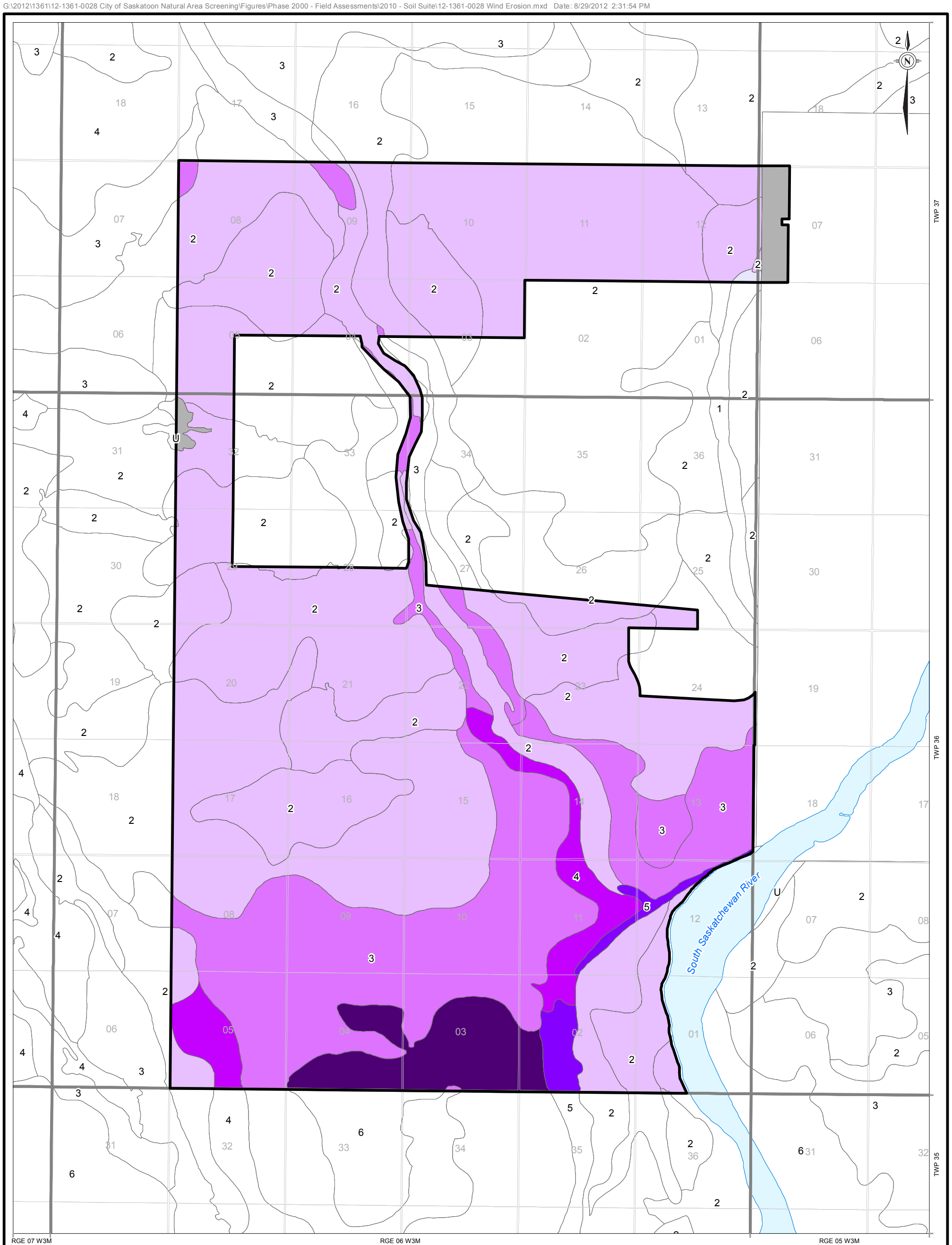


LEGEND

- STUDY AREA
- TOWNSHIP/RANGE BOUNDARY
- SECTION BOUNDARY
- 1 - VERY LOW
- 2 - LOW
- 3 - MODERATE
- 4 - HIGH
- 5 - VERY HIGH
- 6 - EXTREMELY HIGH
- U - UNCLASSIFIED

1 0 1
SCALE 1:50,000 KILOMETRES

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
WIND EROSION POTENTIAL IDENTIFIED WITHIN THE STUDY AREA

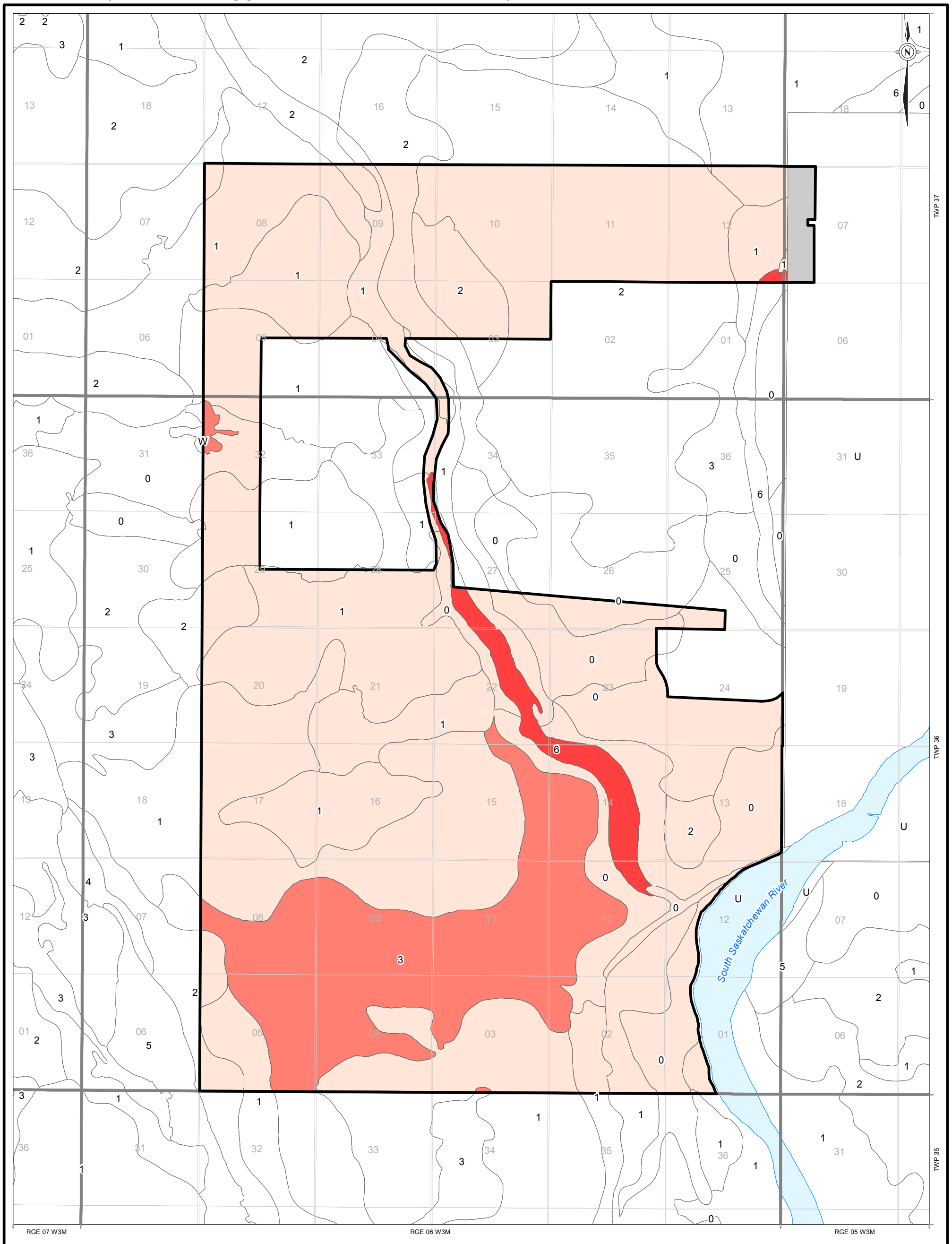
REFERENCE

SASKATCHEWAN LAND RESOURCE UNIT, 2004. SKSISV2, DIGITAL SOIL RESOURCE INFORMATION FOR AGRICULTURAL SASKATCHEWAN, 1:100,000 SCALE. AGRICULTURE AND AGRI-FOOD CANADA, SASKATOON, SASK.

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.2000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	LMR/JW	19/07/12	FIGURE: 7-4	
CHECK	MT	29/08/12		
REVIEW	ME	29/08/12		

G:\2012\1361\12-1361-0028 City of Saskatoon Natural Area Screening\Figures\Phase 2000 - Field Assessments\2010 - Soil Suite\12-1361-0028 Salinity.mxd Date: 9/12/2012 10:10:38 AM



LEGEND

- STUDY AREA
- TOWNSHIP/RANGE BOUNDARY
- SECTION BOUNDARY
- 0 - NONSALINE
- W - WEAK
- M - MODERATE
- U - UNCLASSIFIED

1 0 1
SCALE 1:50,000 KILOMETRES

REFERENCE

SASKATCHEWAN LAND RESOURCE UNIT, 2004. SKSISV2, DIGITAL SOIL RESOURCE INFORMATION FOR AGRICULTURAL SASKATCHEWAN, 1:100,000 SCALE. AGRICULTURE AND AGRI-FOOD CANADA, SASKATOON, SASK.

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
SOIL SALINITY IDENTIFIED WITHIN THE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.2000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	LMR/JW	19/07/12	FIGURE: 7-5	
CHECK	MT	29/08/12		
REVIEW	ME	29/08/12		

Stoniness

The majority of the soil map units within the Study Area have an unclassified surface stoniness and may have a wide range of surface stoniness ratings. The Alluvium (Av3) map unit is classified as non-stony (Figure 7-6).

7.3 Summary

The northern and central portion of the Study Area (approximately 70%) is within the Saskatoon Plain Landscape Area, and the southern portion (approximately 30%) is within the Moose Wood Sand Hills Landscape Area. Both Landscape Areas have very gently undulating terrain. The Saskatoon Plain Landscape area is developed on glacial till plains and the Moose Wood Sand Hills Landscape Area is developed on glaciofluvial terrain.

The Study Area is comprised of 15 Soil Associations and 18 map units with the Bradwell (Br3) map unit being the most dominant (20.5% of the Study Area [4,398 ha]).

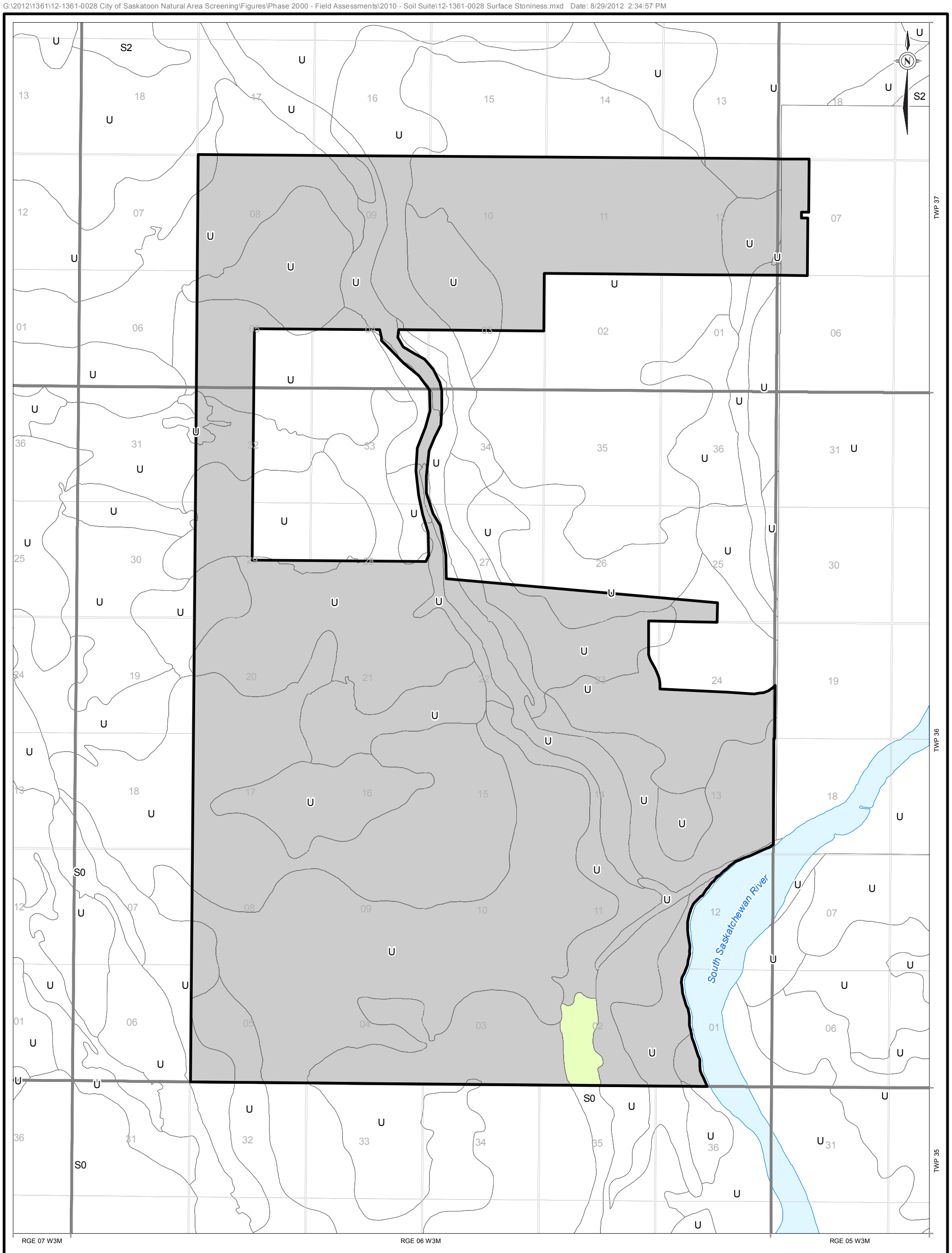
The following is a summary of the findings for soils in the Project Study Area:

- agriculture capability classes for soils within the Study Area range from Class 2 to Class 7 (Section 7.2.2.2, Table 7-4);
- soils within the Study Area typically have very low to low water erosion potential (Section 72.2.3, Table 7-4);
- soils within the Study Area typically have a very low to low wind erosion potential (Section 7.2.2.3, Table 7-4);
- map units with high (Aq1), very high (Av3 and Aq1), or extremely high (Vr4) wind erosion potentials have sandy, sandy loam, and loamy sand textures (Table 7-3);
- approximately 20% (approximately 4,200 ha) of the Study Area may have saline conditions, based on the presence of map units that are defined by saline/sodic soils;
- the majority of the map units within the Study Area have between 0% and 3% of soils within the map unit area affected by salinity; and
- the majority of the map units within the Study Area have an unclassified surface stoniness; however, the Alluvium (Av3) map unit is classified as non-stony.

8.0 DEVELOPMENT CONSIDERATIONS

A Screening Study has been completed on the West/Southwest sector of the Corman Park – City of Saskatoon Planning District to provide information regarding the existing natural habitat and the potential for sustainable development in support for future urban planning initiatives. 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 some species.

G:\2012\1361\12-1361-0028 City of Saskatoon Natural Area Screening\Figures\Phase 2000 - Field Assessments\2010 - Soil Suite\12-1361-0028 Surface Stoniness.mxd Date: 8/29/2012 2:34:57 PM



LEGEND

- STUDY AREA
- TOWNSHIP/RANGE BOUNDARY
- SECTION BOUNDARY
- S0 - NONSTONY
- U - UNCLASSIFIED

1 0 1
SCALE 1:50,000 KILOMETRES

REFERENCE

SASKATCHEWAN LAND RESOURCE UNIT, 2004. SKSISV2, DIGITAL SOIL RESOURCE INFORMATION FOR AGRICULTURAL SASKATCHEWAN, 1:100,000 SCALE. AGRICULTURE AND AGRI-FOOD CANADA, SASKATOON, SASK.

PROJECT
CITY OF SASKATOON
NATURAL AREA SCREENING

TITLE
STONINESS
IDENTIFIED WITHIN THE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	12-1361-0028.2000		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	LMR/JW	24/08/12	FIGURE: 7-6	
CHECK	MT	29/08/12		
REVIEW	ME	29/08/12		

Most of the Study Area has been previously disturbed and modified through cultivation, construction and use of road and infrastructure, and rural and urban development and; therefore, consists of limited wildlife habitat. The northern two-thirds of the Study Area is largely agriculture land. However, modified grassland and small tracts of native grassland are found in the southern portion of the Study Area. Habitats that persist in the Study Area are associated with three landscape features: wetland complexes dispersed throughout the Study Area, the West Swale, and areas of modified and native grassland associated with the banks of the South Saskatchewan River and the southern boundary of the Study Area.

The Study Area supports a number of semi-permanent to permanent wetlands and waterbodies, providing suitable wildlife habitat for a variety of waterbird and amphibian species. However, the lack of connectivity of habitats between the wetland patches in the Study Area may cause or increase the potential for local extinctions. These extinctions can impair recruitment, in and out migration, function as a movement or distance barrier, or increase predation risk when leaving cover to travel between patches. In this case, the above mentioned 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 West Swale (a natural swale) meanders through the Study Area and passes through Chappell Marsh Conservation Area before connecting with the South Saskatchewan River. Terrain in the swale is relatively level, with many small wetland areas (providing abundant habitat for aquatic vegetation), and portions of native and modified grassland on its peripheries. High precipitation this year has flooded several areas, creating large open wetlands. The West Swale is one of the more prominent landscape features within the Study Area.

A shape file of the eastern boundary of the swale for the majority of the length of the Study Area is provided on a compact disc, for informational purposes. The boundary was identified in the field using topography and vegetation change (e.g., from hydrophilic vegetation to crop or modified grassland) as the guiding features for the boundary. The boundary line was created by walking the boundary and gathering location information using a GPS. It is recommended that this boundary be used for informational purposes only to provide guidance as to where the West Swale is located within the Study Area. Future development planning and decision making should be done so in accordance with the regulations in place at the time regarding development near water and in consultation with the appropriate regulatory agencies (e.g., MOE and Saskatchewan Watershed Authority).

There is potential for the West Swale, or portions of it, to be used as a stormwater facility as part of future urban development. However, alterations would be required to meet guidelines. Development of the swale for stormwater facilities within an urban development also may facilitate the maintenance of a natural habitat corridor for wildlife species and aquatic vegetation. The portion of the West Swale in the centre of the Study Area includes a large wetland and connects to the Chappell Marsh Conservation Area. Increased water levels in these areas may affect wildlife habitat within the Swale and Chappell Marsh Conservation Area.

Some small native grassland communities are located in the southern portion of the Study Area, usually in association with hills and near trembling aspen bluffs. Areas of modified grassland are located throughout the Study Area, but most notably in the southern portion. The diversity of plant communities in native and modified grassland provides an array of habitat types for many wildlife species, including some rare and endangered species. The remaining areas of native grassland/woodland and modified grassland within the Study Area provide habitat for local wildlife. Should these areas be developed, it is likely that species diversity in the area would decrease. However, these remnant patches of wildlife habitat are already affected by development occurring in the surrounding area, which reduces the quality of this habitat by decreasing connectivity to native habitat outside the Study Area. As well, several remnant patches of native habitat are isolated and small in size which reduces their ecological function, decreases suitability for some species, leads to higher potential for local extinctions and reduces recruitment.

Major roads, such as Highway 7 and Highway 14, that cross through the Study Area or new access roads for future developments can also function as movement barriers for small mammals, reptiles, and amphibians. These also may function as higher risk mortality zones for larger mammals, 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.

The landscape that currently characterizes the Study Area appears to be mostly suited to highly mobile species (e.g., birds and scavenger species) and species that are considered habitat generalists (i.e., can use or adapt to a variety of habitat types or conditions). However, some of the wetlands 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, or water quality). For example, a number of Class IV and Class V wetlands of moderate size found in the Study Area provide suitable habitat for the horned grebe, a federally listed species. In addition to birds, terrestrial species that frequently are likely to use the habitat matrix in the Study Area include scavenger species such as raccoon, skunk, and coyote (also considered to be habitat generalists).

Development within the Study Area likely will result in the permanent displacement of some wildlife species, especially those species that require large open habitats for foraging and will not adapt or habituate to urban settings. In addition, some wildlife displaced from the remaining habitats that are removed in the planning area, may migrate to other suitable habitat in the region, which could lead to 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 years (Debinski and Holt 2000).

Incorporation of Class IV and Class V wetlands into planning for Country Residential Districts or for municipal reserve or recreational districts within an urban setting would provide an opportunity to preserve some of the existing habitat patches within the planning district. While this patchy or fragmented habitat may be less desirable from a wildlife perspective, it still would provide habitat that is suitable for temporary or limited use as species move through the area. Maintenance of existing low areas and wetlands within an urban development also provides options for stormwater drainage.

Establishment of a habitat corridor that includes the West Swale, Chappell Marsh, and the area where the swale reaches the South Saskatchewan River may maintain or offer some level of interconnected habitat that could provide a wildlife movement and recruitment corridor between the urban and rural settings. This may mitigate the creation of isolated habitat patches, which may otherwise change from their current characteristics, function, and process due to 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.

The area where the West Swale joins the South Saskatchewan River appears to be adjacent to an area designated as a potential flood hazard in the Corman Park – Saskatoon Planning district Zoning Bylaw. Continued use or expansion of the conservation area adjacent to South Saskatchewan River would accommodate safety (e.g., avoid or limit development within the floodway and flood fringe) and also maintain the migratory bird concentration site development buffer.

If the City of Saskatoon is considering the conservation, preservation, or establishment of natural areas that can be used as habitat patches or corridors, it is recommended that additional assessments be conducted to identify and focus on key species or habitat types; and determine the expected and realistic end objectives.

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).

Additional considerations for future development, particularly in the northeast portion of the Study Area will be meeting the zoning restrictions associated with the Saskatoon Airport Zoning Regulations (1987). Building and vegetation height restrictions are based on the elevation at the airport reference point (495.30 metres above sea level) and become less restrictive with increasing distance from the airport. Disposal of waste is not permitted on lands included in the regulations as described in the schedule (Saskatoon Airport Zoning Regulations 1987) so that birds are not attracted to the airport area. Development in the northeast portion of the Study Area may require approval from Transport Canada prior to proceeding.

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 used by a variety of wildlife species and provide suitable growing sites for numerous plants. The persistence of biological populations in continuing 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 apply sound ecological principles as part of the planning process.

9.0 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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Senior Ecologist/Reclamation Specialist

MT/CNF/AS/DC/BH/BLC/TJM/BT/AM/KH/CJ/rz/ldmg/jlb

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APPENDIX A

Saskatchewan Activity Restrictions

Table 1
Saskatchewan Activity Restriction Guidelines for Sensitive Species in Natural Habitats

These guidelines are to assist proponents during the planning of proposed projects. If your project will include any activity falling within the listed setback distances, you are advised to contact the appropriate Saskatchewan Environment EcoRegion office early in the planning stage to ensure all work will be completed in a manner that will minimize impact. Discussing your project in advance with Saskatchewan Environment will reduce the chance your project will be delayed during the construction phase due to concerns with potential impacts on rare or endangered species.

Species[1]	Key Wildlife Areas	Restricted Activity Dates	Recommended Setback Distances by Disturbance Category		
			Low[2]	Medium[3]	High[4]
AMPHIBIANS					
GREAT PLAINS TOAD	Ponds Used for Breeding, Living, or Hibernating	Year Round	10 m	400 m	500 m
NORTHERN LEOPARD FROG	Ponds Used for Breeding, Living, or Hibernating	April 1 to October 31	10 m	200 m	500 m
Canadian Toad Plains Spadefoot (Toad)	Ponds Used for Breeding, Living, or Hibernating	Year Round	0 m	90 m	90 m
REPTILES					
Prairie Rattlesnake Western Hognose Snake Smooth Green Snake	Hibernacula	April 1 to September 30	50 m	200 m	200 m
		October 1 to March 31	0 m	200 m	200 m
EASTERN YELLOWBELLIED RACER	Hibernacula	Year Round	100 m	200 m	1000 m
SHORT-HORNED LIZARD	Eroded Slopes (blue-shale outcrops)	March 15 to November 15	50 m	200 m	200 m
Snapping Turtle	Nesting Site	March 15 to June 30	0 m	400 m	400 m
BIRDS					
LOGGERHEAD SHRIKE	Nest Site	May 1 to August 15	50 m	250 m	400 m
RED-HEADED WOODPECKER	Nest Site	April 15 to June 30	0 m	100 m	100 m
YELLOW RAIL	Nest Site	May 1 to July 15	100 m	150 m	350 m
PEREGRINE FALCON	Nest Site	April 1 to August 15	300 m	500 m	1000 m
BURROWING OWL	Nest Site	April 1 to July 15	200 m	300 m	500 m
		July 16 to October 15	100 m	200 m	500 m
		October 16 to March 31	10 m	200 m	500 m
PIPING PLOVER	High Water Mark	May 1 to July 31	200 m	400 m	600 m
		August 1 to September 30	100 m	200 m	600 m
FERRUGINOUS HAWK Prairie Falcon Bald Eagle	Nest Site	March 15 to July 15	500 m	750 m	1000 m
Golden Eagle	Nest Site	February 15 to July 15	500 m	1000 m	1000 m
SHORT-EARED OWL	Nest Site	March 25 to August 1	100 m	300 m	500 m

Species[1]	Key Wildlife Areas	Restricted Activity Dates	Recommended Setback Distances by Disturbance Category		
			Low[2]	Medium[3]	High[4]
BIRDS (continued)					
SPRAGUE'S PIPIT	Nest Site	April 21 to August 31	50 m	200 m	250 m
LONG-BILLED CURLEW	Nest Site	April 15 to July 15	100 m	200 m	200 m
SAGE GROUSE	Lek	March 1 to July 15	500 m	1000 m	1000 m
		July 16 to February 29	100 m	1000 m	1000 m
	Nest Site	April 15 to June 15	200 m	300 m	500 m
Gulls/Terns (*e.g.*, Caspian Tern) (Excluding Ring-billed and California Gulls)	Nesting Colony	May 1 to July 15	200 m	400 m	400 m
Colonial Nesting Birds (*e.g.*, herons, pelicans, cormorants)	Nesting Colony	April 1 to July 31	500 m	1000 m	1000 m
Colonial Nesting Grebes (*e.g.*, Western, Clark's and Eared Grebes)	Nesting Colony	May 15 to July 15	100 m	200 m	200 m
Osprey	Nest Site	May 1 to August 15	500 m	1000 m	1000 m
Cooper's Hawk	Nest Site	April 1 to July 31	200 m	400 m	400 m
MOUNTAIN PLOVER Snowy Plover	Nest Site	May 1 to July 31	200 m	400 m	500 m
Barred Owl Hawk Owl Great Gray Owl Western and Eastern Screech-Owls	Nest Site	March 1 to July 15	100 m	400 m	400 m
American Bittern	Nest Site	May 1 to July 31	200 m	400 m	400 m
SAGE THRASHER	Nest Site	May 15 to June 30	100 m	200 m	200 m
Trumpeter Swan	Nest Site	April 1 to July 31	500 m	1000 m	1000 m
Sharp-tailed Grouse	Lek	March 15 to May 15	200 m	400 m	400 m
MAMMALS					
SWIFT FOX	Den	February 15 to August 31	500 m	500 m	2000 m
		September 1 to February 14	100 m	500 m	2000 m
BLACK-TAILED PRAIRIE DOG	Colony	Year Round	0 m	250 m	500 m
ORD'S KANGAROO RAT	Den	Year Round	50 m	250 m	500 m
PLANTS[5]					
SAND VERBENA	Population	Year Round	0 m FTO	25 m	50 m
TINY CRYPTANTHE	Population	Year Round	0 m FTO	25 m	50 m
WESTERN SPIDERWORT	Population	Year Round	0 m FTO	25 m	50 m
SLENDER MOUSE-EARCRESS	Population	Year Round	0 m FTO	25 m	50 m
HAIRY PRAIRIECLOVER	Population	Year Round	0 m FTO	25 m	50 m

Species[1]	Key Wildlife Areas	Restricted Activity Dates	Recommended Setback Distances by Disturbance Category		
			Low[2]	Medium[3]	High[4]
PLANTS[5] (continued)					
POWELL'S SALTBUSH	Population	Year Round	0 m FTO	25 m	50 m
UPLAND EVENING PRIMROSE	Population	Year Round	0 m FTO	25 m	50 m
PLAINS GRAPEFERN	Population	Year Round	0 m FTO	25 m	50 m
BUFFALOGRASS	Population	Year Round	0 m FTO	25 m	50 m
STALKED MOONWORT	Population	Year Round	0 m FTO	25 m	50 m
GASTONY'S CLIFFBRAKE	Population	Year Round	0 m FTO	25 m	50 m
PECULIAR MOONWORT	Population	Year Round	0 m FTO	25 m	50 m
PALE MOONWORT	Population	Year Round	0 m FTO	25 m	50 m
ATHABASCA THRIFT	Population	Year Round	0 m FTO	25 m	50 m
BEAKED ANNUAL SKELETON WEED	Population	Year Round	0 m FTO	25 m	50 m
BUR RAGWEED	Population	Year Round	0 m FTO	25 m	50 m
FELT-LEAF WILLOW	Population	Year Round	0 m FTO	25 m	50 m
FLOCCOSE TANSY	Population	Year Round	0 m FTO	25 m	50 m
IMPOVERISHED PINWEED	Population	Year Round	0 m FTO	25 m	50 m
LARGE-HEADED WOOLY YARROW	Population	Year Round	0 m FTO	25 m	50 m
MACKENZIE HAIR-GRASS	Population	Year Round	0 m FTO	25 m	50 m
PRICKLY MILKVETCH	Population	Year Round	0 m FTO	25 m	50 m
SAND CHICKWEED	Population	Year Round	0 m FTO	25 m	50 m
SMALL LUPINE	Population	Year Round	0 m FTO	25 m	50 m
TYRRELL'S WILLOW	Population	Year Round	0 m FTO	25 m	50 m
TURNOR'S WILLOW	Population	Year Round	0 m FTO	25 m	50 m
SMOOTH ARID GOOSEFOOT	Population	Year Round	0 m FTO	25 m	50 m
SHORT-CAPSULED SAND-DUNE WILLOW	Population	Year Round	0 m FTO	25 m	50 m
TALL WOOLYHEADS	Population	Year Round	0 m FTO	25 m	50 m
SAND-LOVING BARRENGROUND WILLOW	Population	Year Round	0 m FTO	25 m	50 m
FISH[6]					
BIGMOUTH BUFFALO	The Qu'Appelle basin; including the waters of Buffalo Pound, Last Mountain, Pasqua, Echo, Mission, Katepwa (The Fishing Lakes), Crooked and Round Lakes.				
LAKE STURGEON	The waters of the North Saskatchewan, South Saskatchewan and Saskatchewan Rivers (including large connected waters such as the Torch River) and the waters of the Churchill River below the confluence of the Reindeer River.				
CHESTNUT LAMPREY	The waters of the Qu'Appelle River below the outlet of Round Lake and the upper Assiniboine basin including the Whitesand and Shell Rivers.				
SHORTJAW CISCO	The waters of Reindeer Lake, Lake Athabasca, Black, Giles and Wapata Lakes.				

(1) Species in capital letters are listed or pending listing under Saskatchewan's *The Wildlife Act* or are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and under the federal *Species at Risk Act*. See the INTERIM LIST for further details on Saskatchewan's provincial list. http://www.biodiversity.sk.ca/FTP.htm. See the following website for species listed by COSEWIC http://www.cosewic.gc.ca/eng/sct5/index_e.cfm.

(2) *e.g.*, foot traffic, small vehicles (<1 ton), ATVs, operating oil or gas wells, pipelines.

(3) *e.g.*, trucks >1 ton (gravel, oil, grain), tractors (including farm tractors), pipeline construction (diameters <1 foot), operating compressor station or battery.

(4) *e.g.*, road construction, roads, drilling rigs, mines and quarries, construction of compressor station or battery, forest harvest, large-diameter pipeline construction, seismic exploration, blasting, rock crushing, asphalt batching, gravel pit.

(5) These are the general Activity Restriction Guidelines for federally and provincially listed plants. Contact the Saskatchewan Conservation Data Centre Botanist for mitigation considerations for these and other S1-S3 species. FOOT TRAFFIC ONLY (FTO) is permitted for the Low disturbance category. Small vehicles (<1 ton), ATVs, operating oil or gas wells, pipelines fall under Medium disturbance along with the other examples listed for animals. Examples of High level disturbance are the same as indicated for animals.

(6) Proponents should be aware of the following listed fish species and the waters in which they live. Contact the Department of Fisheries and Oceans http;//www.dfo-mpo.gc.ca/home-accueil_e.htm if your project is in or near these waters.

Species not capitalized are ranked S1-S3 by the SKCDC or require special consideration during the breeding period. See 'Guide to Rank Definitions' at http://www.biodiversity.sk.ca/FTP.htm.

For most projects near water, you must obtain work permits as required under provincial legislation. Also, the federal Fisheries Act provides for the protection of fish habitat. Under the Fisheries Act, no one may carry out any work or undertaking that results in the harmful alteration, disruption or destruction ("HADD") of fish habitat, unless this HADD has been authorized by the Minister of Fisheries and Oceans Canada. The Act also states that no one is permitted to deposit a deleterious (harmful) substance into water containing fish. In some instances, additional approvals may be required. For example, some docks may need to be approved by the Canadian Coast Guard (Fisheries and Oceans Canada) due to navigation requirements.

When working near water, contact:

Regional Office of SE (list):

http://www.se.gov.sk.ca/environment/assessment/oilandgas/contacts.PDF

DFO Offices: Prince Albert – 306-953-8777

Regina – 306-780-8725

APPENDIX B

Photoplates

Photo 1: Looking northeast at a class IV wetland in the W½ 11-37-06 W3M. (WET003 - 13U 379256 5780815)

Photo 2: Looking southwest at a Class V wetland associated with the West Swale in the NW 09-37-06 W3M. (LAKE01 - 13U 376545 5781834)

Photo 3: Looking west at a class IV wetland in the NE 20-36-06 W3M.
(WET008 - 13U 375826 5774303)

Photo 4: Looking west at a class IV wetland in the SE 16-36-06 W3M. A muskrat was observed at this location.
(WET009 - 13U 377425 5772761)

Photo 5: Looking southeast at a class IV wetland in the NE 07-36-06 W3M. (WET010 - 13U 374015 5771935)

Photo 6: Looking northwest at West Swale along the section boundary between SW 27 and NW 22-36-06 W3M. (LAKE02 – 13U 377948 5775230)

Photo 7: Looking north at a class III wetland associated with the West Swale in the SE 14-36-06 W3M. (WET015 - 13U 380107 5772004)

Photo 8: Looking southeast at a class III wetland associated with the West Swale in the NE 11-36-06 W3M. (WET015 - 13U 380107 5772004)

Photo 9: Looking northwest at Chappell Marsh in the NE 15-36-06 W3M. A red-necked grebe was observed at this location. (CONSERVE – 13U 379077 5773634)

Photo 10: Looking south at a Class IV wetland associated with the West Swale in the SW 34-36-06 W3M. A horned grebe was observed at this location. (LAKE03 - 13U 377675 5778547)

Photo 11: Looking south at a class IV wetland in the NE 32-36-06 W3M. (WET016 - 13U 375458 5778602)

Photo 12: Looking west at a class IV wetland in the NE 18-36-06 W3M. (WET012 - 13U 374179 5773580)

APPENDIX C

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 occuring 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.

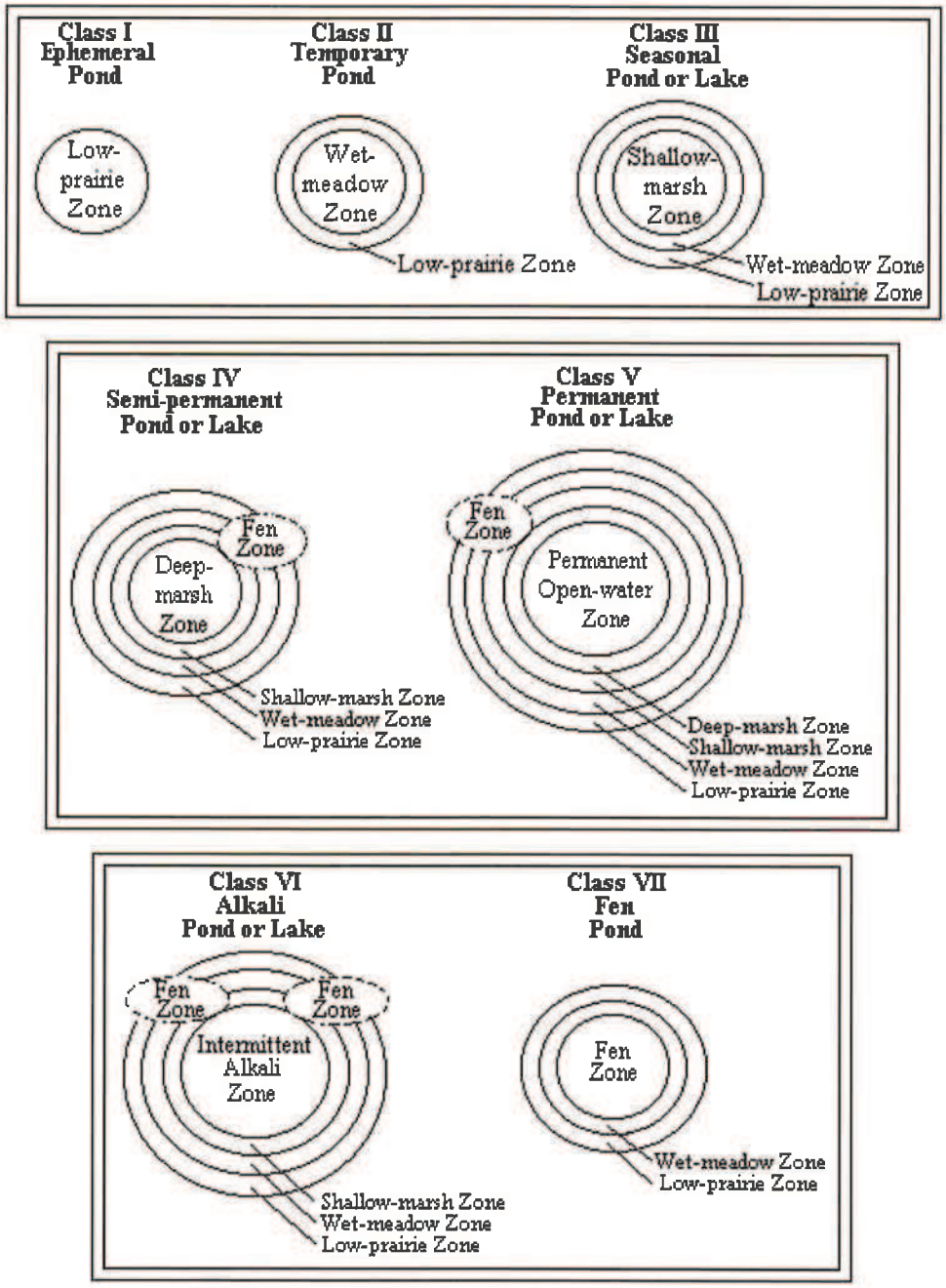

Figure 2. Spatial relation of vegetational zones in major classes of natural ponds and lakes.

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 D

Aquatic Communities and Water and Sediment Quality

September 2012
Report No. 12-1361-0028

Table D-1: Supporting Environmental Variables and Limnology Data for Selected Ponds Located in the City of Saskatoon West-Southwest Sector, June 2012

Waterbody	Station Code	Date	Air Temperature (°C)	Cloud Cover (%)	Precipitation Type	Wind Rate	Wind Direction	Secchi Depth (m)	Max Depth (m)	Profile Depth (m)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH	Comments
1	COS-001-WQ01-P12	20-Jun-12	19	<25	None	Calm	None	1.0	1.3	0.00	17.63	5.09	3090	7.97	Water sample and duplicate, and sediment sample collected.
										0.50	17.53	4.90	3093	7.93	
										1.00	17.46	4.86	3097	7.92	
										1.20	17.44	4.55	3096	7.91	
2	COS-002-WQ01-P12	20-Jun-12	19	75 to 100	None	Calm	None	1.6	1.6	0.00	17.20	10.72	2649	8.92	Water sample, and sediment sample and duplicate collected.
										0.50	17.15	10.75	2650	8.93	
										1.00	17.14	10.72	2653	8.93	
										1.50	17.07	4.67	2656	8.78	
3	COS-003-WQ01-P12	20-Jun-12	16	75 to 100	Moderate Rain	Light	NW	1.8	1.8	0.00	16.91	7.76	2804	8.68	Water sample collected.
										0.50	16.92	7.70	2802	8.69	
										1.00	16.95	7.67	2803	8.69	
										1.40	16.93	6.45	2804	8.66	
										1.60	16.64	4.79	2824	8.58	
4	COS-004-WQ01-P12	19-Jun-12	16	75 to 100	None	Light	E	1.4	1.4	0.00	16.46	8.81	2987	8.74	Water sample collected.
										0.50	16.47	8.80	2988	8.74	
										1.00	16.45	9.15	2989	8.76	
										1.25	16.43	8.86	2977	8.64	
5	COS-005-WQ01-P12	20-Jun-12	19	25 to 50	None	Calm	None	0.9	0.9	0.00	16.39	3.24	3324	7.80	
										0.50	15.74	2.93	3335	7.75	
										0.70	15.68	2.95	3334	7.74	
6	COS-006-WQ01-P12	21-Jun-12	13	50 to 75	None	Light	E	1.0	1.2	0.00	17.03	9.38	1663	7.76	Conductivity near the bottom was highly variable, ranging from approximately 2300 to 2700 µS/cm.
										0.50	16.45	6.36	1659	7.65	
										1.00	16.50	0.76	2530	7.19	
7	COS-007-WQ01-P12	20-Jun-12	18	<25	None	Calm	None	1.6	1.6	0.00	17.05	12.46	1272	8.66	Large amount of submergent vegetation inhibited secchi depth measurement. Water was clear and the secchi depth was estimated to be at the bottom.
										0.50	16.34	12.71	1272	8.66	
										1.00	16.09	11.63	1270	8.57	
										1.50	15.90	4.23	1273	7.77	
8	COS-008-WQ01-P12	19-Jun-12	16	75 to 100	Light Rain	Light	E	0.84	0.84	0.00	16.04	8.45	1665	8.11	Large amount of submergent vegetation inhibited secchi depth measurement. Water was clear and the secchi depth was estimated to be at the bottom.
										0.50	15.65	8.46	1658	8.11	
										0.75	15.54	9.69	1656	8.16	
9	COS-009-WQ01-P12	20-Jun-12	16	<25	None	Calm	None	1.1	1.1	0.00	16.03	7.03	1891	8.05	Water and sediment sample collected.
										0.50	15.93	6.65	1907	7.87	
										1.00	15.88	4.32	1905	7.02	
10	COS-010-WQ01-P12	21-Jun-12	12	50 to 75	None	Light	E	0.7	0.7	0.00	18.28	11.87	1870	8.79	Abundant submergent vegetation interfered with YSI sonde reaching the bottom of the wetland.
										0.50	16.28	4.70	1936	8.31	
										0.65	16.23	4.75	1914	8.33	
11	COS-011WQ01-P12	19-Jun-12	16	75 to 100	None	Light	E	1.2	1.2	0.00	16.00	8.94	610	8.24	
										0.50	16.05	9.13	610	8.08	
										1.00	15.97	4.25	622	7.87	

Table D-1: Supporting Environmental Variables and Limnology Data for Selected Ponds Located in the City of Saskatoon West-Southwest Sector, June 2012 (continued)

Waterbody	Station Code	Date	Air Temperature (°C)	Cloud Cover (%)	Precipitation Type	Wind Rate	Wind Direction	Secchi Depth (m)	Max Depth (m)	Profile Depth (m)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH	Comments
12	COS-012-WQ01-P12	19-Jun-12	17	75 to 100	Light Rain	Moderate	E	1.2	1.2	0.00	16.76	11.60	837	8.74	Abundant submergent vegetation interfered with YSI sonde reaching the bottom of the wetland.
										0.50	16.73	11.49	838	8.71	
										0.90	16.28	5.30	845	8.40	
13	COS-013-WQ01-P12	19-Jun-12	18	75 to 100	None	Moderate	E	0.9	0.9	0.00	16.58	9.80	896	8.61	
										0.50	16.58	9.77	895	8.67	
										0.75	16.57	8.52	900	8.64	
14	COS-014-WQ01-P12	19-Jun-12	18	75 to 100	None	Light	E	0.5	1.3	0.00	16.72	11.67	1050	8.99	Abundant submergent vegetation interfered with YSI sonde reaching the bottom of the wetland.
										0.50	16.16	12.11	1023	9.00	
										1.00	15.92	10.66	1022	8.85	

Table D-2: Water Chemistry for Wetlands in the City of Saskatoon West-Southwest Sector, June 2012

Parameter Name	Units	Guidelines		Detection Limits	Wetland 001	Wetland 001 Duplicate	Wetland 002	Wetland 003	Wetland 004	Wetland 009	Wetland 012	Field Blank
		SSWQO [a]	CWQG[b]									
Conventional Parameters (Field-Measured)												
Dissolved Oxygen	mg/L	5.5 to 9.5	5.5 to 9.5	-	**5.09**	-	10.72	7.76	8.81	7.03	11.60	-
Water Temperature	°C	-	-	-	17.63	-	17.20	16.91	16.46	16.03	1676	-
pH	pH units	-	6.5 to 9.0	-	7.97	-	8.92	8.68	8.74	8.05	8.74	-
Specific Conductivity	µS/cm	-	-	-	3090	-	3090	2649	2987	1891	837	-
Conventional Parameters (Laboratory-Measured)												
Conductivity	µS/cm	-	-	10	3110	3110	2680	2830	3000	1900	844	<10
pH	pH units	-	6.5 to 9.0	0.1	8.04	8.04	8.77	8.52	8.70	7.93	8.61	8.66
Total Alkalinity	mg/L	-	-	5.0	233	237	315	324	432	178	285	<5.0
Total Dissolved Solids	mg/L	-	-	1.0	2380	2350	1930	2110	2420	1390	531	<1.0
Total Hardness	mg/L	-	-	1.0	1350	1340	924	913	1040	811	338	<1.0
Total Suspended Solids	mg/L	-	-	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Nutrients												
Ammonia as nitrogen	mg/L	[c]	[c]	0.050 to 0.25	**2.25**	**2.29**	**0.053**	**0.150**	**0.158**	**0.065**	<0.050	<0.050
Dissolved Organic Carbon	mg/L	-	-	1.0	22.8	22.6	29.4	32	45.4	21.6	24.9	1.4
Nitrate+Nitrite-N	mg/L	-	-	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nitrate	mg/L	-	13	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nitrite	mg/L	-	0.6	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Orthophosphate	mg/L	-	-	0.050	0.184	0.183	0.068	0.145	0.836	<0.050	0.381	<0.050
Phosphorus	mg/L	-	-	0.20	<0.20	<0.20	<0.20	<0.20	0.89	<0.20	0.39	<0.20
Phosphorus, dissolved	mg/L	-	-	0.20	<0.20	<0.20	<0.20	<0.20	0.76	<0.20	0.36	<0.20
Total Organic Carbon	mg/L	-	-	1.0	23.6	23.5	28.5	30.7	37.5	21.6	24	<1.0
Total Kjeldahl Nitrogen	mg/L	-	-	0.20	4.22	4.05	2.66	2.9	3.47	1.57	1.82	<0.20
Major Ions												
Bicarbonate	mg/L	-	-	5.0	285	289	290	332	422	217	292	<5.0
Calcium	mg/L	-	-	0.20 to 2.0	193	194	79.5	84.6	112	115	51.6	<0.20
Carbonate	mg/L	-	-	5.0	<5.0	<5.0	46.2	31	51.8	<5.0	27.1	<5.0
Chloride	mg/L	-	120	1.0 to 5.0	294	289	281	359	46.3	91	21.8	<1.0
Fluoride	mg/L	-	0.12	0.10	0.16	0.16	<0.10	<0.10	<0.10	0.15	<0.10	<0.10
Hydroxide	mg/L	-	-	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Magnesium	mg/L	-	-	0.050 to 0.50	209	207	169	166	182	120	47.7	<1.0
Potassium	mg/L	-	-	0.20 to 2.0	64.3	64.4	37.9	33.6	37	21.4	22.1	<1.0
Silicon	mg/L	-	-	0.050 to 0.50	8	8.11	0.37	1.18	1.13	0.83	0.433	<0.050
Silicon, dissolved	mg/L	-	-	0.050 to 0.50	8.15	7.76	0.34	1.14	1.1	0.79	0.386	<0.050
Sulfate	mg/L	-	-	3.0 to 15	1250	1230	876	941	1390	796	154	<3.0
Cation - Anion Balance	%	-	-	-	-0.7	-0.3	-0.9	-4.2	-0.1	-0.5	1.7	-

Table D-2: Water Chemistry for Wetlands in the City of Saskatoon West-Southwest Sector, June 2012 (continued)

Parameter Name	Units	Guidelines		Detection Limits	Wetland 001	Wetland 001 Duplicate	Wetland 002	Wetland 003	Wetland 004	Wetland 009	Wetland 012	Field Blank
		SSWQO [a]	CWQG[b]									
Total Metals												
Aluminum	mg/L	0.1 [d]	0.1[d]	0.0050 to 0.050	0.051	0.07	<0.025	<0.025	<0.025	<0.025	0.009	0.0083
Antimony	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	0.00017	<0.00010
Arsenic	mg/L	0.005	0.005	0.00010 to 0.0010	**0.0053**	**0.0055**	**0.00711**	**0.00593**	**0.00849**	0.00435	0.00448	<0.00010
Barium	mg/L	-	-	0.00010 to 0.0010	0.0463	0.0477	0.0526	0.0469	0.0433	0.0252	0.0764	0.00013
Beryllium	mg/L	-	-	0.00050 to 0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.00050	<0.00050
Bismuth	mg/L	-	-	0.00050 to 0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.00050	<0.00050
Boron	mg/L	-	1.5	0.0050 to 0.10	0.31	0.31	0.075	<0.050	<0.050	<0.050	<0.010	<0.010
Cadmium	mg/L	0.000017 to 0.0001[e]	[f]	0.000010 to 0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010
Chromium	mg/L	0.001 [g]	0.001 [g]	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
Cobalt	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	0.0002	<0.00010
Copper	mg/L	0.002 to 0.004 [h]	[i]	0.00050 to 0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	0.00113	<0.00050
Iron	mg/L	0.3	0.3	0.010 to 0.10	0.13	0.15	<0.050	<0.050	<0.050	0.078	0.03	0.011
Lead	mg/L	0.001 to 0.007 [j]	[k]	0.000050 to 0.00050	<0.00050	<0.00050	<0.00025	<0.00025	<0.00025	<0.00025	0.000225	<0.000050
Lithium	mg/L	-	-	0.0050 to 0.50	0.414	0.409	0.319	0.289	0.215	0.236	0.0643	<0.0050
Manganese	mg/L	-	-	0.00030 to 0.0030	0.338	0.35	0.0584	0.113	0.0582	0.458	0.0664	<0.00030
Mercury	mg/L	0.000026	0.000026	0.000050	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Molybdenum	mg/L	-	0.073	0.00020 to 0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.00020	<0.00020
Nickel	mg/L	0.025 to 0.150 [l]	[m]	0.00050 to 0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	0.00099	<0.00050
Selenium	mg/L	0.001	0.001	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	0.00015	<0.00010
Silver	mg/L	0.0001	0.0001	0.000010 to 0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010
Strontium	mg/L	-	-	0.00010 to 0.0010	1.87	1.78	0.809	0.845	0.917	0.751	0.387	0.00011
Thallium	mg/L	-	0.0008	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
Tin	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
Titanium	mg/L	-	-	0.010 to 0.10	<0.10	<0.10	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010
Uranium	mg/L	0.015	0.015	0.000010 to 0.00010	0.00796	0.00788	0.00337	0.00415	0.00487	0.00502	0.000665	<0.000010
Vanadium	mg/L	-	-	0.0010 to 0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010
Zinc	mg/L	0.03	0.03	0.0030 to 0.030	<0.030	<0.030	<0.015	<0.015	<0.015	<0.015	<0.0030	<0.0030
Dissolved Metals												
Aluminum	mg/L	-	-	0.0030 to 0.030	<0.030	0.042	<0.015	<0.015	<0.015	<0.015	<0.0030	<0.0030
Antimony	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	0.00015	<0.00010
Arsenic	mg/L	-	-	0.00010 to 0.0010	0.0056	0.0058	0.00769	0.00627	0.00923	0.00448	0.00498	<0.00010
Barium	mg/L	-	-	0.00010 to 0.0010	0.0436	0.0425	0.0524	0.0454	0.042	0.0244	0.0719	<0.00010
Beryllium	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
Bismuth	mg/L	-	-	0.00030 to 0.0030	<0.0030	<0.0030	<0.0015	<0.0015	<0.0015	<0.0015	<0.00030	<0.00030
Boron	mg/L	-	-	0.010 to 0.10	0.29	0.25	0.074	0.051	<0.050	<0.050	<0.010	<0.010
Cadmium	mg/L	-	-	0.000010 to 0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010
Chromium	mg/L	-	-	0.00020 to 0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.00020	<0.00020
Cobalt	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	0.00017	<0.00010
Copper	mg/L	-	-	0.00050 to 0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	0.00099	<0.00050

Table D-2: Water Chemistry for Wetlands in the City of Saskatoon West-Southwest Sector, June 2012 (continued)

Parameter Name	Units	Guidelines		Detection Limits	Wetland 001	Wetland 001 Duplicate	Wetland 002	Wetland 003	Wetland 004	Wetland 009	Wetland 012	Field Blank
		SSWQO [a]	CWQG[b]									
Dissolved Metals (continued)												
Iron	mg/L	-	-	0.0050 to 0.050	<0.050	<0.050	<0.025	<0.025	<0.025	<0.025	0.0057	<0.0050
Lead	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
Lithium	mg/L	-	-	0.0050 to 0.050	0.461	0.448	0.338	0.341	0.259	0.214	0.0639	<0.0050
Manganese	mg/L	-	-	0.00020 to 0.0020	0.319	0.311	0.0102	0.0066	0.0423	0.398	0.0036	<0.00020
Mercury	mg/L	-	-	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Molybdenum	mg/L	-	-	0.000050 to 0.00050	0.001	0.00088	0.00049	0.0004	0.00069	0.00037	0.000146	<0.000050
Nickel	mg/L	-	-	0.00050 to 0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	0.00092	<0.00050
Selenium	mg/L	-	-	0.00020 to 0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.00020	<0.00020
Silver	mg/L	-	-	0.000020 to 0.00020	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.000020	<0.000020
Strontium	mg/L	-	-	0.00010 to 0.0010	1.89	1.68	0.821	0.948	0.941	0.668	0.368	<0.00010
Thallium	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
Tin	mg/L	-	-	0.00010 to 0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
Titanium	mg/L	-	-	0.0010 to 0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010
Uranium	mg/L	-	-	0.000050 to 0.00050	0.00778	0.00776	0.00356	0.0048	0.00493	0.00483	0.000698	<0.000050
Vanadium	mg/L	-	-	0.0010 to 0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010
Zinc	mg/L	-	-	0.0030 to 0.030	<0.030	<0.030	<0.015	<0.015	<0.015	<0.015	<0.0030	<0.0030
Others												
Chlorophyll a	µg/L	-	-	0.010	2	2.09	2.09	2.72	0.195	2.07	3.12	<0.010

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 italicized.

[a] Saskatchewan Environment's (2006) SSWQO.

[b] CCME's CWQG for the protection of freshwater aquatic life (CCME 2012).

[c] The guideline for ammonia is based on pH and water temperature.

[d] Aluminum guideline is 5 µg/L if pH is <6.5 or 100 µg/L if pH is ≥6.5.

[e] Cadmium objective: 0.017 µg/L where hardness is 0 - 48.5 mg/L; 0.032 µg/L where hardness is 48.5 - 97; 0.058 where hardness is 97 - 194; 0.10 µg/L where hardness is >194.

[f] Cadmium guideline is hardness-dependent and based on the equation Cadmium concentration = 100.86[log10(hardness)]-3.2 µg/L.

[g] Guideline is for hexavalent chromium (Cr VI).

[h] Copper objective: 2 µg/L where hardness is 0 - 120 mg/L; 3 µg/L where hardness is 120 - 180 mg/L; 4 µg/L where hardness is >180 mg/L.

[i] Copper guideline is hardness-dependent and based on the equation Copper concentration = e0.8545 [ln (hardness)]-1.465 * 0.2 µg/L.

[j] Lead objective: 1 µg/L where hardness is 0 - 60 mg/L; 2 µg/L where hardness is 60 - 120 mg/L; 4 µg/L where hardness is 120 - 180 mg/L; 7 µg/L where hardness is >180 mg/L.

[k] Lead guideline is hardness-dependent and based on the equation Lead concentration = e1.273[ln(hardness)]-4.705 µg/L.

[l] Nickel objective: 25 µg/L where hardness is 0 - 60 mg/L; 65 µg/L where hardness is 60 - 120 mg/L; 110 µg/L where hardness is 120 - 180 mg/L; 150 µg/L where hardness is >180 mg/L.

[m] Nickel guideline is hardness-dependent and based on the equation Nickel concentration = e0.76[ln(hardness)]+1.06 µg/L.

Table D-3: Sediment Chemistry for Wetlands in the City of Saskatoon West-Southwest Sector, June 2012

Parameter Name	Units	CCME Sediment Quality Guidelines		Detection Limits	Wetland 001	Wetland 002	Wetland 002 Duplicate	Wetland 003	Wetland 009
		ISQG [a]	PEL [b]						
Physical Properties									
Loss on Ignition	%	-	-	1	15	18	24	20	5
% Moisture	%	-	-	0.1	83.3	77.7	88.4	84.7	54.4
Nutrients									
Total Nitrogen	%	-	-	0.20	0.674	0.828	1.06	0.737	0.152
$CaCO_3$ Equivalent	%	-	-	0.80	24.4	4.0	6.41	9.98	6.79
Inorganic Carbon	%	-	-	0.10	2.93	0.48	0.77	1.2	0.81
Total Phosphorus	mg/kg	-	-	50	794	709	849	707	494
Phosphorus	mg/kg	-	-	50	688	637	766	638	431
Total Carbon by Combustion	%	-	-	0.1	9	8.9	11.7	9.7	2.4
Total Organic Carbon	%	-	-	0.10	6.09	8.46	10.9	8.51	1.56
Major Ions									
Calcium	mg/kg	-	-	100	86300	17800	27700	29700	26200
Magnesium	mg/kg	-	-	100	11100	6450	7030	10400	7030
Potassium	mg/kg	-	-	100	5080	4220	3780	2820	1990
Sodium	mg/kg	-	-	100	1130	1380	1780	1900	380
Metals and Metalloids									
Aluminum	mg/kg	-	-	50	9660	9850	9120	9940	8240
Antimony	mg/kg	-	-	0.10	0.18	0.26	0.27	0.26	0.36
Arsenic	mg/kg	5.9	17	0.10	3.8	2.98	3.68	3.7	5.64
Barium	mg/kg	-	-	1.0	244	108	110	135	191
Beryllium	mg/kg	-	-	0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bismuth	mg/kg	-	-	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	mg/kg	0.6	3.5	0.10	0.35	0.39	0.38	0.33	0.23
Chromium	mg/kg	37.3	90	0.50	14.1	15.5	14.8	18.5	14.8
Cobalt	mg/kg	-	-	1.0	6.3	6.1	5.8	6.4	7.1
Copper	mg/kg	35.7	197	1.0	14.9	17.1	16.8	16.8	12.7

Table D-3: Sediment Chemistry for Wetlands in the City of Saskatoon West-Southwest Sector, June 2012 (continued)

Parameter Name	Units	CCME Sediment Quality Guidelines		Detection Limits	Wetland 001	Wetland 002	Wetland 002 Duplicate	Wetland 003	Wetland 009
		ISQG [a]	PEL [b]						
Metals and Metalloids (continued)									
Iron	mg/kg	-	-	50	14000	13200	12600	15300	14300
Lead	mg/kg	35	91.3	1.0	9	12.4	13.6	19.3	8.1
Lithium	mg/kg	-	-	2.0	25.6	11.7	12.3	13.8	12.2
Manganese	mg/kg	-	-	1.0	563	267	357	320	316
Mercury	mg/kg	0.17	0.486	0.0050	0.0191	0.0323	0.0366	0.0360	0.0265
Molybdenum	mg/kg	-	-	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nickel	mg/kg	-	-	1.0	16.4	15.6	15	18.5	18.5
Selenium	mg/kg	-	-	0.20	0.57	0.53	0.53	0.4	0.62
Silver	mg/kg	-	-	0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Strontium	mg/kg	-	-	1.0	410	111	161	93.5	76.6
Thallium	mg/kg	-	-	0.10	0.16	0.14	0.15	0.16	0.17
Tin	mg/kg	-	-	2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium	mg/kg	-	-	5.0	100	71.1	67.5	72.3	72.2
Uranium	mg/kg	-	-	0.10	6.32	4.07	5.21	3.32	2.89
Vanadium	mg/kg	-	-	1.0	27.9	24.9	23.1	28.7	24.4
Zinc	mg/kg	123	315	5.0	67.7	73	75	69.6	54.4

Notes: Values are presented on a dry weight basis. Values greater than or equal to ISQGs are **bolded**. Values greater than or equal to PELs are **bolded** and underlined.

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

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

< = less than; - = not applicable.

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